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HIGH TECHNOLOGICAL & INNOVATIVE DEVELOPMENTS IN INDIAN SCENARIO

BRIG (DR) R C PATHAK

Professor,
JSPM's Group of Institutes, Wagholi, Pune.

PRABHA SHARMA

Asst. Professor,
JSPM's Kautilya Institute of Management & Research,
Wagholi, Pune.

ABSTRACT

Organisations of modern era are passing through fiercely competitive battlefield scenario. Decidedly, the compelling vision, bold leadership and technological core competence, puts the corporations at the higher echelons of the global arena. High technology has become a prime mover, driving force as well as a 'force-multiplier', behind the growth and prosperity of a nation. A country, which masters technological innovations, thus derives competitive advantages and respect.

Globally competitive and enlightened society, today, is standing at the threshold of a new age – the 'age of new economies' and the 'age of revolution'. Change has changed. No longer it is additive or linear – rather it has become 'abrupt', 'discontinuous', challenging and more 'non-linear'. Emergence of knowledge society and convergence of breakthrough technologies, and its further sustenance has come to stay. Technologically, one has to rethink or perish. In this 21st Millennium, competition has become fiercer.

Today, using the talent of the knowledge workers has become more important and further retention of talent, unleashing the brain power and strategic execution of the projects have become more significant important than the earlier times. High technologies impart an upshot towards achieving the competitive advantage, to any nation. As per the great vision of Dr APJ Abdul Kalam- past President of India – the nation should be self- reliant, self – dependent in critical technologies and envision INDIA to look ahead as among Developed Nation around 2025.

In this regards, as per Dr. Kalam's view some real visionary and renaissance leaders are required, who can motivate the masses into a cohesive team for bringing the Nation into international top reckoning country in the technological race. In fact the technological developments can only bring pride to the nation and in reality transform the society positively.

The product-strategists should continuously define, re-define and reinvent the competitive rules, challenging the status quo. The strategists should also find order out of chaos, disorder and certainty out of uncertainty. The high- technology products cannot be static – it has to be brutally dynamic. Also, one has to change in response to external changes – otherwise one becomes gradually irrelevant and finally

unproductive. Product strategy is like a road map and road map is useful only when you know where you are, where to go and in what direction. Core competence of an organization is vital in this regard.

In the present paper, the case studies of Missile programme, Light Combat Aircraft (LCA), Delhi & Calcutta Metro and Bandra Worli Sea Link have been briefly discussed.

INTRODUCTION

Globally competitive and enlightened society of India is standing at the threshold of a new era and age – ‘the age of new economies’, and the ‘age of revolution’. Change has changed. Business competitive battlefield has become more aggressive and fiercely competitive. Decidedly, at this juncture, a compelling vision, bold leadership and bold strategic decision alongwith technological core competence leverages the corporations, at the higher echelons of the global business economy.

High technology has become a prime mover, a driving force, as well as ‘force-multiplier’, behind the accelerated growth and prosperity of any Nation. And so is the case with India. A country, which masters technological innovations, thus derives utmost competitive advantages and respect. The technological changing curve and growth super highway, is no longer additive- rather it has become ‘abrupt’, ‘discontinuous’, ‘challenging, and more ‘non-linear’. Emergence of knowledge society and convergence of various dimensions of global technologies, and its further sustenance has come to stay. Technologically, one has to think, rethink or perish. In this 21st millennium, the competition has become fiercer due to strategic uncertainties, knowledge wave and enlightened society. The geopolitical, socio-economic-culture and market strategy today is making a more deeper a niche than the earlier time. The convergence of all the above three major forces imparts a positive influence on the organizations. And, at the same time, divergences of the above forces dissipate the overall productive effects.

Whereas the technology and knowledge economy are the buzz-word today, the retention of talents and unleashing the brain-power of the people of organization has become more difficult task. ‘Ignited mind’ has been the slogan of Dr APJ Kalam who dreams about INDIA to become self- developed, self-reliant and among the top reckoning in the developed countries race. His ‘Global Knowledge Platform’ concept and e-chaupal introduction to the society is correct in trends with the advent of manifestations of ‘Management Web 2.0’. The world and the competitive organizations have to convert them into a ‘globally adaptive organisations’ (GAOs) for better deliverance. The other top renaissance and dynamic leaders have to ruthlessly support the ongoing technological programmes for furtherance and sustenance of the fast pace of developments. (Navi Radjou, 2006, Hamel, 2007).

The product- strategy is a complex business. The product-strategists should continuously define, redefine and reinvent the competitive rules, challenging the status quo. The strategists should also find order out of disorder & chaos and certainty out of uncertainty. The high – technological products cannot be static. It has to be brutally dynamic. Also, one has to adapt in response to external changes- otherwise one gradually becomes irrelevant, unproductive and finally derelict. (McGrath, 2001).

Product-strategy is like a road map and road map is useful only when you know, where you are, where you want to go and finally the direction of the

destination. This requires in between checking, mid-course corrections, as well and maintaining like North Compass direction. We have to be apt to be able to manage 'Strategic Uncertainties' and practice the infallible tool / technique of 'strategic flexibility'. The core competence of the organisations and competitive advantage has to be whetted and harnessed at all cross-section of time. Herein, we have to be aware of 'strategic paradox' and 'pitfalls of high – soaring companies', also (Raynor, 2007).

Within the last decade or so, world-over, many giant technological feats have been achieved like: Big-Dig Project of Boston, English Channel tunnel projects, High-way bridges etc. India also is not behind the race of technological advancements. In this paper few case studies of IGMDP, Delhi-Metro & Calcutta-Metro have been briefly discussed. Also the Worli – Bombay overseas bridge highways, which opened up only in July this year , has also been briefly touched upon.

WORLD – TECHNOLOGICAL FEATS – THROUGH AGES:

The kind of technology used by a society has been an indicative landmark / replica of its advancement and development often the nations are remembered by their technology, they use. We have traveled through Old Stone Age, New Stone Age, Bronze Age and Iron Age each referring to the technology shared by the people of that age. Further the societal transformation is referred as:

- Agricultural Age
- Industrial Age
- Information Age
- Knowledge Age
- Nano technology age of 21st Century.

In between them, Chemical Age, Plastic Age, Material Age, Nuclear Age, Biotechnology Age, Info & Knowledge Age also have usher in. Space and Ocean technologies are also having a reckoning in the above ages.

Due to Nuclear Age Missile Technology Control Regime (MTCR), CTBE (Comprehensive Test Ban Treaty), NOT (Nuclear Non-Proliferation Treaty), FMCT (Fissile Material Cut off Treaty) and WMD (Weapons of Mass Destruction) have come to stay.

Space and Aerospace programmes have been developed all over the world by firstly developed nations and then developing nations as well. World over high technology is replete with Eiffel Tower, English Channel Tunnel, Big-Dig of Boston(USA), and many highways bridges (including suspension bridges) all over the world. In these, the technocrats & scientists have used smart materials, composite materials and latest nano-technologies (Pillai, 2005).

The subject is very vast. In this paper, authors are going to confine to the technological developments in Indian scenario only. In the Defence category, in India, land, sea, under water, air and even deep sea equipments have been developed. Apart from ISRO (Indian Space Research Organisation), ASLU (Augmented Satellite Launch Vehicles), PSLV (Polar Satellite Launch Vehicles), and GSLV (Geosynchronous Satellite Launch Vehicles) have been successfully developed. In Defence R&D organization, LCA (Light Combat Aircraft) and ALH (Advanced Light

Helicopter) have been developed and service introduced. For the purpose of this, paper some technological aspects of Missile programme, BRAMHOS, Delhi-Calcutta Metros, and Worli-Bombay Sea link bridges will be discussed briefly and their technologies will be brought out as salient features. Apart from this evolution of Nano-technology and renaissance visionary leaders and leadership of latest generation will be discussed (Pillai, 2005).

TECHNOLOGICAL STRATEGIC REFLECTIONS:

For developing technological techniques and appropriate designs, one has to look for identification and the current level of technology availability in all the required areas and adapting tailor- made strategies to bridge the gaps.

- **Level-5(L5):** At the national level whether in Defence R&D Organisation (DRDO) or other firms/corporates, if the required technologies and systems are available off-the-shelf, then outsourcing and sub-contracting are more suitable approaches. This condition may be called Level-5(L5). This is the approach mainly followed by the developed countries.
- **Level-4(L4):** When the required technologies are not available, the next best option is to substitute them with the available strength; this condition may be called Level-4 (L4).
- **Level-3(L-3):** Whenever any individual agency can be identified with the requisite core competence to develop technology, the approach of development partnership can be adopted. This process can be called Level-3 (L-3) technology.
- **Level-2 (L-2):** In the case of no individual agency, with the required competence is found, we need a consortium approach where the required technology can be developed by the combined efforts of a number of agencies. This condition may be called Level-2 (L-2).
- **Level-1(L-1):** In the extreme cases where even a consortium cannot be formed, we need to nucleate and grow the required competence around an identified agency,. This approach is called the technology empowerment, and the condition may be called Level-1 (L-1).

Once the technology requirements and gaps are identified, the gaps can be bridged by using one of the identified strategies,. The various approaches which are followed for overall strategies processes are:

- Multi-user, multi-role approach.
- Partnerships
- Multi academia – institutional partnership.
- Consortium approach.
- Outsourcing approach.
- R&D laboratories.
- Collaborative team efforts.
- Special task forces.

HIGH- TECHNOLOGICAL UNCERTAINTIES AND COMPLEXITIES

High technology is full of challenges due to its inherent uncertainty and associated risks and complexities. High technology development involves knowledge workers, specialized equipment, matrix & networked organization with multi-institutional partnerships & concurrent engineering practices. Innovative multi-project management approaches, different measurement techniques and changing performance requirements many uncertainties as depicted in Fig.1 (Pathak, et.al, 2008).

Also for combating the uncertainty, some specific focus is required on problem forecasting, troubleshooting, and contingency planning. Some special mechanisms for monitoring, reviewing & controlling like computer aided scheduling & Monitoring Systems (CASMS), multi-user and multi-role features are to be installed (Refer Fig.2). Apart from these socio-economic challenges also pose problems / complexities in high –technological developmental projects.

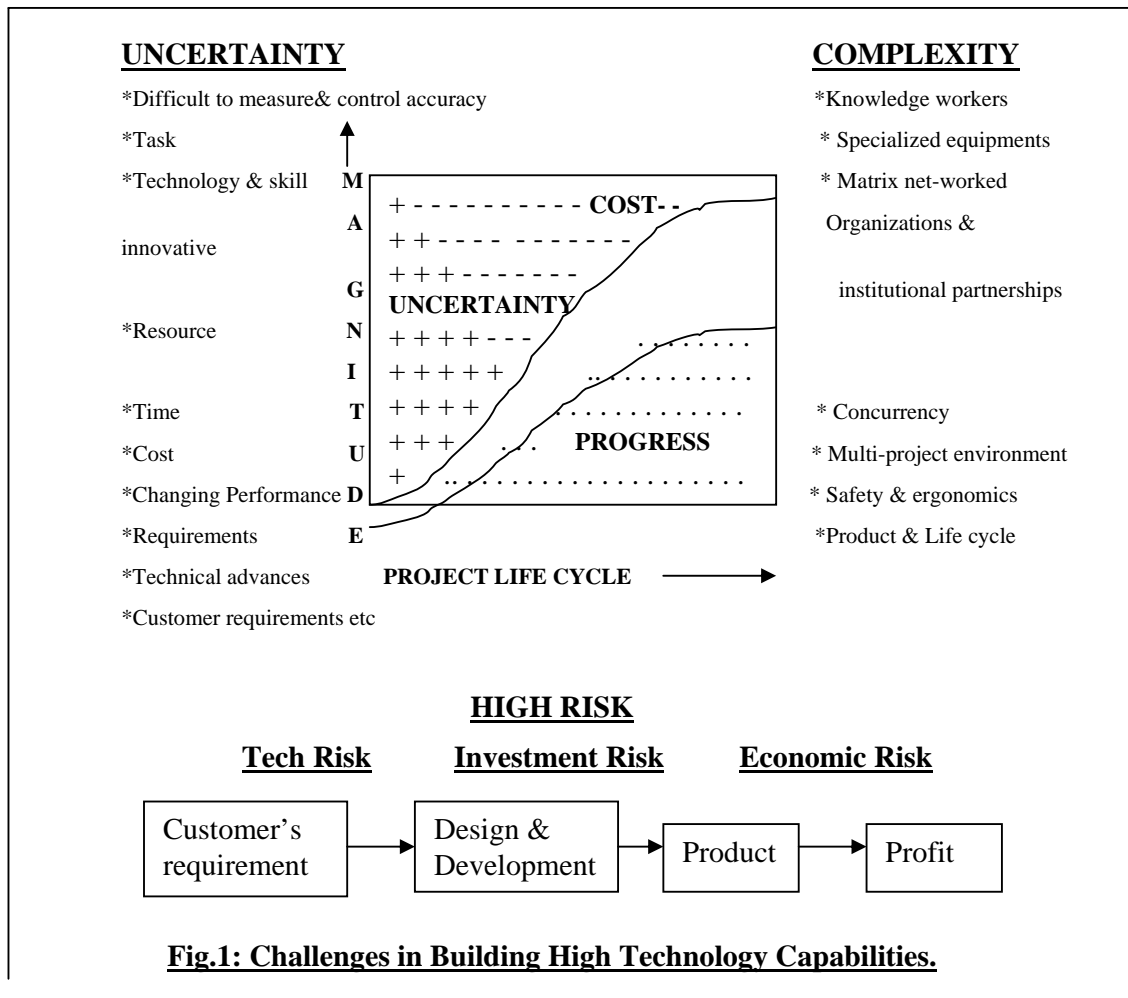
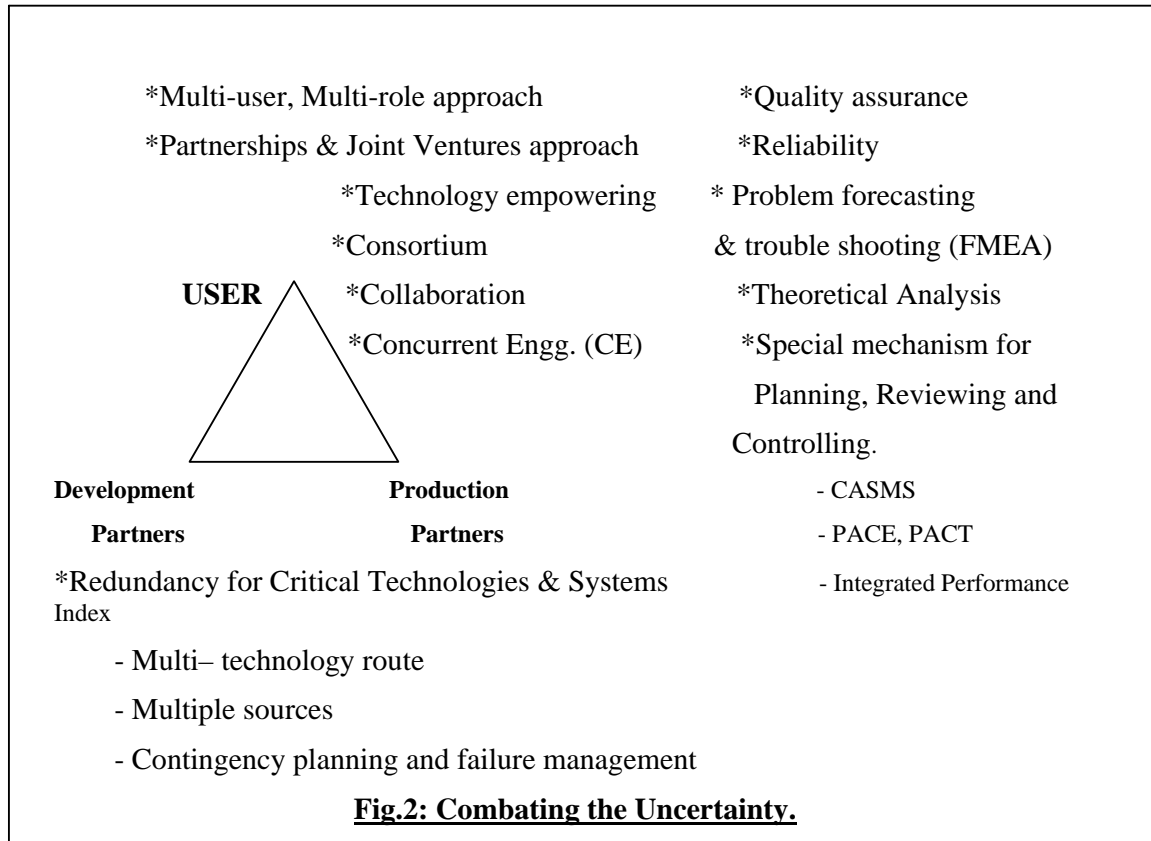


Fig.1: Challenges in Building High Technology Capabilities.



CASE STUDY: 1 IGM DP (MISSILE PROJECTS)

Since the full length discussion of the projects in the case studies are not possible in the limited scope and length/breadth of this paper, a brief discussion of the India's Integrated Guided Missile Development Program (IGMDP) along with BRAHMO and LCA (Light Combat Aircraft) has been presented herein. (Pillai, 2005).

- (a) PRITHVI is a short range battlefield, surface to surface missile launched from a mobile launcher. It uses liquid propellant rocket engines, a light weight airframe, a system, and an electro-hydraulic control system.
- (b) AGNI is an intermediate range ballistic missile, which uses a specially developed carbon composite re-entry which structure and re-entry guidance and control system.
- (c) TRISHUL is a short range, quick reaction, surface to air missile system, designed to defend moving armoured columns from attacking aircraft and helicopters. The naval version of Trishul is designed to defend ships from incoming sea-skimming missiles also.
- (d) AKASH is a medium range, surface to air missile, with multi-target handling capability, and advanced propulsion & software.
- (e) NAG is a third generation, anti-tank guided missile with fire and forget and tank attack capabilities. Nag has the state-of-the-art guidance system using an Imaging Infra red seeker.

(f) **BRAHMOS**: This missile possesses supersonic velocity and long flight range. The missile is capable of being launched from multiple platforms like warships, submarines, different types of aircraft, mobile autonomous launchers, and silos – i.e. based on land, sea, sub-sea and air. The system can be configured depending upon the users requirements. The combination of supersonic speed and large warheads provides high kinetic energy ensuring tremendous lethal effect. The missile is cannisterised for the purpose of containerization, transportation and launch.

BrahMos is quite unique among other missiles, that it is first time a joint venture between India and Russia for developing a defence product from design to marketing, which state-of-the-art missile comparable to the most advanced countries.

Joint venture encompasses, sharing of responsibilities, executive positions, building trust, creating common culture as well as sharing the technological knowledge – it also, further builds brand- character.

CASE STUDY 2: LIGHT COMBAT AIRCRAFT (LCA):

This is another product other than missiles and is the pride of the Aerospace aeronautical community as well as India. A successful launch of LCA was demonstrated by the first prototype during year 2001. Multiple aircraft are flying to accumulate the required flying hours. Today, the country has the design & development capability of military aircraft apart from helicopters of HAL (Hindustan Aeronautics Limited).

Tejas, India's first modern fighter LCA is designed specifically to meet the requirements of the Indian Air Force. The light weight aircraft incorporates state-of-the-art technologies in every respect of design & development.

The Aeronautical Development Agency (ADA) an autonomous registered society under the Defence R&D Organisations (DRDO), Ministry of Defence, is the nodal agency for design and development of the LCA. HAL is the principal partner. Several other lead laboratories of DRDO have contributed to the LCA programme for the development of systems, including flight control system, brake parachute, integrated life support system, carbon brake pads, Kevlar radome, and engine. The other worth mentioning laboratory of NAL (National Aeronautical Laboratory), an institute of CSIR(Council of Scientific and Industrial Research), have been responsible for many key activities such as wind tunnel testing, design of control land and development of composite wing, fin, and fuselage components.

In all the above programmes , various coordinating meeting , design review (DR), PDR etc takes place under Governing Council and various Directors, Project directors, Group directors, deputy project directors of various working groups, with Director General (DG) of ADA. In this regards various institutes, academia, industries, private & public sectors take part periodically. The chairman of the General Body is the Defence Minister himself. (Pillai, 2005).

CASE STUDY 3: DELHI-CALCUTTA METRO RAIL

Delhi and Calcutta (now KOLKATA) are technological achievements and eye-opener landmarks for Indian advancement. Calcutta metro is the first metro

build in India, which started operation (through limited) during the year 1984, whereas, Delhi-Metro started during 24 Dec, 2002.

During the construction period at both the place, very many difficulties have been encountered, especially, administrative and being in Urban & thickly populated city areas. It was very challenging task of the construction, wherein no disturbance or routine daily life to be disturbed. Delhi, being of the newer origin it had advantages of learning the failure lesions from the Calcutta Metro. The technical features and techniques, at both the places were more or less similar with some deviations. Both the metros are being briefly discussed separately in the succeeding paragraphs.

(a) **Calcutta Metro Rail:** Though, the idea of Calcutta Metro was conceived by late Chief Minister of West Bengal B C Roy during 1949, but finally the foundation stone of the project was laid by Smt Indira Gandhi, the then Prime Minister of India, on 29 December, 1972, and the construction work started during 1973. At first, 5 lines were, planned but finally 3 were selected-

- Dum Dum – Tollygunge(16.45km)
- Bichannagar sector 5 – Ramraj tala
- Dakshineswar – Thakurpukur

This MRTB (Mass Rapid Transit System) was run by Indian Railways. There were initial hiccups for relocation of underground utilities, court injunction, irregular supply of vital materials, and so on, apart from the many urban city-busy roads and artery administrative problems faced. The digging of concrete pavement (a very solid construction of I-rails section of British era) really posed problem even cut and cover method has been adopted (author –had visited during construction period including visit of their HQs at Esplanade, Chowranghie at Calcutta. (Pathak, 1995, 2005)

The Metro service was closed for sometime and started later. Many a times the project was manifested with delays, cost overrun and most importantly inconvenience to the public. Finally the project took more than 20 years to complete and expenditure incurred was four times more than the original cost.

The metro construction was technologically a very complex task, in the field of civil, electrical, signaling and telecommunication engineering. Indian engineers with advanced technologies supplemented by the technologies abroad worked hard. Some of the technologies adopted were:

- Cut and cover method of construction using diaphragm walls & sheet piles.
- Use of extensive decking to keep the traffic flowing over the cut while construction is in progress underneath.
- Shield tunneling using compressed air and airlocks.
- Ballast less track using elastic fastenings, rubber-pads, epoxy mortar and nylon inserts.
- Air-conditioning and ventilation system for environmental control of stations & tunnels.
- Third rail current collection system for traction.
- Underground substations with dry type transformers and SF-6 circuit breakers.

- Tunnel – train VHF – radio communication system.
- Micro-processor-based train control and supervisory remote control system for sub-stations.
- Automatic ticket vending & checking system.

North South Corridor: The stations on the metro (South to North) are:

- Tollygurge
- Rabindra Sarobar
- Kalighat
- Jatin Das Park
- Rabindra Sadan
- Netaji Bhawan
- Maidan
- Park street
- Chandani Chowk
- Central
- Mahatma Gandhi Road
- Girish Park
- Shobba bazaar - Sutaruti
- Shyam Bazar
- Belgachia
- Dum Dum.

Some extension of North South Corridor also taking place to Garia in the South, going to be opened to public on 23rd August 2009. The Stations are:

- *Tollygurge *Naktala
- *Kudghat *Garia Bazar
- *Bansdoni *New Garia
- *BRIJEE

After Mamta Banerjee having taken over Railway Ministry after 2009 Central Parliament Elections there is further scope of extensions and adhering to above deadlines dates. (Wikipedia, free encyclopedia, navigation to coach to Calcutta Metro, 2009).

(b) Delhi- Metro Rail:

Delhi Metro is the rapid transit system in the Indian city of Delhi that was built and is operated by Delhi Metro Rail Corporation Limited (DMRC). The concept of a metro for Delhi was first formalized in the Delhi Master Plan of 1960(8), and the

legal framework for the metro was laid out in the Metro Railways (Construction of works) Act of 1978(8).

Actual work on Delhi Metro could only start in 05 March, 1995, when the DMRC was established. Previous experience of Calcutta Metro came handy, wherein it was delayed 12 times over budget, due to political meddling technical problems and bureaucratic delays(9). Due to this DMRC was given full powers to hire people, decide on tenders & control funds. (9).

Physical construction work started on 01 October, 1998. The first broad gauge line was opened on 24 December 2002 and the entire Phase I of the project was completed in December 2005, in designed budget and almost 3 years ahead of schedule – an achievement described as “ nothing short of a miracle” by business week (11).

Most of the technological details are like that of Calcutta Metro only. Some other routes details are:

Phase I: Comprises of 65.11 kms of route length with 13.01 km underground corridor & 52.10 km surface / elevated corridor with 59 stations.

Phase II: This comprises 128 kms of route length and 79 station – with its first section opened in June 2008 and a target completion date of 2010(12) (13)

Phase III (112 kms) & IV (108.5 kms) are planned to be completed by 2015 and 2020 respectively, with the network spanning 413.8km by then, making it larger than London’s Underground (408kms) (13) (14) (15) (16).

Metro is further going to connect Delhi (Narela), (Kundli, Sonapat), Greater Noida sectors etc, There are Red line, Yellow line & Blue line in Phase I & II. International standards ISO14001 and environmentally friendly practices from United Nations (5), RINA (6) have been achieved.

CASE STUDY 4: BANDRA- WORLI SEA LINK:

Rajiv Gandhi (Bandra-Worli) Sea link Project has been one of the most highly recommended project of all the transport studies done for the metropolitan regions during the last 40 years.

Mahim causeway was the only link connecting the western suburbs to island city of Mumbai. This North – South –Western-corridor is highly congested during the peak hours creating a bottleneck. Around 1,20,000PCU vehicles traffic travels every day on this causeway taking around 40-45 minutes for 8 kms distance.(expressindia.com,2009)

The entire project was originally conceived as one large project with different components combined together but in order to accelerate the overall construction schedule, the project was divided into five construction packages. This sea-link is likely to reduce travel time between Bandra – Worli for 45-60 minutes to amazingly 7 minutes (3). The link has an average daily traffic of around 25,000 vehicles on week day. The project was initiated more than 10 years ago during 1999, and was supported to be completed within 5 years, but it was delayed due to public interest and litigations.

The project starts from Interchange at Mahim (i.e. Intersection of Western Express Highway and Swami Vivekananda Road at Bandra) and connects to Worli end with overall length of 5.6 km for the entire project. A Cloverleaf interchange at

Mahim intersection and a flyover at the Love grove intersection have been proposed as part of this project to enhance the faster and safe traffic dispersal.

This Bandra-Worli Sea link (or Rajiv Gandhi Setu) is 8-lane, cable-stayed bridge. With pre-stressed concrete viaduct approaches, this links Bandra and the Western suburbs of Mumbai, with Worli and Central Mumbai, and is the first phase of the proposed West Island free way system. The Rs.1600crore (\$400million approx.) project of MSRDC (Maharashtra State Road Development Corporation) is being executed by Hindustan Construction /Company (HCC). Design and project management is by M/s DAR Consultant (U.K) Ltd. And M/s DAR Consultants Pvt. Ltd, (INDIA).

The Rajiv Gandhi Setu was dedicated to public on 30 june2009by Congress President &UPA chairperson, Sonia Gandhi [(2), Times of India, Indiatimes.com]

FUTURISTIC TECHNOLOGICAL REFLECTIONS:

Today, technological revolution and its impact on the corporates / organizations are felt all over the world. Apart from space technology, Ocean Science, Biotechnology, Material Sciences (sensors), Nanotechnology are also taking place in the latest manifestations of technological advances. Apart from these, even latest leadership and its various manifestations are ushering – in as motivational and vibratory ‘force-multiplier’. Herein Nanotechnology, its convergence and the new generation of leadership will be briefly discussed.

(a) Convergence of Bio-Geo-Info-Nanotechnologies: The future world technological market is for nano-materials, nano-tools, nano-devices, and nano-Bio-technology is going to be the order of the day. Nano-technology offers a wide range of possibilities of high efficient and miniaturized systems & devices. “Nano-technology is a creation of functional materials, devices and system through control of matter on the nanometer length scale (1-100nm), and exploitation of novel phenomenon and properties (physical, chemical, biological, mechanical, elastical, etc.) at that length scale”.

Also advancement in the development of carbon nano-tubes is encouraging. The composite structures made out of the carbon nano-fibres – reinforced with polymer matrix are going to revolutionise the future structures. Even in the medical science micro and nano technology going to revolutionise future treatment including diagnosis as well as disease prevention. Triad of Nano-Bio-Info technologies and convergence of Bio-Geo-Info-Nano- technologies are going to lead to potential triad and quadrant materials and going to establish ‘Nano-Tech-Enterprises’. Oceans are also rich source of natural products and they form an abundant source of bio and geo-diversities. This natural resource coupled with nano-science & nano devices in the information age, amazingly leverages the potential resource of energy. Convergence of Bio-Info-Geo-Nano technologies really provides a cohesive global energy source and synergetic working conditions.

(b) New Generation Leadership: The impact of technology has got a substantial effect /impact on organizational structure. The rapid changes in technology together with advent of the knowledge worker will necessitate far reaching changes in the traditional organizational structure. With all these changes taking place, the different type of leaderships transformations also taking place.

At present, we are in the fifth generation of leadership. The management challenges leads into the evolution of sixth and seventh epoch of leadership generation. Very briefly these are going to be discussed here. (Refer Fig.3). Fig 3 shows epoch-wise (era-wise), leadership qualities.

Generations (EPOCHS)	I (1780)	II (1800-1950)	III (1960-1980)	IV (1980-2000)	V (2004-2010)
Organisations	Proprietary ship	Steep - Hierarchy	Matrix	Horizontal (Computer interfacing)	Knowledge net-working
Leadership Qualities	Authority Heredity	Charisma & Self-esteem	Motivator Team-player knowledgeable	Team Playing & Knowledge of IT-enabled services	Extensive teamwork Motivator of people

Generations (EPOCHS)	VI (2010-2020) Global	VII (Beyond 2030)
Organisations	Global Knowledge networking	Enlightened Circular
Leadership Qualities	International exposure – cross-cultural work environment	Self-esteem self actualized, Team player, path finding, aligning, empowering & Enabling.

Fig: 3 Leadership Generations

Leadership has traveled from Adam Smith, period of wealth generation & principle of division of labour which was further reinforced by Taylor’s Theory of scientific management and further Henry Fayol’s theory of unit of command. From matrix organization to ‘one person-one boss’, and in matrix (‘two or more managers’) etc. Then the leadership phenomenon has travelled through, ‘personality traits’ based on leader’s personality, then human relations –task-people- and personality based, which is different than the earlier one of proprietorship. This now has traveled to the present day ‘knowledge society’ and ‘knowledge worker’ (Luthan, 2005; Davis, 2002; Verma, 2001). Thus we have traveled through Boss-oriented leadership to Employee-centered leadership. Hersey, Blanchard and Johnson (1998) and Peter F.Drucker (2001) have described the leadership style from ‘situation to situation’, charismatic leader to TRUST and followers. Many more things on leadership have been amply written.

Today, we are passing through fifth generation of leadership of knowledge workers and it is difficult to command & control the knowledge workers. Herein,

vision and transformational leadership is essentially required (Pillai, 2005). Prof.Pritam Singh and Bhandarkar (2002) talk about 'self-lotussing and 'Renaissance leadership' of the style of Mahatma Gandhi and Martin Luther King Jr, Abraham Lincoln, and now Jack Welch etc. Many Indian Leaders like Homi J. Bhabha, Vikram Sarabhai, Satish Dhawan, Dr Abdul Kalam, Dr R A Mashelkar, and even Verghese Kurien etc are in the category of Renaissance leaders. Today, the style of leadership calls for a large degree of human networking and sustenance & management of such networks for the accomplishment of mission objectives.

Now, the Sixth Generation leadership comprises of 'global networking', and of 'advanced multi disciplined society.' They work on cross-cultural environment. A good example of sixth generation is BrahMos - the Indian Russian joint venture project partnership, which harnesses capabilities of both the countries. In the 'Seventh Generation of leadership', the leadership is mostly enlightened with global knowledge, spiritually adopt and should possess enormous mental power. They must work on 'globally adaptive organizations (GAO) concept and beyond. (Navi, 2006).

Thus, it will be observed that for the higher and technological breakthrough, 'man behind the machine' is essentially concept required and that is a dominant / dynamic leadership spirit.

CONCLUSION:

Organisations of modern era are passing through globally competitive battlefield scenario. Today, the globally competitive and enlightened society is standing at the threshold of, new age- 'the age of new economics' as well as 'age of revolution'. Change has changed. No longer it is additive or linear – rather, it has become 'abrupt', discontinuous', challenging and more & more 'non-linear'.

Emergence of knowledge society, convergence of breakthrough technologies, and its 'further sustenance has come to stay. Technologically, one has to rethink or perish. The right moves, can lead to tremendous success and wrong moves to disaster and devastations. Also, high technological products cannot be static- it has to be brutally dynamic. We have to change in response to external environment, or else we will become gradually irrelevant and unproductive. We have to have a clear road-map and know where we want to go- the destination and direction must be distinctly clear (Pathak et al.2007).

World technologically has moved through agricultural, industrial, information knowledge ages, and now, we are in 'nanotechnology age' of 21st century. Space ocean, material science, defence technology, and finally 'nano-technology' have become the guiding factor of all the emerging technologies. Technological strategies have traveled from Level-1 to Level-5. Also, we have to live in this era in strategical paradoxes and uncertainty due to rapid pace of changes.

Various defence projects like, IGMDP products, LCA, Brahmos, and technologies of Delhi-Calcutta Metros and Bandra-Worli Sea-link have been suitably discussed in the paper. Also, 'man behind the machine' is ever green dictum and in that regard in the paper the leadership mechanism has also been discussed right from first generation (1780), epoch to seventh generation (2030 epoch.)

The authors are more than convinced that the present paper will generate and evoke an ardent urge for serious study and further research on the subject.

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