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COLONELS COMMANDANT

Lt Gen NB Singh, VSM

NDC, HC, SC, psc, JC, ONBC, OAFVE, ME (Automotive Engg), DE(M), HDRV MAN (Germany), M Phil, MDBA, FIE, MSAE(I)

Maj Gen PK Jaggia

NDC, LDMC, SC, JC, EME(RE), M Tech(Comn), BSc Engg (L), VHF/UHF SAF SYS (UK), MMS, M.Phil, FIE, FIETE

Maj Gen AV Subramanian, VSM

LDMC, OACT, M Tech (Cmptr Sc), DE(L), MMS

Maj Gen Rajesh Datta

LDMC, SC, ptsc, JC, OALE(R), ORrE, FIE, FIETE, MMS

CHANGE OF BATON

Lt Gen NB Singh, VSM assumed the appt of DGEME and Sr Col Comdt on 01 Dec 2011 vice Lt Gen IJ Singh, AVSM, VSM proceeding on retirement.

EME JOURNAL

December - 2011

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Equipment Sustainment Activities

WORK IS SUPREME DUTY

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EDITORIAL

ARTICLES

EST NEWS

SPORTS & ADVENTURE

FAREWELL

LAST POST

Edited, printed and published by The Editor on behalf of Commandant,
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Editorially Yours

I experience an immense sense of pleasure and accomplishment to bring you this edition based on the changed schema of things for the EME Journal wherein this issue is based purely on thematic, non-thematic articles along with organizational development initiatives and a few excerpts from the Dte, HQ TG, HQ BWG, MCEME and EME School.

The thought provoking article on 'Alchemy of Equipment Sustainment" by Lt Gen NB Singh, VSM, DGEME and Sr Col Comdt emphasises the need to expand our concept of operational availability, combat readiness and accentuates the theme for this edition: "Life Cycle Sustainment Management". The classical approach on equipment availability for the plethora of Army Equipment has been analysed with an aim to incorporate the necessary changes for this metamorphosis and paradigm shift from 'Maintenance' to 'Sustenance' in the thematic articles. A diversified collection of theme based articles on Building Life Cycle Eqpt Sustainment during Acqn, Effective Equipment Sustainment, Sustainment of Aviation Assets and Condition Based Monitoring Sys for 'A' Vehicles should surely sensitise and update the environment on concepts of 'Mission Readiness' and `Low Life Cycle Cost'.

Non-thematic articles encompassing a wide bandwidth of topics from GIS, simulators to the field of leadership have been incorporated to satiate the desire for learning and understanding technology and quench the literary thirst of our wide spectrum of readers this journal reaches out to.

I hope you enjoy this endeavor of ours in bringing out substance on the theme and also the aesthetics of this edition. The April 2012 Issue will be a Newsletter and I would request units to keep inundating our database with news and photographs with captions. Keep communicating with us with your views, news and valuable suggestions through emejournal@gmail.com.

Wishing our esteemed readers a Happy Reading!

(VK Pokhriyal)
Col

ASSOCIATE EDITOR
Maj Praveen Latwal

OUR NEW DGEME

Lt Gen NB Singh, VSM, DGEME & Sr Col Comdt

Lt Gen NB Singh, VSM was commissioned into the Corps of EME on 23 Dec 1973. After preliminary training at NDA, Khadakwasla, the General Officer passed out from IMA, Dehradun with the President's Silver Medal. The General Officer excelled in the Degree Engineering Course by securing a First class with Distinction and was awarded Comdt's Silver Medal during EME 'A' Veh Course. He has to his credit a Masters Degree in Automobile Engineering from University of Bombay with a First Class (Distinction). He has attended a course on base repairs of HDRV Man at Germany. The General Officer is an alumnus of DSSC Willington and has undergone SC & HC Course at the Army War College, Mhow. He completed the prestigious NDC Course in 2006 & was conferred M. Phil in Def & Strategic Studies from Chennai University. The General Officer has held variety of Regimental, Command, Staff and Instructional appointments during his illustrious career. He had a stint as Deputy Military Attaché at Embassy of India in Moscow and handled the induction of tank T-90 during that period. He thereafter Commanded 505 Army Base Wksp at Delhi, laying the foundation of Project Cosmos.

The General Officer has wide instructional experience and has held instructional tenures at EME School, Baroda and CME, Pune. He has also been at helm of affairs at MS-16. As a General Officer he has been MGEME Northern Command and thereafter Cdr HQ Base Workshop Group at Meerut. In both these appointments, he has made a stellar contribution on pursuing strategic organizational issues. For his distinguished service, he has been awarded GOC-in-C Southern Command Commendation Card & Vishist Seva Medal. The General Officer was appointed as 52nd Col Comdt of the Corps of EME wef 15 Sep 2008. He is the first technical officer selected for the prestigious and challenging assignment of DGIS. His deep vision and in-depth understanding has been pivotal in taking fwd strategic TAC C3I system and other important e-office projects.

The General Officer took over as Comdt MCEME on 07 Jul 2011, where he brought out a paradigm shift in the training orientation of the college. With his insight into the requirement of the rapid technological advancements of the Indian Army, the General Officer broadened the technical horizons and threshold of the teaching faculties through his personal interaction and keen involvement right from the grassroot level of TTIs in the college. With a view to carry out mission reliability, life cycle support management and equipment readiness at the levels of Fmn and EME Cdrs, the General Officer laid the foundation of Data Analytics Center at FIET. The General Officer also sensitized the Senior and Middle Level Management Courses on the concepts of Combat Force Regeneration and Sustenance Engineering. He has paved the way for metamorphosis of MCEME into a Knowledge Based Organisation.

The General Officer took over the reins of the Corps of EME on 01 Dec 2011, when he was appointed as the DGEME and Sr Col Comdt of the Corps of EME. The General Officer is well known for his compassion, fairness and approachability to all ranks.

OUR 56th COLONEL COMMANDANT

Maj Gen Rajesh Datta

Maj Gen Rajesh Datta, an alumnus of NDA, Khadakvasla was commissioned in the Corps of EME on 21 Dec 75. The General Officer is a recipient of Silver Medal in NDA for standing second in the order of merit in his course. A keen sportsman, he was also awarded a 'Blue' in tennis at the NDA. He was also awarded the Bedi Memorial Trophy for standing first in the overall order of merit in the YOs course. The General Officer has undergone the prestigious Technical Staff Course, SC Course & the LDMC at CDM, Secunderabad. He has been honored with GOC-in-C Eastern Comd Commendation Card in 1998 & the COAS Commendation Card in 2007. The General Officer is a Fellow of the Institution of Engineers & the Institution of Telecommunication Engineers.

During his illustrious career spanning 36 years, the General Officer has held a variety of regimental, command & staff appointments. His regimental appointments include exposures in all type of EME units. The General Officer has commanded a Border Roads Wksp in Andaman & Nicobar Islands and an AD Regt Wksp, dply in CI environment. He has the distinction of commanding two EME Bns, both dply in a CI environment. As a Brig, the General Officer has commanded 1 Adv Base Wksp with elan. His notable staff appts include, JDEME (Org), Dir EME (L) & DDG MISO. The General Officer served as MGEME, Northern Command prior to his present assignment of Commandant, EME School.

The General Officer is a thoroughly professional soldier who has vision, in-depth engineering acumen and is imbued with the ethos and traditions of our Corps. The General Officer has been appointed as the 56th Colonel Commandant of the Corps of EME wef 01 Dec 2011. The General Officer exudes compassion, modesty and approachability to all ranks.

THE ALCHEMY OF EQUIPMENT SUSTAINMENT

- Lt Gen NB Singh, VSM, DGEME & Sr Col Comdt

The new Army vision is all about rapid deployment followed by an immediate employment. A force will have to pick up and go in the existing readiness state, arrive in the area of operations, ready to fight and it is therefore vital that it has the ability to sustain a high combat ratio as it fights. Keeping Army's equipment ready to go, needs a lot of finance & personnel. Equipment heavy divisions of US Army get supported by up to 20% sustainers. To be able to do this, we need to develop metrics to realistically portray how well equipment readiness capabilities support the war fighting doctrine. Equipment sustainment aims at creating capabilities to make mission capable equipment available during operations. Equipment sustainment in tactical battle area will be a critical part of the manoeuvre battle, a critical battle procedure that makes / remakes weapon systems in the tactical battle area & recycles these to battle. The classical approach of working on availability as a measure has certain inconsistencies. Today, we in Corps do not have a technology driven system for analyzing equipment readiness results and understand what drives readiness, both during peace & combat. Without this analysis we are unable to identify where the problems and opportunities are, which process improvements are paying off & where added impetus is needed. Process mapping and interdependent process management comprising a family of technology, techniques & formal protocols have to be created. An attempt to expand the concept of operational availability has been made in this paper.

Activity Based Systems Evaluation

We have to broaden our process vision & focus on our core business process of Combat Engineering Support (CES). One can call it equipment reset / Combat Power regeneration. A re-look at processes from a clean state perspective may be best now as we graduate to the sustainment concept. Corps of EME is to understand the benefits of this corporate methodology, to analyse how processes influence equipment readiness and hence be in a state to evaluate how process tweaks or reengineering could work synergistically to achieve maximum impact. Readiness goals need to be set by unit, formations or higher HQs. To achieve these goals an optimal mix of sustainment capacities have to be configured. This has to be backed by a highly responsive spares support system so that parts needed by units to meet readiness goals are provided. This has to be monitored as Key Performance Indicator and as a necessary capability for Combat Power Regeneration. We begin with our first hand 'in the trenches' knowledge and the age old mathematical relationship that underlies availability or Non Msn Capable (NMC) rate. When trying to understand the cause of NMC trends, almost no information is available about relative contribution of failures and repairs carried out, to equipment readiness trends. We have no system of examining failures, in say an armoured regiment over the course of a year to examine the tank failure process. There is also a complete lack of clear, realistic understanding as to how equipment readiness fares in a demanding environment, say in Northern Comd. Nevertheless, zooming forward with our analysis; from our equipment management inputs of WCC & SO courses it is known that:-

$$Ao = \frac{MTBCF}{MTBCF + MDTp}$$ where,

Ao - Operational availability (rarely kept below 98-99 %.) It is the average percentage of force that is msn capable over a period.

MTBCF - Mean Time Between Critical Failures (mechanical damage and combat damage)

MDTp (MTTR and AWT) - Mean Down Time per failure during the combat pulse (comprises active repair time or broke to fix time and waiting time / lead time).

MTTR - Mean Time to Repair or the clock time it takes for a specialist to diagnose & repair a fault, assuming all diagnostic equipment & spare parts are available.

AWT - Administrative Waiting Time.

The critical failures could be on account of equipment break down or combat damage. Without onsite re-generation, the Army will find it difficult to maintain the surges of continuous operation or operational tempo. We will work on this equation to develop the concepts of sustainment.

Time is too slow for those who wait, too swift for those who fear, too long for those who grieve, too short for those who rejoice, but for those who love, time is eternity. ***- Henry Van Dyke***

Techno Tactical Concepts : Sustainment

Combat Pulse Availability is the minimum level of availability (percentage of force that is mission capable) that a force is expected to maintain over the course of a combat pulse, which in turn is the length of time over which a combat force is prepared to operate & conduct ops i.e. continue on mission without losing stride. It could be defined in terms of No of days of equipment usage required to achieve the msn. During actual combat, clear thresholds of capability have to be identified. A troop of three tanks can have 0, 33, 67 or 100 percent Ao at a given time, based on equipment availabilities. How do we link both combat losses & mechanical losses to fighting capability? How do we decide on viability of manoeuvre elements? If a Combat Team is attacking a position at what point in terms of equipment casualties would it decide to break off the attack and regroup. Identifying such step functions in mission capability is an interesting area of deep analysis and forms the niche field of combat development engineering. EME needs to create data mining, modelling and interactive visualization capabilities providing critical inputs to planners.

MTBCF

Enhancing average availabilities during peace time by comprehensive reset maintenance, medium repairs, recapitalization (metrics being 'Like New' condition) is the way fwd to achieving higher MTBCF. Under no circumstances should we allow equipment resets like medium repairs and recap (OH) to be carried out without a focus on up scaling MTBCF & without complete content and processes. A poorly conducted medium reset is akin to complementing the breakdown failure rates and reducing MTBCF, thus having a negative effect on Ao. It also compromises on the original integrity of the weapon system by insertion of low quality and counterfeit spares.

MDTp

Improving MTTR and AWT during the combat pulse can be achieved by a 'replace forward' concept built around Line Replacement Units (LRUs) using common tools of Grade 2 & 3 technicians. When supported by interactive electronic technical manuals in tough books or onboard tracked forward repair team vehicles, with condition based monitoring systems using embedded diagnostics and prognostics and net enabled asset tracking, a web of FRTs can be created. This calls for digitisation of the large fleet of Russian equipment & future procurements of net enabled systems. The digitisation of the T-90s tank executed brilliantly by MCEME is a positive step. AWT can be controlled by the concept of Combat Force Self Sufficiency using Ready to Fight Spares (RTFs or Warpacs), Readiness Drivers (floats and rotables) and monitoring combat force fill rates i.e. No of parts demanded supplied.

Combat Engg Battle Map : Distribution centred sustainment that is fully integrated into the operational manoeuvre process, using a common operating picture which allows tracking of equipment on a tactical computer through colour coded representation of equipment that is fully mission capable or a combat team that has suffered combat damage and breakdowns is one way forward. A Combat Engg Battle Map will present a 24 hr, 360° picture of combat power degradation and actions in progress to regenerate combat power in the TBA. This total asset visibility in real time will be accompanied by a Battle Damage Situations Report as an overlay for the Common Operating Picture (COP) of the Operational Commander, enhancing situational awareness.

Combat Engg Sp (CES): The fall in operational availability day wise over a 10 day combat pulse could be as shown at fig 1. The red worm on the graph assumes non availability of any kind of CES. It is obvious that the daily msn capable rates fall drastically to unacceptable levels of 50 / 60% on the third / fourth day. In future combat situations, with enemy possessing assets to increase battle field transparency, net enabled standoff capabilities & lethality, combat damage rates could shoot up to unprecedented levels.

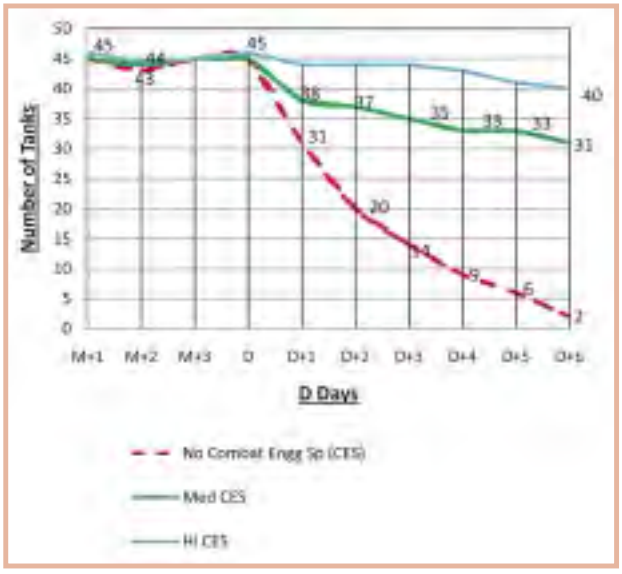

Fig 1 : Msn Capable rates for an Armd Regt

Only five out of a hundred live according to what they think and believe in their minds. And four out of those five think and believe what others tell them to think and believe - ***Dr. William Mitchell***

Using a well orchestrated & responsive CES with 24-48 hours maximum recycling time & warpacs, the regeneration rates could be up scaled providing a huge competitive advantage and operational overmatch. (Ref fig 1, green graph). This equipment sustainment trade space needs to be appreciated. A highly responsive forward repair concept built around LRUs can upscale operational availability as shown in blue. Technology is a double edged weapon and with increased complexity of weapon systems, more failures could result. Given the criticality of responsive combat engg sp (battlefield sustainment) to operational plans, sustainment engineering has to be designated as a battlefield operating system. A shared purpose of sustainment has to be created.

Techno Strategic Concepts: Sustainment

Applying Sustainment in Equipment Acquisitions: Development and Production Agencies and acquisitions branch need to understand the necessity to identify equipment with higher and higher reliability - a reliability centric orientation, instead of cost centric. Dramatic reliability improvements are required to support the Army's current vision in real terms. The present reliability gap between current systems & those desirable to sustain operations is very large due to a host of factors. This needs to be monitored and bridged. Future design requirements from the sustainment angle can be categorised into reliability, maintainability, durability, & life cycle systems management. Reliability requirements are indicative of the ability to accomplish missions and CES required during a combat pulse. Maintainability requirements would influence duration of down time during combat pulses e.g. a modular design of power plant enables power pack replacement in 3-4 hours alongside process oriented best practices. These aspects must be factored in during acquisition process.

Life Cycle Systems Management: This would look at formation wise failure rates and reliability degradation of the systems due to ageing, effect of weather, high altitude, high temperature, humidity, etc. It would point to a time for refit, recapitalization, system upgrades etc, and help to lower life cycle cost. Initial spare parts provisioning, creation of floats, ready to fight spares (warpacs), fixing of failure rates, training requirements, competency building; all designated as readiness drivers will all be aimed at up scaling equipment readiness. When combined with reengineering & configuration management, LRUs can also bring in engineering changes to defeat obsolescence e.g. insertion of new generation exchange units, new generation Commander Control panel insertion of new power packs.

Durability (Reliability Degradation): The aspect of durability needs to be factored in while making procurement decisions. An AFV power plant giving MTBF of 2000hr is a preferred option than one giving 700hr, even though acquisition cost of former is high. Estimation of reliability (performance) degradation with age as it affects mission critical failures should be used in estimating combat pulse, e.g. if Army expects to keep a weapon system for 15 yrs before recapitalisation (OH) and the system deteriorates at the rate 2% compounded every year, then the reliability requirements selected abinitio should be $(1.02)^{(15)} = 1.35$ or 35% higher than current standards. This can help us to make appropriate choices.

Recapitalisation : Comprehensive planning of capital repair infrastructure and competencies abinitio as a part of the life cycle sustainment plan is an inescapable requirement to support the Army's war fighting doctrine. Design of overhaul regimes or phased recapitalisation with technology insertion will help determine the sweet spot, balancing cost and base level restoration of readiness during peace time. Building of surge capacities in house will provide the operational over reach. Age based recapitalisation programmes are critical to maintaining combat effectiveness and maximizing pulse availability in the context of our storage practices & exploitation of weapon systems. Besides, it will lower life cycle costs.

Conclusion

High level sustainment requirements need to be pragmatically evolved based on our own experiences of supporting weapon systems for the past 65 years. A courageous sustainment plan based on 'next practices', candour, risk taking & people's competency could recreate asymmetric combat ratios, guaranteeing victory. A right balance between cost, schedule and performance will optimise precious life cycle costs & guarantee high operational availability. Sustainment is a Battle Field Operating System of future wars - the kernel has to be ours. For EME, it is a Corps (Core) Business Process.

The author is DGEME & Sr Col Comdt. Prior to taking over the reins of the Corps of EME, the Gen Offr has tenated the appts of Comdt, MCEME and DGIS. The article is based on inputs available in open domain with suitable adaptations.

He who does not know his opponent's viewpoint does not completely understand his own. - ***Anonymous***

BUILDING LIFECYCLE EQPT SUSTAINMENT DURING ACQUISITION

- Brig Sanjeev Kumar Mathur

The Indian Army, like most modern armies of the world, has been considerably influenced by the Revolution in Military Affairs (RMA). At the core of RMA are wpn and sp sys with increased range, precision, speed, lethality and capability to network, all driven by contemporary technologies. These sys are exponentially enhancing the capabilities of def forces and their impact on the war fighting potential is decisive. To harness the full potential of RMA there is an inescapable need to ensure that the eqpt is always msn ready and 'Op Preparedness' of the army is maint at optimal levels. This calls for evolving an effective system for sustainment of eqpt capability which has the flexibility to adapt to the dynamics of the environment and the challenges that confront the army.

Costs of Inadequate Eqpt Sustainment

Poor eqpt sustainment substantially degrades the comb power generation capabilities of the army. The maj effects of inadequate eqpt sustainment are: -

- **Low Msn Readiness.** Msn readiness of a unit / fmn depends on both, the 'Avl of Eqpt' and its 'Msn Reliability'. The present methodology of judging op readiness based on average avl of eqpt alone, masks the true msn readiness state.

- **Large Sustainment Footprint in TBA.** While eqpt reliability and maintainability are influenced by design, upgrades and in-service sustainment, the avl of eqpt is dependent on the effectiveness of the structures and processes for engg sp, velocity of sup chain, and skill sets of human resource. Inadequate focus on any of these, results in an enlarged footprint of sustainment elements in TBA.

- **Incr Lifecycle Cost.** It is a fact that the sustainment cost is approx 70% of the lifecycle cost of the eqpt. Due to the fact that this cost is spread over the lifecycle of the eqpt, which may vary from a decade to three / four decades, the significance of this substantial investment is seldom realised. Further, inadequate attn on sustainment reqmts at the development stg or during acquisition, translate either into faster obsolescence of eqpt or for the need to recapitalize it through upgrades early in its in-service life.

- **Reduced Comb Eff due to Poor Interoperability.** This is relevant for countries like India, which largely depends on import of comb sys. Due to proc of sys from different sources, maint common protocols, interfaces, etc, is a maj challenge. Eqpt sustainment sys thus needs to focus on ensuring interoperability through attaining the expertise to develop upgrades and interface units.

Implications of Op and Technical Imperatives on Eqpt Sustainment

The implications of op imperatives, on eqpt sustainment are indicated in Table 1.

Op Imperative	Implications on Eqpt Sustainment
War emerging at short notice	● Comb sys to be msn ready at all times. ● Focus of all stakeholders on msn readiness of eqpt and enhancement of sup chain velocity.
Short duration, high tempo conflict	● Quick re-cycling of casualties. ● Adoption of the paradigm 'Replace forward Repair rearwards'
Non-linear ops	● Self sufficiency of mvre force ● Matching mobility of grouped sustainment elements
Deeper and wider comb zones	● Remote diagnostics features ● Concept of 'Sys Mechanics' and 'Specialists' ● Grouped sustainment teams with comb forces
Incr jointmanship	● Interoperability between comb sys
Network Centric Warfare	● Interoperability between all sys on the network

Table 1 : Implications of Op Imperatives on Eqpt Sustainment

The implications of tech envt on eqpt sustainment are indicated in Table 2.

ARTICLES

Never doubt that a small group of thoughtful, committed, citizens can change the world. Indeed, it is the only thing that ever has. - ***Margaret Mead***

Tech Imperative	Implications on Eqpt Sustainment
Rapid rate of devp of tech	● Frequent tech driven upgrades ● Ensuring sufficient upgradation potential in the eqpt during development / procurement
Incr in performance levels of next genr technology	● Need for ab-initio plg for tech driven upgrades ● Ensuring sufficient upgradation potential in the eqpt during devp / proc
Tech Lifecycle Differential	● Need to focus on upgrades at sys vertical level rather than on complete platform ● Incr focus on indigenisation of low tech lifecycle sys
Convergence of Tech	● Raising of fwd sustainment bases to repair and OH maximum modules / rotables ● Need for common interfaces, protocols, etc, for networking of sys

Table 2 : Implications of Technical Imperatives on Eqpt Sustainment

Equipment Sustainment Framework

The op goals and the tech imperatives entail that the IA evolves a sys with a well defined framework for disciplined and unified mgt of all the activities necessary for lifecycle sustainment of eqpt. The arrangement should address all activities necessary for evaluation of tech, design and development / acquisition of a supportable and sustainable sys to achieve the pre-determined set of objectives within an acceptable cost of ownership. The maj components of the eqpt sustainment framework are depicted in Fig 1.

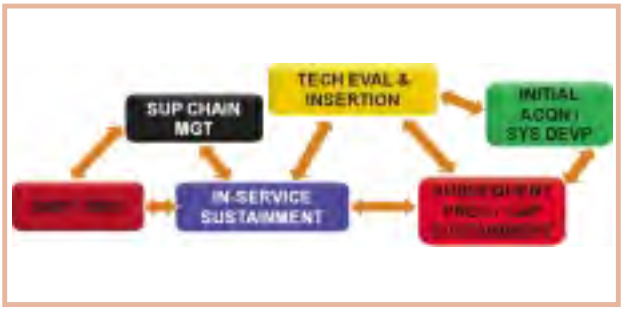

Fig 1 : Eqpt Sustainment Framework and Linkages

Recommendations

The foundation for effective lifecycle eqpt sustainment needs to be laid prior to and during acquisition. The activities / actions recommended to be taken during this part of the framework are elucidated ahead in the article.

● **Tech Envt Assessment.** This ex is presently carried out by the Perspective Planning (PP) Dte in consultation with DRDO and other agencies internal to the army. To enhance the efficacy of the process following is recommended: -

◆ **Institution of a Chair at DRDO HQ.** In view of the rapid evolution of tech and the domain knowledge needed, it is recommended that a dedicated chair be instituted in DRDO HQ for the purpose. DRDO needs to prepare the tech envt assessment and submit it to PP dte which utilized while formulating the Request for Information (RFI) and Request for Proposal (RFP).

◆ **Envt Scan by the Army.** A similar ex can be undertaken by the Line Dtes and EME to supplement the foresaid assessment. Info can be collated from the trg ests, literature svy, internet and vis of teams to Def Expos in India and abroad.

● **Macro Level Interaction under the aegis of PP Dte.** For maj wpn / sp sys to be proc, a macro level interaction can be held under the aegis of the PP dte to formulate maj policy directives for lifecycle sustainment of the eqpt. Besides the line dte, MGO's Branch, EME, Ord and AHSP can be part of this interaction.

● **Formulation of Provisional Eqpt Mgt Policy Statement (EMPS).** Based on the decisions taken during the macro level interaction, a provisional EMPS can be formulated prior to issue of the RFI clearly highlighting the expected life of eqpt, policies for OH / MR / component level repairs, etc.

● **Request for Information (RFI).** The RFI needs to be formulated by the Line Dte in consultation with EME so that info reqd for eff lifecycle sustainment of the eqpt is obtained.

● **Acceptance of Necessity (AoN).** AoN is a vital milestone in the acquisition process wherein budgetary sp for the main eqpt and associated proc is accorded. The two possible models, viz, Model A and B that can be adopted are depicted in figures 2 and 3 respectively.

◆ **Model A for AoN.** In this model, shown in Fig 2, AoN for main eqpt, Eqpt Support Plan (ESP)

The saddest aspect of life right now is that science gathers knowledge faster than society gathers wisdom. ***- Isaac Asimov***

incl Mfr Recommended List of Spares (MRLS) for four / five yrs for est of OH, MR and component level repair facilities is obtained ab-initio. This can be done when budgetary estimates for the maj sustainment infrastructure can be projected with reasonable amount of confidence. In the commercial response OEM has to incl cost for est of component level repairs, OH and MR facilities, along with their budgetary estimates. The salient aspects of this model are: -

- There is no need to apch the MoD on multiple occasions for AoN for the infrastructure needed for maj sustainment interventions. The OEM would submit realistic budgetary estimates for est of maj sustainment facilities, as these would be incl for selection of L1.
- The component level repair facilities would get est within two to three years of signing of the contract.

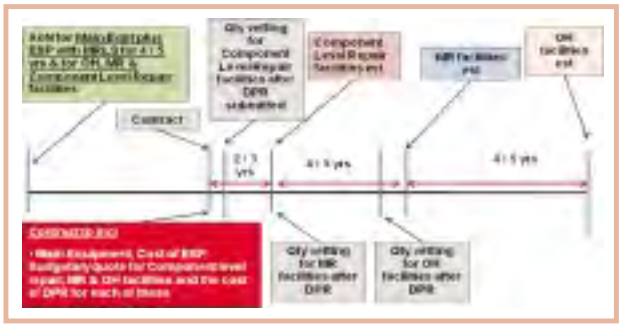

Fig 2: Model A for AoN

◆ **Model B for AoN.** In this model, shown in Fig 3, AoN for main eqpt, ESP incl MRLS for four / five yrs, est of OH, MR and component level repair facilities are obtained ab-initio. In the commercial response OEM must incl cost for est of component level repairs, OH / MR facilities. The vendors to submit budgetary estimates for est of OH, MR and component level repair facilities before the Contract Negotiation Committee (CNC) along with the commercial bid. This would ensure that the selected vendor does not quote exorbitant prices after the contract is awarded. The salient aspects of this model are:-

- AoN for requisites for maj sustainment interventions would be realistic as it would be based on the budgetary estimates of vendors and the OEM will not inflate the cost of the facilities needed for maj sustainment interventions.
- The est of component level repair facilities may take four to five after the first contract. Thus a longer period of AMC for this vital sustainment activity would be needed (when compared to Model A).

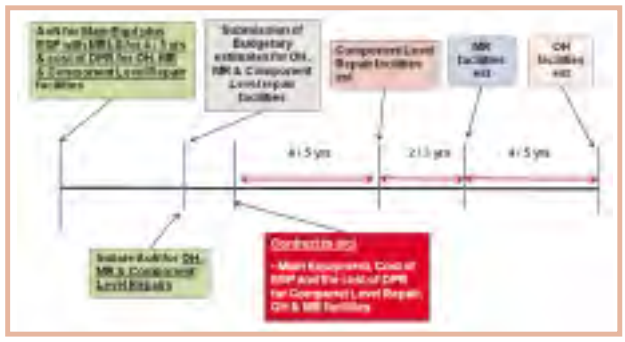

Fig 3 : Model B for AoN

● **Request for Proposal (RFP).** Some changes to refine the sys are:-

◆ **Terms of Wty.** The wty clause should empower the maint agency and AHSP to get fully integrated with all sustainment activities undertaken by the OEM.

◆ **Engg Sp Package(ESP).** The tendency to limit the ESP being initially proc should be curbed, the EME needs to link and highlight the adverse implications of any tradeoff on eqpt msn readiness.

◆ **Maint Philosophy.** The EME needs to obtain the maint philosophy of the OEM so that the best practices can be adopted. The OEM needs to indicate the recommended periodicity of OH of platform and rotables along with all the facilities / docu needed.

◆ **Mfr Recommended List of Spares (MRLS).** The initial spares contracted must cater for four / five yrs of expl in the fd army. The spares needed to sp platforms should be put through Accelerated User cum Reliability Trials (AUCRT) and the Pilot OH kits must be avl for min two platforms and all rotables.

- Four / five yrs of expl in the fd army.
- Spares needed to sp platforms put through AUCRT.
- Pilot OH kits for min two platforms and all rotables.
- WWR and all other res needed incl samples for Ord depots, AHSP.

To live is the rarest thing in the world. Most people exist, that is all. - ***Oscar Wilde***

◆ **Ready to Fight Kits.** During ops the expl rate of war fighting machy would exponential incr, consequently, the rate and pattern of consumption of spares would not correlate to that observed during peacetime. There is a reqmt adopt the concept of 'Ready to Fight Kits' which would comprise of spares needed for the msn of the fmn. These spares can be held in the fwd sustainment bases and released to the wksps.

◆ **Maintainability Evaluation Trials (MET).** The present aim of these trials is to ensure that eff engg sp is rendered to the eqpt throughout its lifecycle. This needs to be amended; the trial should est the methodology for lifecycle sustainment of eqpt to ensure that the intended op capb is sustained. To achieve this, the trial is proposed to be conducted in the following four phases: -

- **Ph I: After TEC and commencement of User Trials.** Once the TEC has shortlisted potential vendors, the sustainment evaluation trails can commence, for which WE Dte needs to ensure that the requisites i.e. tech literature, MRLS, OEM recommended maint philosophy, list of SMTs / STEs and trg aggregates are provided.
- **Ph II: During User Trials.** During the user trials the SET team must closely interface to iden critical sys, undertake and observe whether there are any maj variations in the maint philosophy recommended by OEM.
- **Ph III: When the Eqpt is offered for SET.** The trial team must focus on critical systems, analyse them in detail by interaction from vendors tech rep and formulate the lifecycle sustainment plan.
- **Ph IV: Between Ph III and CNC.** This time would be used to iden the reqmts of sustainment requisites to be proc, and the guarantees to be committed by the vendor.

● **Contract Negotiation Committee (CNC).** All obsns made during the trials need to get discussed during the CNC in detail and incl in the contract.

● **ToT Contract.** For Buy and Make cases, the user and EME reps must get fully integrated during the ToT contract negotiations. Also, provns need to be built in under which the agency taking the ToT shares the tech info needed for component level repairs, MR and OH with the EME. In all these cases the vendor should be asked to incl the SMTs / STEs needed to carry out these activities in Annexure 1 of Appx D to RFP.

● **Maint ToT.** When MToT is being taken by EME, a conscious decision is to be taken whether the Corps is to be involved with the provn of spares for all echelons of repairs throughout the lifecycle of the eqpt. It may be better to limit the scope of MToT to component level repairs, MR and OH.

Conclusion

The comb genr capb of the army is becoming more and more dependent on the capb of eqpt in the hands of fighting forces. It has thus become vital that the eqpt capb is maint throughout its lifecycle through an eff sys of sustainment. The present sys for eqpt sustainment existing in IA was suitable in yesteryears, when the rg and complexity of wpn and sp sys were limited, however, the same is seriously suboptimal for the rapidly modernizing army of today. It is thus inescapable that all stakeholders of the org take a de novo look and holistically evaluate the sustainment sys to incorporate systemic changes needed that would ensure that the op preparedness is maximised. The recommendations made in the article would enable adoption of a lifecycle view of the eqpt by all stakeholders and would ensure that maj aspects related to sustainment get meticulously planned and addsd during acqn of the eqpt.

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Everything you can imagine is real. - ***Pablo Picasso***

EFFECTIVE EQUIPMENT SUSTAINMENT

- Lt Col Arvind Kumar

Introduction

Growth in any field is driven by effective sustainment and nurturing of assets, already in hand. The same is true for industry. **Acquisition** of assets is just the start point; it is their **effective sustainment** that presents the real challenge. Most businesses are raised with profit as the primary motive; profit in turn depends on **reducing input costs** and simultaneously **enhancing output** for a given amount of input. Businesses have traditionally sought to optimize input costs by focusing on the most obvious **cost of acquisition;** what is often lost sight of is the **life cycle cost** of sustaining these acquisitions in order to ensure that their functionality remains optimally aligned with the plan to achieve organizational goals. Low upfront cost of acquisition can be so misleading that the woods can often be missed for the trees. **Taking a life cycle view** of equipment sustainment is thus absolutely imperative.

Input efficiency is dependent on operational effectiveness of the equipment and the lifecycle cost to achieve the same. The various components that contribute to the lifecycle cost are depicted in figure 1. As the lifecycle cost is spread over a large timeframe and a number of agencies are involved in incurring the same, the significance of this is often not fully understood. It is an established fact that the sustainment cost adds up to approximately 70% of the lifecycle cost, thus even a small saving in this could make a substantial amount available for procurement of any additional assets.

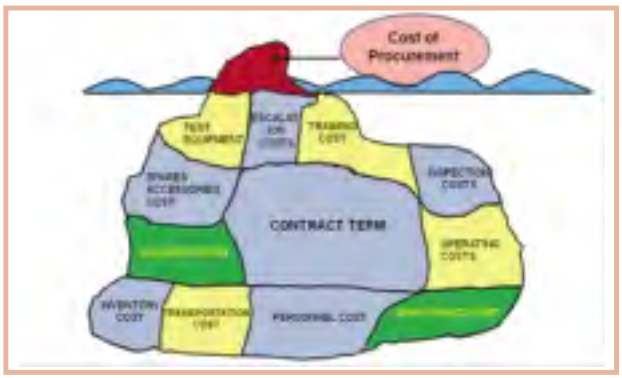

Fig 1: Lifecycle Cost of Equipment

Implicit in the Life Cycle Sustainment of equipment, is the need to constantly track development and progress in the technologies involved and to go in for **planned upgrades** and **technology insertion** so that the equipment is kept current for the maximum time possible and does not have to be discarded as scrap on becoming obsolete because of the failure to upgrade in time. The primary purpose of this paper is to highlight the need as well as numerous benefits adopting a holistic approach to **Effective Equipment Sustainment.**

Equipment Sustainment Challenges

- **Reducing Time Cycle for Technology Development and Enhancing the Performance Potential.** Fig 2 given below depicts the technology development life cycle vs the performance potential for the existing and next gen technology. The difference in performance potential between existing and the next generation technologies is large. The same will be true for the consecutive generations. The challenge posed will be reducing technology development time and also to bridge the difference in performance potentials between two consecutive technologies. This would entail the need for frequent **upgrades and /or technology insertions** wherever possible.

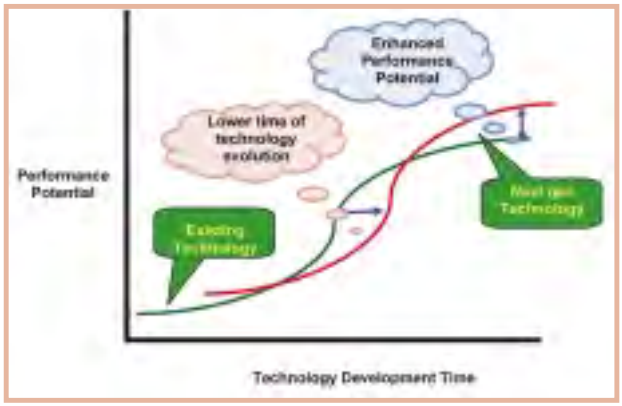

Fig 2 : Technology Trends

- **Technology Management.** It is pertinent to note that the growth rates vary widely for different fields of technologies, the implication is that management of various types of technologies that go into a system is a

If you ever find happiness by hunting for it, you will find it as the old woman did her lost spectacles, safe on her own nose all the time. ***- Josh Billings***

core issue for effective equipment sustainment. The observed rate of growth is the fastest in the fields of electronics, communications and information technology, which have become all pervasive in every system. Consequently most modern equipments have become **"System of Systems"** possessing capabilities unmatched by earlier technologies. One of the major challenges to effective equipment sustainment posed by the explosion in technologies is in terms of technology development versions obsolescence management.

- **Convergence of Technologies.** Convergence of technologies is another defining feature of contemporary systems. It is their convergence which is largely responsible for the substantial enhancement of performance, reliability and greater intra as well as inters system integration. The benefits however come at a cost in terms of the diverse infrastructure, tools and skill sets needed to sustain such diverse technologies.

Pillars of Equipment Sustainment Eco-system

The four pillars that have a strong influence on the equipment sustainment eco-system are given in Fig 3. The interrelationships between the pillars and their dependence on each other, stipulate that a holistic view is taken to concurrently address these to achieve the desired end state. The organisational transformation so undertaken should be able to tailor these facets in tandem, as dictated by the distinct phases of the equipment lifecycle, to achieve the overall operational goals.

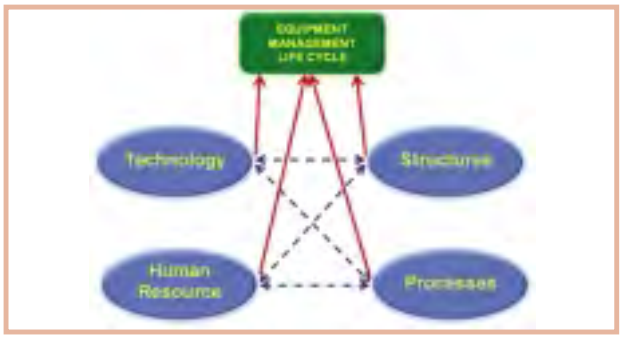

Fig 3 : Pillars of the Equipment Sustainment Eco-System

Equipment Sustainment Inputs/Levers

The inputs / levers that directly influence the objectives of equipment sustainment, and in turn the levels of operational efficiency and effectiveness, are depicted in Fig 4. It is prudent to comprehensively analyse these to strengthen the pillars of the equipment sustainment eco-system.

Fig 4: Equipment Sustainment Inputs / Levers

The effects of the inputs / levers and processes on the overall system of equipment sustainment, terminating finally into operational efficiency of the organization are as follows: -

- **System / Operational Effectiveness.** This is a product of 'Product Effectiveness' and 'Process Effectiveness'. Consequently, the organisation needs to procure the best products available and adopt the best processes / practices that suit the environmental imperatives to ensure that the operational effectiveness is optimally maintained at all times.

- **Process Effectiveness.** The processes followed for operating the equipment, its maintenance and the logistics support are the key determinants of the overall process effectiveness of the organisation.

- **Product Effectiveness.** The product effectiveness is a product of 'System Performance' and 'System Availability'. An organization thus needs to procure equipment with capabilities and performance attributes entailed by its requirements. The continuous availability of the equipment with requisite functional reliability at all times is another key challenge.

- **System Performance.** The overall performance of any equipment is directly related to its functional parameters, attributes and priorities that get assigned at the design stage. It is therefore very important that these are defined in great detail during the development / procurement stage. To avoid contradictions in the desired priorities, attributes and performance parameters, quantitative tools like 'Analytic Hierarchy Process' need to be used, especially for complex machinery/equipments.

*However many holy words you read, however many you speak, what good will they do you if you do not act on upon them? - **Siddhartha Gautama***

- **System Availability.** The key inputs / levers that influence system availability are, producing of the equipment, the reliability features that have been built-in by design, supportability and maintainability features of the equipment. These levers need to be explicitly defined in verifiable terms during the design and development acquisition stage.

Major Tenets for Equipment Sustainment

To have an effective in-service sustainment of the equipment the organisation needs to tailor its structures, processes, human resource and technology adoption to attain this objective, which directly impinges on the organizational readiness. The major tenets identified, based on the inputs and metrics defined to achieve Effective Eqpt Sustenance Cycle are shown in Fig 5.

Ser No	Input / Lever	Design Objective	Metrics for Defining Equipment Sustainment Requirements
1.	Reliability	• Minimise mission critical failures • Minimise maint reqmt • Maximise life of sub assy and components.	• Enunciate Mean Time Between Critical Failure (MTBCF) • Preventive / predictive maint reqmt [Mean Time Between Scheduled Maintenance (MTBSM)] • Corrective maint reqmt [Mean Time Between Unscheduled Maintenance (MTBUM)]
2.	Maintainability	• Prevent mission critical faults • Minimise corrective maint downtime • Reduce time for diagnostics	• Condition monitoring in real-time / offline of critical systems. • Enunciated safe life of rotables. • Mean Time to Repair (MTTR). • Maint Man Hour (MMH) for scheduled & unscheduled maintenance. • BITE. • Percentage of high frequency faults predicted / diagnosed.
3.	Producibility and Standardisation	• Minimise Prod time • Maximise Standardisation	• Configuration documentation • Number of sub-vendors. • Standards followed for design and quality assurance.
4.	Life Cycle Management	• Account for lifecycle operation (cost) • Sustain reliability and maintainability at necessary levels	• Overhaul (OH) periodicity. • Servicing periodicity. • Study reliability degradation with ageing.
5.	Supply Support	• Minimise lead time • Minimise cost and footprint	• Sub assemblies components • Fast moving spares

Table 1 : Metrics for Equipment Sustainment Requirements

Metrics for Effective Equipment Sustenance

Based on these inputs and levers for an effective sustainment, the potential metrics identified for effective equipment sustainment are listed in Table 1.

Another major consideration for effective equipment sustainment apart from those depicted, is to make a distinction between different types of equipment and being sensitive to the system verticals, rather than having a straight jacketed approach common to all

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The poorest man is not without a cent, but without a dream. - ***Anonymous***

Fig 5 : Major Tenets for an Effective Equipment Sustainment

platforms. This is becoming increasingly relevant with the wide differential in the rate of growth of diverse technologies, their lifecycles and the variations in the challenges associated with their sustainment. Thus there is a need for customisation of sustainment plans for different types of platforms, and in them, having a distinct approach for distinct system verticals.

Conclusion

The organisation, needs to ensure that its capability is built up in a well planned and logical method; and more importantly, all stakeholders need to ensure that the equipments are maintained in a capable state at all times. There is thus an inescapable need for organisation to transform its structures, processes, technology orientation and human resource skill sets to meet the challenges to effective equipment sustainment.

Equipment sustainment management objectives get derived from the highest organizational objective. The issue is complex and acquisition spans the entire spectrum of activities right from concept development to equipment discard. It is also highlighted that activities along the equipment lifecycle are not independent of each other because of the very strong forward and backward linkages that exist. Consequently, a tradeoff made at any stage has an adverse affect on all activities that follow. The sustainment issues therefore need to be addressed with requisite alacrity at each stage, as the price to pay for inadequate sustainment is indeed phenomenal.

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LETTER FROM A GOLFER

Dear Abby,

I've never written to you before, but I really need your advice. I have suspected for some time now that my wife has been cheating on me. The usual signs. Phone rings but if I answer, the caller hangs up. My wife has been going out with "the girls" a lot recently although when I ask their names she always says, "Just some friends from work, you don't know them."

I always try to stay awake to look out for her coming home, but I usually fall asleep. Anyway, I have never approached the subject with my wife. I think deep down I just didn't want to know the truth, but last night she went out again and I decided to really check on her. Around midnight, I decided to hide in the garage behind my golf clubs so I could get a good view of the whole street when she arrived home from a night out with "the girls".

It was at that moment, crouching behind my clubs, that I noticed that the graphite shaft on my driver appeared to have a hairline crack right by the club head. Is this something I can fix myself or should I take it back to the pro shop where I bought it?

Signed,
Perplexed

"Insanity is doing the same thing, over and over again, but expecting different results." - ***Albert Einstein***

INTEGRATING DATA ANALYTICS IN SUSTENANCE & RELIABILITY OF EQUIPMENT

- Col Vinay Gupta

In today's environment, organisations are constantly re-aligning themselves to improve efficiencies and focus on core operations. To lead organization in today's challenging operational conditions, one needs fact-based answers that we and others can believe in. Traditional approaches to decision support have not yielded optimal results. The field of business analytics has improved significantly over the last few years, providing users with better insights, particularly from operational data stored in transactional systems.

Analytics have been used in business since the time management exercises that were initiated by Frederick Winslow Taylor in the late 19th century and Henry Ford measured pacing of assembly line. But analytics began to command more attention in the late 1960s when computers were used in decision support systems. Since then, analytics have evolved with the development of Enterprise Resource Planning (ERP) systems, data warehouses, and a wide variety of other hardware/ software tools and applications.

Leading banks use business analytics to predict and prevent credit fraud, saving millions. Retailers use business analytics to predict the best location for stores and how to stock them. Pharmaceutical firms use it to get life-saving drugs to market more quickly. Even sports teams are getting in on the action, using business analytics to determine game strategies, optimal ticket prices and real time feeding to the racing crew. Other companies use the analytics for product sales analysis, supply chain & operations analysis, website analysis, customer acquisition, retention and attrition analysis, and many other emerging applications.

Our organization, being responsible for Life Cycle Sustainment of equipment, generates large amount of transactional data on a daily basis. However, there are limited / no tools, application or framework which enables us to extract meaningful information or gain insights into the data which can be of immense value to improve our process efficiency, reduce time to repair, enhance quality, enable forecasting of spares, maintenance, or optimize cost and staffing. It is therefore imperative that we understand the significance of Data Analytics for implementation in our organization.

Concept of Data Analytics

Presently report & returns driven processes put information into the hands of an officer, leaving him to make sense of the situational context and the information's effect on the repair process, thereby meaning that execution lies in the hands of the receiver and how he or she interprets the information.

This type of **Static Reporting** is not enough to support decision making, particularly if it requires backward looking and forward-looking information. The most effective & simplest way to **Embed Analytics** into our EME organizational workflows is to create a process that captures data, analyzes it and then feeds the results back into the operational data store (ref Fig 1). During this process of implementation & development, basic reporting might be initially needed to check the result, and once the application is performing correctly, specific monitoring reports can be added.

Fig 1. Schematic on work flow for data analysis and storage

One of the perceptible change/ outcome of implementing Analytics in organization would be that, there will not be a requirement of sending traditional reports & returns up the hierarchical chain. Data in customised & pictorial forms (dashboards) can be generated on the fly by the analytical tools and application framework. With the advancement in analytic systems, we need to build our expertise and competency in these tools and customize their applications in our work processes for effective decision making. The customized analytical tools and application framework will allow rapid analysis of information and

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Wanting to be someone else is a waste of the person you are. - ***Kurt Cobain***

graphical presentation of information for requisite decision making (ref Fig 2).

Fig 2: Schematic depicting info analysis and decision making

Presently, we have enabled the collection of certain data about inventory management, the performance of maintenance echelons, and maintenance schedule, etc in a limited and ad hoc manner. However, new applications are required to be developed to simplify & structure data capture, analyze this data to provide insights about the status of critical equipment, reliability parameters, quality of repair efforts, response of ordnance supply, and accuracy of casualty forecasts etc. Out of the various tools/software available in the market, the most pervasive, capable, user friendly and cost effective is MS Excel. It has tremendous data analysis features and to begin with we need to increase its utilization in our repair data analysis. This can help kick-start establishing the framework and lay a foundation to implement advanced, repeatable and efficient analytical processes that can fundamentally and positively create, build and enhance the '**Analytics Culture**' within the EME.

Analytics is dependent on data. The most important factor to the successful implementation of business analytics practices is **sufficient volumes of high quality data.** The difficulty in ensuring data quality is integrating and reconciling data across different systems, and then deciding what subsets of data to make available at different hierarchical level. Our organization is still stymied by challenges related to data capture, data quality and data sharing across systems and organizational entities. There are isolated analytic processes, with a perennial focus on hindsight reporting rather than predictive insight. New Analytic approaches applied in our organization can close key information gaps and create powerful strategic advantage and empower the key appointment holders. A few insights which can be obtained are as under:-

- Operational Readiness of formation.
- Eqpt Readiness Rate & Non Mission Capable Status.
- Mission Reliability to support current operational objectives.
- Pulse Availability, Operational Availability & Combat Pulse Self Sufficiency.
- Fault Freq Analysis (diagnosis & prediction), Failure rate.
- Procurement Lag Time and Inventory Delivery Lag Time.
- Technical resources, voids & distribution.
- Technical skill shortage and distribution.
- Lifecycle costing of major weapon system.

Once we are able to analyze data about our core functions related to Life Cycle Sustainment, it is only natural for us to begin analyzing data about our personnel. A new generation of analytic applications allows organisation to identify optimal staffing requirements, such as performance parameters, technical skills, intake / retirement rates, and perform tasks such as compensation and benefits analysis The ultimate promise of this effort is an enhanced capability and empowerment of the decision makers to focus on areas where they will have the greatest effect on keeping equipment ready to fight, enabling Cdrs and those engaged in the acquisition and recapitalization processes to examine which improvements will most likely lead to higher equipment readiness and the Army's ability to sustain equipment readiness while reducing total support costs.

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"The books that the world calls immoral are books that show the world its own shame." - ***Oscar Wilde***

SUSTAINMENT OF THE ARMY AVN ASSETS: THE CURRENT ISSUES

- Col Sunil Kumar Yadav

Introduction

A unit / fmn is org and equipped to fulfill its designed Operational role. However, by just equipping it with the required eqpt does not ensure its msn readiness at all times, if the eqpt itself is not sustainable. The term sustainment (as regards to eqpt) in most simple term can be defined as the activities undertaken to keep eqpt in such a condition that the unit / fmn is always in **msn readiness** state involving least possible **life cycle cost.** Therefore **'Msn Readiness'** state and **'Low Life Cycle Cost'** becomes two pillars of sustainment. The fig 1 depicts the same.

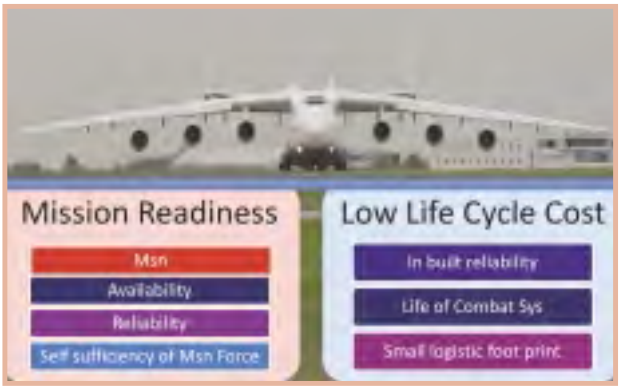

Fig 1: Eqpt Sustainment-What does it mean?

Army Avn Fleet

The Army Avn fleet presently consists of only two types of heptr. These are Cheetah / Chetak and ALH (various versions). The Engg Sp to avn fleet is org in three ech, the 'O' and 'I' level being undertaken at fd level and the 'D' level by OEM (primarily HAL). Before coming to specific issues of sustainment of army avn assets, it is relevant to understand the typical characteristic of avn eqpt which has direct bearing on the sustainment of the eqpt. These are as under :-

- Flight safety is of paramount importance.
- High cost of inventory.
- No local purchase.
- HAL is the single pt agency for MRO activities.
- CASD is the single depot for all stores.
- Maintenance authorised only by "On Type" trained staff.

Sustainment Issues

Having known about the army avn assets, ech of repair, and peculiar characteristic of avn eqpt, now we come to the current sustainment issues. These issues have been cat based on the two pillars of sustainment i.e. Msn Readiness state and Low Life Cycle Cost.

- **Msn Readiness.** The following factors effects the Msn readiness state of an avn unit.
  - **Availability of Heptrs.** Keeping in mind that one heptr will always remain "On Ground" on account of servicing/snag rectification, a flt is equipped with 5 heptrs. The flt is said to be in Msn readiness state if the availability is more than 80%. It is generally observed that availability state is much less than the desired msn readiness state. The factors for low availability state were iden and listed below
    - **Delay in Overhaul and Servicing at HAL.** There is a considerable delay at HAL in overhaul of heptrs/rotables and servicing of heptrs. Because of this, many flts are holding four or less heptrs at any given point of time thus adversely impacting their msn readiness state.
    - **Capacity Constraint at HAL.** There are a substantial number of pending Repair and Maint Supply Order (RMS order) at HAL. Because of this constraint, auth spares are not avail with flts as well as with CASD which further affects the avl state.
    - **Dependency of HAL on Foreign Vendors.** This is particularly applicable for ALH. ALH has been indigenously developed by HAL in collaboration with BMM, Germany and there are various LRU which have been developed by various countries. However comprehensive MTOT has not been signed by HAL with various foreign vendors and therefore even today large No of assys are being sent back to OEM for defect investigations and repairs. This increases the 'Turn Around Tune' (TAT) to a great extend and reduces the avl of LRUs/spares.
    - **Product Stabilisation Issues.** This pt is again more relevant to the ALH fleet. Though

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"He who knows all the answers has not been asked all the questions." - ***Confucius***

it is understood that the indigenously developed product does take time for stabilization, however there are still pending tech issues which have not been resolved for long now like rain water proofing, MFD failures, actuator failures etc. This also adds to non availability.

▼ **Provisions of Spares.** The constraint of HAL in terms of capacity and high TAT if catered in provision plg can ensure better avl of spares. However at this point of time conventional provisioning methods are being used and avl of spares remain far less than the satisfactory levels.

◆ **Reliability.** High rate of premature failure particularly in cheetah / chetak heptrs needs to be looked into. Though premature failure of LRUs is attributable to various factors, however in most of the cases it is attributable to process control and quality control at OEM level. The reason for same is changing priority of OEM where the HAL is more focused on development of ALH and new heptrs, rather than on support to the vintage Cheetah / Chetak heptrs. High rate of premature failure reduces the avail of heptrs.

● **Low Life Cycle Cost.** For the developing country like us, life cycle cost as a factor of sustainment, assumes greater significance. Following factors directly effects the life cycle cost of avn assets.

◆ **Time Between Overhaul (TBO).** Higher the TBO, lesser is the life cycle cost. This factor is to be taken into consideration during design stage itself, however there is a scope of increasing TBO in case of Cheetah / Chetak and ALH heptr by incorporating Health & Usage Monitoring Sys (HUMS).

◆ **Freq of Sch Servicing.** Cheetah / Chetak being of vintage tech have a min interval of 25 hrs between sch servicing. Since now we have enough experience on these heptrs, the sch serving interval can be increased by carefully examining all aspects or at least number of sch activities can definitely be reduced. As regard ALH heptr, 50 hrs interval between sch servicing is really too less (as adv tech have been used in the heptr) and there is definitely a scope of increasing it to 100 / 200 hrs as in the case of other contemporary heptrs in the world.

◆ **Multi Ech Inventory Optimisation (MEIO).** There is tremendous scope of reducing life cycle cost by inventory optimization. Analytics and power of IT can be leveraged to achieve this.

◆ **Increased Reliability during Design Stage.** Though it will increase the development and procurement cost, however will result in reduced life cycle cost.

Sustainment Philosophy for Avn Assets

Keeping the current sustainment issues in mind, a suitable sustainment philosophy for avn assets can be drafted. It must be appreciated that this philosophy needs to be different for "Buy and Make" and "Buy" cases. Given below are certain aspects which need to be taken care of while formulating the sustainment philosophy. It also needs to be emphasized that formulation of the sustainment philosophy will require much extensive deliberation and the pts highlighted below are for certain not exhaustive and comprehensive.

- To buy only mature and stabilized sys.
- Comprehensive ToT and M ToT.
- Est In house capability to develop critical technology.
- Effective use of sustainment enablers like MEIO and Analytics.
- Formulation of Msn Upgrade Mgt Teams.
- Formulation of Sustainment Eval Trial directives.
- Accelerated trial for indigenously developed product.
- HR aspects of sustainment.

Conclusion

There are many sustainment issues regarding army avn assets. These needs to be addressed by developing valued partnership between services and OEM, primarily the HAL. Integration of existing strong industrial base in our country with the avn related technological issues shall reduce our dependency on foreign vendor in due course of time resulting in better sustainment of existing and future accretion of avn assets.

Col Sunil Kumar Yadav, *Dean FAE, MCEME was commissioned into the Corps of EME on 10 Jun 1989 as a Tech graduate. He is a Mech Engineer from MREC (Now MNIT), Jaipur and has done Avn Tech course. The offr has also done M.Tech (Aerodynamics) from IIT Mumbai and TSOC from IAT, Pune. He commanded 7001 EME Bn and has also served as Col Avn in HQ Tech Gp EME.*

"He who has a why to live can bear almost any how." - ***Friedrich Nietzsche***

CONDITION BASED MONITORING OF ARMOURED FIGHTING VEHICLES

- Lt Col Manmeet Singh Soni

Introduction

Weapon systems / platforms and military equipment support combat missions and availability of these combat assets is of paramount importance. These assets when deployed, carry out most valuable combat critical roles and in order to keep these work horses delivering their best, there is a need to monitor their health parameters and their residual msn reliability continuously and dynamically and take necessary maintenance action if functional deviations are diagnosed.

The apriori knowledge of the mission reliability of a weapon system is very important for planning any missions or operations. Especially, when weapon systems are mothballed and kept for actual missions, or when weapon systems are used continually for training purposes, the knowledge of residual mission reliability becomes an important factor for planning and success of mission as it facilitates commanders to optimize deployment of weapon system. This knowledge also helps the logistic agencies to be proactive in providing effective and timely repair and maintenance support.

It can be appreciated that most equipment failures have no relationship to length of time in-service and are unpredictable. But the key lies in detecting a likely failure early so as to prevent a breakdown. Therefore, with only about 15% to 20% of equipment failures being age related, and the other 80% to 85% being totally time-random events, the question which needs to be answered is `How can the reliability of an eqpt be improved?'

The Concept and Advantages of Condition Based Monitoring(CBM)

The concept of CBM turns a corner on the age-old firefighting mentality, replacing it with a more planned environment. CBM is a form of proactive, preventive or predictive maintenance that can be defined simply as maintenance initiated on the basis of an asset's condition. Physical properties or trends are monitored

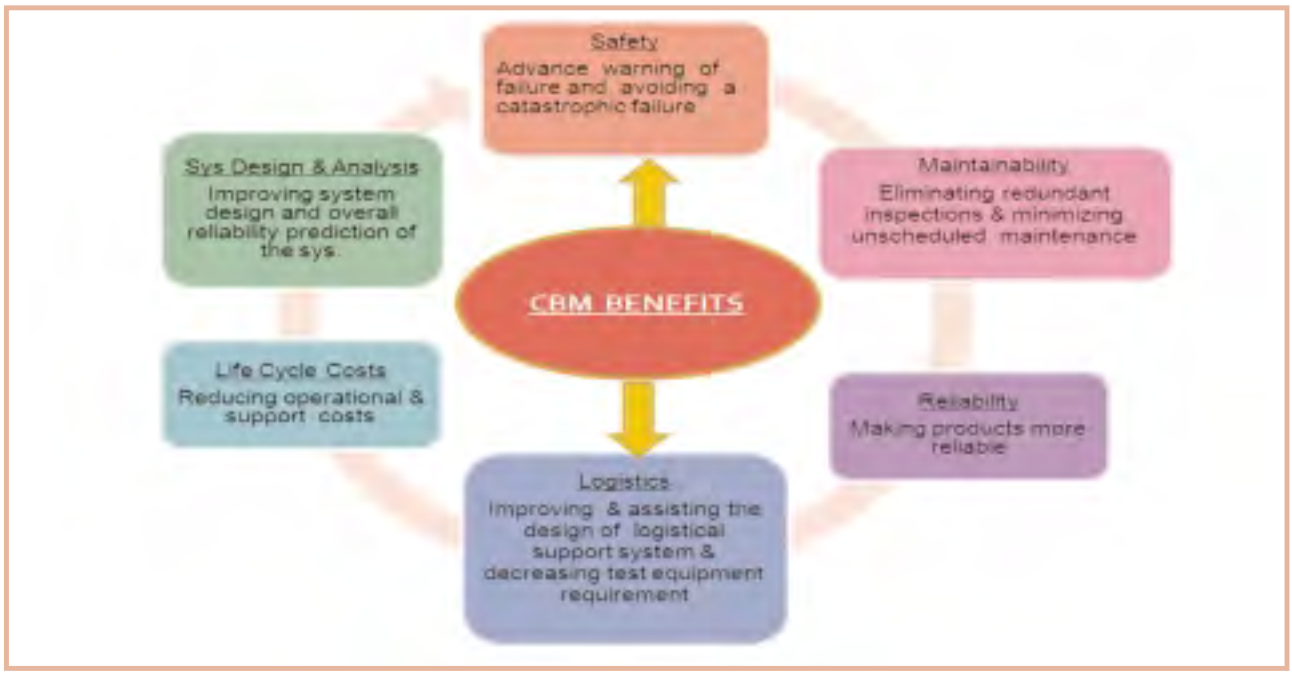

Fig 1: Advantages of CBM

"The human mind is as driven to understand as the body is driven to survive." - ***Hugh Gilmore***

on a periodic or continuous basis for attributes such as vibration, temperature, pressure, particulates in the oil, wear and so on. CBM is an alternative to failure-based maintenance initiated when assets break down, and use-based maintenance triggered by time or meter readings.

Today, most maintenance actions are carried out by either the predetermined preventive or the corrective approach. The predetermined preventive approach has fixed maintenance intervals in order to prevent components, sub-systems or systems to degrade. Corrective maintenance is performed after an obvious fault or breakdown has occurred. The fundamental difference between predictive maintenance and preventive maintenance is that predictive maintenance is used to define needed maintenance task based on quantified material / equipment condition. Condition Based Monitoring(CBM) or predictive maintenance is a technology that strives to identify incipient faults before they become critical which enables more accurate planning of the preventive maintenance. It may also be defined as Maintenance actions based on actual condition obtained from in-situ, non-invasive tests, operating and condition measurement. In a functional and real environment CBM is a set of maintenance actions based on real-time or near-real time assessment of equipment condition which is obtained from embedded sensors and/or external tests & measurements. Fig 1 on previous page shows the various advantages of a CBM system.

The CBM process requires technologies and communication to integrate all available equipment condition data, such as diagnostic and performance data, maintenance histories, operator logs and design data, to make timely decisions about the maintenance requirements of major / critical equipment. The data is collected and analysed to project equipment failures. Once the timing of equipment failure is known, action can be taken to prevent or delay failure. In this way, the reliability of the equipment can remain high. A flow chart depicting the info flow in a CBM environment is shown in Fig 2.

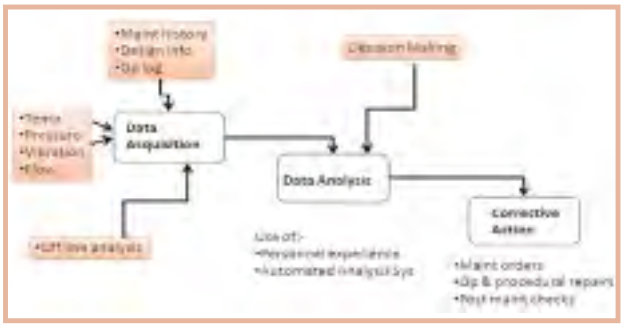

Fig 2: Information flow for CBM

Condition Monitoring (CM) Procedure

The CM data collected is used in one of the following ways to determine the condition of the equipment and to identify the precursors of failure:

- **Trend Analysis.** Reviewing data to see if a sys or sub-sys is on an obvious and immediate "downward slide" towards failure. For trending purposes, large no of monitoring points are considered as these data points allow one to determine whether equipment condition depreciates linearly.
- **Pattern Recognition.** Looking at the data and realizing the causal relationship between certain events and eqpt failure. For example, noticing that after eqpt 'x' is used in a certain specific condition, component 'a' of 'x' fails due to stresses unique to that condition.
- **Tests against Limits and Ranges.** Setting alarm limits (based on OEM data) and seeing if they are exceeded.
- **Statistical Process Analysis.** If published failure data on a certain eqpt / component exists, comparing failure data collected on site with the published data to verify / disprove, use that published data.

Condition Monitoring Versus Automatic Control

Implementing automated control systems minimizes human error and significantly improve service levels. For example, suppose a critical piece of equipment is monitored continuously to ensure that some temperature is within an acceptable range. If the temperature rises above the upper limit, a control loop can activate a fan to cool the overheated area until the temperature returns to an acceptable range. This is clearly superior to a condition-monitoring system that merely alerts a human that the temperature was too high. It is then up to the human to eliminate the variance condition effectively and efficiently.

However, it isn't always possible to determine the root cause of a variance automatically. Nor is it always possible or cost-effective to take automatic action. In such cases, human intervention is desirable, making a condition-monitoring system preferable over an

"He who has never learned to obey cannot be a good commander." - ***Aristotle***

automated control system. For example, when a sensor detects a eqpt vibration level above the upper control limit by a user-defined amount for a user-defined period, it can initiate an alarm condition. A human analysis might be required to determine the many possible root causes of excessive vibration, such as operation error, unbalance of rotational masses, eqpt wear and so on and hence decide on the most appropriate corrective action.

Basic Steps for CBM

There are many permutations and combinations to evaluate when trying to select and prioritize the conditions to monitor like, how often to monitor, which all components to monitor and what all the possible actions to be taken. The following examples of a cooling system where out of range temperature may have catastrophic consequences gives out the steps applied to the system / sub system for CBM.

- Determine operating range for the sys being analyzed (cooling system is to maintain coolant between 90°C and 120°C).
- Define the asset's functions (maintain coolant temperature and level in the tank).
- Assess possible failures (coolant too hot or too cold).
- Identify possible failure modes or root causes (heat exchanger fouled, valve closed, pump bearing faulty).
- Determine the most probable failure effects for each failure.
- Propose an appropriate maintenance task for each failure mode using failure history, probability and technical feasibility of corrective, preventive or predictive actions .

System Architecture for CBM of Armoured Vehicle

With an aim to develop remote assessment of residual mission reliability of AFVs through Condition Based Monitoring, MCEME has already undertaken a project on CBM of A Vehs. The CBM envisaged in MCEME is a broad based maintenance concept intended to predict eqpt failures based on real time assessment of eqpt condition. Different sensors mounted on the A veh can provide critical parameter monitoring of the automotive, gun control and the fire control system. This sensor data can be processed in an analytics program to yield system readiness info and would lead to reduction in maint cost, improved scheduling, logistics support mishap analysis. Fig 3 given below depicts the system architecture for CBM of an armoured vehicle.

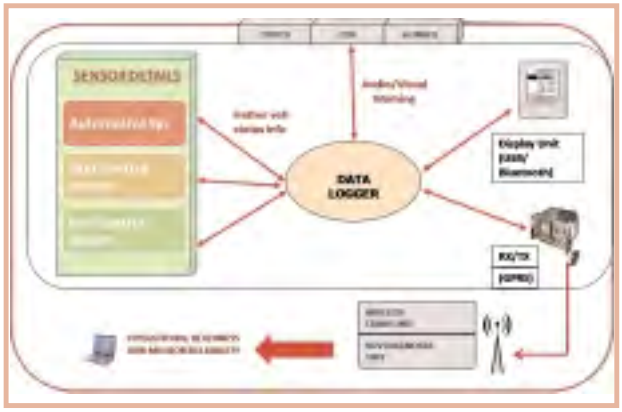

Fig 3: System Architecture for CBM of 'A' Vehicles

- **Technical aspects of the System.** The system will collect data in near real time from onboard sensors and assess current and near-term health of the tank. The system provides user interfaces that can report on operational status based on fault and failure modes, the system offers standard interfaces for data exchange and internal devices to improve data collection to support total life cycle management functions.The premise of CBM is that regular monitoring of the actual mechanical condition of sys and operating efficiency of sub systems will ensure the maximum interval between repairs, minimize the number and cost of unscheduled outages created by eqpt failures .It will optimize the availability of the eqpt, greatly reduce the cost of maintenance and reduce the mean time required to repair (MTTR). The ability to predict equipment failures and the specific failure mode provides the means to reduce spare parts inventories. Rather than carrying repair parts in inventory, repair echelons have sufficient lead-time to demand repair or replacement parts as needed in many cases.

A variety of technologies can be used as part of a comprehensive CBM programme which include monitoring and diagnostic techniques. These techniques include:

- Vibration monitoring.
- Thermography.
- Tribology.
- Process parameter monitoring.

"If you love what you do, you will never work another day in your life." - ***Confucius***

- **Operational Advantages of the System.** Apriori knowledge of residual mission reliability is of paramount importance for planning any operations or missions. This was evident largely during Op Parakram. Today there are no automated systems or decision support systems to facilitate commanders to know the mission capability of the individual tank or the entire fleet held with a unit. Manual computations are very time consuming and complex in nature, keeping the inter-linkage of various systems that are contributing to the functioning of the tank. The remote assessment of residual mission reliability would help Cdrs to dynamically optimise the deployment of AFVs to achieve the best and maximise the chance of success in any operation or mission. On the other hand the system would help in reducing the down time thus increasing the availability. The remote monitoring of functional parameters would result in early detection of functional deviations and enable maintenance agency to take proactive action to put the tank into functional state leading to increased operational readiness and avoidance of consequential damage. The diagnostic capabilities of the maintenance agency would improve resulting in reduction in maintenance cost, improved scheduling, logistics support and event / incident / mishap analysis.

- **Software for CBM and Trend Analysis.** Condition monitoring data should be trended and analyzed. Trained analysts should use analysis software where appropriate. There should be a process in place to generate and distribute equipment condition reports including a technology-integrated status. It should be clear who is making decisions to act (LRW / Wksp), based on indications of equipment condition. Such decisions should be made in a timely manner among personnel taking and analyzing data, user units, personnel responsible for assigning, planning and performing maintenance tasks. Decisions to take corrective action based on CBM data and analysis lies with repair echelons.

A comprehensive software with a variety of features such as dashboard type of display and trending of data has to be in place. More sophisticated features include:

- Multiple indicators per asset.
- Recommending corrective action based on condition.
- Triggering a PM routine on a preferred day or date if the meter reading is within tolerance.
- Forecasting when the next meter reading should occur based on historical readings.
- PM shadowing to avoid duplicate PMs.
- Color-coded alarm tables for indicators.
- Visibly distinguished conditions and alarms on the graphic (blinking, color change).

Conclusion

CBM assumes that all equipment will deteriorate and partial or complete loss of function will occur. CBM monitors the condition or performance of equipment through various technologies. The data is obtained, analyzed, trended, and used to predict equipment failures. When equipment failure timing is known, then actions can occur to prevent or delay failure. In this way, the reliability of the equipment can remain high. Condition Based Monitoring obtains indications of system and equipment health, performance, integrity (strength) and provides information for scheduling timely corrective action. The CBM depends upon the ability of the staff to assimilate the information into useable trends and combine seemingly unrelated technology outputs into sensible story boards that help to define how the equipment is performing.

Lt Col Manmeet Singh Soni, *alumnus of NDA, was commissioned into the Corps of EME, on 10 Dec 1994. The Offr has done his MTech in (Tribology and Maint Mgt) from IIT, Delhi with distinction. He has a vast experience with A vehs and had the privilege of serving in two Armd Divs. The Offr has been a proud recipient of the COAS Commendation Card during OP Parakram in 2001 and the GOC-in-C Commendation Card, ARTRAC in 2011.The offr has written a variety of articles on technical and maint mgt subjects. Presently he is posted as Instr Class 'A' at MCEME and is associated with the development of CBM for tk T-90 since last 2 years and is also involved in development of Health and Usage Monitoring Sys for ICV BMP-II.*

"A leader takes people where they want to go. A great leader takes people where they don't necessarily want to go, but ought to be." - ***Rosalynn Carter***

GEOGRAPHIC INFORMATION SYSTEM

- Lt Col RS Panwar

Introduction

Geographic Information System (GIS) is a computer based information system used to digitally represent and analyse the geographic features present on the earth's surface and the events (non-spatial attributes linked to the geography under study) taking place on it. Fundamentally GIS has a database of objects present on the earth which are geo-referenced. Here, the term 'database' indicates a collection of information about things and their relationship to each other and 'geo-referencing' refers to the location in space defined by the co-ordinate referencing system.

Defining GIS

A GIS is an information system designed to work with data referenced by spatial / geographical coordinates. In other words, GIS is both a database system with specific capabilities for spatially referenced data as well as a set of operations for working with the data. GIS technology integrates common database operations such as query and statistical analysis with the unique visualization and geographic analysis benefits offered by maps. These abilities distinguish GIS from other information systems and make it valuable to a wide range of public and private enterprises for explaining events, predicting outcomes and planning strategies. It is a computer based system which is used to digitally reproduce and analyse the feature present on earth surface and the events that take place on it. Hence GIS is looked upon as a tool to assist in decision-making and management of attributes that need to be analysed spatially.

Underlying concept of GIS

GIS stores information about the world as a collection of thematic layers that can be linked together by geography (Fig 1). The thematic layer approach allows us to organize the complexity of the real world into a simple representation to help facilitate our understanding of natural relationships. This simple but extremely powerful and versatile concept has proven valuable in solving many real-world problems. It is a tool acting as a means to attain certain objectives quickly and efficiently. Its applicability is realized when

Fig 1: Same area of earth is represented as distinct thematic layers connected together by common coordinate system

the user fully understands the overall spatial concept under which a particular GIS is established and analyses his specific application in the light of those established parameters. Before the GIS implementation is considered, the objectives, both immediate and long term, have to be considered. Since the effectiveness and efficiency (i.e. benefit against cost) of the GIS will depend largely on the quality of initial field data captured, organizational design has to be decided upon to maintain this data continuously. This initial data capture is most important.

Questions GIS can answer

There is another way to describe GIS by listing the type of questions the technology can (or should be able to) answer.

- **Location :** What is at…? A location can be described in many ways, using, for example place name, postal code, or geographic reference such as longitude/ latitude or (x,y) coordinates.
- **Condition:** Where is it…? The second question is the converse of the first and requires spatial data to answer. Instead of identifying what exists at a given location, one may wish to find location(s) where certain conditions are satisfied (e.g., an open space of at-least 500 square meters in size, within 100 meters of road).

There are only two ways to live your life: one as though nothing is a miracle; the other is as if everything is.
- Albert Einstein

- **Trends:** What has changed since…? The third question might involve both the first two and seeks to find the differences (e.g. in land use or elevation) over time.
- **Patterns:** What spatial patterns exist…? One might ask this question to determine whether landslides are mostly occurring near streams or to determine whether crime density is higher in affluent localities. It might be just as important to know how many anomalies there are that do not fit the pattern and where they are located.
- **Modelling:** What if…? "What if…" questions are posed to determine what happens, for example, if a new road is added to a network or if a toxic substance seeps into the local ground water supply or what additional area will be flooded if certain volume of additional water is released from an upstream dam. Answering this type of question requires both geographic and other information (as well as specific models).
- **Non-spatial Questions:** "What's the population of Hyderabad?" is a non-spatial question - the answer to which does not require the stored value of location information like latitude and longitude nor does it describe where the places are in relation with each other.
- **Spatial Questions:** "Which are the primary schools located within 3 Km of my residence? ", or "What is the shortest route from railway station to airport". These are spatial questions that can only be answered using location information.

Advantages of GIS

The GIS has been an effective tool for implementation and monitoring of infrastructure projects. The use of GIS in civilian domain has been in vogue primarily due to the advantage mentioned below:

Planning of Project: Advantage of GIS is often found in detailed planning of project having a large spatial component, where analysis of the problem is a prerequisite at the start of the project. Thematic maps generation is possible on one or more than one base maps, e.g. the generation of a land use map on the basis of a soil composition, vegetation and topography.

Making Decisions : The adage "better information leads to better decisions" is as true for GIS as it is for other information systems. A GIS, however, is not an automated decision making system but a tool to query, analyze, and map data in support of the decision making process.

Visual Analysis : Digital Terrain Modeling (DTM) is an important utility of GIS. Using DTM / 3D modeling, landscape can be better visualized, leading to a better understanding of certain relations in the landscape.Many relevant calculations, such as (potential) lakes and water volumes, soil erosion volume (Example:landslides), quantities of earth to be moved (channels,dams, roads, embankments, land leveling) and hydrological modeling becomes easier.

Improving Organizational Integration :

Many organizations that have implemented a GIS have found that one of its main benefits is improved management of their own organization and resources. Because GIS has the ability to link data sets together by geography, it facilitates inter-departmental information sharing and communication. By creating a shared database one department can benefit from the work of another. Data can be collected once and used many times.

Components of GIS

GIS constitutes of five key components:

Hardware: It consists of the computer system on which the GIS software will run. The choice of hardware system range from Personal Computers to Super Computers having capability in Tera FLOPS. The computer forms the backbone of the GIS hardware, which gets it's input through the Scanner or a digitizer board (refer Fig 2). Scanner converts a picture into a digital image for further processing. The output of scanner can be stored in many formats e.g. TIFF, BMP, JPG etc. A digitizer board is flat board used for vectorisation of a given map objects. Printers and plotters are the most common output devices for a GIS hardware setup.

Fig 2: A digitizer

Software: GIS software provides the functions and tools needed to store, analyze, and display geographic information. Some of the GIS softwares in use are

The tragedy of life is not that it ends so soon, but that we wait so long to begin it. - ***W. M. Lewis***

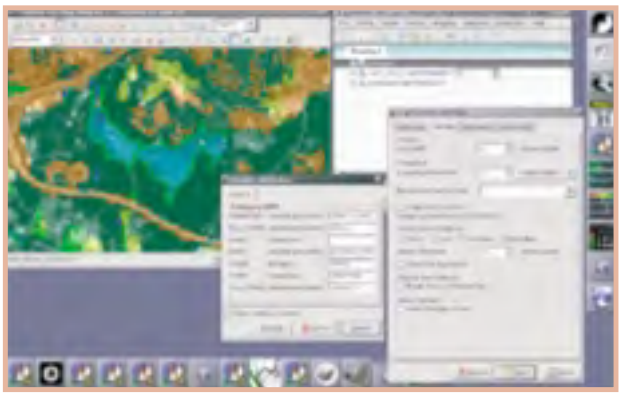

Fig 3: A GIS software interface

MapInfo, ARC GIS, AutoCAD Map, GRASS, QGIS etc.The software available can be said to be application specific. When low cost GIS work is to be carried out, desktop MapInfo is the suitable option. It is easy to use and supports many GIS feature. If the user intends to carry out extensive analysis on GIS, ARC GIS is one of the preferred option. For people using AutoCAD and willing to step into GIS, AutoCAD Map is a good option. Fig 3 shows the schema of a GIS software interface.

Data: Geographic data and related tabular data can be collected in-house or purchased from a commercial data provider. The digital map forms the basic data input for GIS. Tabular data related to the map objects can also be attached to the digital data. A GIS will integrate spatial data with other data resources and can even use a DBMS, used by most organizations to maintain their data and to manage spatial data.

People: GIS users range from technical specialists who design and maintain the system to those who use it to help them perform their everyday work. The people who use GIS can be broadly classified into two classes. The GIS operator, whose work is to vectorise the map objects. The use of this vectorised data to perform query, analysis or any other work is the responsibility of a GIS engineer / user.

Method: Above all a successful GIS operates according to a well-designed plan and business rules, which are the models and operating practices unique to each organization. There are various techniques used for map creation and further usage for any project. The map creation can either be automated raster to vector creator or it can be manually vectorised using the scanned images. The source of these digital maps can be either map prepared by any survey agency or satellite imagery.

GIS Applications

Computerized mapping and spatial analysis have been developed simultaneously in several related fields. The present status would not have been achieved without close interaction between various fields such as utility networks, cadastral mapping, topographic mapping, thematic cartography, surveying and photogrammetric remote sensing, image processing, computer science, rural / urban planning, earth science and geography.

The GIS technology is used to assist decision-makers by indicating various alternatives in development and conservation planning and by modelling the potential outcomes of a series of scenarios. It should be noted that any task begins and ends with the real world. Data are collected about the real world. Of necessity, the product is an abstraction; it is not possible (and not desired) to handle every last detail. After the data are analysed, information is compiled for decision-makers. Based on this information, actions are taken and plans implemented in the real world.

Capabilities of GIS as mentioned above can be easily extended to following military domains :-

- Terrain visualization and analysis.
- Quick retrieval of data for decision making.
- Generation of cmptr generated maps.
- Line of sight analysis.
- Logistic planning.
- Convoy planning.
- Recce & Svl.
- PSDA.
- Mine detection.
- Msn plg.
- Facilities management in cantonments

Applications of GIS for EME

Major exploitation of GIS within EME will be towards measuring op readiness metrics from the perspective of eqpt readiness, combat damage assessment and combat force regeneration. GIS will also play pivotal role in planning, coordination and allocation of repair and recovery resources in a dynamic operational environment. GIS will also be used for infrastructure planning by using 2D and 3D modelling tools. This can be used to plan efficient layout of workshops and various industrial plants. The likely scenarios for exploitation of GIS by EME are given in succeeding paragraphs. This list is not exhaustive and new applications can be visualized based on domain knowledge and experience gained in specific situation.

Lives begin to end the day we become silent about things that matter. ***- Martin Luther King Jr.***

Devp of Rec Plan. A considerable amount of time and effort is invested each year to work out Recovery Plans at various formation Headquarters. In the absence of a GIS system, field EME is not able to leverage the benefits of technology in planning for operations. A GIS System can not only provide information about terrain, relief and features in an area but can also help Commanders visualise the terrain precisely. One of the primary roles of the Officers and JCOs / OR in the Corps of EME is to carry out recovery of vehicle and equipment casualties during active operations to ensure that the axis of maintenance remains clear. Even route to be taken by a recovery vehicle to approach a vehicle/equipment casualty can be planned by appreciating the various approaches and obstacles, if any.

Devp of Repair Plan. A comprehensive GIS System will help EME functionaries utilise the resources at their disposal in the most optimal manner. GIS databases can be built-up, over a period of time, so as to give very precise inputs to EME Commanders while planning placement of repair resources. GIS can also be used to achieve better situational awareness on dply of repair resources in dynamically changing op scenario. This enhanced situational awareness can be used to reallocate resources. These resources could be the repair stores, special tools or entire dets. This will provide fine grained control over limited EME resources during active ops leading to effective repair cover.

2D and 3D Modeling for Infrastructure Planning. GIS software allow advanced 2D and 3D modeling. These models can be used to obtain dynamic view of proposed layouts of workshops and industrial units. Different layouts and scenarios can be played out on the model before making a decision on the final layout. This will help in ensuring optimum design and layout based on given parameters. Some of the useful models are:

- **Utility Networks.** As an example, in an electrical network, the user can analyse as to what is the coverage of a particular transformer. We can visualise which plant units are affected if this transformer fails and which are the nearest transformers with spare capacity which can share the load.
- Floor layout with details of plant machinery, work area etc.
- 3D fly through models of proposed layout.

Situational Awareness of Op Readiness Parameters. During different operational situations, EME elements will be required to carry out assessment of op readiness of combat force from eqpt perspective. GIS will be used as a tool to provide the required situational awareness. This would be provided in the form of various overlays created from data acquired by EME elements. These overlays will then be incorporated with other operational overlays at decision support center to get a complete picture on op readiness. The various overlays that EME can provide are:-

- **Eqpt Readiness Overlay.** EME commanders in field will be able to provide geo-referenced data on eqpt readiness as an overlay. This overlay will provide much needed situational awareness on eqpt availability. The ability to visualize eqpt readiness in the geographical context of force deployment will definitely provide better situational awareness than tabular data which needs to be manually linked to force dply.
- **Rep / Rec Overlay.** In addition to using GIS for developing repair and recovery plan in a dynamic environment, it will also be used to develop overlays to convey this plan to force commanders. Greater awareness of recovery and repair resources will help quick re-allocation to support the progress of ops.
- **Combat Damage Overlay.** As ops progress, eqpt state of a combat force will change. EME can provide valuable inputs to the cdrs in the form of combat damage overlay. This overlay when analysed along with repair/recovery and operational overlays will help EME to reallocate and prioritize limited available resources.
- **Combat Force Regeneration Overlay.** This overlay will enable cdrs to visualize the extent of combat force regeneration along with its geographical extent. It can be combined with other layers to update the eqpt readiness overlay.

Conclusion

The article describes a higher level view of GIS while abstracting technical details. It is a compilation of information on GIS available in the public domain and some possible applications in EME. It is emphasized that once the capabilities of GIS system are well understood, its potential applications in a given user domain are only limited by creativity, domain knowledge and experience of the analyst.

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"Don't tell people how to do things, tell them what to do and let them surprise you with their results." - ***George S. Patton***

TRAINING THROUGH MAINTENANCE SIMULATORS

- Lt Col Anuraag Bhardwaj

Introduction

Maintenance simulators are synthetic training devices that appear to duplicate the performance characteristics of operational equipment under normal and many malfunction conditions. Maintenance simulator incorporates computer support to provide a large variety of malfunctions for instructional purposes and measure trainee's performance.

Initially maintenance simulators were used by modern armies in the world for improving the performance of the poorly skilled technician. This situation has changed not only due to the increasing cost of military equipment and the associated recognized need to protect that investment, but also because modern training technologies are enabling improved and more accessible maintenance training to take place.

Instructors at EME training establishments provide trainees with a methodology to familiarize themselves with components of equipment, review common maintenance tasks and troubleshooting procedures in a format as a training tool and this needs to be taken to the repair bay of workshops so as to be referenced while on the job. Training through good maintenance simulators would enable our men to capture this knowledge of subject-matter-experts or instructors who may be retiring or are being posted at training establishments only and ensure that this knowledge is retained by using interactive 3D simulators.

Benefits of a Maintenance Simulator

The major benefits of using a maintenance simulator compared to actual equipments are enumerated as:-

- **Ability to introduce and diagnose realistic faults:** It is not possible to introduce and diagnose faults on real equipment like practice of responses to emergency situations (e.g. surges, fires and power failure) when compared to doing same with a maintenance simulator.
- **Multi-configuration scenario:** A single maintenance simulator can cater for all variants of equipment. These may arise from upgraded systems, modification, functional variants e.g. single / twin seat, nationality variants and others. The instructor is able to quickly reconfigure the maintenance simulator as per the requirement of the training.
- **Low cost:** Cost of maintenance simulator would be much less than real equipment when compared in terms of numbers of trainees trained and non availability of actual equipment, if used.
- **Equipment friendly training:** The trainee is safe from injury and the equipment is safe from potential damage that may occur during physical hands-on training. Training on actual equipment is always a higher risk if it is a low population and highly critical equipment.
- **Flexible training environment:** It is easy for an instructor to set faults conditions on a maintenance simulator as compared to doing the same on real equipment. Less training time of the trainee is wasted whilst repeatedly carrying out time-consuming but low-value tasks such as undoing twenty screws to remove and put them back on actual equipment for next trainee to use.
- **Increased trainee throughput:** Maintenance simulator engages the trainee in new interactive learning methods by mixing a game-like atmosphere.
- **Team Training Capabilities:** Maintenance simulators allow trainee on individual computers or systems to interact with each other and simultaneously undertake a maintenance training task.

Types of Maintenance Simulators

There are two major categories of maintenance simulators which are virtual reality (VR) based maintenance simulator and augmented reality (AR) based maintenance simulator. A virtual environment is viewed by the trainee in VR based maintenance simulators whereas AR based maintenance simulators allows users to view the 'real' world along with

Great opportunities to help others seldom come, but small ones surround us every day. - ***Sally Koch***

superimposed or composited computer generated displays. The content of these displays is determined by the observer's point of view, usually by tracking head orientation and motion.

Virtual Reality based Maintenance Simulator

The main components for virtual reality (VR) based maintenance simulators are:-

VR hardware which includes

- 3D pointing devices such as 3D mouse and 3D digitizer.
- Whole hand inputs devices such as haptic gloves and exoskeleton devices which is a powered mobile machine consisting primarily of an exoskeleton-like framework worn by a person and a power supply that supplies at least part of the activation-energy for limb movement.
- Tracking devices to measure the motion of the user's head, hands, and eyes.
- Output devices such as stereoscopic visual, auditory, haptic, and motion.
- Computer workstations.

VR software is used for design of virtual environments. There are umbers of software which can be used for development of virtual environment depending on type of application.

VR Systems. These are system which decides the level of immersive capability of the simulator, which include CAVE (Cave Automatic Virtual Environment), Immersa Desk and Infinity Wall system.

Virtual Reality Modeling Language (VRML). It is a language for description of 3D scenes with multimedia content. Virtual reality based maintenance simulator provides the user with a 'virtual environment' which is driven by a faithful model of the equipment's behaviour. The trainee is presented a view on the screen with high fidelity graphics representing all relevant views of the equipment to be operated as shown in fig 1. These views can range from front panels of equipment, cables, printed circuit boards with their test points, and even test sets. The trainee is then able to interact with these items in the same way as if standing in front of the original equipment. Faults may be readily injected and the resulting effects propagate through the equipment

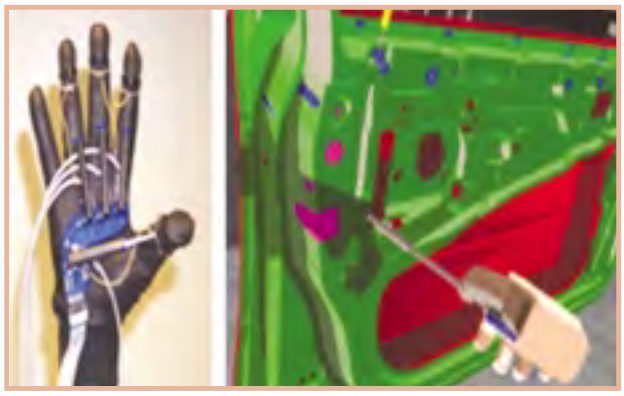

Fig 1 : High Fidelity Graphics

and result in observable symptoms which must be diagnosed by the trainee.

Virtual reality is used in a variety of areas (military, medical, equipment operation, etc.), education, design evaluation and maintenance tasks. Another example of a virtual reality based maintenance simulator is shown in fig 2 wherein sub components of an engine block of a light vehicle is shown for training purpose.

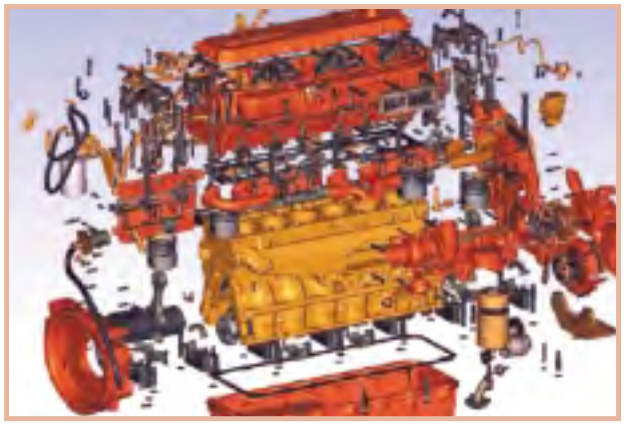

Fig 2 : Virtual reality based maint simulator

Augmented Reality based Maintenance Simulator

Augmented Reality (AR) is tool which allows one or many viewers to enhance their field of view with virtual elements usually generated by a computer. It is a field of computer research which deals with the combination of real-world and computer-generated data (virtual reality), where computer graphics objects are blended into real footage in real time. The technology used for augmented reality based simulators is different as far as the hardware components are concerned when compared

I may disagree with what you have to say, but I shall defend to the death you're right to say it. - ***Voltaire***

to virtual reality based maintenance simulators. The main hardware components for augmented reality based maintenance simulators are:-

- **Display Devices :** There are three major display techniques for AR which are Head Mounted Display (HMD), Hand Held Display and Spatial Augmented Reality (SAR). SAR makes use of digital projectors to display graphical information onto physical objects.
- **Motion or MEMS Sensors :** These could be gyroscopes, accelerometers, digital compasses and inertial modules etc.

These elements make them prospective AR platforms. HMDs are further categorized according to how they combine views of the real and virtual worlds. Optical see-through displays provide the user with a direct view of the real world and overlay virtual content on top of this view whereas Video see-through displays use cameras to capture real world imagery, combine the real and virtual content digitally or through video mixing hardware, and present it on the same displays. AR based maintenance simulators explore the use of augmented reality to aid in the execution of procedural tasks in the maintenance and repair domain. They use a tracked head-worn display as shown in fig 3 to augment a mechanic's natural view with text, labels, arrows, and animated sequences designed to facilitate task comprehension, location, and execution which bring in more training value. Head-worn, motion-tracked displays augment the user's physical view of the system with additional information such as sub-component labelling, guided maintenance steps, real time diagnostic data, and safety warnings.

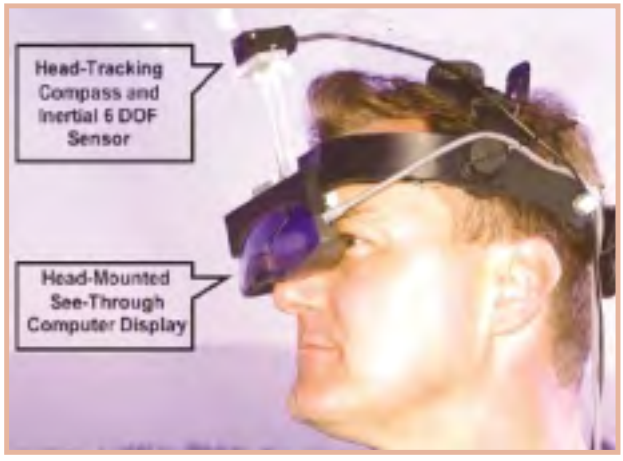

Fig 3 : Head-worn, motion-tracked displays

Additionally, the integration of real world knowledge bases with detailed 3D models, AR based maintenance simulators provides better opportunities to use the system as a quality training tool as shown in the fig 4 where a mechanic wearing a tracked head-worn display performing a maintenance task inside an armoured personnel carrier whereas a view through the head-worn display captured in a similar domain depicts information provided using augmented reality to assist the mechanic.

Fig 4 Tracked head-worn display to carry out maint inside an APC

Maintenance Simulators for EME

Maintenance simulators are being increasingly used for training soldiers all over the world. Research has shown that maintenance simulators have proved to be practical and effective educational tools for imparting safe repair and maintenance training techniques to soldiers. Equipment repair and maintenance training in Corps of EME is conducted at various training establishments through a host of mediums such as:-

- Class room teaching
- Training through CBT's
- Training through cut models
- Practical classes on actual equipment

Basic training provided to our soldiers at the training establishments is then often extended through the application of supervised. On the Job Training (OJT) using the real equipment. Use of real equipment for basic training or OJT does raise the issue of damage to

Be more concerned with your character than your reputation, because your character is what you really are, while your reputation is merely what others think you are. - ***Anonymous***

that equipment as well as the creation of bottlenecks in training if equipment is unavailable.

Maintenance simulators can be an extremely effective training medium within EME whether it is field or peace. Maintenance simulators can be used for training our men during various upgrading and refresher courses at EME School and MCEME blended with regular teaching curriculum.

Maintenance simulators have enhanced role in workshops. Once installed in various workshops it would bring in more training opportunities for our men before they lay their hands on actual equipment. The increasing availability of maintenance simulators outside the training environment will bring great benefits, not just to the maintainers, but to other areas as well, such as in failure analysis and in preparation of the maintenance procedures. An advantage of use of maintenance simulators for EME is the reduction of risk as the less skilled trainee is often put in a complex scenario, which might be hazardous when applied in non-virtual environment, i.e.real environment. Maintenance simulators would also have an ability to monitor trainees and facilitate supervisors to identify the core performance areas of trainees.

As the Corps of EME is preparing towards the futuristic technology of warfare, the role of training through maintenance simulators would be significant and indispensible.

Conclusion

Maintenance training continues to grow in spite of the economic downturn in the world economy. Maintenance simulators provide a safe and comfortable environment for men to become familiar with the procedures used to maintain and repair military equipment rather than doing the same on the equipment.

By bridging the gap between theoretical and practical knowledge, these simulators prepare men, in a hands-on environment that helps them develop the motor skills and muscle memory necessary to perform real-life tasks. In addition, they are a cost-effective and safe way to train equipment maintenance skills. This growth in demand of maintenance today is mainly focused on virtual maintenance simulators but the futuristic maintenance simulators would be based on augmented reality. Training through maintenance simulators is an indispensable tool for teaching men the complexities of maintenance and repair of military equipment.

Lt Col Anuraag Bhardwaj *was commissioned into Corps of EME on 12 Jun 1999 from IMA. The offr is a B Tech in Computer Science from Pune University and M Tech in Computer Science from IIT Madras. He is presently posted as Vehicle Group Officer in Simulator Development Division (SDD).*

A Really Bad Day

There was a guy at a bar, just looking at his drink. He stays like that for half of an hour. Then, this big trouble-making truck driver steps next to him, takes the drink from the guy, and just drinks it all down. The poor man starts crying. The truck driver says, "Come on man, I was just joking. Here, I'll buy you another drink. I just can't stand to see a man cry."

"No, it's not that. This day is the worst of my life. First, I fall asleep, and I go late to my office. My boss, outrageous, fires me. When I leave the building, to my car, I found out it was stolen. The police said that they can do nothing. I get a cab to return home, and when I leave it, I remember I left my wallet and credit cards there. The cab driver just drives away."

"I go home, and when I get there, I find my wife has left me. I leave home, and come to this bar. And just when I was thinking about putting an end to my life, you show up and drink my poison."

Grief can take care of itself, but to get the full value of joy you must have someone to divide it with. - ***Mark Twain***

KEY PERFORMANCE INDICATORS - APPLICABILITY TO THE CORPS OF EME

"You Can't Manage What You Don't Measure"

Col Raja Bhattacharjee

Introduction

Measurement as a human activity is not new. It emerged in early history as a means for discovery and sense making. Evaluation as a form of measurement was used as early as the 3rd century AD, when emperors of the Wei dynasty rated the performance of official family members. The biased nature of individual performance evaluation was noticed by the Chinese philosopher, Sin Yu, who reportedly criticised a rater thus: "The imperial Rater of Nine Grade seldom rates men according to their merits, but according to his likes and dislikes."

A major milestone in making the connection between measuring as a human activity and performance was in 1494, when Luca Pacioli published in Venice the 'Summa da arithmetica, geometrica, proportioni et proporitonalita' (Everything on arithmetic, geometry, proportions and proportionality). It detailed the practice the Venetian sailors had in place to evaluate the performance of their sailing expeditions, which in turn became the basis of the double entry accounting system.

Thus, the subjective nature of individual performance evaluations and the dominance of financial indicators for evaluating enterprise performance became the stepping stones for performance management in human activity.

Over time, the use of Key Performance Indicators (KPIs) became synonymous to performance measurement and management. In their essence, KPIs are performance measurement tools that organisations in different sectors employ to improve performance. Traditional database systems don't provide real-time information and require a lot of money for customisation and consulting. By using a real-time performance measurement system as a basis for KPIs, organisations can enhance their competitive advantage and improve overall decision making across the entire enterprise.

Applicability to the Corps of EME

The need for KPIs in the EME was felt once the Organisational Development Intervention initiative of the Corps was in the process of being rolled out across the organisation. Numerous feedback and follow up presentations were held at various Headquarters to monitor the initiative. What was noticed was that while various headquarters reported success (or work-in-progress), there was no common denominator to monitor progress. The same progress, could, in effect, be portrayed with various hues to higher ups. The challenge was in having a common parameter to measure progress.

A series of brainstorming sessions were held within the organisation to determine exactly what to measure, and how to measure it and the results were sobering. We realised that we in the Corps of EME have some of the best monitoring tool available in the form of the IM/E 200. The problem was that over the time, reports and returns have gotten so humungous, that for the workshop, it is difficult to focus on these essentials. With a view to develop a set of measurement metrics, a KPI model was developed The details of the same are outlined below in succeeding paras.

The Comprehensive Model

A comprehensive model developed for monitoring the 'essential business of the organisation' is given at Fig 1. At each level, the KPIs were quantified to a score

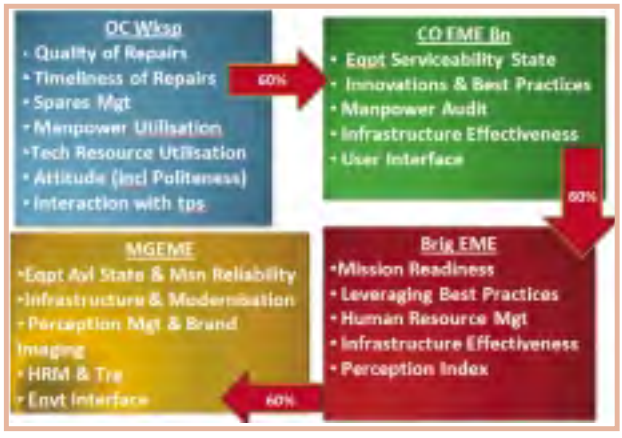

Fig 1: KPIs - Comprehensive Model

The most difficult thing in the world is to know how to do a thing and to watch someone else doing it wrong, without commenting. - ***T.H. White***

of 1000. Sixty percent of the score of the subordinate level is to be transposed towards the upper level, to build in accountability.

- **Fd Wksp Level.** Being at the front end of the engg sp delivery mechanism, the OC Wksp has to primarily concentrate on the quality and timeliness of repairs and in order to ensure these two important factors, technical manpower and resources at the fd wksp level needs to be optimally utilised. In addition to this, the OC Wksp must also ensure the right attitudinal aspects amongst the key personnel in the workshop.

  Quality of repairs is the most important KPI for the Field Wksp, and indeed for the Corps of EME. Towards quality, MTBF is the most evident and obvious parameter through which quality can be measured. In addition, it is envisaged to plough in User feedback as a factor, as apart from MTBF, the perception of quality must be felt as an intangible to the User too. Wksp practices contribute to quality, and are suitable indicators for quality in the future.

- **CO EME Bn.** The eqpt serviceability state is the Key Indicator for the CO EME Bn. He also needs to foster an environment of innovation, correctly identify the need for any innovation and field it successfully. He has a big role to play in the correct utilisation of manpower. It is at the level of the CO that there is a need to have a roll on plan for the use of modernization grants, and also an imperative to project works cases to bridge gaps in infrastructure. The CO also has a major role to play in the User Interfaces, by instituting a correct approach towards inspections, interacting with his peers and with the Brigade Commanders, and taking action on the feedback received.

- **Brig EME.** At the level of the Brig EME, Mission Readiness levels assume importance. The Brig EME is the focal point in leveraging best practices in technology forums, financial management and workshop practices. It is at this level that the Brig EME has access to a host of interactions with formation commanders and Units, and is in a position to gauge any anomalies in perception through feedback. Factors like Human Resource Index, including timely postings of manpower, finding ways and means to bridge infrastructure gaps become critical parameters at this level.

- **MGEME.** Eqpt Avl State and Mission reliability are key drivers for the MGEME. In addition to this the MGsEME need to have infrastructure as their highest priority and thus needs to push for release of works for EME Units. Upholding of the Corps policies and ethos towards Perception Mgt and Brand Imaging, and managing the skill inventory towards Manpower Audit and trg, are other key activities. The MGEME also performs a key role as the fd army's interface with the rest of the Corps, ie the Base Wksps, the HQTG and the Dte Gen.

Conclusion and the Road Ahead

An important lesson that came out of the interactions held on the KPI model was that, 'we need not measure everything' and 'all KPIs are metrics, but all metrics are not KPIs'. It is worthwhile, at the end of the day, to remember that KPIs are tools to help us manage the business - they are not the business itself! In effect, KPIs should work for the organisation without requiring that half the entire organisation works for groups that make, maintain and feed these KPI systems.

Project EMERALD is in the implementation stage and at the end of it the EME would be fully networked. With the backbone in place, there would be a need to monitor the critical operating parameters of engineering support across the organisation. An exercise on KPIs would be apt to discover just how much we need to monitor, and where to keep the leeway for innovation at the grassroots.

Col Raja Bhattacharjee *is a 1988 batch officer. He has served in 610, 606 and 627 EME Bns, apart from stints at MCEME and 1 EME Centre. An alumnus of DSSC, he had tenure as GSO 1 Mgt Studies at Army HQ. He has commanded 628 EME Bn. He was part of the team that developed the KPI model during his stint at MCEME as HoD (OL). He is currently undergoing the Higher Defence Management Course at the College of Defence Management.*

Great ambition is the passion of a great character. Those endowed with it may perform very good or very bad acts. All depends on the principals which direct them. - ***Napolean Bonaparte***

CHANGE LEADER: A PERSPECTIVE

Col SR Chaudhuri

"Good judgment comes from experience, experience comes from bad judgment"

Introduction

Change is inevitable in any organisation to keep pace with the changing environment; both internal and external and we require change leaders to stimulate, facilitate and co-ordinate changes within a system. As per R Stephen Robbins, change leaders are "Persons, who act as catalysts and assume the responsibility of managing change activities in an organization." To implement Organisational Development Interventions, it is imperative that we assume the role of change leaders at the respective execution level and therefore, is the requirement to understand the role and competencies of a change leader.

Role

The role of a change leader is often to identify opportunities for improvement in the internal operations of an organisation, gain acceptance for the need for change, and lead the implementation of the appropriate new processes or cultural changes. Therefore, the primary role of a change leader is to create a favorable state in an organisation conducive to change as also pilot the desired changes. They also generate requisite knowledge about the process of change, change methods and / or techniques and most importantly the means of resolving certain problems. Goodstein and Pfeiffer consider managing change as a problem solving activity and enumerated following five roles for a Change Leader:-

- Catalyst
- Process Facilitator
- Solution Provider
- Resource Linker
- Stabiliser

Broadly speaking the most important role of a change leader is to sustain the organization's current performance and assure its future performance i.e., enabling people to work effectively as they plan, implement and experience change and increasing their ability to manage future changes. A change leader often applies various tenets of behavioural science to manage change effectively. According to Curtis Mial, the change leader may serve as "The exhaust value, enabling the client to let off steam; as the ignition to spark action; as the accelerator to build up momentum; as the break for too quick action; as the radiator absorbing some of the heat of the controversy; as the shock absorber when the going is rough; or as the fog lamp when the future is hazy".

A Change leader needs to educate people on the need and importance of change. Since 'resistance' is the most common response to any change effort; therefore one of the tasks of the Change leader is to sense the hidden problems and break the inertia by sensitising and motivating people for adopting the solution. Although the change process is initiated by creating a sort of disturbance in the equilibrium, after successful change process, the equilibrium has to be regained once again. The newly learnt mechanisms and behaviours have to get stabilized and become normal. A dynamic interplay between 'change' and 'stability' is required continually in any organization.

Competencies of Change Leaders

Competency is an underlying characteristic of a person that results in effective and / or superior performance (Boyatzis, 1982). Change leaders may need a different mix of competencies according to the size, complexity and needs of the organisation. Typical requisites are good project management and leadership skills, with a particular focus on the ability to motivate people. Also important are the ability to understand the external environment and the management vision for the organisation. Successful change leaders should have the following ability to: -

- Diagnose problems to identify performance issues and analyze their impact on short and long term results.
- Build relationships with clients.
- Ensure that the vision is articulated.
- Set a leadership agenda and have the tenacity to insist on the agenda's accomplishment.

Coming together is a beginning, staying together is progress, and working together is success. - ***Henry Ford***

- Solve problems by honest and often difficult measures.
- Implement plans to achieve change goals.
- Ability to tolerate ambiguity.
- Managing resistance and conflicts, if any.

In general, competencies for change leaders may be broadly classified into: -

- Cognitive Competencies;
- Functional / Technical Competencies;
- Personal Competencies;
- Inter-personal Competencies.

Cognitive competencies are required for perceiving and thinking. It can be sub-divided in following two types: -

- Analytical thinking;
- Conceptual thinking.

Analytical thinking enables a person to understand a situation by breaking it apart into smaller pieces, whereas, **Conceptual thinking** involves understanding a situation or problem by putting the pieces together and seeing the large picture.

Technical competencies are the skills required to perform effectively in a particular discipline whether in a functional or technical area. According to Spencer and Spencer, there are four main dimensions to technical competencies: -

- Depth of Knowledge.
- Breadth of Knowledge.
- Expertise Acquisition Motive.
- Distribution / Dissemination of Expertise.

Personal competencies help a person to be effective in achieving his goals even amidst environmental difficulties and pressures. The skills, which are essential to develop these competencies, include self control, self confidence, flexibility to work effectively in a variety of situations with different individuals or groups, initiative, communication skills, assertiveness and finally persuasiveness.

Inter-Personal competencies are essential for dealing with other people effectively by developing and maintaining smooth and co-operative working relationships with them. Communication including empathising plays an important role in developing these competencies. Other important skill is the skill to influence and make an impact on others. These skills help in expressing an intention to persuade, convince, influence or impress others in order to get what one wants to get from them.

Levels of Change Leadership Skills, as derived from Jim Canterucci, are as under:-

Level I	Accepts the need for change, communicates and defends the need for change throughout the organization, creates an open and receptive environment.
Level II	Defines and initiates change, identifies leverage points for change in processes and work habits.
Level III	Leads change, translate the vision of the organization into the context of a specific change initiative and bring this message to the entire organization, redirects approaches in the face of new opportunities.
Level IV	Manages complex change, understands the cultural dynamics of the current state of an organization and creates a strategic practical course, balancing the current reality with the need for rapid adoption of the desired future reality.
Level V	Champions change, challenges the status quo by comparing it to an ideal or a vision of change, causes crisis in order to support dramatic actions and change efforts, transforms the organization.

Implementing Skills. Since, at present, we are in the implementation stage, the skills required for the same assume more significance and are enumerated below: -

- Articulation of the activities required for implementing the plan.
- Defining objectives.
- Attending to details.
- Taking responsibility.
- Intervening at appropriate time.
- Admitting mistakes and working for their rectification.
- Building and maintaining morale of the team.

There is only one way... to get anybody to do anything. And that is by making the other person want to do it.
- Dale Carnegie

- Prioritisation of activities / use of resources.
- Time management.

Change processes and change projects have become major milestones in many organizations' history. Unfortunately, not every change process leads to the expected results. There are multiple reasons for potential failure: Typical barriers to change are unexpected changes in the external conditions, a lack of commitment in implementation, resistance of people involved, or a lack of resources. The implications of failed change projects go beyond missed objectives. More important is the negative symbolism and the demotivation of the people involved. Similarly, people affected by the (failed) change effort will develop growing skepticism. They might perceive future change projects as "another fancy idea from management", which brings a lot of work and few benefits. In the light of the many problems and risks associated with change projects, the change leaders have a very important role to play to determine the success or failure of the project, and on the extent of potential unwanted side-effects.

Conclusion

Change leaders always need the ability to get all people affected by the project involved, to ensure their support and commitment. This requires a high competency as the basis for acceptance as well as soft skills, which are often summarized as emotional intelligence. An endeavor has been made to present a perspicacious article, which should provide a brief exposure to the roles and competencies of Change leaders. Most of the competencies mentioned above are applicable not only for the Change leaders but are expected out of leaders at all levels; hence is the importance of its assimilation by all of us-wherever we are and whatever we are.

Col SR Chaudhuri *was commissioned in Dec 1993 with President's Silver Medal from IMA, Dehradun. He is OALE (R) qualified with Comdt's Gold Medal, an M Tech in Electronics Engineering and M Sc in Defence and Strategic Studies. The offr is a recipient of Bedi Memorial Trophy, Lt Col Avtar Krishna Memorial Medal and Maj VK Sharma Memorial Medal in various courses in Army. He is also a Fellow of the Institution of Engineers (India). He had a tenure in Lebanon (UNIFIL) and was posted as a staff offr in Army HQs (GS Branch). He has commanded 3 Corps Zone Wksp and is presently commanding 604 EME Bn.*

Give it a thought for sure

A company was hiring a new staff and the question of the written exam was - You are driving a car on a stormy night and passing a station. There are three people waiting for the bus. One old lady who is dying, a doctor who saved your life before, one guy/lady whom is someone you have been dreaming to get married to..You can take only one passenger , which one will you choose and why?

We all will have different answers, thoughts and different reasons to justify them. Old lady is dying, you should save her first, however old people end up dying anyway.You should save the doctor because he saved you life before, this is the perfect chance to pay him back. At the same time people think did the doctor treat you without a fee? Even if 'yes' you can always pay the doctor back in future, but you may never have a second chance to find your perfect love if you miss this chance.

Within the 200 candidates, the one who was hired did not explain his answer but only simply stated that: "Give the car key to the doctor, let the doctor take the old lady to the hospital and I stay to wait for the bus with the lady of my dream". Most of us will agree that this is the best answer but none will think of this answer first :- Is that because we never want to give any advantage we are holding in our hands (the car key)?. Moral of the story - Sometimes, we can gain more if we were able to give up our stubbornness, limitations and even advantage.

"When you were born, you cried and the world rejoiced. Live your life so that when you die, the world cries and you rejoice." - ***Cherokee Expression***

BMP Urban Survival Kit : "BUSK"

The BMP Urban Survival Kit was flagged off at VRDE Ahmednagar, a premier laboratory of DRDO on 14 Sep 2011 by Additional Director General Mechanised Forces Maj Gen RS Chand, VSM. During this occasion Commandant MIRC, Ahmednagar Brig Joydeep Bhati, Shri R Shankar, Director Combat Vehicle and Engg from DRDO HQ, Dr. CP Ramanarayanan, Director VRDE, Dr. SB Singh Principal Associate Director.

The kit modular in nature has been designed and developed by Vehicles Research & Development Establishment (VRDE), Ahmednagar under guidance of Dr. CP Ramnarayanan, Director VRDE. The Kit can be assembled & disassembled in a short span of time and is well protected against weapons utilised by the terrorists. The unique features of the project are light weight high technology advanced armour and very high modulus and strength fibre nets which has enabled the vehicle to meet any kind of threat from Armoured piercing and shaped charge attack. The project was executed in a record time of six months and is a milestone in the history of VRDE towards delivery to the user, which exhibits it commitment to the Armed forces. This prestigious project was headed by Col G S Radkar of EME.

BMP Urban Survival Kit

Flagging Off Ceremony

EME Officers at Naval Postgraduate School in USA

HQ IDS military delegation visited USA for discussions as part of "Subject Matter Expert Exchange (SMEE) on ORSA Applications in Defence" at Naval Postgraduate School (NPS), Monterey from 29 Aug to 02 Sep 11. The team's visit to USA was in pursuance of the SMEE on ORSA applications, agreed to at the 11th India - US Military Cooperation Group (MCG) meeting held at New Delhi from 20 - 21 Apr 11 and subsequently approved by Honourable Raksha Mantri (RM) in Aug 11. The visit was coordinated by the US Pacific Command (USPACOM).

The team was led by AVM M Bahadur, VM, ACIDS (WSOI). However, the highlights of the SMEE were the inclusion of two EME offrs viz Brig SK Aneja, DACIDS (ORSA) and Col Rajesh Puri, Dir (ORSA) in the team selected by HQ IDS.

Corps of EME ultimately turned out to be the show stopper with Col Rajesh Puri giving a presentation to the ORSA faculty at this prestigious and top rated Management Establishment of world repute. The presentation was well received and generated a lot of questions and discussion from all attendees.

"If you are seeking revenge, start by digging two graves." - ***Ancient Chinese Proverb***

RAJDHANI MAIL

Corps Matters : Core Matters

CHANGE OF BATON

Lt Gen NB Singh, VSM assumed the appt of DGEME and Sr Col Comdt on 01 Dec 2011 vice Lt Gen IJ Singh, AVSM, VSM proceeding on retirement.

Lt Gen IJ Singh, AVSM, VSM, DGEME and Sr Col Comdt and Lt Gen NB Singh, VSM, DGEME (Designate) paying homage at Amar Jawan Jyoti on the occasion of DGEME's Farewell.

EST NEWS

68th ANNIVERSARY CELEBRATIONS

- The Corps of EME celebrated its 68th Corps Anniversary with traditional gaiety and grandeur on 15 Oct. Lt Gen IJ Singh, AVSM, VSM, DGEME and Sr Col Comdt, in his message, stated that, "The Indian Army is in the midst of a major modernization program while it transforms itself. In synchronisation with this, the Corps has embarked on a mission to restructure its organisation to make it lean and more efficient in engineering support delivery to meet the rising aspirations of users towards sustainment of the equipment and weapon systems. In this changing time there is need to look at 'Life Cycle Sustainment' with focus on mission reliability. This realignment dictates a deeper and intimate involvement of the Corps in the induction and subsequent sustainment of the equipment."

- The DGEME gave away the professional excellence awards to the pers of Dte Gen of EME at a function held in Dte Gen of EME. On 16 Oct 2011, Cocktails were held for the veterans at EME Officers Mess and was attended by the COAS, and other dignitaries.

AT A GLANCE

BIDDING ADIEU : MAJ GEN PP SINGH, ADG EME (RM)

FAREWELL TO DGEME AT EME DTE

DINING OUT OF DGEME AT EME OFFRS' MESS

COLLEGE CAUSERIE

Welcome. We welcome Cols Vinay Gupta, Ravinder Singh, Lt Cols Diwakar Mishra, BS Rathee, Satish Kumar, JPS Johal, Kuldeep Singh, Maj AS Parihar and Capts Gazelle Satuti Sareen & Divya Sharma.

Adieu. We bid farewell to Lt Gen NB Singh, VSM, who took over the reins of the Corps of EME as the DGEME. We bid farewell to Maj Gen Rajpal Singh, Lt Cols DK Thapliyal, VK Kapoor, Prashant Mahajan and Maj Amit Sharma. We also bid farewell to Col Raghu Kumar Pillai who proceeded on retirement. We wish the offrs and their families the very best.

Heavier Brass. We congratulate Col MPC Rao, on his promotion to the rank of Colonel.

Visits. The fwg VIPs and distinguished dignitaries visited the College from 01 Sep to 15 Dec 2011:-

- Lt Gen Goutam Moorthy, VSM, Comdt CMM vis MCEME 02 Sep 2011.
- Lt Gen SK Singh, UYSM, AVSM, GOC-in-C South Western Com vis MCEME & SDD on 06 Sep 2011.

- Naval Offrs on Long Gunnery Course, INS Dronacharya, Kochi vis MCEME on 08 Sep 2011.
- Maj Gen Krishnan GOC (Designate) Andhra Sub Area vis MCEME on 10 Oct 2011.
- Lt Gen AK Singh, AVSM, SM, VSM, ADC, GOC-in-C, Southern Comd vis MCEME on 31 Oct 2011 and also conducted the Annual Adm Insp of MCEME.

- Lt Gen SP Kochhar, AVSM, SM, VSM, SO-in-C & Sr Col Comdt, Corps of Signals vis MCEME on 05 Nov 2011.
- Lt Gen AS Chabberwal, YSM, GOC 2 Corps vis MCEME on 15 Nov 2011.
- Lt Gen K Surendra Nath, AVSM, VSM, GOC-in-C ARTRAC vis MCEME on 16 Nov 2011.

68TH EME CORPS DAY CELEBRATIONS

68th Corps Day was celebrated with traditional gaiety and enthusiasm at the college. The celebrations included Comdt's Special Sainik Sammelan, Tea with Civilian Staff, Barakhana and entertainment programmes. A cocktail party was org at MCEME Offrs Mess which was attended by a number of serving and retired EME Offrs and ladies in the station.

68th Corps Day Comdt Sainik Sammelan

Lt Gen (Retd) YV Radhakrishna, AVSM and the juniormost EME Offr in the station cutting the Corps Day Cake

Mrs Asha Singh, Chairperson, FWO MCEME giving prizes to winners of events conducted as a part of 68th Corps Day celebrations

Troops enjoying the Barakhana on the occasion of Corps Day

PASSING OUT PARADE (TES-18)

The Passing out Parade (POP) of the TES-18 course was held at 1 EME Centre Parade Grnd on 05 Nov 2011. Lt Gen SP Kochhar, AVSM, SM, VSM, SO-in-C & Sr Col Comdt, Corps of Signals was the Reviewing Officer. The event was attended by serving / retired EME Offrs and proud parents of the passing out GCs.

FAREWELL TO DGEME

A number of events were organised to bid farewell to Lt Gen IJ Singh, AVSM, VSM, DGEME & Sr Col Comdt, Corps of EME. DGEME laid wreath at the War Memorial and was given the Gd of Honour. The Gen Offr addressed all EME Offrs in Stn. The Gen Offr attended the RA meet, RA Lunch and was dined out from the Corps Mess. A Special Family Welfare Meet was organised in honour of Mrs Umita Singh at MCEME.

Wreath Laying by Lt Gen IJ Singh, AVSM, VSM, DGEME & Sr Col Comdt

Lt Gen IJ Singh, AVSM, VSM, DGEME & Sr Col Comdt being dined-out at the Corps Mess

Special Family Welfare Meet in honour of Mrs Umita Singh at MCEME

FAREWELL TO LT GEN NB SINGH, VSM, COMDT MCEME & COL COMDT

The College bid farewell to Lt Gen NB Singh, VSM, Comdt MCEME & Col Comdt, who moves on to take over the reins of the Corps of EME. The Gen Offr addressed all TTIs & Diploma Courses to accentuate and emphasise his vision of transforming MCEME into a Knowledge Based Organisation. Comdt's Spl Sainik Sammelan, Tea at JCO's Mess and Regt Dinner Night at the Corps Mess was organised to bid farewell to the Gen Offr.

Mrs Asha Singh, visited Army Pre Primary School, Mahila Samiti and deliberated on the steps that need to be taken for further growth of these institutions. A Special Ladies Meet was also organised to bid farewell to Mrs Asha Singh, Chairperson, FWO, MCEME.

Dining-out party in honour of Lt Gen NB Singh, VSM, Comdt MCEME & Col Comdt

Ceremonial Send Off to Lt Gen NB Singh, VSM, Comdt MCEME & Col Comdt

Special Ladies Meet to bid farewell to Mrs Asha Singh, Chairperson FWO, MCEME

29TH PENTANGULAR SPORTS MEET

29th Pentangular Sports Meet-2011 was held at MCEME and 1 EME Centre, Secunderabad from 07 Dec to 10 Dec 2011. Offrs from Arty, Engrs, Corps of Sigs, AAD and Corps of EME participated in the event. The meet consisted of golf, squash and tennis matches.

The event witnessed a spectacular blend of young age exuberance, agility and the skill and experience of the senior offrs. All the three events were close encounters between the five teams with EME bagging the golf and Engrs winning the tennis and squash events. Engrs emerged as the overall champions and became the proud recipient of the prestigious 'Pentangular Trophy'. The event terminated with a jovial social evening for all participants at lawns of Vohra Institute, MCEME and the prizes were distributed by Maj Gen Rajesh Datta, Comdt EME School & Col Comdt, Corps of EME. This spectacular sports forum will definitely strengthen the unity, brotherhood, association and togetherness of the five pillars of the Indian Army.

OVERALL TEAM POSITIONS

Team	Golf	Squash	Tennis	Total Points	Position
Engrs	5	7	7	19	I
EME	7	5	5	17	II
Signals	3	1	3	7	III
Arty	1	3	1	5	IV
AAD	-	-	-	-	V

SCHOOL SCANNER

Visits

Following dignitaries visited EME School since Jul 2011 till Oct 2011:-

- Maj Gen Srikant Sharma, SM, Comdt RVC College and Centre.
- Maj Gen Ajay Saxena, GOC, Pune Sub Area.
- Lt Gen K Surendranath, AVSM, SM, VSM, HQ Southern Comd.
- Lt Gen AK Singh, AVSM, SM, VSM, ADC, GOC-in-C Southern Comd.
- Lt Gen Rajesh Kochhar, AVSM, SM, VSM, COS, HQ ARTRAC.
- Lt Gen (Retd) AKS Chandele, PVSM, AVSM, Ex DGEME.

Lt Gen AK Singh, AVSM, SM, VSM, ADC, GOC-in-C, Southern Comd during his visit on 22 Sep 2011

Lt Gen K Surendranath, AVSM, SM, VSM, HQ Southern Comd visited EME School on 01 Sep 2011

Annual Trg Insp for the year 2010-11

Lt Gen Rajesh Kochhar, AVSM, SM, VSM, COS, HQ ARTRAC visited EME School during Annual Trg Insp for the yr 2010-11 on 23 Sep 11.

Lt Gen Rajesh Kochhar, AVSM, SM, VSM, COS, HQ ARTRAC during the Annual Trg Insp on 23 Sep 11

Honours & Awards

- Fwg JCOs / OR / Civs of EME School has been awarded with DGEME Professional Excellence / Commendation Card on the eve of 68th EME Corps Day.
  - Sub D Maruti Rao
  - Sub Saji K
  - Sub RK Dhiman
  - Nb Sub V Paswan
  - Sub Subrata Bera
  - Sub Praveen Jha
  - Nb Sub P Chandrasekaran

- HMT Asif Tarafder
- HMT Rajesh Kumar
- HMT Rajeev Kumar
- HMT Ram Pratap Rai
- Hav S Krishnan
- Hav V Pillai K
- Nk Valera NK
- Sep Parvesh
- UDC Smt Kalpana Bhatt.

- Fwg JCOs / OR of EME Corps were awarded with DGEME Gold Medal for best sportsman for the year mentioned against each by Maj Gen Rajesh Datta, Comdt, EME School and Chairman, Sports and Adventure Committee in Special Sainik-Civ Sammelan on 15 Oct 11 on eve of 68th EME Corps Day.
  - Sub Saji Thomas (1 EME Centre) - 2007.
  - Hav MV Ramu (1 EME Centre) - 2008.
  - Hav Srinivas Rao (3 EME Centre) - 2009.
  - Nb Sub Giriraj Singh (1 EME Centre) - 2010.

The Bright Sparks

Following offrs were the proud recipients of trophies/medals for outstanding performance on courses:-

- **YTO-85**
  - Capt Vaibhav Patodia- Co-curricular Technical Activity Award.
  - Capt Mayank Agarwal - Bedi Memorial Trophy.
- **YO-112**
  - Lt Rahul Kumar - Co-curricular Technical Activity Award and Bedi Memorial Trophy.

68th EME Corps Day Celebrations

The 68th EME Corps Day was celebrated on 15 Oct with great enthusiasm and gaiety. The celebrations included:-

- Special Sainik-Civ Sammelan.
- Pagal Gymkhana.
- Central Barakhana
- Offrs' Mess Function.
- Various competition like Neat House, Mehndi, Solo Singing, Instrument Playing, Rangoli etc and magic show were organised during the period for all ranks, civ and their families.

68th EME Corps Day Celebrations

TG's TABLEAU

Ex Gyanwardhan

Eqpt Mgrs Conclave Ex Gyanwardhan - II was org by HQ Tech Gp EME from 20-21 Oct 2011.This was the second ex of the yr in which only offrs participated. The focus of Conclave was to create awareness of the concept of 'Life Cycle Sustainment of Eqpt' in the envt, acquaint offrs with various activities being undertaken by Corps of EME and to enable the participants to further tfr knowledge gained in the ex to the environment so as to generate cohesiveness and synergy in the fd army. An eqpt display was also org on the first day of the ex wherein seven civ vendors displayed their products and provided relevant info to the participants through handouts.

Tri-Sevices Working Gp Mtg on Mgt of Halon and ODS in the Services

HQ IDS, (PMOC-Principal Maint Offrs Committee) convened a tri services working gp to formulate a comprehensive policy for mgt of ODS in the services. CE ATC was nominated as the Chairman of the Tri-services working gp, with the stakeholders from Army, Navy, AF, DGQA and DRDO as members. The draft policy has been formulated by the study gp on the mgt of Halon and ODS in the services and presented during the PMOC mtg held on 03 Nov11.

Maj Gen SC Jain, VSM, Cdr HQ TG being briefed on the Eqpt display

Projects displayed by TIDC in the Eqpt Exposition 2011.

WORKSHOP ON "INNOVATION FOR EME"

A one day workshop on "Innovation for EME" was conducted by Lt Gen SS Apte, PVSM (Retd) for offrs and ladies of HQ Tech Gp EME on 17 Sep 11.

INAUGURATION OF HQ TG EME OFFRS MESS

Offrs Mess for HQ Tech Gp EME was inaugurated by Lt Gen Vinay Sharma, PVSM, SM, VSM, MGO on 28 Jun 11.

Inauguration of Offrs Mess of HQ Tech Gp by Lt Gen Vinay Sharma, PVSM, SM, VSM, MGO on 28 Jun 11

DGsEME CONCLAVE

The DGsEME Conclave was held on 06 Nov 11 at MP Hall, HQ Tech Gp EME. All retired DGsEME, Lt Gens and Col Comdts of the Corps of EME alongwith their lady wives settled in Delhi/NCR attended the event.

DGsEME Conclave was held on 06 Nov 11 at MP Hall, HQ Tech Gp EME

WEB ADDRESSES ON ARMY INTRANET

EME	**:**	**http://emeweb.army.mil//**
Equipment Helpline	**:**	**http://ehl.army.mil/ehl//**
EME Records	**:**	**http://emerecords.army.mil/**

BASE WKSP GROUP CORNER

Visits

The following dignitaries vis HQ BWG and the ABWs :-

- Lt Gen Rajinder Singh, UYSM, SM, MGO, IHQ of MoD (Army) visited HQ BWG on 08 Sep 2011.
- Lt Gen IJ Singh, AVSM, VSM, DGEME & Sr Col Comdt, visited HQ BWG on 30 Sep 2011.
- Sh SP Yadav, IOFS, Sr GM, GCF, Jabalpur vis 506 ABW on 23 Sep 11 in connection with mfr of 155mm FH 77 BO2 at GCF, for which they have the ToT. An EME officer has also been posted for the project. The team led by him was briefed on complexity of the gun, type of infrastructure reqd and level of competence desired for technicians.
- 31 GCs from IMA, Dehradun, vis 506 ABW on 23 Sep 11. They were briefed on all facets of wksp and shown the methodology of overhaul of various gun systems of IA. An interactive session was also organized by the ABW to address various issues raised by them.

- 32 GCs from first batch of OTA, Gaya, vis 506 ABW on 03 Oct 11. They were briefed on all facets of wksp and shown the methodology of overhaul of various gun systems of IA.

- Maj Gen P K Mangal, ADG (EM), MGO Br vis 512 ABW on 24 Aug 11.
- Lt Gen Sanjeev Chopra, SM, GOC, MG & G Area vis 512 ABW on 20 Sep 2011
- Lt Gen IJ Singh, AVSM, VSM, DGEME & Sr Col Comdt vis 512 ABW on 20 Oct 2011.

Lt Gen IJ Singh, AVSM, VSM, DGEME & Sr Col Comdt vis 512 ABW on 20 Oct 11

Sh SP Yadav, IOFS, Sr GM, GCF, Jabalpur vis 506 ABW on 23 Sep 11

Honours & Awards

Following awards were conferred to persons of ABWs:-

- Ftr Shri Sameer Kumar Choudhury of 506 ABW has been awarded VCOAS Commendation Card and award of Rs 500/- on the occasion of Independence Day 2011.

- The following persons of 507 ABW were awarded the DGEME Professional Excellence Cert and Cash Award :-
  - T. No 3473 VM (MV) Mahendra Jha.
  - T. No 3302 VM (MV) T Chalak.
  - 14691452F SSK PK Sarkar.
- Veh Mech Shri Nabav Singh of 510 ABW has been awarded GOC-in-C Commendation Card and four pers have been awarded Cdr's Commendation Card.

Misc Activities

Rolling Out of 684th ICV BMP-I. OH of ICV BMP-I ceased wef 01 Apr 2011 as per dirns of IHQ of MoD (Army). Commemoration of last overhauled BMP-I was held on 19 Aug 2011 with the handing / taking over of the subject BMP between Brig Dalip Singh, Comdt CAFVD and Comdt & MD 512 ABW.

Sahayta Rally. Ex-servicemen "Sahayta Rally" was conducted by Lt Gen (Retd) Sushil Kumar, PVSM along with Maj Gen SM Mehta, SM, VSM** on 22-23 Oct 2011 at 510 ABW. A large number of ex-servicemen of the neighboring districts attended the rally and participated actively.

Sports

Outstanding Sportsmen. Shri Kammu Singh of 506 ABW won gold medal in Distt level Body Bldg Championship 2011, on 15 Oct 2011.

Rolling Out of 684th ICV BMP-I at 512 ABW

ESM 'Sahayta Rally' conducted by 510 ABW

ARTICLES / UNIT NEWS

- Pl fwd soft copy of articles alongwith the following :
  - Authors Write up
  - Authors Certificate*
  - Latest passport size photograph in Uniform
  - NOC*
- Unit news should also be fwd in soft copy alongwith High Resolution photograph with suitable captions.
- Photograph should be in high resolution JPEG format in separate softcopy also.

Note : Ref Para 21 of SAO 3/S/2001/MI

SPORTS AND ADVENTURE

ATHLETICS

51st Open National Athletics Championship

Athletes from 1 EME Centre participated in 51st Open National Athletics Championship as members of Services Athletics team held at Kolkata from 10 Sep to 13 Sep 2011. Performance of the players is as under:-

Ser No	Rank	Name	Event	Medal
(a)	Hav	Rahul Kumar	Decathlon	Silver
(b)	Cfn	Karamvir	3000M Steeple Chase	4th Posn
(c)	Cfn	A K Singh	Javelin Throw	8th Posn
(d)	Cfn	Sashikant Yadav	Decathlon	9th Posn
(e)	L/Hav	R Sebastian	Services Team Coach	

Services Championship

Rect Palla Nagarjuna represented Army Green team in 4x 100m Relay in Services Championship 2011 and won Bronze Medal.

61st Services Athletics Championship 2011-12

Athletes of 1 EME Centre participated in 61st Services Athletics Championship 2011-12 held at Arty Centre, Hyderabad from 16 Aug to 19 Aug 2011. Performance of the players is as under:-

Ser No	Rank	Name	Event	Medal
(a)	Cfn	Karamvir	3000M Steeple Chase (Army Red team)	Silver
(b)	Cfn	AK Tiwari	Javelin Throw (Army Green Team)	Bronze
(c)	Cfn	Sashikant Yadav	Decathlon (Army Green Team)	Bronze
(d)	Rect	P Nagarjuna	4x100M Relay (Army Green Team)	Bronze

Cfn Karamvir

Cfn AK Tiwari

Rect P Nagarjuna

ROWING

14th Asian Senior Rowing Championship 2011

The following players/coaches of Corps Rowing team represented India Rowing team in 14th Asian Senior Rowing Championship 2011 held at Hwacheon, South Korea from 09 Oct to 17 Oct 2011. Performance of the players is as under:-

Ser No	Rank	Name	Event	Medal
(a)	Hav	Shokender Tomar	Lt Wt Mens Double Scull	Gold
(b)	Nb Sub	Binu MT	-	Coach
(c)	Hav	Amit Singh	-	Coach

Hav Shokender Tomar

Nb Sub Binu MT

Hav Amit Singh

WRESTLING

Commonwealth Wrestling Championship

Nb Sub Sunil Kumar +66 Kg wt cat Greco Roman Style represented India in Commonwealth Wrestling Championship 2011 held on 07 Aug 2011 at Melbourne (Australia) and won Gold Medal.

Army Inter Comd Wrestling Championship

Hav M Mulani Sarif represented Southern Comd in +96 Kg wt cat in Army Inter Comd Wrestling Championship conducted at Jat Regt Centre, Bareilly from 27-30 Jun 2011 and won Gold Medal.

WEIGHTLIFTING

Jr Commonwealth Weightlifting Championship 2011

Rect/Hav Vompu Prabhakar 105 Kg wt cat represented India in Jr Commonwealth Weightlifting Championship 2011 held from 10-15 Oct 2011 at Cape Town, South Africa and won Gold Medal. NCO had also obtained 4th posn in Jr Asian Championship, Malaysia 2011.

KAYAKING & CANOEING

14th Asian Canoe Sprint Championship

Hav Yendapha A

Hav Yendapha A of Corps Kayaking & Canoeing team represented India in 14th Asian Canoe Sprint Championship held at Tehran, Iran from 13 Oct to 17 Oct 2011. Performance of the player is as under:-

- Kayak-K4 - Semi final - 7th Posn (Out of 22 countries)
- Kayak-K1 - Semi final - 6th Posn (Out of 22 countries)
- Kayak-K2 - Semi final - 7th Posn (Out of 22 countries)

26th Services Handball Championship

The Handball players of 1 EME Centre represented Army Red team in 26th Services Handball Championship held at Chandigarh from 20 Sep to 23 Sep 2011. Performance of the players is as under:-

Ser No	Rank	Name	Event	Medal
(a)	Hav	Naveen Yadav	Handball (Army Red Team)	Gold
(b)	Hav	K Ganpathi	Handball (Army Red Team)	Gold

Final Posn - Army Red team - First
Army Green team - Second

Hav Naveen Yadav

Hav K Ganpathi

HOCKEY

All India Baba Farid Gold Cup Hockey Tournament and Jagbir Singh Jaggi Memorial Hockey Tournament

Corps Hockey team participated in All India Baba Farid Gold Cup Hockey Tournament held at Faridkot (Pb) from 19-13 Sep 2011 and Jagbir Singh Jaggi Memorial Hockey Tournament held at Jalandhar (Pb) from 29 Sep to 02 Oct 2011 . The Corps team emerged as winners at both the tournaments.

Corps Hockey Team won All India Baba Farid Gold Cup Hockey Tournament and Jagbir Singh Jaggi Memorial Hockey Tournament.

Hyderabad Half Marathon

Sep Asheesh Kumar

50 pers of 1 EME Centre participated in Half Marathon (10 Km) on 28 Aug 2011. Performance of the indls is as under:-

Ser No	Name	Position	Prize Money
(a)	Sep Asheesh Kumar	1st Posn	₹ 14000/-
(b)	Cfn Vikash	6th Posn	-
(c)	Nk Satyanarayana	7th Posn	-

VOLUNTEERS FOR MOTOR SPORTS

All offrs, JCO & OR of Corps of EME who are volunteer for Motor Sports are requested to submit their volunteer appln to 2 (I) Para Fd Wksp, C/o 56 APO or contact OC, 2 (I) Para Fd Wksp on Mob- 9639015601 or Army No 2016.

Desert Rally and SJOBA Rally are scheduled during Jan-Mar 2012.

HOT AIR BALLOONING

Hot Air Ballooning Race. HAB race was conducted by 3 EME Centre wef 27 Sep to 04 Oct 2011 from Nasirabad to Bhopal. 03x Hot Air Balloons were used. Maj Gen PR Shankar, VSM, GOC 41 Arty Div flagged off the balloons on 27 Sep 2011 from Nasirabad. The race was flagged in by Lt Gen Sanjiv Langer AVSM, GOC, 21 Corps at a colourful ceremony held at the Centre on 04 Oct 2011.

Flag off Ceremony from Nasirabad on 27th Sep 11 by Maj Gen PR Shankar, VSM, GOC 41 Arty Div

Flag in Ceremony at Bhopal on 4th Oct 11 by Lt Gen Sanjiv Langer, AVSM, GOC 21 Corps

WORLD MASTER'S ATHLETIC COMPETITION, SACRAMENTO (USA)

Mrs Sharada Venkataraman, wife of Brig Venkataraman (Retd) represented India in the Asian Athletic meet held in Kuala Lumpur in December 2010 and bagged a silver medal in the 5Km race. Having qualified at the Asian level she represented India in 5Km and 10Km race at the World Master's Athletic Competition that was held in Sacramento (USA) between 6th and 17th July, 2011. Hats Off to the will and determination of the lady.

FAREWELL TO ARMS

We bid farewell to following officers on their retirement and wish them and their families a very happy, healthy and prosperous post retirement life...

Lt Gen IJ Singh, Ati Vishist Seva Medal, Vishist Seva Medal, who, after an illustrious career spanning four decades superannuated on 30 Nov 2011.

An alumnus of the National Defence Academy and Indian Military Academy, the General Officer was commissioned into the Corps of EME on 13 Jun 1971. The General Officer had a brilliant academic record right through his career. Recipient of the Bedi Memorial Trophy for standing first in the YO course, he went on to be adjudged the best all-round officer in the Degree Engineering Course for which he was awarded the coveted NK Agarwal Trophy.

The General Officer attended the Long Defence Management Course at CDM Secunderabad and was retained on the instructional staff of the prestigious institution, post the course. An alumnus of the National Defence College, New Delhi, his impressive academic credentials includes a Masters Degree in Industrial Engineering and Operations Research from IIT, Kharagpur, an MBA in Finance from Faculty of Management Studies, Delhi University and a Master of Management Studies from Osmania University.

For his distinguished services of the highest order, he was awarded the Vishist Seva Medal on 26 Jan 2007 and also honoured with the Ati Vishist Seva Medal on 26 Jan 2010. He is a fellow of the Institute of Engineers and a distinguished fellow of the Institute of Directors (IoD). The General Officer was awarded the Eminent Engineers Award-2011, by the Institute of Engineers (India), Delhi State Centre for his outstanding achievements in the field of Engineering.

His well rounded exposure as a regimental soldier which includes command of the prestigious 617 EME Bn is balanced by the insight he has gained in a variety of staff appointments, including that of JDEME (Vehicles) at Army Headquarters, Brig (OL) at HQ Eastern Command, DDG (Tech Adm) at HQ DGBR and ADGEME (P &A) at Army HQ. While at DGBR, he was selected as part of the team responsible for construction of the 9 km Rohtang Pass Tunnel and visited Germany, Austria, Switzerland and Spain to acquire expertise on latest trends in 'Road Tunneling'.

He has been an Instructor at MCEME and later the Comdt at MCEME, where he brought about a paradigm change in the training methodology, and revitalized and galvanized the training processes and infrastructure across the entire spectrum. He introduced the concepts of 'Just in Time Training', 'Responsive Training', 'System Mechanic' and 'Soft Skill Development' for improving engineering support delivery to the field army.

As the DGEME with his vision and pragmatism, he heralded a major initiative to sensitise the hierarchy of the army about the importance of 'Life Cycle Sustainment' for equipment and weapon systems at the induction stage itself. This initiative has brought back the matter into focus and major efforts are on to put an effective system in place while also an 'Equipment Life Cycle Sustainment Doctrine' for the Army is under formulation.

He initiated a planned restructuring of the Corps for realistically optimizing EME units based on "Composite Repair Group" (CRG) concept of engineering support based on operational employment considerations instead of the existing Staffing Norms and Work Values model. The test beds of this restructuring are undergoing validation in a number of formations.

He conceptualized a major organization-wide Organisational Development Intervention (ODI) initiative in the Corps of EME with a view to rejuvenate the organizational focus on the technical ethos and technical functioning of EME units and to evolve as a valued partner for the field army. A much required 'Back to the Basics' for the Corps.

A keen sportsman, the General has represented the services in cricket. He is an avid golfer, an excellent tennis player and a keen sailor having sailed Lasers at National level. For his stellar contribution to sailing, the General has been awarded the 'Admiral NK Kohli Trophy' for sailing this year. He was also a council member of the Yachting Association of India as the Chairperson of the Olympic and Asian Games Classes Committee.

The General Officer, post retirement is settling down at **House No - 9399, Pkt -9, Sector-C, Vasant Kunj, New Delhi-110070.**

Maj Gen PP Singh, an alumnus of the Sherwood College, Nainital and a B Tech from GB Pant University of Technology in 1976 was commissioned into the Corps of EME on 03 Sep 1977. The General Officer graduated from DSSC, Wellington and has done the HC Course from the Army War College, Mhow. He also attended the OSA-AK Course in erstwhile USSR apart from the other mandatory courses.

During his illustrious career spanning 34 yrs, the General Officer had held many regimental and staff appointments. A diehard paratrooper, he commanded the only Para Wksp of Corps of EME in Agra. His other assignments include Adjt, EME School, Col MS and Works Manager 512 ABW. The General Officer Commanded 608 EME Bn during Kargil Ops with aplomb and brought many a kudos and awards to the Corps of EME. His staff assignments range from DAQMG of a Mtn Bde in high altitude to the Brig Adm of Assam Rifles in the North East. As the Brig EME of a strike Corps he was complimented for professional handling and execution of an investiture ceremony which called for exceptional organizational skills. In Sep 2008 the General Officer was appointed as the ADG EME (RM).

The General Officer was an avid golfer and an outstanding sportsman. He had the distinction of having played Hockey for the Corps Hockey team. After a dedicated and distinguished service spanning over 34 years, the General Officer hung his uniform on 31 July 2011. We wish the General and his family a very happy, healthy and prosperous second innings. The post retirement address of the General Officer is **Flat No L-4074, Sector-56, Devinder Vihar, Gurgaon-122011, Haryana.**

Col Anil Sud, an alumnus of NDA was commissioned into the Corps of EME on 10 Jun 1978. The officer has had an illustrious carrier of over 33 years, during which he has served with distinction in various ERE, Regimental, Command and Staff appointments; His courses/qualifications include YO, ORrE, Spl Wpn, ME Mech (Guided Msls), course on OSA-AK Msl Sys at Mari (erstwhile USSR), ONBCW-Basic, and PGD Comptr Software Tech. He has served with a number of AD Regt Wksps, including all the three AD Msl Regt Wksp (SP) maint OSA-AK wpn sys. The officer then served with 606 EME Bn (Op Vijay), commanded 7012 EME Bn, held the appointment of DDEME HQ Delhi Area, CME, MAG 4 and finally hung up his uniform on 31 Oct 2011. A dedicated professional and good all rounder on the sports field, this second generation. EME Officer will be missed by the organisation. His post retirement address is **B-6062, Vimal CGHS, Plot No 3, Sector-12, Dwarks, New Delhi-110075, Tele 01142815010, email : sudanil@yahoo.com.**

Col P Prem Kumar was born on 30 Oct 1957 in Banglore (Karnataka). He graduated as B.E. (Metallurgical Engineering) from National Institute of Technology (Regional Engineering College) Tiruchirapally (TN) during 1979 and was commissioned into the Corps of EME under SSC (Tech-24) from OTS, Madras on 26 May 1981. The officer has done YTO, JC, OAFVE, WCC and SO-71 course. He has undergone specilised training on LYNX GLX 5900FC SNOW MOBILE at NORDTRAC OY-ROVANEIMI, Finland during Mar 1996. During his service, he served with 7002 CMA Wksp, 183 (I) Fd Wksp Coy, 219 Fd Wksp Coy EME (Spl), Station WKsp EME Chennai, 294 Armd Wksp EME, Mumbai, Veh Depot Wksp EME, Delhi & Station Wksp EME Delhi Cantt. He assumed the appointmewnt of Col EME at HQ ATNK &K Area on 09 Sep 2009. He finally hung uniform on 31 Oct 11 (AN). His post retirement address is - **House No. 60, Santhome High Road, Mylapore, Chennai - 600 004.**

Col (TS) Ravinder Nath Raina was commisioned into the corps of EME on 13 Jun 1981 with seniority of 13 Jun 1979. A BE (Electrical) from REC Srinagar, Kashmir, the offr has undergone YTO ORrE & OALE (R) & WCC Course. In his carreer spanning over three decades he has served in 610 EME Bn, 976 AD Regt Wksp, 901 AD Regt Wksp, HQ TG EME, 617 EME Bn, 7033 Comb Wksp, 629 EME Bn, 611 EME Bn, ESD (GREF), EBW (GREF), 611 (I) AD Bde, 505 ABW & HQ 16 Corps. He was posted to 506 ABW on 02 Aug 10. After a dedicated, satisfying and distinguished service, spanning over 32 yrs in the corps of EME, the offr hung his uniform on reaching the age of superannuation on 30 Nov 11. The offr has been re-employed in the Army and stands posted to HQ 3 Corps. His post retirement address is - **KM Partment, C/101, Plot NO 12, Sector-12, Dwarka, New Delhi PIN 110 075.**

LAST POST

With deep sense of loss we inform the sad demise of the following veterans Eagles :-

Lt Gen (Retd) Harbhajan Singh Banga, PVSM, VSM (Born - 24 Sep 1924, Died - 22 Dec 2011). It is a sad news for all of us in olive green that we have lost one more of that rare breed of Gentlemen-Soldiers.

Gen Banga came from an illustrious family. His father, Dr Gyan Singh was an eminent doctor. Following the footsteps of his elders, the Gen Offr excelled in both professional and academics front. He began his military life as the course topper in the First Technical Graduates course in Dec 1948. During his career spanning more than four decades, he attended most of the prestigious courses. He firstly attended the course in UK when he was a Capt in 1959. As a Maj and Lt Col he was posted to 512 ABW, where the technical acumen of the Gen Offr was appreciated by one and all. For his distinguished services in the Armd Div during the 1965 war, he was awarded Vishisht Seva Medal. In 1970 he served as Dy DEME as Brig and subsequently participated in 1971 war in the Eastern Sector. The Gen Offr was the Director General of Corps of EME from Mar 1978 to Mar 1982, when he was decorated with the Param Vishisht Seva Medal.

After retiring from the Army in 1982, he joined Ashok Leyland and served for about seven years as Plant Director, first in Alwar (Rajasthan) and then in Hosur (Tamil Nadu). Thereafter, the Gen Offr was Head of the Administration of Hindujas hospital in Mumbai and became the first non-medico to be the CEO. During his decade long service with the hospital, he acquired so much knowledge of the medical science, that he was often invited to preside over seminars and discussions. Gen Banga was an epitome of professionalism, both while in service and in the industry.

Gen Banga is survived by his wife Mrs Jaswant Banga, their two sons Manvinder and Ajaypal and their daughter Deepa. The Gen Officer enjoyed an illustrious career even after hanging his uniform. His memory will be cherished by the EME fraternity.

Mrs Jaswant Banga may be reached at: **H No-80, Sector-37, Arun Vihar, NOIDA.**

Messages Received from Eminent Personalities

Lt Gen (Retd) C Sundara Rao, PVSM, Ex DGEME

I first met Capt Banga when he returned after attending a course in the UK. Later in 1959/60, when I was Comdt 512 ABW he joined me as a Major & then picked up the rank of Lt Col. In 1970/71 when I was the DEME he joined me as Dy DEME in the rank of Brig. He was my successor's successor as DEME. Please convey our condolences to his wife Jaswant Ji and his sons and daughter.

Maj Gen (Retd) Gurdayal Singh

His admirers are innumerable in numbers. May his soul rest in peace. He indeed was a great Role Model for EME officers.

Mr Srikant Srinivasan, Corporate HR, Ashok Leyland Ltd

Gen Banga was the epitome of professionalism both while in OG and in the civvy street. I have very pleasant memories of the time I worked under him at Hosur. He seamlessly fitted into the corporate world and by his qualities of mind & heart endeared himself to many of us at Ashok Leyland. Even as I write this, I can sense his towering presence, quiet demeanour, careful and attentive listening, the dignity and concern that he showed to everyone from the GM to the junior most operator.

The Editorial Team expresses special gratitude to
Maj Gen (Retd) Surjit Singh, AVSM, VSM, FNAE for his valuable inputs.

LAST POST

Col (Retd) GP Srivastava. The offr belonged to 1949 batch. He passed away on 26 May 11. The present address of Mrs Chandra Mohini Srivastava is as under:- **Mrs Chandra Mohini Srivastava, 1547, Arun Vihar, Sector-37, Noida (UP)-201303.**

Col (Retd) BT Nagrani. The offr belonged to 1944 batch. He passed away on 23 Sep 11. The present address of Mrs Sati Nagrani is as under:- **Mrs Sati Nagrani, D-267, Defence Colony, New Delhi-24.**

Col (Retd) EKB Nambiar. The offr belonged to 1965 batch. He passed away on 15 Jul 11. The present address of Mrs Jaya Bhaskar is as under:- **Mrs Jaya Bhaskar, Nandanam, Panapuzha, Kannur, Kerala - 670306.**

Lt Col (Retd) Thomas E Mathew. The offr belonged to 1967 batch. He passed away on 30 Jul 11. The present address of Mrs Sosa Thomas is as under:- **Mrs Sosa Thomas, Ezhumanthuruthil House, Pallithanzham, Mulanthuruty, Kerala - 682314.**

Brig (Retd) MS Virk. The offr belonged to 1963 batch. He passed away in Sep 2011 at Sacremento USA. The present address of the son of deceased offr is as under:- **Col SS Virk, Attending HDMC-07, CDM, Secunderabad, AP-500015.**

Lt Col (Retd) BS Shenoy EME, served the Corps of EME from 27 Jan 1965 to 16 May 1985. The Offr passed away on 31 July 2011. The present address of the next of kin, wife, Jaya Shenoy,is as under: **Jaya Shenoy, C/O Dr Ajay Kamat, 1402, West Wing Apartments, Collector's Gate, Balmata, Mangalore-575001, Phone-09880455685, 082442185521.**

EXAMINATION - DSSC / TSOC RESULTS - 2011

Nominated Officers DSSC - 68

Maj Brijesh	633 EME Bn
Maj Pankaj Sharma	4R & O Flt
Maj Shikharesh Vatsa	633 EME Bn
Maj Bharat Singh Shekhawat	505 Army Base Wksp
Maj Malhotra R	953 AD Regt Wksp
Maj Rohan Seth	588 FRI
Maj Raj Singh Duhan	614 EME Bn
Maj Debasish Sinha	642 EME Bn

Reserve Officers for DSSC - 68

Maj Ahlawat Suryajeet	914 Lt Ad Regt Wksp
Maj Pant Piyush	625 EME Bn

Nominated Officers for TSOC - 38

Maj Dahiya Vikram, SM	EME School
Maj Abhishek Dimri	2 (I) UH Flt
Maj Thakur SS	Stn Wksp, Bangalore
Maj Harsh Chandra Rastogi	3 EME Centre
Maj Amit Shetty	21 FD Wksp Coy EME
Maj Ankur Amul Jayakar	403 Sata Regt Wksp
Maj Sidharth Jandial	138 (I) Wksp EME
Maj Sartaj Singh	6016 (I) Armd Wksp
Maj Rajendra Singh Nagar	611 EME Bn
Maj Ajit Khatri	534 Fri
Maj Gaurav Singh	9 Para
Maj Kapil Sanawar	641 EME Bn

Reserve Officers for TSOC - 38

Maj Karun Gosain	7015 EME Bn
Maj Rathee KS	Stn Wksp, Delhi Cantt
Maj Soni Mayank	MCEME, Secunderabad
Maj Murali Kishore Velagada	621 EME Bn

CHANGE OF ADDRESS

You are requested to amend my address as under :-

.....

.....

Place : Rank & Name :

Present Address :

Date : Signature :

Retd Offr & Offrs Serving In Civ Est : Editor, EME Journal, FEL, MCEME, Secunderabad - 500015.
Email : emejournal@gmail.com

Serving EME Offrs : Respective Comd HQs through EME channel.

THEY SERVED WELL

Sub (Hony Lt)
Rishi Pal Singh

Sub (Hony Lt)
Pratap Narain

Sub (Hony Lt)
Ramnivas Singh

Sub (Hony Lt)
SV Thakor

Sub (Hony Lt)
Akshaya Kumar

Sub (Hony Capt)
Sardar Singh

Sub (Hony Capt)
NK Sharma

Sub (Hony Capt)
PT Mani

Sub Maj (Hony Lt)
Shailendra Kumar Tripathi

Sub Maj (Hony Lt)
HP Singh

Sub Maj (Hony Lt)
SB Singh

Sub Maj (Hony Lt) Tech (SA)
Suprakash Mukherjee

Sub Maj (HonyLt)
RK Sharma

PROMOTION STATE JCOs/OR : 01 DEC 2011

S No	Trade / Cat / Band	Naik		Havildar			Nb Subedar			Subedar		
		Date of Enrollment	Date of Promotion to Nk	Date of Enrollment	Date of Promotion to Nk	Date of Promotion to Hav	Date of Enrollment	Date of Promotion to Hav/HMT	Date of Promotion to Nb Sub	Date of Enrollment	Date of Promotion to Nb Sub	Date of Promotion to Sub
TECH CAT												
1	Master Technician (Elect)						11-Jun-87	19-Feb-06	01-Jan-12			
2	Master Technician (Gun)						28-Apr-94	22-Jan-06	01-Jan-12			
3	Master Technician (Opto Electronics)						28-Oct-95	02-Jul-06	01-Aug-11			
4	Master Technician (Rdr)						23-Feb-96	23-Sep-07	01-Jan-12			
5	Master Technician (A Veh)	}					22-Feb-95	11-Jun-06	01-Dec-11	7-May-87	01-Sep-05	01-Jan-12
6	Master Technician (B Veh)											
7	Master Technician (C Veh)											
8	Master Technician (GCE)						06-Jun-96	24-Dec-06	01-Jan-12			
9	Master Technician (Comn)						22-Aug-85	03-Dec-06	01-Dec-11			
10	Master Technician (Networking)						24-Feb-94	20-Aug-05	01-Dec-11			
11	Master Technician (SA)						09-Jan-89	29-May-05	01-Nov-11			
TECH AVN CAT												
12	Master Technician (Avn/AF)						22-Feb-97	22-Feb-09	01-Nov-11			
13	Master Technician (Avn/AE)						06-Nov-95	30-Mar-08	01-Jan-12			
14	Master Technician (Avn/Elect)						28-Aug-95	30-Mar-08	01-Nov-11	20-Jul-84	01-Oct-07	01-Oct-11
15	Master Technician (Avn/I&P)						30-Dec-95	30-Mar-08	01-Dec-11			
16	Master Technician (Avionics)						28-Dec-96	22-Feb-09	01-Nov-11			
17	Master Technician (Avn/Armt)						-	-	-			
ARTZN AVN CAT												
18	Avn Technician (AF)	05-Jun-02	01-Sep-11	10-Mar-97	01-Apr-08	01-Sep-11	28-Nov-84	17-Nov-04	01-Oct-10			
19	Avn Technician (AEN)	20-Mar-02	01-Dec-11	14-Apr-01	01-Apr-09	01-Oct-11	28-Apr-95	01-Feb-06	01-Oct-10			
20	Avn Technician (Ele)	23-Sep-11	01-Dec-11	03-Jan-01	01-Jul-08	01-Sep-11	11-Dec-87	01-May-06	01-Oct-10	26-Nov-83	01-Oct-08	01-Jul-11
21	Avn Technician (I & P)	26-Jun-02	01-Sep-11	27-Feb-97	01-May-08	01-Sep-11	13-Jan-86	01-Nov-06	01-Feb-10			
22	Avn Technician (Avn)	22-Jan-02	01-Sep-11	13-Sep-01	01-Oct-08	01-May-11	17-May-96	01-Sep-07	24-Oct-10			
ARTZN ELIGIBLE CAT												
23	Auto Elect 'A' Veh	15-Sep-03	01-Aug-11	17-Jul-00	01-Apr-09	01-Sep-11	25-Aug-84	01-Apr-07	01-Sep-10			
24	Auto Elect 'B' Veh	9-Jan-03	01-Jan-12	28-Aug-95	01-Sep-08	01-Oct-11	10-Nov-85	01-Mar-07	01-Nov-11			
25	Auto Tech ENGR Eqpt	27-Jun-05	01-Dec-11	25-Jan-02	01-Dec-08	01-Sep-11	25-Jan-85	09-Mar-08	01-Nov-11			
26	Auto Tech 'A' Veh	17-Sep-02	01-Nov-11	23-Aug-96	01-May-09	01-Oct-11	20-Nov-87	05-Oct-99	01-Dec-11			
27	Auto Tech 'B' Veh	14-Mar-03	01-Dec-11	27-Jun-96	01-Apr-09	01-Dec-11	22-Jan-86	01-Dec-07	01-Jan-12			

S No	Trade / Cat / Band	Naik		Havildar			Nb Subedar			Subedar		
		Date of Enrollment	Date of Promotion to Nk	Date of Enrollment	Date of Promotion to Nk	Date of Promotion to Hav	Date of Enrollment	Date of Promotion to Hav/HMT	Date of Promotion to Nb Sub	Date of Enrollment	Date of Promotion to Nb Sub	Date of Promotion to Sub
28	Tech Opto Electronics	23-Mar-04	01-Dec-11	30-Oct-96	05-Jul-09	01-Nov-11	31-Mar-86	01-Dec-05	01-Sep-11			
29	Tech GCE	03-Oct-02	01-Dec-11	31-Oct-97	01-Jun-09	01-Dec-11	19-Mar-84	01-Nov-99	01-Sep-11	11-Feb-84	01-Sep-09	01-Dec-11
30	Tech Comptr	28-Feb-03	01-Sep-11	15-Jun-99	01-May-09	01-Dec-11	-	-	-			
31	Tech Radar	15-Aug-02	01-Dec-11	17-Oct-01	01-Jun-09	01-Oct-11	30-Mar-91	01-Apr-09	01-Dec-11			
32	Tech Comn	23-Jan-02	01-Nov-11	28-Jun-96	01-Jul-09	01-Jan-12	19-Dec-91	01-Jan-08	01-Dec-11			
33	Armt Tech (Fd)	08-Sep-02	01-Nov-11	29-Mar-01	01-Feb-08	01-Oct-11	20-Dec-85	01-Aug-08	01-Sep-11			
34	Armt Tech (Afv/Ad)	25-Feb-97	01-Jan-12	25-Feb-95	01-May-09	01-Nov-11	13-Dec-85	01-Aug-05	01-Dec-11			
ARTZN NON ELIGIBLE CAT												
35	Dtmn Tech	05-May-97	01-Jan-12	31-Mar-89	01-Feb-09	01-Sep-11	03-Mar-87	01-Feb-10	01-Oct-11			
36	Refg Tech	29-Oct-93	01-Oct-11	27-Dec-92	18-Nov-98	01-Oct-11	04-Jun-85	01-Dec-97	01-Dec-09			
37	Artisan Metallurgy	05-Mar-01	01-Jan-12	29-Apr-95	01-Jan-09	01-Feb-12	27-Feb-92	01-Jan-09	01-Jan-12			
38	OTRP (A)	27-Jun-90	01-Feb-09	05-Jun-89	01-Aug-07	06-Feb-10	-	-	-			
39	Mach GP (Incl Tnr, Mach, T/Maker)	07-May-96	01-Nov-11	28-Feb-94	01-Aug-08	01-Aug-11	19-Jul-86	01-Apr-08	01-Dec-11	15-Mar-84	01-Jun-09	01-Nov-11
40	Welder	09-Mar-96	01-Jan-12	28-Apr-94	01-Jun-08	01-Nov-11	19-Jan-86	01-Jun-07	01-Nov-11			
41	Artisan Wood Work GP (Incl LM, Moulder & P/Maker	18-Dec-02	01-Aug-11	28-Dec-95	01-Apr-09	01-Dec-11	22-Feb-86	05-Apr-09	01-Oct-11			
42	Ptr & Dectr	24-Jan-02	01-Oct-11	29-Feb-92	01-Feb-09	01-Sep-11	13-Jan-89	01-Apr-08	01-Jan-12			
43	Sopport Staff (ER)	12-Feb-96	01-Jan-12	01-Mar-99	01-Mar-09	01-Oct-11	04-Feb-87	01-Mar-08	01-Aug-11			
OTHER INDEPENDENT TRADES												
44	Clk (SD)	22-May-08	01-Nov-11	10-Mar-05	01-Jun-08	01-Aug-11	31-Jul-86	01-Dec-96	01-Dec-11	15-Mar-84	01-Aug-07	01-Feb-12
45	Skt	05-Jul-08	01-Dec-11	09-Mar-05	01-Aug-09	01-Nov-11	30-Dec-89	01-Jan-00	01-Jan-12	28-Sep-88	01-Aug-10	01-Feb-12
46	Tech SA	11-Mar-05	01-Nov-11	06-Apr-02	01-Aug-09	01-Sep-11	16-May-87	01-Dec-99	01-Jan-12	4-May-84	08-Mar-09	01-Oct-11
47	Opr & Dvr Rec	29-Oct-06	01-Dec-11	12-Mar-03	08-Aug-09	01-Nov-11	27-Feb-86	01-Sep-08	01-Dec-11	04-Oct-83	08-Mar-09	01-Oct-11
48	Musn	11-Jul-01	01-Nov-11	28-Jun-89	01-Aug-07	01-Jul-11	10-Oct-86	02-Sep-07	25-Oct-09	-	-	-
49	Dvr (MT) & Dvr (Spl)	28-Mar-98	01-Dec-11	30-Apr-94	01-Mar-05	01-Sep-11	28-Dec-85	01-Mar-05	29-Oct-11	15-Mar-85	01-Nov-08	01-Feb-12
50	Chef Comm	04-Jun-00	01-Jan-12	03-Mar-95	01-Oct-08	01-Nov-11						
51	Mess GP	03-Nov-95	01-Mar-11	24-Dec-93	01-Dec-08	01-Nov-11						
52	Dresser	01-Mar-96	01-Apr-11	11-May-94	01-Feb-09	01-Nov-11	NA			NA		
53	House Keeper	26-Oct-95	01-Aug-11	28-Aug-93	01-Dec-08	01-Oct-11						
54	W/Man	02-Mar-95	01-Nov-11	20-Aug-91	01-Sep-09	01-Oct-11						