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Revolution in Military Affairs
A Roadmap for the Indian Sapper of 2020

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To engineer is to arrange, contrive, manoeuvre, guide.

Introduction

The Spirit of Engineering, Sapping and Soldiering

Engineering is defined as the art and science of arranging, contriving, manoeuvring and guiding, while sapping implies trenching to a pattern which permits successful manoeuvre towards the enemy with the purpose of undermining his position. Thus, by definition, the engineer is expected to be a motivator, an initiator and a prime mover of the military force he supports. In this context, it is relevant to consider the role of engineers. It is: "To apply engineering knowledge and skills to the furtherance of the commander's plan". All other arms have well demarcated and specifically defined roles concisely spelt out in a couple sentences; not so in the case of the sapper who is ordained to successfully accomplish under all eventualities all such tasks which do not fall within the ambit of responsibilities of any other arm or service. In addition, the sapper force has to perform the role of infantry when so asked. It is a tall order, and it has been so ever since the dawn of military organisation.

With a mandate so vast and unlimited, we have to understand what military engineering signifies and what is entailed in making it an effective engineer force. To do this, we have to start at the roots of our existence, see where we are today and what is expected of us in the coming decades.

Chapter 1: Past, Present and Future of Military Engineering

The Matter of Discussion

The purpose of this part of the paper is to examine if the Indian Army in general and the Corps of Engineers in particular are duly seized of their ordained responsibilities of the future, and to see what more needs to be done to identify the right direction. Thus, as the militaries the world over articulate their future course in the light of the ongoing Revolution in Military Affairs (RMA), we too may devise an appropriate roadmap for the Corps of Engineers of tomorrow.

But before we delve into such an exercise, it is imperative that we get into the essence of military engineering through a brief study of the history and trends in sapping.

From the Origin to the Present: Progression of Military Engineering

From time immemorial, military engineering has been a traditional spearhead of technological developments in human society, taking charge of the extreme challenges in the technicalities and adversities of nature across the entire spectrum of construction activities. It is also a historical fact that as the technological and situational difficulties are assimilated and tamed, and as the expertise of yesteryears settles down to the regime of simple routine in a gradual process of deliberate shift of focus, military engineers hand over to quasi-military or civilian organisations and move on to the next challenge. The pioneering contribution of military engineers in shaping the Public Works Department (PWD), Survey of India and Military Engineering Service (MES) during the 19th century, and the Border Roads Organisation (BRO) in the 20th century are but a few examples of this age-old trend. The axiom is true even within the armed forces. For example, during the American Civil War, engineers had to cut passages through foliage and swamp for the infantry to move on till the latter mastered the art of wielding the simple

'Dah'. Similarly, bunker bursting was an exclusive engineering expertise till infantrymen became adept at handling simple charges, while not long ago, the tank-men looked at the sappers to deploy fascines to cross small ditches. The engineers handing over the task of military signalling to the Corps of Signals and repair and recovery to the Corps of Electrical and Mechanical Engineers (EME) are some other examples. It would be, therefore, appropriate to infer that organisations live, develop and thrive through a system of discarding the old and adapting to emerging trends. Just as the infantry has graduated to undertaking simple field engineering tasks such as laying small foot bridges and bursting bunkers from standoff distances with tandem warhead rockets, and armoured units have gained expertise in crossing minor obstacles by themselves, engineers must move on to acquire higher levels of expertise in the realm of mobility, counter-mobility and survivability, thereby opening up wider vistas and new possibilities for the emergence of better forms of military tactics and strategy.

This is an imperative if we, the engineers, are to retain our status as the premier supporting arm for the three Services and a colossus of technical innovation in the country.

History of Sapping

In the ancient times and the Middle Ages, there were men of mathematics and science who trained to be engineers in the employment of the state. Like most officials of the court, they too, were involved in the pursuit of warfare, which, among other responsibilities, presented them with opportunities in the field of engineering as well. When the state was not engaged in military action, these engineers built palaces, forts, bridges and canals. To this day, the term 'engineers' is specifically dedicated to the military engineers, and the term 'civil engineer' emerged to refer to those engineers who were not soldiers. The latter term evolved about 200 years ago, when the need for engineering skills emerged in the civil sector as a consequence of the Industrial Revolution. Later, of course, other disciplines of engineering branched off, to be referred to as 'mechanical engineering', etc. in keeping with the trends of technological advancements.

As the recorded history of Armies the world over reveals, the sapper component of the military consisted of a chief engineer, who was also a

senior field commander. He was assisted by a few formally trained engineer staff officers and artisans who planned and executed military engineering tasks with the help of troop labour, or, at times, through a muster of civilian work force. A similar system was in vogue during the Hindu as well as Muslim rule in India. 'Engineers' as a distinct corps are of comparatively recent origin – probably the mid-18th century, just as India was gradually slipping under the British rule. Marshal Sebastien le Prestre de Vauban of France, one of the great military engineers, was admitted as a King's Engineer in 1655, granted lieutenancy in the Royal Guards in 1668 while continuing as the Chief Engineer; he commanded an infantry division against the English from 1691 to 1697, before finally returning to his first love, that is, fortress engineering, in 1703, in the rank of 'Marshal of France'. Major General Lazare Nicolas Marguerite Carnot was another great engineer of his times, who shouldered the duties of Chief Engineer in the 'Armies of the Rhine and the North', as well as Defence Minister in post-Revolution France, before falling out with Napoleon in 1807. The tradition of great military engineers taking on the mantle of operational leadership at the national level and in times of crisis – Field Marshal Lord Kitchener, Field Marshal Robert Napier and General Gordon of Sudan, to name only a few – is as much in evidence in the British Army too. British India was served by a roll of great military engineers who are respected and remembered as heroes by all Indians to this day. The feat of the construction of the Ganga Canal by Colonel Cautley, great irrigation works by Colonel Sir Arthur Cotton and Major John Pennycuick, construction of great roads, cantonments and majestic buildings at Madras by Captains William Dixon and Sankey, at Calcutta by Lieutenant Forbes and at Bombay by Lieutenant Fuller, to name only a few, are celebrated even today, as indeed are the contribution made by Colonel Swinton Jacob in developing the Indo-Saracenic style of architecture. However, the overwhelming contribution of the military engineers in the Army, as well as in nation-building, is best seen in the USA. West Point was the pioneering institution of engineering education in America and the roll of great sappers who influenced the shaping of the nation includes leaders such as Generals McClean, Lee and McArthur. The primacy of the role of the US Corps of Engineers in designing, executing and controlling all major civil engineering and transportation projects in the American mainland has been the most

acclaimed foundation of her technological superiority over the rest of the world, and to this day, remains one of the great strengths of that nation.

Even as construction works of great engineering feats abound in the folklore of our Hindu dynasties, many of which – mostly forts and temples – survive to this date, unfortunately, little is known of either the engineers or the engineering practices of those times. Record keeping has never been our forte', and what little was actually recorded, must have been destroyed when the seats of learning and culture were torched by the invaders from Central Asia. After the first millennium, great feats of engineering were accomplished by the military engineers of our Muslim dynasties, the first lot of whom had mostly migrated from West Asia. The 240-km-long Jamuna-Hissar Canal constructed during Feroze Shah Tughlak's rule, reconstruction of Emperor Ashok's Grand Trunk Road by Sher Shah Suri and Shah Jehan's construction of Delhi Canal, the Red Fort at Delhi, and the Taj Mahal at Agra, the design of high-technology water supply schemes at various forts and 'Mahals' – for example, the one at Mandu is simply brilliant – and numerous other works of grand engineering projects stand testimony to the prowess of the Indian military engineers of those days. During the later half of the Mughal period, however, European engineers came to be employed more and more while indigenous engineering practices were gradually forgotten. This unfortunate loss of scientific temper and inability to keep up with the technological progress are perhaps the true causes of our problems of today. It took another two hundred odd years for the Indian engineer to emerge once again, trained under the British tutelage and who worked as the white man's understudy. It was the necessity during the World Wars, followed by independence, which finally paved the way for the emergence of a truly competent and independent community of indigenous engineers – both military and civil. Today, Indian engineers have progressed to such an extent that even the technological foundations of the world's sole superpower is sustained by many of them.

Even then, we have a long way to go before our engineers blaze the trail of independent and indigenous engineering designs which are customised to the Indian conditions and local requirements. That would be the time when the nation will acquire its rightful status in the modern world.

Military Engineering in the Contemporary Indian Army

As our past would reveal, there is an intimate connection between the tradition of competent engineering and the strength of nationhood. It also follows that due advancement in military engineering is an imperative for the present thrust towards modernisation of the Indian Army. Unfortunately, in the evolution of the post-independence Indian Army, perhaps in the backdrop of inexperience in strategic perception and higher direction of war, the Corps of Engineers has somehow got consigned to peripheral roles. Except for a short duration in the late 1960s and 1970s, when the equation between military engineering and combat power had come to be recognised and substantial strides in combat engineering made, the practice of coopting engineer commander-advisers in tactical decision-making right from the inception stage is seldom, if ever, allowed to go beyond the training pamphlets. Similarly, the system of organisational upgrading, resource allocation and fiscal provisioning seems to have been confined to pro-rata distribution between the bigger arms rather than being governed by the considerations of balanced force-structuring. As a result, the *mantra* for successful war-fighting in the contemporary era – that no element of combat is restrained from full tactical exploitation due to inadequacy of support from another – does not obtain in our context. This is a serious deficiency due to which the range of possibilities and options borne out of the limitless capabilities and infinite facets of military engineering in support of operations are rarely realised in our Army. Consequently, military initiatives in our Army are yet to rise to the levels of brilliance as exemplified by the Napoleonic concept of campaigning astride strategic axes and logistic flexibility, the tradition of exploitation of waterways in the US Army, the originality of Schliffen's strategy of outmanoeuvring, or Guderian's unique breakthrough across the so-called impassable Ardennes forests. The exception of the Bangladesh Campaign in 1971 notwithstanding, our military planners see the difficulties of terrain and vagaries of the weather as undesirable hindrances rather than as opportunities for advantageous tactical manipulation by means of efficient combat engineering.

An unfortunate fallout of this self-inflicted denial of military engineering opportunities in our Army, that is, to be able to manipulate the terrain towards successful prosecution of military operations, is that little progress has been achieved to devise our own version of tactical theology or doctrine.

Thus, confinement of our military options into conformist and stereo-type plans, devoid of audacity, has, more or less, become an ingrained habit, and dependence on straightforward but bloody attrition to gain favourable results at a heavy cost of life and resources is becoming a comforting resort for most of our military commanders and staff. In the context of the changing paradigm of military progressions in the contemporary era, such a conceptual mindset would turn out to be disastrous. It is time, therefore, that the sapper fraternity looks at its own role in the context of the ongoing Revolution in Military Affairs (RMA) – as tailored to indigenous conditions – and articulates the relevance of military engineering options in tackling tactical situations with more efficiency. Efforts to enhance the Army's combat power, after all, cannot be considered to be the sole burden of 'generalists', alone.

A point to clarify here is that even as this paper is devoted to the modern aspects of combat engineering, the concept of progression in tune with the contemporary needs remains equally applicable to all arms and services; it is not wise to think of promoting military engineering in isolation.

But, first, let us have a look at the emerging trends in the art and science of wielding military power which would dictate the scope of concepts and practices of military engineering in the coming years.

Chapter 2: The Emerging Nature of Warfare and the Global Revolution in Military Affairs

I prefer to learn from the experience of others.

—Otto von Bismark

Looking Yonder

In the preceding part, we have seen that 'engineering' has been the eternal prime mover of human society in both war and peace. We have also seen how the progression of military engineering has, over the centuries, opened up new vistas in the fields of tactics and strategic opportunities. It is time now to move on to the next step, that is, to see what would be the character of future warfare and how this character would condition the concept of engineering support in the coming decades.

Emergence of Modern Military Concepts

Along with higher aspirations for progress and security, the world today is experiencing another cycle of paradigm changes in the political, economic and strategic environs. Social awareness, economic compulsions and the advent of high technology of the contemporary era have necessitated far-reaching rearrangements among the various nuances of warfare, which, in turn, would influence the concepts and practices of planning and execution of military operations in the future. Thus, at the strategic levels, we see manifestation of localised conflicts; involvement of non-state militancy, regional conflicts generated out of economic and environmental competition, application of diplomatic-militancy posturing, economic arm-twisting, technology denial and graduated orchestration of armed response, ranging from small-unit intervention at the lowest end to nuclear deterrence at the top. The strategic goal in the future would be to project military power to prevent rather than wage war, and to win it without much fuss should the sabre rattling fail. Accordingly, reorganisation of the

military structure, including weapons, equipment and logistics, which are duly dovetailed into nuclear capability and integrated through exploitation of information technology is underway in most modern Armies. At the operational and tactical levels, surveillance, deception, mobility, precision engagement, simultaneity and information operations are the corresponding fallouts of such a dispensation.

In the context of the issue under discussion, the most significant conceptual changes, brought about by the marriage of military intellect with the emergent super-technology the world over, with particular reference to the aspects of military engineering, may be described as follows.

Combat Power Redefined

The days of counting soldiers, tanks and guns to define combat power is past. Not only have the elements constituting the combat power proliferated across a wider spectrum, various force elements would henceforth combine differently under specific conditions to generate unique results. For example, a battle group integrated with the requisite degree of engineering support so as to be capable of moving across a seemingly impassable terrain would project combat power many times more than another which is confined to the predictable courses. As a corollary, military engineering resources would constitute one of the important force-elements towards achievement of the modern version of combat superiority. Equipping, orienting and training the armed forces are time consuming processes. Farsighted steps towards reorganisation and modernisation of the Corps of Engineers in conformity with its futuristic mandate, therefore, needs to be initiated well in time, for it to be able to stand up to the emerging challenges.

Determination of Relative Strength

In similar vein, the factor of relative strength would encompass a much wider spectrum to cover the enemy's strengths and vulnerabilities vis-à-vis that of own forces. The relevant factors would be in terms of the teeth, the jaw and the tail elements of the force, besides the quasi-military capabilities such as communications, transportation system and military industry. Therefore, in view of the fact that the operational goals would be dictated by the capabilities of military forces, their equipment profile and logistic assets as available at the

time and place of action, the Corps of Engineers too has a tedious mandate ahead for modernisation. It must provide frontline engineering support in the Tactical Battle Area (TBA), it must also think ahead to be able to create the necessary logistic infrastructure within a given timeframe which would generate tactical and strategic flexibility in the time of need. Roads, rail, waterways, air-heads, storage for military hardware, water management and material handling are some examples of such infrastructure which sustain modern war efforts, and enhanced capability in these fields would count towards building up the modern version of relative strength.

Combined Arms Operations

In the emerging context, 'combined arms' would imply an optimum grouping of supporting elements with the battle groups, rather than the present practice of allocating the minimum inescapable supporting arm elements to compose what is allowed to pass off as an 'all arm-force'. Under the present arrangement, a typical battle group is just about capable of engaging in an intense dog-fight, applying brute force to impose an adverse ratio of attrition upon the enemy – man against man and tank against tank. Thus, the war machine is denied the opportunities to undertake audacious manoeuvre – in terms of the theory of indirect approach – so as to deceive and surprise the enemy and, thus, ensure his eventual defeat even before the first attrition is inflicted. Therefore, the modern force-structure would need to be 'balanced' to see that the infantry and the armour assets are better supported with that degree of firepower, mobility, counter-mobility, communication, aviation and logistic resources, which would pave the way for achievement of tactical and strategic goals with greater efficiency and minimal loss. Adequacy of contemporary engineering resources is an imperative for achievement of this condition.

The Concept of Interoperability

In the emerging dispensation in the field of military organisation, an element of 'interoperability' is manifesting itself, with the possibility of a task being accomplished by a number of alternate means. Thus, a piece of ground may be denied either by deployment of troops, or by means of heavy volume of precision fire, or by means of deterrent obstacles, or even by hazardous contamination.

The factor of interoperability would, thus, dictate the troops-to-task, and the balanced force structure. Formations would have to be grouped with varying combinations of arms, as dictated – besides the conventional factors of terrain, enemy, mission and tactics – by an additional factor, that is, the method of execution to be adopted. Larger commitment of combat engineers to enable passage of forces through unexpected terrain or unlikely directions – *a* favourite recourse of the Great Captains – to successfully tackle particular tactical situations is an example of this concept. Further, dynamic development of favourable operational situations by a field force through a system of flexible response has to be founded upon the element of high mobility – which is the traditional burden of combat engineers.

The Nuances of Application of the Concept of 'Simultaneity'

Simultaneous engagement of a number of echelons of enemy forces in attack or defence would involve variations in terms of operational timings and phases to avoid dissipation of effort. As the depth of engagement proceeds deeper into the enemy territory, the density of resistance would lessen and the targets encountered would turn softer, while the ranges at which engagements take place would expand. As a corollary, the 'friction of terrain' (to imply resistance imposed to forward movement) and the 'tension of logistics' (to imply retarding pull exerted from launch bases) would assume larger proportions as operations progress into deeper areas. Fielding heavier forces to tackle the hard crust of the enemy forces and the lighter and faster elements to manoeuvre and engage the depth echelons, while special forces are unleashed deep inside to create havoc at the vulnerable centres of gravity, would be the standard military practice in the modern era. The concept of simultaneity, thus, calls for a high degree of mobility, both in the ground and air, and this is another facet of combat engineering which needs to be appreciated in matters of tactical as well as logistic planning.

The Measure of the Predominant Arm

In the emerging dispensation in the field of military operations, predominance of an arm over another would be dictated by, besides the terrain and the enemy opposition, the method of execution. Fire assault, passage of purportedly impassable terrain, electronic attacks and exploitation of nuclear

strike are cases in point, when the degree of predominance may either temporarily shift to artillery, engineers, signals or nuclear forces, or may even remain indeterminate. The matter of predominance is further qualified by the concept of 'asymmetric response'. This concept calls for application of such 'antidotes' which would exploit the enemy's weak points – in offence as well as in defence. For example, at tactical levels, this concept could manifest in the form of taking advantage of armour's vulnerability to light infantry tank hunters by a conventionally weaker force, while at the operational level, it could be the exploitation of overwhelming electronic superiority by a modern force, and at the strategic level, it may be the imposition of logistic interdiction by the stronger or recourse to guerrilla warfare by the weaker among the adversaries. Thus, the modern concept of predominance of one arm over the other will itself need to be redefined in terms of the method of execution and the asymmetry of response. In either case, like the other arms, engineers have to be structured according to the operational doctrine adopted by the Army. The Viet-Cong strategy of infiltrating whole engineer battalions into Saigon to devastate the American military structure and, thus, bring about their inglorious downfall is a good example of engineer force-structuring within the overall ambit of an Army's strategic doctrine.

Scope of Mobility

In the modern dispensation, the concept of mobility of the field forces has already broken free of its moorings on the ground. Air mobility as well as mobility against the friction of terrain – marshes, water bodies, sand, snow and broken ground – today is intrinsic to the Army's operational as well as logistic requirements, and this fact needs to be formally recognised. Here again, engineers have to gear up for the role of facilitators of such multi-dimensional mobility by means of high response construction capabilities.

Rapid Deployment and Graduated Response

No Army today can maintain itself in a state of perpetual readiness for combat; the costs are too prohibitive. The course adopted, therefore, by even the most powerful nations, is to keep one part of the force in readiness for rapid deployment so as to stabilise any tactical situation and pave the way for the larger force to prepare and build up. Operations are, thus, initiated at the

appropriate time of own choosing while the time lag is filled up with politicking, sabre rattling and psychological warfare. Organisation and capabilities of combat as well as the line of communication engineers of the future, as part of the rapid deployment and the main force, as also to sustain the complex logistic system of the modern era, would be governed by this emerging trend.

The Role of Information Warfare

This is a field which is characterised by the vast extent of the role military engineers have to play in the conduct of modern warfare. No modern military plan can be executed and no modern weapon or military hardware can be effective without the benefits of high grade digital mapping and the Geo-Spatial Information System (GIS). These systems need the commitment of the best skills in military engineering over long years to devise, a fact not much realised within the fraternity.

Low Intensity Operations

A point to appreciate is that all the above listed fields of modernisation are also applicable in full measure in the case of counter-insurgency or low intensity operations. The basic parameters of surveillance, intelligence, communications, mobility, firepower, etc. do not change after all, even if a certain degree of variation in emphasis is necessary. The inability to activate these imperatives may have been the reason that this form of warfare has become more or less the sole burden of the infantry and an exercise in perpetuity. Better success rates can be achieved by exploiting the full benefits of focussed intelligence, surveillance grid, obstacle capability and air mobility, duly backed up by civic and political developments. The engineer organisation has to be adapted to each of these thrust areas accordingly, to be able to take up its enlarged role in tackling low intensity war.

Having, thus, examined the nuances of contemporary as well as futuristic concepts in the field of war-fighting at the global level, we may now venture to analyse what the future demands of us, the military engineers of the Indian Army.

Chapter 3: A Mandate for the Indian Sappers of 2020

What is necessary to be accomplished in the heat of action should constantly be practised in peace.

— Roman General Flavius Vegitus

Military Engineering Opportunities in the Indian Context

With an immensely diverse terrain and limitless military challenges borne out of political and social conflicts, the conditions in India provide for substantial scope and opportunities for the military engineer to contribute. Besides execution of terrain-intensive mega-projects for nation-building, which is beyond the scope of this paper, the sapper can play a very crucial role in securing the desired end-state of conflict termination with the least expenditure to the state or damage to the people. This is to be achieved by elevating the extent and quality of engineering support to the Indian armed forces.

In 1847, during the Mexican Campaign, the American forces under the command of General Winfield Scott, found themselves insufficiently equipped to capture Mexico City, which was protected first by extensive marshlands, and then a lava field which was reputed to be impassable by man or beast. Besides, the capital was defended by a Mexican Army three times as large. The engineers, led by Captain Lee (later General Lee of the Civil War fame), then developed an alignment through the marshes and thereafter cut a passage across the 'impassable' lava field, in seven days flat. Through this route, the Americans moved in to cut off the Mexicans, and strike them on three sides. The defenders broke and ran in minutes.

Let us explore how this may be so with us.

Ingredients of Engineering Support to the Indian Army in the Coming Era

In the context of the Indian Army, the concept of engineer support in war is sanctified by the role of the military engineer, which is worthy of a repeat, that

is, "to apply engineering knowledge, skill and resources to the furtherance of the commanders' plan". This all-encompassing definition takes military engineering – unlike the well delineated roles of other arms and services – beyond the bounds of routine confines, and involves undertaking of any range of unspecified and unique variety of tasks to support a war effort. This is a fundamental difference between the engineers and the other arms and implies that any war effort, which is not specifically covered within the roles of other arms or services, is to be the sapper's burden. As the Indian Army gears up for its impending role in the Himalayan mountains, the plains, the deserts and island territories as envisaged in the year 2020 and beyond, these considerations would dictate the future course of engineer organisations and capabilities.

As we all know, the essential ingredients of engineering support involve tasks to facilitate own mobility, denial of mobility to enemy forces and to enable own forces to survive the hostile environs of a battlefield. Activities associated with these ingredients are: firstly, rendition of engineering advice to each echelon of command; secondly, forward planning, from inception to the culminating point; and thirdly, timely execution of tasks as per the incidence. When carried out to perfection, good engineering support leads to such military advantages, the cumulative effects of which pave the way for achievement of operational and logistic flexibility by a force of combined arms and services, and, thus, contributes substantially towards the ultimate success. Important ingredients of good engineering support may thus be described as follows:

- **Emergence of *'Engineer Options' to* Tactical Problems:** The term, 'Engineer Option' implies that apart from the various tactical courses visualised by a commander, the doors to additional and more advantageous courses *are opened* to him by his engineer adviser. In effect, the engineer adviser applies engineering skill and knowledge to find additional avenues of approach or directions of attack in the case of offensive actions, or optimal utilisation of all military resources while undertaking defensive operations. Napoleon's extrication of his Army from the doomed situation during his retreat from Russia in December 1812 – in which he was trapped between the River Neisse and a swiftly advancing Cossack Army – by constructing a bridge on an unexpected site, is an example of an engineering solution to a

tactical problem. Montgomery's totally unexpected frontal attack followed by massive minefield breaching operations which paved the way for the armour to break out and cut the German defences into two during the Battle of Al Alamein is another example. The spark of our engineering ingenuity was in full evidence during the Bangladesh War too; that spark seems to have become dormant due to many reasons which we shall examine a little while later.

- **Achievement of *Operational and Strategic Surprise and Deception:*** Shaping or modifying the terrain to own advantage is the method by which this mandate is fulfilled. Surprise is achieved by adopting unlikely courses of action which is rendered possible by means of engineering the terrain so as to facilitate or hinder mobility, as the case may be, while deception is the fallout of 'engineering' false perceptions upon the enemy's leadership. The People's Liberation Army's (PLA's) super-fast track construction from Tawang to Se La and beyond in 1962 and the Indian Army's flooding of the Valtoha Gap on 8 September 1965 to counter the advance of Pakistan's 4 and 5 Armoured Brigades in the Khemkaran Sector are some good examples of this concept. Presently, however, the wherewithal available to the Corps of Engineers in terms of earth moving, demolition and bridging capability vis-a-vis the imperatives of the modern battlefield are so outdated as to be matter of concern and a critical issue for immediate redressal.
- **Ability to Articulate the Tempo of Operations to Upset the Enemy's Design of Battle:** The method to achieve this is by breaking or accelerating the movement of own as well as the enemy's battle formations in tune with the operational plans. In other words, it implies manipulative control over mobility and counter-mobility with the help of an in-built ability to negotiate through obstacles or interpose new obstacles. Rommel's see-saw manoeuvres, with the help of mine warfare and demolitions during the North African Campaign in 1941-42, in attack as well as withdrawal, especially the latter, provide many examples of application of combat engineering methods to control the tempo of battle to advantage. The organisational structure of our combat engineer units, in terms of both manpower and equipment, needs to be enabled for such capabilities in tune with the battlefields of the modern era.

- **Capability of Sustaining Forces in the Battlefield for Periods Longer than Anticipated by the Enemy:** In most areas where the Indian Army is obliged to operate, sustainability of stronger force-capabilities would be the deciding factor towards a successful tactical outcome. Connecting forward posts to the bases by means of tracks, helipads, air-landing grounds or ropeways, erecting shelters and field fortifications for the troops to live in, and fight the rough hostile weather or enemy fire, and overcoming lack of water are some of the engineering challenges to achieve this end. The Indian Army's escalated deployment in Ladakh in 1986 to forestall Chinese adventurism and its preemptive occupation of the Siachen Glacier are some examples of survivability dictating the tactical outcome. On the other hand, the most prominent cause of the British misadventure in Crimea in the 1850s – besides bad generalship – was a callous indifference of the General Staff towards creation of adequate facilities for the troops to live in, and fight. Even as we have easy access to the requisite engineering skills, stores and indigenous equipment to meet this end, there is a need to break free of our fixed ties to the system of ground-based transportation and proceed to explore the air dimension for efficient execution of engineering tasks in support of combat troops. In other words, the air transportation system needs to be promoted to gain surprise and maintain an operational as well as logistic upper hand. Creation of an extensive air transportation network, besides the conventional sustainability tasks in base as well as remote areas would, thus, be an added responsibility upon the sappers in the coming years.
- **Pivotal Role of Military Mapping and Geo-Spatial Information System:** As highlighted earlier, a high grade digital version of military-specific terrain mapping and development of an all pervasive Geo-Spatial Information System (GIS) duly customised for military use, are the basic requirements of effective operational planning and execution of military tasks in the contemporary era. More crucially, no modern weapon or equipment can be operated to its full potential, including the scope for precision targeting, unless the fundamental databanks in digital form are integrated into the weapon or equipment operating systems. The regime of Information Warfare (IW), therefore, remains completely subservient to the availability of a range of accurate digital military maps and databanks. This

is an added responsibility upon our military engineers. Only this arm has the requisite training and core competence – a judicious mix of tactical acumen and technological expertise – to find pragmatic methods of adjustments between the tactical commander's dreams and the technological possibilities. Engineers, are therefore, the best suited to build up, with due accuracy and regular updating, the military-specific cartographic databank through optimal exploitation of enabling technologies. Even though, traditionally, the Indian engineers have been pioneers in the field of military mapping and can boast of expertise which is enviable even by the standards of the most advanced Armies, the Indian Army is yet to indicate a degree of alacrity in exploiting this potential to cover the widening gap between the modern weapons and equipment it seeks to acquire – Unmanned Aerial Vehicles (UAV), electronic warfare and signal intelligence gadgetry, fire control systems for state-of-the-art guns and tanks, precision munitions, radars, missile guidance, etc. to name only a few – and the digital cartographic databanking to operate these effectively. It would take years to build up this fundamental input for the range of activities which are clubbed under the umbrella of IW systems; it took the US Army 15 years to get their basic GIS going. In the meantime, many pseudo and half-informed military as well as civilian agencies are trying their hand at this military engineer-specific expertise, with self-depredating results. The absence of any urgency shown by a military hierarchy, educated as they have been through the 'non-science' stream in our academies, to address this aspect needs to be loudly articulated by the Corps of Engineers. Else, it will be too late and too costly to bring about true modernisation in the Indian Army.

Features of Successful Engineering Support in the Indian Army

Engineers are ordained to alter the terrain to suit the conduct of own military operations, a mandate rendered extremely complex due to the widely varied configuration of the Indian landmass. Thus, even as the basic features of engineering support remain true for all types of terrain, the contextual characteristics of ground and weather, as these affect the operational plans, dictate the degree of emphasis to be laid on various aspects and methods of execution of military engineering tasks. The main features of the requisite degree of engineering support in this context are as enumerated below:

- **Engineer Intelligence:** Modern means of intelligence-gathering permit us to overcome the limitations of the past. Moreover, since operational and logistic infrastructures which are of interest to the military engineer take years to build up, a continuous vigil over the areas of interest would pay good dividends. There is, therefore, no justification for not having comprehensive and accurate engineering information on areas of our concern, so as to be able to correctly predict the enemy's offensive as well as defensive capabilities. This, however, is apparently one of our weakest links in engineering planning today, which needs to be addressed by incorporating dedicated engineering staff in the system of acquisition of military intelligence. As engineer vacancies in the Military Intelligence set-up have diminished over the years, more and more high sounding politico-military discourses by the 'generalists' are being churned out in the name of intelligence inputs, of which little is of relevance either to the field commander to help him conceive tactical options, or to enable the engineer commander to render meaningful advice to him. Besides, there is a strong case for upgrading the intelligence sections in engineer units to the contemporary levels of technology, including real-time connectivity to the intelligence and surveillance network in the sectors or theatres of operations. This is perhaps one aspect on which the Corps of Engineers themselves are yet to be adequately sensitised.
- **Engineering Advice:** The dictum of dovetailing engineering advice into the campaign plan from the very inception is even more crucial in the contemporary scenario. This is so because the equation among terrain, availability of axes for progressing operations, battlefield transparency, effects of precision targeting and the time-intensiveness of combat engineering tasks have a major bearing on mobility, counter-mobility and survivability of forces during the conduct of operations. As exemplified on numerous occasions in the past, including the Italian and North African Campaigns of World War II, the Chinese aggression of 1962 and even the recent Gulf War, a heightened operational tempo interspersed with carefully controlled tactical pauses and phasing of the campaign would be obligatory for any force to achieve the desired end state purely on account of military engineering considerations alone. Since operational reach cannot be allowed to outstrip the progress of track construction,

water supply, forward supply of fuel, etc, variation in tempo and phasing have to be planned in relation to the incidence of engineering tasks. These variations are to be dovetailed into the tactical as well as the overall strategic plan so that the initiative is not lost while the logistic echelons catch up. This kind of tactical practice was amply demonstrated by the Chinese in 1962 and the Americans in Iraq in 2003. More concerned and fully occupied with the day-to-day and static, attrition driven operations at the unit or even formation levels, the military hierarchy in India today seems to have become oblivious of the advantages of good engineering advice. This deviation needs to be removed if we want to be a modern military force.

- **Organisation of Engineer Force:** Military campaigns are seldom sustained by standing combat engineer organisations; deployment of quasi-military or even drafted civilian resources has always been a matter of rule. In our context, the BRO, MES, PWD and resources of the public as well as the private sector undertakings will have to be incorporated to play a substantial role in the sustenance of military operations in the forward operational bases as well as in the rear communication zones. Dependence on civil labour would also be necessary, and its attendant logistic implications must be catered for. Thus, would emerge the optimum combat engineering force-structure designed to tackle close as well as general support engineering tasks in the battle zone. At the same time, the quasi-military engineering agencies would have to be drafted into the strategic plans to undertake the rear-area engineering tasks, through invocation of the provisions of the Union War Book. This idea has been in contention at the apex level for some time, albeit informally.
- **Modernisation of Engineering Equipment:** Our adherence to a defensive strategy in the past and continued deployment in low intensity operational environments has stunted the development of combat engineering equipment, especially that of varieties which are designed to perform in the Indian subcontinental terrain. The earth-moving plant, blasting tools, construction plant, pumping sets, etc are either too cumbersome or wanting in output capacity to suit modern battle conditions. Therefore, on the one hand, execution of field engineering works need to be rendered equipment – rather than personnel –

intensive to achieve higher efficiency without accretion in manpower, while, on the other, the range and extent of engineering works have to be upgraded in tune with the demands of modern war or war-like operations. In other words, more effective combat engineer support is what the Army of tomorrow asks of us. For example, track construction task forces would have to be based on field platoons duly integrated with a larger complement of earth moving and construction plant and equipment rather than deploying the entire field companies with just one dozen or two and in such a manner that the overall output and speed of construction is increased. Similarly, the water supply teams must be rendered capable of meeting the higher requirements of the present-day Army within the acceptable timeframe, rather than just continuing with the woefully outdated arrangement of establishing the so-called 'brigade water point'. Another aspect of equipment management entails our recognition of the fact that different kinds of terrain require different designs of engineering equipment. For example, it is impractical to expect the mine breaching trawls to perform in all kinds of terrain; it is imperative to hold a mix of trawls, flails and explosive hoses to be able to breach mines under all conditions. The adaptation of the latest equipment to perform in the environs of the modern battlefield, therefore, calls for an urgent drive towards upgrading the combat engineering capabilities in the Indian Army, this being a prerequisite to the Army's drive towards overall modernisation and an imperative towards a concerted approach to solve the emerging challenges of the battlefield. A point to note is that most of the commitments towards such a modernisation drive are achievable indigenously and at a very small cost, in comparison with the other arms.

- **Time Required for Execution of Engineering Tasks:** Execution time, as far as the military engineer is concerned, is the cumulative duration of store-induction, deployment, construction or destruction and maintenance. Depending upon the configuration of terrain, secondary considerations such as availability of axes, location of transfer points, availability of transport, labour and equipment for load handling, weather and temperature, etc manifest in the form of additional factors to further affect the time plan for execution in a substantial manner. Meticulous

and realistic plans to include time for planning, build-up of stores and task forces and execution under war-like conditions, with in-built cushions at each link, therefore, should be a mandatory responsibility to see that the progress of operations, logistic build-up and execution of engineering tasks are mutually compatible. The tempo of operations being dependent upon logistic support, would, thus, relate to the incidence of execution of engineering tasks and the final outcome of the operation would be conditioned according to such a time-plan. Of late, an attitude of expediency appears to have emerged among the combat engineers wherein impractical execution timings are being quoted with enthusiasm and the well conceived planning figures questioned without due consideration of the factors discussed above or practical adaptation to war-like situations. Claims of impractical levels of efficiency in execution of engineering tasks are advanced, thus, even as the combat engineering resources remain either short or obsolescent. It is time we restored our military engineering pragmatism.

- **Mobility of Engineering Resources:** Mobility of the Engineer Task Force is synonymous with the logistic mobility of the entire force. We have already seen that the logistics of force-deployment would be the key factor in articulating the military postures in the coming years. As the Indian Army graduates from merely being a reactive force to a proactive initiator of politico-military measures to promote national interests within and outside the region – individually or as a partner in multinational initiatives – it is time to think of the intrinsic mobility of the Engineer Task Forces. Today, the provider of tactical and strategic mobility is itself less mobile as compared to the supported arms, simply because the focus is either on own land frontiers or just a few kilometres in depth across the battle lines. In the coming years, this fixation would have to change; successful battles would have to be fought over larger depths and frontages and across such terrain which may range from mountains to creeks and deserts to islands. To reach and then sustain forces across such a complex landmass would necessitate scaling of high mobility vehicles to the engineering units, duly supplemented with air mobile transportation – and in some sectors, even air-cushion vehicles – so as to ensure that the

highly mobile military operations of the coming era are accorded the corresponding degree of engineering support.

From the foregone analysis, it is clear that terrain remains the most important object of military engineering, while enhancement or containment of the friction of terrain to own advantage is the primary role of this arm. It would, therefore, be appropriate to delve into the nuances of 'terrain engineering'.

Chapter 4: Tactical Nuances of Terrain Engineering

God made terrain and permitted only the engineers to alter it.

Dictates of the Terrain in Appreciation of Combat Engineering Support

We have discussed in passing the varied nature of terrain that the military engineer has to contend with in his mandate to 'doctor' these in tune with the requirements of conducting successful military operations. However, comprehensive evaluation of the dictates of terrain, in so far as the commitments of the engineers are concerned, remains only marginally explored amongst us due to the reasons already highlighted. Today, the prime focus is on minor tactics and unit level actions. In the Indian Army, this situation is already on the mend for the better, and, therefore, the re-discovery of the sapper's tasks from obscurity would be necessary to tackle future challenges.

The issue of terrain imperatives in the context of modern warfare is vast and would require large fora for discussion. However, it would be worthwhile to highlight certain core issues in order to seek a sample road-map which could be the basis for taking up detailed operational and terrain specific analyses. The best method of identifying the imperatives of terrain as it affects the military engineer, is to carry out a 'case study' to arrive at 'sample deductions' as these apply to a particular terrain, which may then set the tune for all the other kinds of terrain variations. Towards this end, let us discuss the mountains that we engineers are destined to operate in. Other types of terrain – plains, desert, riverine, jungle and islands – could also be subject to scrutiny in a similar template.

Terrain Sampling: Case Study for the Mountains

Even within the classification of mountains, we have the mid-altitude, high-altitude and glaciated regions; the high-altitude regions are further differentiated into Northwestern Kashmir, Eastern Ladakh, and Central and

Northeastern Sectors. Each of these areas has unique characteristics, and, therefore, requires customised engineering support. For example:

- There are areas conducive to human inhabitation, the weather and climate being within the limits of human tolerance. These are generally well populated and the network of roads and tracks is correspondingly well developed. Military operations in these areas will have to be developed astride the valleys, with dominating features on flanks and shoulders targeted as the tactical objectives for attack or defence, while communication centres and townships at the hub of economic activity may be taken as the terminal objectives. Speed of advance, development of alternate avenues and attainment of surprise through unexpected execution timings would be the main object of engineering support in these areas.
- Then there are those areas which are characterised by sparsely populated, summer cultivated and seasonally green river valleys situated at altitudes between 2,500 to 3,000 m and surrounded by an endless extent of rugged peaks 4,000-5,000 m high, which are barren and snow-clad for a good part of the year. Narrow, deep valleys and rugged ridge lines tend to degrade the potential of artillery and air support, and the process of attack or defence would be extremely slow, exhausting and costly in terms of casualties. On the other hand, occupation of features in the depth to cut off the enemy from his logistic life-lines could induce him to abandon his positions or even surrender. Provision of logistic infrastructure for the troops executing such manoeuvres in defence or attack would be the main engineering challenge in this kind of terrain.
- In 1984, the Indo-Pak confrontation spilled over to the areas north of Point NJ 9842, thus, heralding a unique form of warfare. The Siachen Glacier is a combination of very high-altitude, extreme cold and deep snow – a terrain which had never been considered for engagement in warfare. National concerns and sovereign pride, however, necessitate tactical occupation of this glacier and, consequently, a permanently confrontational situation prevails. Deployment as well as conduct of defensive and offensive operations in such conditions has over the years, evolved into a new branch of military art and science. Deployment on the Actual Ground Position Line (AGPL) is in the form of a large number of forward posts, the governing factors being the scope for tactical domination and logistic capability to

sustain the troop strength. Operations in this area would basically involve stealthy approach of small bodies of highly acclimatised troops to destroy selected enemy posts in close quarter battles, followed by occupation of these so as to alter the AGPL in own favour. It is a tall order, requiring the extremes in terms of human effort as well as logistic sustenance, the latter being purely dictated by the military engineering capabilities.

Characteristics and Effects of Terrain

Taking a step further, let us see how the characteristics of the mountainous regions would dictate the nuances of engineering support in the coming years; the characteristics of other types of terrain could also be articulated along similar lines.

Altitude, Climate and Weather

These attributes dictate the logistics of troop deployment and execution time of field engineering tasks in support of tactical operations. *Inter alia*, these attributes would dictate the pace and tempo of operations.

Surface Communications

The most crucial engineering task in this context would be the development and construction of all weather roads astride the valleys and fair weather tracks up to the dominating features. Maintenance of heavily used axes, construction of additional by-pass loops, passing places, alternate routes, bridges, and heavy duty earth work to prepare deployment areas, load transfer points and convey grounds would assume high priority in order to sustain operations.

Air Communications

The limitations of surface communication, on the one hand, and the need for simultaneity in operations, on the other, make it imperative to exploit air-dimensional capabilities in future wars. These would be in the form of air-drop, air-landing or heliborne operations, and would involve construction of a large number of dropping zones, landing grounds, helipads, and even full-fledged 'air-heads' at the terminals of 'air-bridges' for conduct of sustained operations well across the battle lines.

Obstacles

These affect military operations in various ways, as follows.

Tactical Operations

Fast flowing mountain streams, deep ravines and steep slopes would have to be exploited in defence or attack to achieve surprise. Similarly, artificial obstacles laid in conjunction with natural ones would have either to be created or negotiated, as the case may be, by dedicated groupings of engineers even down to the sub-unit level.

Tactical Movement

Artificial obstacles in axial form would be devised in the form of road denials by means of cratering, demolition of bridges and triggering of land slides. Mines would deny access to bottlenecks, crossing places, bridge sites and likely deployment areas. Dedicated engineering effort in terms of manpower and equipment would, therefore, need to be deployed in close support to ensure that the battle plans, defensive or offensive, are sustained.

Anti-Landing Obstacles

Suitable landing areas being limited and well defined, obstacles to prevent air or heli-landing of forces and air supply would become relevant. Conversely, intended sites of airfields and helipads would have to be cleared before these can be activated for use.

Defence Works and Field Fortifications

The mountainous terrain affords additional strength to field defences due to the combined effects of robust construction, defiladed protection, and limitations on approaches and reduced effects of artillery fire. In attack, therefore, destruction of defences would require deployment of assault teams as well as employment of suitable direct firing weapons, such as tandem warhead missiles and Air Defence (AD) weapons in the ground role. While engineers would be required to be grouped with assault echelons for the first requirement, construction of temporary tracks or helipads would have to be resorted to in the latter case. In defence, *near-real time* construction

of modern field defences in tune with the tempo of operations and denial of approaches to them would be major engineering tasks. Base areas consisting of ammunition dumps and other rear services which are sited astride roads and tracks would be soft targets for artillery and air bombardment. This fact will dictate preparation of secured deployment areas for the follow-up echelons and construction of protective works for logistic installations.

Local Resources

Availability or otherwise of the local resources would have to be assimilated into modern field engineering designs so to exert higher influence upon siting and construction of defensive works and logistic installations of the modern era. Water supply teams would have to graduate beyond the obsolescent concept of the 'brigade water points' and low-technology pumping sets to modern multiple-stage water supply schemes to support troops even on the higher reaches, and, thus, provide tactical flexibility to the force commander. Similarly, the scope of electricity supply in the field would need to modernised either through higher captive generation or execution of ready-to-install micro projects.

Camouflage, Concealment and Deception

Battlefield transparency and precision targeting of modern wars, on the one hand, and the need to protect high cost military hardware from annihilation, on the other, have enhanced the importance of these measures. Modern technology provides for ample opportunities in these fields by way of suppressing or misleading the target signatures and, thus, influences the outcome in a most favourable manner. The Corps of Engineers must tap these emerging opportunities before we miss the bus; it would be a complex mandate in any case: given the limited appreciation of the advantages and the additional fiscal commitment that the military leadership has to contend with, even this would be only a short-term burden.

C3I: The terrain dictates the scope of exploitation of surveillance, electronic warfare, communication and target acquisition devices. Effects of screening due to ground configuration and foliage will be more pronounced on the attacker who will be obliged to establish temporary 'Command, Control, Communication, Information (C3I) Nodes' and leap-frog these in step with the progress of operations. The attacker's problems can be overcome to

a considerable extent through correct siting of these nodes, for which site preparation and track construction may be necessary. In defence, such nodes would be good demolition targets while electronically defiladed positions would have to be devised through a combination of construction, camouflage and artificial screens. This is a new concept which needs to be developed by the military engineer to cope with the emerging requirements.

Time Factor

Terrain imposes time penalties on engineering works in terms of movement time, transfer of loads and dumping of stores at site. Tedious lines of communication for the supply of engineering stores in our context necessitate meticulous planning and strict adherence to time schedules. Timings during inclement weather may yet go completely off the mark, leading to the undesirable situation of assault echelons being separated from supporting elements. Telescoping various timings and engagement in simultaneous activities to avoid such a separation may have to be resorted to. For example, track construction does not need to await completion of a particular phase of the operation, and multi-point construction may have to be adopted through air induction.

Campaigning Season

The concept of conducting operations at all times of the year under even the harshest conditions with the help of modern kits for survival would have to be thought of in order to achieve surprise. Consequently, battle formations would have to be committed for long periods and remain so deployed even after the objectives have been secured. Field engineering works must, therefore, cater for the capability to sustain troops over long campaigning periods. Conditions which were considered to be 'inhabitable' heretofore, would have to be rendered somewhat 'hospitable' by means of modern means of military engineering. Siachen is an example.

Low Intensity Operations: It will be seen in closer scrutiny that with due adaptations for the peculiarities of this form of warfare, the fundamental concepts and practices discussed above remain as true in the case of low intensity war and aid-to-civil authority, as it is for conventional – or even Nuclear, Biological, Chemical (NBC) – warfare in the contemporary era.

Aspects of Terrain Engineering in the Coming Era

The foregoing discussion on terrain versus operational interface in the 'mountainous template' leads to the following inferences as related to planning and execution of engineering tasks in future operations :

- Effective engineering support for conduct of military operations should be possible *most times of the year*. Capability to provide all weather logistic back-up, including storage facilities, special clothing, advanced medical facilities, reliable surface and air communications, designer shelters, sourcing for water, etc would assume the highest importance.
- A quantum increase in the construction of mule tracks and class 3, 5, and 9 fair weather *tracks will be the most important commitment* for the sappers, to be undertaken on the heels of the assaulting echelons. A substantial network of ancillary track-work would also be required for temporary siting of direct and indirect firing support weapons, surveillance and target acquisition devices, electronic warfare centres, and command and communication nodes, and the subsequent leap-frogging of these in tune with the progress of operations.
- *Speedy development of axes* would involve extending the road-heads and creation of the associated network of bypasses, alternate routes, transfer points, convoy areas, etc by the engineers. Subsequently, the class 9 axes would have to be improved to all weather specifications. Except in certain areas, there would be no local resources to depend upon. These tasks would, therefore, be time-critical from the logistic angle.
- *Construction of air-heads* in the form of advanced landing grounds and a large number of helipads would be a priority task for the engineers to help the forces sustain the momentum of *simultaneous deep strike operations*.
- *Lighter engineer elements* will have to grouped with various battle groups to ensure efficient conduct of *obstacle warfare* – mine fields, anti-heli-landing devices, exploitation of natural streams and areas of difficult going, to name a few – as well as creation or destruction of field fortifications. Similarly, follow-up echelons must be grouped with *heavier engineering resources* to tackle tasks associated with development or denial of axes such as bridges, roads, tracks and deployment areas within the acceptable tactical timeframe.

- The scope for camouflage and concealment from the air or from vantage points would vary according to the terrain. Apart from what is defiladed due to the configuration of broken ground, judicious siting, use of multi-texture camouflage equipment and construction of protective screens would be necessary to cater for the enhanced effects of the adversary's precision fire.
- Higher scale of earthwork on deployment areas, gun areas and administrative areas for a modern Army would be necessary to ensure that forces are balanced in disposition. *Siting and construction of defence works* such as protected weapon emplacements, ammunition points, field hospitals and execution of survivability tasks for living, water supply and power back-up, to cater for a long campaign period, would involve employment of additional engineering troops, state-of-the-art shelters as well as heavy construction plant and machinery in the third echelon.
- Portable and high capacity water supply *equipment* to cater for gravity feed as well as pumped water points will be required to support various echelons of the force which would be deployed at difficult and isolated locations in defence or attack.
- The engineering support plan must also cater for the *tedious lines of* supply of stores and slow rate of execution of tasks on account of reduced efficiency in man and machine. It should also cater for long periods of the campaign.

Having, thus, examined the various aspects of the military engineering interface in relation to the conduct of operations in a template of mountainous terrain, we can similarly infer the requirements which may confront the military engineer in the future in various other kinds of terrain. It is time, therefore, to move on to the concluding part of this discussion, that is, to examine as to what would be the parameters for organising an engineer force that would not only provide effective support to the Indian Army of the future, but also play a pivotal role in opening up new vistas for development of indigenous tactical, strategic and logistic concepts and practices.

Chapter 5: Organisation for Effective Combat Engineering Support

Organisations created to fight the last war better are not going to win the next.

— General James M Gavin

Genesis of Revolution in Combat Engineering

Armies today are maintained to prevent rather than wage war, and should war still be inevitable, to win it with least pain and suffering. Thus, we have the concept of *'Peace Dividend'* – that is, the fallout of being militarily prepared. In the preceding part of the paper, we have seen how the military hierarchy in independent India has been defensive in outlook – a legacy of Nehruvian idealism – and compulsively committed to the 'attrition theory', an attitude no doubt imposed upon us due to limited access to military technology, political restraints and fiscal confines. We had let the world know that we were happy just guarding our borders and that no one need fear our retribution. Our Army too, therefore, reflected a similar outlook – in organisation as well as in concepts – and had to seek tactical advantages in numerical terms only after matters had nearly gone out of hand. Obviously, the Indian Corps of Engineers was but a reflection of the Army it is meant to support. And so our neighbours had taken us for granted; one of them had even been emboldened enough to ignore our military superiority and impose a proxy war upon us with immunity.

As India breaks into the global big league, all this would have to change; Kautilya's and Machiavelli's concepts would be rediscovered by its polity. As the mindset of counting the numbers of personnel, tanks and guns is overcome, the military planners would propagate that within the ceiling limits of the sustainable numbers of tanks, guns and other hi-tech military hardware – which are cost-intensive and import-dependent, and, hence, conditional – wider options of tactical, operational and strategic measures

are possible, if the strengths of our indigenous engineering are allowed to blossom. With a highly competent and large base for construction engineering materials, engineering plants, equipment, engineering skills, vast labour force and potential for logistic wherewithal ready to be tapped, it would be preferable to deploy and redeploy each force-element from one battle area to another in quick succession so as to manoeuvre the opponent into hopeless situations and, thus, achieve the strategic aims at lower costs in terms of death, destruction or fiscal burden. To illustrate, we can sustain only fixed numbers of tanks, guns or even infantry units within our technological, industrial and fiscal capacity, and so derive only a specified level of tactical payoffs. Should it be possible for the Army to exploit the abundance of our inherent capabilities in surface, sea or air transportation and indigenous habitat engineering industry and 'engineer' *dual-use logistic infrastructure* at various operational areas, the same force levels can be built up unexpectedly, moved across 'ímpassable' terrain, sustained at uninhabitable locations, deployed and redeployed in unthinkably quick time, and poised to strike where it hurts the enemy most – repeatedly and in quick succession. In other words, elaborate logistic infrastructure and lines of communication created by making use of the ready indigenous engineering capability in peace-time and by upgrading the scope of combat engineering support during operations would by itself emerge as another force multiplier. Another aspect of force multiplication through 'engineering' is by means of building up effective capabilities in terms of *camouflage,* concealment and deception*;* every real body of troops and piece of real equipment protected or falsely projected to counter precision strike would add to the force level. An additional highlight of such practices is that it would promote native industry and reinforce the local economy. This is also the classical concept of exploiting one's indigenous strengths to pose a situation of asymmetry upon the adversary, thereby, forcing him to fight on own terms. This is what the proactive Armies have attempted to achieve through the ages – the Carpathians, Greeks, French, Germans, Americans, Vietnamese, et al – and so do the modern Armies plan to achieve when necessary, with the military engineers playing an appropriately expansive role in peace and war. One can only imagine the concerns an adversary would develop when he knows that the powerful battle-groups of the Indian Army can be built up in quick time at any location of tactical choice, remain well

protected against counter-action, depict false build-up elsewhere, exercise tactical mobility and counter-mobility of a high order within the battle area and be sustained in that manner across even very difficult terrain for long periods.

The Indian Army's Corps of Engineers must, therefore, not only prepare for an extended mandate in the future, but to be true to the profession, it must also assume the mantle of a catalyst, or even a motivator and facilitator, in bringing about the due changes towards conceptual modernisation of the Army in its own way, just as the other arms and services too should. The advantages of exploiting engineering solutions to military problems needs to be articulated by thought and practice – just the JC-Course-type parroting of "engineer tasks" would not do anymore.

Progression and modernisation of the Indian Army require each arm or service to do their bit commensurate to their role in the overall scheme. Let us then see as to what would be our destination as an arm of the modern Indian Army. The purpose is not to list out what we should have – that can be worked out well if the destination is known – but to identify which direction we should head for.

The Fundamental Concept

The most important condition for war-fighting in the contemporary era – *that no element of combat is* restrained due to lack of support from another – needs a hard look in our context. The organisational structure that is required to enable preparation of the battlefield and application of force in the correct manner needs to be taken note of, in order that the four pillars of modern warfare – viz surveillance, communications, mobility and logistics (note that two of these four are engineer-specific) – are adequate to sustain optimum deployment of our entire fighting force. There is no use having sharp 'teeth' if the 'jaw' is weak and the 'tail' is too short to balance the body poised in action. Unless the force structure is 'balanced in composition', the 'teeth' element of an Army – infantry and mechanised forces – would suffer a very large *'unusability factor'*, wherein the full weight of the 'bite' cannot be brought to bear due to inadequate strength of the 'jaw' – the supporting arm. Similarly, unless the 'tail' element – the logistic capability – is adequately built up, neither is 'balance in disposition' achievable, nor can the

momentum of operations be sustained in order to optimally employ all the deployable fighting echelons as well as the controlling headquarters. As a corollary, the commanders would have little option of manoeuvre and would have no choice but to bank upon brute force to defeat the enemy through attrition alone, sacrificing infantrymen and tanks to ' buy' pyrrhic victory – one which could turn out to be as costly as defeat. In fact, in the present context, heavy losses would not be acceptable to the nation. As the reader would appreciate, there has to be a more cost-effective manner of building up an Army. True modernisation would, therefore, also imply balancing up the support and logistic capabilities – fire support, engineering capability, Command, Control, Communication, Computers, Information, Intelligence (C4I2), transport units, base facilities, and so on – within the overall structure of the modernised Army.

The second most important consideration in organisational structuring is the need for graduation to higher expertise. As the standards of human understanding expand and expertise flows downwards, organisations must discard the routine and the mundane, and graduate to higher levels of skills and complexity of performance. If this is not ensured, an organisation would be doomed to oblivion. For example, over the years, the state of expertise required for the present practices of mine laying, bridging, construction of tracks and make-shift shelters, operation of generators and pumps for rudimentary electrification and water supply – most of the traditional field engineering tasks, in fact – are no longer exclusive to the engineers alone; just as with a better level of training and awareness, patrolling, driving, field communications or even basic medication and tank operations are no longer the exclusive preserve of the traditional mother arms and services. The theory of progression of healthy organisations, therefore, indicates that there must be a gradual shift to higher levels of expertise, and, at the same time, opening up of new vistas for expansion and diversification. The signalmen and the gunners are alive to this need, so is the BRO and, to some extent, the MES. A similar thrust must be made and pursued vigourously in the field of combat engineering too. For example, the corps should be thinking of restructuring rather than disbanding the unique facility of the Engineer Stores Depots and find new roles for this strategic asset. In the coming years, if the corps keeps on the right track of modernisation, management of a large range and volume

of theatre specific stores and equipment of engineering, operational works, and import and trade origin would pose serious challenges. The burden of managing and maintaining these would be beyond the roles and priorities of the Corps of EME or the Ordnance, and here the Engineer Stores Depots would come in to play a vital role. The degree of such commitments would multiply as India graduates to the regional power-equation and then on to the global arena under the backdrop of an emerging politico-strategic dispensation, in league with players as diverse as the Americans, the Chinese, the UN, the European Union, to name only a few.

Testing the regime under which the Corps of Engineers in the Indian Army is to function, it would be revealed that there are ominous signs which indicate a loud warning. Two of the four modern pillars of modern warfare – mobility and logistics – being engineer-centric, there is little option but to modernise the military engineering organisations. It is, therefore, an imperative for the corps to articulate the emerging picture, and for the General Staff to recognise the writing on the wall. On the other hand, the full burden of finding the means to seek modernisation, and progression to higher expertise in combat engineering rests upon us engineers; it is an 'in-house' issue. As most field engineering tasks of dated technology and limited scope are taken over by the supported arms, graduation to higher levels of military engineering skills becomes a natural corollary for the corps, if we are to retain our status within the Army as well as in nation-building. By implication, this condition dictates that we equip ourselves with more efficient means of executing traditional as well as newly acquired engineering tasks, be it mine laying, bridging, track construction, electricity and water supply, habitat and survivability tasks, camouflage and deception or digital mapping of the required accuracy and creation of an terrain database of the necessary range and depth. At the national level, the corps has to assume the role of provider of a digital terrain database, an agency for coordinating strategic projects in the shape of waterways, canals roads, disaster management schemes, construction in remote areas, sea-water conversion, and so on. We already have the example of the Corps of Signals that has donned the mantle in the field of Information Technology (IT) and the Army Medical Corps which is emerging in the field of state sponsored medical programmes.

Conceptualisation and implementation of modernisation programmes require time. We need to start now; else we will become a rock suspended from the neck of the Indian Army. A new breed of infantrymen, tankmen and gunners would emerge while we would be hard put to find compatible bridges, roads and GIS to meet their requirements. Being trapped in a race to catch up – with what is required of us and what we are actually capable of delivering – is not a desirable situation for an engineer who, by definition, is destined to be always in control.

Methods of Force Organisation for the Future War and Peace

The principles of military organisation handed down over the centuries dictate that for the optimum efficiency in management of war, military formations or units should be self-contained for routine employment (Standard Composition), while additional resources are 'grouped' for specific tasks (Task Specific Composition) on an as required basis. Over the past six decades, after World War II, due to new technical and tactical developments, there has been some dilution in observance of this principle. Today, engineering units are no longer so balanced in composition as to be capable of fully sustaining the supported formations in all their routine operational or logistic commitments, unless uneconomical and inefficient recourse to ad hoc arrangements are adopted, be it in terms of firepower, mobility, reconnaissance or transportation. On the other hand, it is neither cost-effective nor necessary to build up each engineer unit to cater for all eventualities given the advanced state of communication and transportation that can be exploited to attach or detach resources in quick time, and, thus, achieve force-multiplication effects. There is, therefore, a case for a review of the existing organisations at tactical (unit, brigade and divisional formations), operational (corps) and strategic (theatre Army) levels to arrive at the right mix of integral as well as centralised engineering resources which would allow us to meet our operational commitments more efficiently and, at the same time, contribute to the engineering needs at the national level during the long years of peace that may prevail. Accordingly, an in-depth review may have to be undertaken along the lines articulated below.

Standard Force Composition

As stated, while a standard engineer force composition for various field formations is already in place in our Army, this needs to be reassessed and reconstructed based on our own contemporary as well as futuristic operational requirements. This step will have to be devised after taking into account the factors of 'simultaneity' and 'interoperability' as relevant in our context, because these would dictate the balanced composition and equipment profiling in the manner discussed above. Articulation of policies in respect of placing added reliance on mechanisation rather than personnel strength, recourse to effective water supply, demolitions, booby trapping, alarm devices and obstacle schemes to provide relief to permanently deployed troops and optimum utilisation of resources by means of better tactical mobility, strategic transportation and signal communications are a few examples which would guide us in profiling the War Establishment of the engineer units of the future. The imperative, therefore, is to modernise our combat engineer units in step with the overall scheme of the Army's modernisation. What is more important is that these initiatives must emerge from within the corps, rather than being driven by a chorus of inescapable demands from the supported arms. As modern tanks, guns, electronic warfare equipment and infantry weapons are acquired, the corresponding engineering back-up – bridges, roads, digital topographical data, GIS, obstacle systems, alarm systems, habitat stores and equipment and engineer intelligence – have to be *ab initio* articulated by the engineers at the planning stage itself. This would help the Army in two ways: first, engineering input to overall decision-making would be available, thus, improving the quality of planning, and second, full tactical exploitation of new acquisitions by the field formations would not have to wait till the engineering deficiencies are filled up by trial and error over a long period. Acquisition of modern artillery systems, remotely piloted vehicles, electronic warfare capabilities, surveillance systems, state-of-the-art armour, etc. are cases in point wherein the corresponding engineering infrastructure for full exploitation of these has to come up – before these are inducted. The imperatives, therefore, are:

- Comprehensive efforts to modernise the War Establishments, War Establishment Tables and the related Schedules and Lists, in terms of categories, design features and models, need to be made in a more

institutionalised manner. Engineering stores and equipment scaled to engineer units today are considered for upgradation to the contemporary levels only when these become so obsolete that the industry is no longer able to manufacture them, or the troops get shy of using them. Our pumping sets, compressors, machine lorries and even carpenter tools are cases in point in which the corps remains thirty years behind the low cost, high-tech and indigenously available replacements. Efforts to remove such anomalies would be a milestone towards modernisation of engineering support.

- Introduction of modern features in combat engineering support by way of acquisition of modern engineering tools, plant and equipment is now a compulsion. Higher track construction, bridging, obstacles, water supply, material handling, camouflage, deception, habitat and transportation capability in terms of the *extent* of support as well as the timeframe in which these may be executed under operational conditions would play a catalytic role in the development of the Army's futuristic doctrines for war and peace.
- Finally, the enhancement in combat engineering capabilities must conform to the current ceiling on manpower. *Inter alia*, it implies that the thrust of execution of combat engineering tasks must shift from strength of personnel in units to execution by mechanised means. This would effect savings in manpower which could then be utilised for new raisings against the voids in the engineer force structure. For example, the basic task force for operational track construction should be revised to a field platoon with higher mechanised capability rather than the field company.

The point to note here is that for this effort to succeed, in most cases, the engineers have to find their own answers to the problems of engineering support rather being entirely dependent upon equipment which the supported arms can afford to release or discard – armoured vehicle chasses for bridge systems, for instance – or a design the Defence Research and Development Organisation (DRDO) may stumble upon. Many such answers were, indeed, found, and improvised equipment developed by the unit commanders during the recent Operation Parakram; the idea needs to

be further nurtured. There may even be a case for establishing a cell to organise in-house combat engineering development programmes, say, at the College of Military Engineering. When this effort succeeds, a revolution in engineering support would result. That should be our aim.

Mission Specific Force Organisation

Since each operational and tactical situation would invariably be unique, there would be a need to regroup the forces for each specific operation, so as to achieve balance in composition as well as in disposition. Requirements of engineer units for execution of specific tasks – over and above their integral resources – would have to be attached for specific periods and then quickly redeployed at the next point of criticality. This would be necessary for achievement of force-multiplication effect and 'surprise manoeuvre' within the framework of battle time and space. In some cases, when the requirement is predicable, these could be formalised in the form of formal operational orders to foster affiliation and cohesion. In other cases, operational balance in composition would necessitate attachment of troops or equipment or release of stores from centralised resources on a case-to-case basis. The engineering resources which would fall under this category would range from heavy earth moving, water supply, bridging and construction plant and equipment, to pre-fabricated shelters and voluminous construction materials, which would be maintained as sector or theatre stocks. To achieve the requisite degree of flexibility in this context, it would be imperative that an integrated system of reconnaissance, communication and inter as well as intra-theatre mobility is also put in place. Deciding about the architecture of such a system would pose a major challenge to the engineer leadership; but it would be worth the effort, so vast are the possibilities. It is, therefore, a major commitment on the part of the engineers to consider the following:

- Expansion of the scope of theatre reserves of stores, plant and engineering equipment in tune with the futuristic requirements, and based on the imperatives of terrain and tactical alternatives.
- Elevation of the engineering capabilities within the theatre to that level which would encourage the emergence of new tactical options for the field commanders *to* exploit. Higher road construction and water supply capabilities are some relevant examples of such an initiative; ability to

undertake civic action programmes in insurgency areas is another appropriate example. That these initiatives are low in cost and available in abundance indigenously, adds to the desirability.

- Institution of a higher level of mechanisation would also entail greater dependency on in-house or integral organisation for management of 'engineer stores and equipment of engineer origin', as was the practice during the War years; it would be impractical to expect EME or Ordnance to do our bidding. It is here that the relevance of the Engineer Stores Depots, suitably reorganised, comes to the fore.

Strategic Force Organisation

In providing engineering support to a modern Army on territorial, regional or global deployment, the emerging dispensation calls for an integrated system of engineering reconnaissance and an elaborate logistic platform to include transportation of material, chain of supply and warehousing of high tonnages of war material. This is so because engineering resources, when integrated across the entire theatre of operations, would enable our commanders and staff to opt for unorthodox deployment, and, thus, engage hostile forces with an element of strategic surprise. The imperatives to translate such opportunities into remunerative actions on the ground would be the capabilities of mass transportation and efficient supply of stores. We have already discussed that in the contemporary situation, it would be most advantageous to have broader logistic options to deploy, sustain and redeploy the force elements. In other words, when the logistics of transportation and supply are well placed, switching and sustaining of forces is rendered feasible and, thus, the operational capabilities of smaller forces are multiplied. The Chinese advance to the foothills in the northeast during 1962, our vertical envelopment to hasten the fall of Dhaka in 1971 and forestalling Pakistan in Siachen in 1984 are but a few examples of this military dictum, in which small forces, backed up with elaborate logistic support, achieved extraordinary results. In our context, as pointed out earlier, creation of an elaborate logistic infrastructure is well within the indigenous capabilities, while mass manufacture of hi-tech military equipment is yet far away. It, therefore, makes sense to exploit our inherent engineering strengths and build up

our strategic logistic capabilities and so be able to deploy our limited 'teeth' forces – armour, artillery, surveillance and reconnaissance (e.g. Unmanned Aerial Vehicles—UAVs), electronic, and, to some extent, even the infantry elements – and to shift these from one thrust line to another to effectively tackle successive targets in quick time. Issues to be reckoned with in this context could be as follows:

- Reraising of 'Army Engineer Regiments', suitably equipped with heavy construction plant and machinery to undertake large scale construction of logistic bases and transportation chains in the communication zones could be considered. This could either be organised by reconverting and reorganising the Border Road Task Forces or by means of raising Territorial Army units. These units may then be suitably employed in peace-time on gigantic national programmes such as the river linking and highway construction projects, as also to help MES clear the heavy backlog of defence construction schemes.
- Incorporation of earth moving, transportation and construction assets held by the public as well as the private sector into the defence plans. Presently, this aspect is dependent upon local arrangements and mutual understanding, and needs to be institutionalised at the apex level.
- Institution of a well organised engineer element as a component of the nuclear forces, to include capabilities in terms of nuclear-hardened shelters, camouflage and deception schemes, nuclear demolitions and disaster management.
- Even as intelligence is considered to be a part of General Staff functions, over the years, there has occurred a marked void in the quality of engineer intelligence. In modern as well as futuristic combat, the synergy of successful operations would depend upon competent engineer intelligence, including extensive topographic data and GIS. Organisation of an effective system of intelligence collection, collation, inferencing and dissemination in near-rear time would, therefore, be one of the major challenges for the Corps of Engineers in the coming years. Next, the process of regulating the volume of intelligence inputs in tune with the necessity and desirability at various levels of task forces, as well as the ability of assimilation and reaction at these levels, would also need to be worked out in great detail. Furthermore, the resultant system would have

to be dovetailed into the automated data processing and communication grid. These aspects must, therefore, form intrinsic parts of the strategic force structure of the military engineers in the coming years.

Organisation for Counter-Insurgency

In the coming years, 'low intensity wars' – counter-insurgency and counter-terrorism – would crystallise into integral components of national security. It is time, therefore, that this kind of operation is recognised as a bona fide mandate for the Army, and this commitment is seen as a new addition to the family of our traditional 'operations of war'. To that extent, the foregoing analyses must cover the engineering commitments in relation to the low intensity operations, so that the engineer force structure remains 'balanced' even under the conditions of these deployments, and the benefits of good engineer support transcends beyond the confines of external and overt conflicts. For these conditions to be met, it is an imperative that the process of engineer force structuring takes this new role into account. Contrary to the apprehensions regarding the viability of co-relating the 'conventional' and the 'little wars', it is increasingly apparent the world over today that such a connectivity is feasible, indeed, unavoidable. A marginal expansion in the scope of engineering support – confined to additional or customised design features in military engineering hardware and a broader objective in training – would suffice to take care of this additional role. The basic features of combat engineering – viz leadership and ingenuous skills in the backdrop of the idea of 'Sarvatra' – would, and must, remain effective in any case. Thus, the corps would be able to perform in conformity to the expectations of the Army.

The Course Ahead

Due to the considerations as highlighted in the paper, it would be most appropriate to lay out an institutionalised line of thinking towards development of a balanced force structure in the Indian Army, conforming to its strategic as well as tactical mandate, in which there are neither redundancies, nor constraints. The engineer component of such a balanced force could be articulated in the form of a set of guidelines or a conceptual framework which will enable the policy-makers and planners to reorganise engineering

units, update the equipment profile, assimilate new technical capabilities and redesignate the engineering tasks in mutual concert. With modernisation already on the Army's agenda, formalisation of such guidelines may already be at hand; additional emphasis on this account would be most relevant. Further, in order to render these guidelines meaningful, they could be based on likely operational situations in our context and validated through war-gaming at corps and field Army levels. Following such in-depth examination, the broad parameters for tasking and composition of engineer forces at standard, mission specific and strategic levels would get crystallised. These inferences may then form the basis for modernisation of military engineering organisations as well as development of new possibilities and options, tactical as well as strategic, for a modern version of efficient all-arms operations in the Indian Army.

Acknowledgements

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