# REPORT

# TECHNOLOGY VISION

# 2047

| Design Intelligent, Immersive and Autonomous Future | Acquire Super Human Capabilities | Enhance Life Expectancy | Create Phydigital Life Style | Leverage Human and Digital Human Collaboration | Provide Personalized & Contextual Experiences | Produce bio-friendly Food | Effectively Control Disasters | Establish High speed and comfortable Transportation |

Mission India 2047

**TECHNOLOGY VISION DOCUMENT FOR YEAR 2047**

**END TO END VISION FRAMEFORK**

Creating a comprehensive vision framework for a country like India is a challenging task that requires careful planning and execution. It is important to develop a meaningful document that includes a clear implementation strategy and a plan for achieving tangible results and long-term objectives.

To achieve this, the Vision Roadmap plan shall be divided into four stages:

(a)     **Vision Roadmap Definition Document**
(b)     **Vision Roadmap Detail Document**
(c)     **Vision Roadmap – Design Document**
(d)     **Vision Roadmap – Delivery Document.**

Each of the four stages shall commence sequentially after approval and acceptance of the previous stage. **This Report is the Definition document** which is the first stage, will cover the technology aspects of the plan, including the reasons behind the chosen technologies. In simple words it describes the "**Why & Which**" of the Technologies. The Detail Document will follow and cover the implementation strategy, including what needs to be done and when it needs to be done. It describes the **"What & When"** of the Implementation strategy. The Design Document will focus on how to achieve the milestones and objectives step by step. It describes the **"How & Where"** of the implementation roadmap. The Delivery Document will combine all of the elements of the previous stages (**3D's**) and develop a project management plan that will deliver the ultimate goals and objectives.

**INTRODUCTION**

1.      A technology vision roadmap for a nation is a comprehensive document that outlines the country's long-term vision, goals, and strategies for leveraging technology to drive economic growth, social development, and national competitiveness. It is a strategic plan that outlines a country's goals and objectives for technology development and innovation. For a country like India, a technology vision document can be important and necessary for several reasons:

(a) **Fostering innovation and growth:** A technology vision document can help to identify areas of focus and investment for technology development, which can help to drive innovation and economic growth in the country. This can help to create new jobs, increase productivity, and drive economic growth.

(b) **Building a competitive advantage:** A technology vision document can help to identify key technologies and industries where India can build a competitive advantage. This can help to position India as a global leader in certain industries, which can attract foreign investment and increase exports.

(c) **Addressing social and environmental challenges:** A technology vision document can also help to identify technologies and innovations that can be used to address social and environmental challenges in India, such as improving access to healthcare, increasing food security, and reducing carbon emissions.

(d) **Aligning government policies:** A technology vision document can help to align government policies and initiatives with the country's technology development goals. This can help to ensure that government resources and efforts are focused on areas that will have the greatest impact on technology development and innovation.

2. A technology vision document can be an important tool for a country like India to drive innovation, create new jobs, and position itself as a global leader in certain industries. It can also help to address social and environmental challenges, and align government policies with technology development goals.

## SALIENT FEATURES & KEY COMPONENTS OF TV2047

3. A technology vision document for India 2047 should essentially outline the following key components and address key issues thereof, so that a comprehensive strategy to achieve the stated objectives and goals can be drawn with periodic milestones categorized as Short Term (5-7 Years), Medium Term (12-15 Years) and Long Term (25 Years).

(a) **Overall vision and goals:** The document should outline India's vision and long-term goals for technology development and innovation. This could include becoming a global leader in certain technologies or industries, achieving energy self-sufficiency, enhancing food and water security, and becoming a knowledge-based economy.

(b)   **Prioritization of key technologies:**   The document should identify the key technologies and industries that India will focus on developing, based on the country's strengths and weaknesses, as well as global trends and opportunities. This could include artificial intelligence, robotics, renewable energy, advanced manufacturing, biotechnology, and space technology.

(c)   **Strategic plan for Technology Development:**   The document should outline a strategic plan for technology development, including specific initiatives and programs that will be undertaken to achieve the country's goals. This could include investments in research and development, innovation hubs, technology clusters, and partnerships with academia and industry.

(d)   **Investment and Funding strategies:**   The document should outline strategies for investment and funding of technology development, including both public and private sector investment. This could include mechanisms for attracting foreign investment and partnerships, as well as incentivizing private sector investment in key technologies.

(e)   **Education and Human Resource Development:**   The document should address the development of education and human resources for technology development. This could include strategies for improving STEM education, increasing the number of skilled workers in emerging technologies, and promoting entrepreneurship and innovation.

(f)   **Regulatory and Policy frameworks:**   The document should address the regulatory and policy frameworks necessary to support technology development and innovation. This could include strategies for protecting intellectual property, creating a favorable business environment, and ensuring ethical and responsible use of technology.

(g)   **Social and Environmental considerations:**   The document should address social and environmental considerations, such as ensuring that technology development benefits all segments of society, and promoting sustainable and inclusive growth.

(h)   **Collaboration and Partnerships:**   The document should outline strategies for collaboration and partnerships, both within India and with other countries and international organizations. This could include joint research and development initiatives, knowledge-sharing networks, and technology transfer agreements.

4. The technology vision document for India 2047 should provide a comprehensive and cohesive strategy for technology development and innovation, addressing key components such as vision and goals, prioritization of key technologies, strategic plan for technology development, investment and funding strategies, education and human resource development, regulatory and policy frameworks, social and environmental considerations, and collaboration and partnerships.

## BRAINTSORM AT IITB FOR TV-2047 ROADMAP

5. TIFAC, in collaboration with IIT Bombay, organized a **brainstorming session** on **February 6 and 7, 2023**, at **IIT Bombay. T**he first day was dedicated to discussions on the **Technology Vision 2047** exercise, and the second day, Students were invited to express their thoughts and views on the subject. The program agenda for both the days is placed at **Appendix -A.** The Details of the attendees is placed as **Appendix-B** of this report.

6. The Discussion was structured in a **Six S framework** which was curated by **Wg Cdr S Sudhakaran (Retd), CEO QuGates Technologies**. The Six S comprised of **SuSiksha** (Good Education), **Swasthya** (Healthcare), **Sevan** (Responsible Consumption & Production), **Shrishti** (Environment & Climate), **Soochna** (Information) & **Suraksha** (Security). The aim was to ensure that the technology roadmap aligned with these domains, which are integral to every aspect of people's lives in India. By doing so, it would enable a comprehensive and cohesive strategy for technology development and innovation in India.

## BRIEF - INTRODUCTORY SESSION BY HEAD OF TV 2047, TIFAC

7. Dr. V Goswami, Sc-G & Head of TV 2047 delivered an important talk that highlighted the philosophy behind TIFAC's vision for the future, which emphasizes that TV 2047 is **not a foresight, forecasting or prediction exercise**. Rather, **it is a dream for a better future for India**, which may not have a definite shape or form initially and **shall be Nebulous & Amorphous**. The primary goal of this vision is to ensure that technology serves India's interests by **prioritizing security, prosperity, and strengthening the identity of every Indian.**

8.    The impact of TV 2035 on India's growth was also specifically highlighted, which included the following points:

(a)    The Prime Minister's Office has directed all scientific ministries to consult TV 2035 documents while designing future plans.

(b)    Several programs, such as Swachh Bharat, Swasth Bharat, Make in India, Promotion of Start-ups, Skill Development, and the Digital India Initiative, align with the recommendations of TV 2035.

(c)    The Education Roadmap's recommendations are reflected in the New Education Policy of 2020.

(d)    The Smart Advanced Manufacturing and Rapid Transformation Hub (SAMARTH), an Industry 4.0 initiative of DHI, was recommended in the Manufacturing Roadmap.

(e)    Intelligent Transport Systems (ITS) have been demonstrated in Bangalore, Pune, and Indore, as recommended in the Transport Roadmap.

(f)    The Healthcare Roadmap recommended various initiatives such as Medical Textile, Automated alerting system for medical emergencies, and ICT-driven rural healthcare delivery, which are currently under implementation.

(g)    The National Policy on Electronics 2019 has been framed, as recommended in the ICT Roadmap.

(h)    The government plans to maintain health records based on Aadhaar, which was recommended in the ICT Roadmap.

(i)    The Department of Science and Technology has initiated a mission on Interdisciplinary Physical System and Quantum Computing, which was recommended in the ICT Roadmap.

(j)    The Water Roadmap has recommended the development of affordable desalinization technology and indigenous membrane development. BARC has initiated work on state-of-art Thin Film Composite Polyamide (TFCP) membranes.

9.    During the talk, a scenario was presented for the year 2047, which estimated the size of the economy to be between **30 and 40 trillion USD**. Based on this assessment, a **per capita income target of approximately 13,205 USD** was set for 2047.

10.    **Outcomes:**    The envisaged scenario for a 30 to 40 trillion USD economy was expected to result in the following outcomes:

(a)    The establishment of a massive and robust infrastructure system.
(b)    The creation of a global intellectual hub.
(c)    Inclusive and equitable growth, ensuring the socio-economic well-being of the Base of the Pyramid (BoP) communities.
(d)    A significant improvement in the Human Development Index (HDI), currently ranked 132 out of 191 countries and territories as per the HDR-2021/2022.
(e)    The development of a strong export base, with a 10% share in global exports by 2047 as projected by IBEF in 2022.
(f)    The establishment of a world-class innovation, manufacturing, and service hub.
(g)    The creation of data and AI capital for the planet.
(h)    The demographic dividend, with around 25% of the global workforce sourced from India.

11.    **Concerns:**    Some of the present-day concerns that could potentially pose a serious challenge in achieving the stated objectives were

(a)    High import dependency for Rare Earth Minerals
(b)    Low investment in R&D, Industrial Research
(c)    Research Ecosystem, Research Infrastructure, Breakthrough research
(d)    Non acceptance of failures
(e)    Identification of weak signals and Black Swan Events

12.    **Key Drivers:**    The Key drivers for 2047 is Sustainability, Global Leadership, India as an Innovation Hub and Self Reliance. All these aspects are to revolve around Good Education and enhances Skill Set of the Demography.

13.    **Key Components of the Exercise:**    The following were the key components of the exercise as outlined in the Technology Vision, with the vision narrative being "**Striding towards Technology Independence for a Self-Reliant and developed India**"

(a)    Building Plausible Scenarios for 2047 *(Shell Method)*
(b)    Identification of sectoral drivers of change for 2047
(c)    Key Challenges, Trends, Threats and Opportunities of each sector
(d)    Demand supply analysis of each sector

(e)    Identification of Technologies being imported for different sectors

(f)    Identification and prioritization of technologies for different sectors

(g)    Identification of India's capabilities and constraints in achieving the vision

(h)    Delineating strategies

14.    **Uniqueness of TV 2047:**    The Unique aspects of TV 2047 are

(a)    Holistic vision for the nation on technology cutting across all sectors

(b)    Will capture futuristic technologies (game changing and disruptive)

(c)    To complement with overall developmental vision for the nation

(d)    Strategy to be Global Technology Leader

## SIX S FRAMEWORK & BRAINSTORM SESSIONS

15.    The brainstorm sessions were held based on the Six S framework, which covers all aspects of the nation's key sectors. The key drivers for 2047 were identified to revolve around Education and Skilling of the demography, which is stressed as an essential driver for technology and thought leadership to flourish. Intellectual stimulation and decolonization of minds are needed for the nation's demographic to achieve this goal.

16**.**    **SuSiksha (Good Education)**, was focused on understanding the aspirations and thought process of people from that domain and quantify the challenges that confront this sector, so that a strategy can be drawn to mitigate most of these challenges by 2047. The moderator for the session was **Prof Ramgopal Rao.**

17.    **Swasthya (Healthcare)** was focused on ensuring a healthy India so that the people can efficiently contribute towards nation building and catapult the country to a position of global leadership. The pandemic has taught the country very important lessons on the health front and the vaccine diplomacy initiated by the nation has already fetched immediate results both in terms of goodwill and acceptance as a Global power. It is initiatives like this that shall fetch greater adulation amongst all the nations of the world and get our rightful place in the UN security council. The development of vaccines again was a consequence of our command on the pharma & bio technology. The session focused on identifying critical areas of healthcare were India needs to concentrate and develop its capabilities in the short term. Digital Transformation of healthcare and application of Next gen technologies on various aspects of health care were also key focal areas for discussion so that a roadmap can be drawn for each of those identified areas. The Session was moderated by **Dr Mahendra Bhandari.**

18.     **Sevan & Shrishti (Responsible consumption & Production, Environment & Climate),** was focused on the central theme of sustainability and growth. The food production in the country needs to be doubled for a growing population with an increased per capita income. Similarly, to ensure growth across sectors, energy self-reliance and greener technologies for sustainable growth was also seen as key aspects that needs extensive discussion. The Session was moderated by **Prof S S Chakraborty.**

19.     **Soochna (Information)**, was focused on ensuring a regime of information superiority while aspiring for a global leadership role. Control over the Information space is vital for political stability in the country. A stable political regime can only provide **unity of command**, which is a pre requisite for ensuring **robust growth and a strong economy**. Technology leadership needs a congenial political environment backed by a strong macro-economic fundamental, which is dependent on the ability to control the Information space. The session was moderated by **Wg Cdr S Sudhakaran (Retd)**.

20.     **Suraksha (Security)**, was focused on all aspects of security of the nation holistically. It encompassed both the physical and virtual aspects of the subject and the need to achieve absolute self-reliance on all technologies related to all aspects of security by 2047. The Session was moderated by **Gp Capt Amitabh Mathur (Retd).**

## KEY TAKEWAYS & IMPACT TECHNOLOGIES OF THE FUTURE

21.     **Digital Omnipresence:**     There was a unanimous consensus that Digital technologies shall be all pervasive in the future. digital technology has already become deeply integrated into many aspects of our lives, from the way we communicate and access information to the way we work and consume entertainment. As digital technology continues to advance and become more sophisticated, we can expect it to be even more ubiquitous in our daily lives. For example, we are already seeing the rise of the Internet of Things (IoT), where everyday objects such as appliances, cars, and even clothing are being equipped with sensors and connected to the internet. This trend is expected to continue, with more and more objects becoming "smart" and interconnected.

22.     In addition, we can expect digital technology to play an increasingly important role in areas such as healthcare, education, and transportation. For example, telemedicine is already becoming more common, allowing patients to receive medical care remotely using digital technology. Similarly, digital technology is transforming the way we learn, with online education platforms and digital tools enabling personalized learning experiences.

23.     **Era of AI Singularity:**     The practicality of technology vision roadmap shall singly be decided by one factor as to whether AI will achieve singularity in the coming decade or two. If AI singularity becomes a reality, then the complete spectrum of

technologies across all domains shall witness an upheaval and see a change unprecedented in history of humanity. With AI and other advanced technologies, it may be possible to enhance human abilities and extend life beyond what is currently possible. This could lead to a new era of transhumanism, were humans and machines merge in new and unpredictable ways. With AI surpassing human intelligence, it could rapidly improve itself and accelerate technological progress at an unprecedented pace. This could lead to breakthroughs in fields like medicine, energy, and space exploration, among others.

24.    As AI becomes more capable, it could replace humans in many jobs, including those that were once considered safe from automation. This could lead to mass unemployment and a shift in the nature of work, with implications for social stability and economic inequality.

25.    The Nebulous & amorphous nature of the vision as described by Dr V Goswami can attributed easily to this one single factor. **This also throws some key questions before the nation as to whether we can live in a state of denial towards the possibility of AI singularity being a reality or take measures on a war footing to ensure that we are not found wanting in this race of lifetime for humanity as a whole!!**

26.    **Quantum Compute and Quantum Intelligence:**    Quantum computing and AI are interlinked in several ways. Quantum computing can enhance the performance of AI algorithms, while AI can help to optimize the performance of quantum computing systems. Quantum computing can significantly accelerate certain AI computations, such as pattern recognition, optimization, and machine learning. Quantum computing can achieve this by processing and manipulating data in a quantum superposition state, which can lead to exponential speedup in certain types of computations compared to classical computing.

27.    For example, quantum computing can be used to optimize complex supply chains, accelerate drug discovery, and improve the efficiency of financial models. In addition, quantum computing can enable the development of more accurate and sophisticated AI models that can handle larger and more complex datasets. On the other hand, AI can help to optimize the performance of quantum computing systems by addressing the challenges of quantum noise, errors, and decoherence. AI algorithms can be used to identify and correct errors in quantum computing systems, thereby improving their reliability and efficiency.

28.    Furthermore, AI can help to optimize the design and performance of quantum computing hardware by simulating and modeling their behavior under various conditions. This can help to identify potential issues and optimize their performance before actual implementation. Overall, the interplay between quantum computing and AI has the potential to revolutionize the fields of computing and data analysis, and lead to breakthroughs in fields ranging from materials science to healthcare.

29. It is theoretically possible for an AI system to design and optimize quantum computing systems, and for those systems to then improve the performance of the AI algorithms, leading to a self-contained feedback loop. The development of a self-contained feedback loop between quantum computing and AI could potentially lead to the emergence of a new form of intelligence that is significantly more powerful and capable than human intelligence. This could have profound implications for society, and it is important to carefully consider the ethical and social implications of such a scenario.

30. **Energy Self Reliance:** Even if Digital Technologies are going to be all pervasive in the future their dependence on energy is very high. Technologies for efficient production and transfer of energy is therefore significant and to a large extent to ensure global leadership and free the economy of any critical dependence. It is therefore important to draw strategies which will ensure a regime of Energy Self Reliance. Again adoption of AI systems for designing and modelling energy solutions could potentially prove to be a game changer and bring new systems and technologies that could enable India to be energy self-reliant in the near future.

31. **Humanoids:** Tesla CEO Elon Musk showcased his much-touted humanoid robot "Optimus" which is an extremely capable robot to be made in very high volume – ultimately millions of units – and it is expected to cost much less than a car, at under $20,000. The 5-foot-8 prototype walked on-stage, waved to the audience and even busted a move. The bot, running with the same hardware makeup as Tesla's autopilot system, is fully equipped with advanced, human-like qualities.

32. Humanoids could be disruptive because they have the potential to replace human labor in many industries, leading to job losses and economic disruption. They may also raise ethical concerns, such as the potential for them to be used for military purposes or the potential for them to replace human relationships and interactions. Additionally, there may be concerns about the safety and control of humanoids, as well as the potential for them to be used for nefarious purposes.

33. **Strategic Consulting & Thought Leadership:** For India to be a technology leader and be recognized as a Global leader, India needs to immediately recapture the lost space of strategic consulting and thought leadership. Thought leadership involves establishing oneself or one's organization as an authority in a particular field. In the case of a nation, thought leadership can involve promoting research, innovation, and development in key industries or fields. This can help a nation build a reputation as a leader in emerging technologies and drive global progress in critical areas like healthcare, sustainability, and security.

34. In today's interconnected world, where technology and innovation are driving growth and progress, strategic consulting and thought leadership can be essential for nations seeking to stay ahead of the curve and remain competitive on a global scale.

They can help leaders anticipate and navigate emerging trends and disruptions, and position their nations for long-term success and influence.

## KEY FATORS FOR TV ROADMAP FOR 2047

35. **Milestones:** To ensure the success of a vision roadmap, it is recommended to break down larger objectives or problem statements into smaller, more manageable pieces and build upon them with simpler, shorter-term milestones. With this in mind, it is proposed that the Vision 2047 document should be segmented into five smaller short-term milestones of five years each, two mid-term milestones of twelve years each, and one long-term milestone of twenty to twenty-five years. While these milestones are grouped into three categories, they are all aligned with the continuous pursuit of the stated objectives of the TV 2047. Successful completion of all five short-term milestones would inevitably lead to achieving the objectives of the mid-term and long-term goals.

36. **Prioritization and Pre-requisites:** The Objectives that need to be achieved in the various milestones should also be segregated. We need to identify priority sectors which essentially needs to be indigenized to begin with. These sectors that are classified as priority sectors should be pursued relentlessly irrespective of the outcomes or achievements of the stated objectives. achieving the goal of becoming a global technology leader by 2047 will require significant investment in research and development, education, infrastructure, and innovation. The Indian government may need to increase funding for research institutions, universities, and startups, as well as provide tax incentives and other forms of support to encourage private sector investment in technology. Additionally, the government may need to prioritize and strategically allocate resources to key sectors such as artificial intelligence, quantum computing, robotics, renewable energy, and advanced manufacturing. It is important to note that funding is just one aspect of a larger strategy for achieving technological leadership, and other factors such as policy frameworks, regulatory environments, and talent development are equally important.

37. **Funding Strategy for Private entities:** The Indian government allocates funds for research and development (R&D) through various ministries and departments. The Department of Science and Technology (DST), Department of Biotechnology (DBT), Department of Atomic Energy (DAE), Council of Scientific and Industrial Research (CSIR), and Indian Council of Medical Research (ICMR) are some of the major agencies responsible for promoting and funding R&D in the country.

38.     In the Union Budget 2021-22, the government allocated Rs 14,788 crore ($480 million) to DBT, and Rs 18,480 crore (~$2.5 billion) to DAE. These funds are primarily used to support R&D activities in various fields such as space research, biotechnology, renewable energy, nuclear energy largely consumed within the Government controlled ecosystem.

39.     Additionally, the government also has various schemes and initiatives to encourage private sector participation in R&D. For instance, the Technology Development Board (TDB) provides financial assistance to industries for the development and commercialization of indigenous technology, and the Atal Innovation Mission (AIM) supports innovation and entrepreneurship across the country.

40.     Involving private entrepreneurs can be an effective strategy to develop next-generation technology. Private entrepreneurs bring a wealth of expertise, resources, and innovation to the table, which can complement the efforts of the government. By partnering with private entrepreneurs, the government can tap into their knowledge and experience, leverage their networks, and access additional funding sources to support R&D. Moreover, private entrepreneurs are often more agile and flexible than government agencies, which can enable them to move faster and more efficiently in developing and commercializing new technologies. Through public-private partnerships, the government can provide incentives and support to entrepreneurs to undertake R&D projects in areas of national priority, which can help India achieve its goal of becoming a global technology leader by 2047. However, the government must also ensure that the interests of the public and the nation are protected and that the private sector's activities align with the national interest.

41.     The current government funding strategy requires a reevaluation, especially for critical technology sectors that require more significant support in terms of capital investment and policy assistance. **Emphasis should be placed on the quality of research rather than the quantity** to facilitate disruptive next-generation technologies being developed and scaled up. **The current focus on quantity may be a significant barrier to achieving this.**

## <u>TECHNOLOGY VISION ROADMAP 2047- THE FRAMEWORK</u>

42.     It is a five Phase program with Short Term, Medium Term and Long-Term objectives defined at the beginning. The Short Term Objectives of each of the five Phases shall be less Nebulous and Amorphous , while the Long-Term objectives shall steadily crystalize into a consolidated objective with clear clarity with the passage of each phase.

43.    The Objectives chosen for each of the phase considers only those aspect of technology that is not general and is to be matured with investment on solid Research and Development. These Technologies however elementary should be those which are beyond the capability of the country at present and needs to be indigenously developed so as to achieve the larger objective over next 25 years or so.

44.    The framework outlined in the vision document allows for continuous adjustment of objectives during each phase, ultimately leading to the achievement of global leadership and technology supremacy. The framework's agility and flexibility provide clarity on immediate goals at each phase, aligning with long-term strategic objectives and ensuring a consistent pursuit of technology supremacy. Codifying this vision document as a national doctrine can help maintain continuity of thought and perseverance, providing greater assurance in achieving stated objectives and goals.

45.    Converting a long-term technology vision document into a national doctrine could be a viable option to ensure the continuity of the vision across different governments and to make it a core part of the national agenda. It would provide a clear and consistent roadmap for the development and implementation of technological solutions that could address critical national issues and drive growth and development.

46.    TV 2047 shall have the following Milestones

**Phase 1:**
(a)    Short Term Roadmap – 1             (Period 5 Years      2023-2027)
         (i)    Actions (Focus Area)
         (ii)   Expected Outcomes By 2027
(iii)   Mid Term Roadmap -1 A            (Period 12 Years     2023-2034)
(iv)   Long Term Roadmap -1A            (Period 25 Years     2023-2047)

**Phase 2:**
(a)    Short Term Roadmap – 2             (Period 5 Years      2028-2032)
         (i)    Actions (Focus Area)
         (ii)   Expected Outcomes By 2032
(b)    Mid Term Roadmap -1 B             (Period 12 Years     2023-2034)
(c)    Long Term Roadmap -1B             (Period 25 Years     2023-2047)

**Phase 3 :**

(a)    Short Term Roadmap – 3             (Period 5 Years      2033-2037)
         (i)    Actions (Focus Area)
         (ii)   Expected Outcomes By 2037
(b)    Mid Term Roadmap – 1B & 2 A    (Period 13 Years     2035-2047)
(c)    Long Term Roadmap -1 C            (Period 25 Years     2023-2047)

**Phase 4 :**

(a)     Short Term Roadmap – 4          (Period 5 Years     2038-2042)
    (i)     Actions (Focus Area)
    (ii)    Expected Outcomes By 2042
(b)     Mid Term Roadmap – 2 A          (Period 13 Years    2035-2047)
(c)     Long Term Roadmap -1 D          (Period 25 Years    2023-2047)

**Phase 5 :**

(a)     Short Term Roadmap – 5          (Period 5 Years     2042-2047)
    (i)     Actions (Focus Area)
    (ii)    Expected Outcomes By 2047
(b)     Mid Term Roadmap – 2 A          (Period 13 Years    2035-2047)
(c)     Long Term Roadmap -1 E          (Period 25 Years    2023-2047)

## KEY CHALLENGES TOWARDS THE GOALS

47.     **Demography:**       As per the envisaged scenario in para 10 above, one of the key objectives is to significantly improve on the HDI from the present rank of 132 out of 191. Also, it is desired that 25% of global workforce be from India reaping rich demographic dividend, while India being the Intelligence capital of the world. The estimated population in 2047 is approximately 1.6 billion at the present rate of growth.

48.     The median age of India's population is expected to increase from around 28 years in 2020 to 35 years in 2047. This means that the proportion of the population that is younger than 15 years old is projected to decline from around 25% in 2020 to around 20% in 2047. On the other hand, the proportion of the population aged 65 years and above is projected to increase from around 6% in 2020 to around 11% in 2047. This demographic shift towards an aging population has implications for India's economy, social welfare system, and healthcare infrastructure. It could potentially lead to increased demand for healthcare services, retirement benefits, and elder care facilities.

49.     Assuming 20% of population of 1.6 billion Indians to be under the age group of 16 in 2047, it is projected that India's population aged 20-24 years will be around 139 million and the population aged 25-29 years will be around 141 million in 2047. Therefore, the total number of Indians aged 20-29 years (inclusive) in 2047 is projected to be around 280 million.

50.    **Inadequacy of Educational Infrastructure:**    According to the latest available data from the Ministry of Education, Government of India, as of 2019-20, there were a total of 993 universities, 39,955 colleges, and 10,725 standalone institutions offering various courses in India. These institutions had a total enrolment of over 37 million students. there was a total of 4,143 institutions offering technical education courses in India, including engineering and technology colleges, management institutions, and other technical institutions. These institutions had a total enrolment of over 7 million students. In the field of medicine, there were a total of 542 medical colleges in India, with an enrolment of over 425,000 students, according to the same survey. For legal education, there were a total of 1,477 law colleges in India, with an enrolment of over 175,000 students. In terms of other allied professions, such as pharmacy, nursing, and architecture, there were a total of 2,466 institutions offering such courses, with an enrolment of over 1.2 million students. Roughly over 8 Million students out of the 40 million enrolments in the Higher education programs, are only able to enroll in some kind of professional education which has some level of employability.

51.    **Investment in Education :**                Education therefore needs to be a thrust area wherein innovative use of technology has to be adopted to ensure a higher enrollment rate of the demography. If this is not planned correctly India's demographic dividend could well turn into a Disaster of sorts. **The need is to create an educational infrastructure that can meet requirements of approximately 150 million students in the next 10 to 15 years.** Only a total Digital transformation of the educational system with a systematic planning and significant investment of atleast **6% of GDP with immediate effect**, shall pave the way for ensuring skilling and education of the complete demography in the next decade or so.

52.    Addressing the problem of skilling and education of the masses is key to achieving the overall objective of being a Global leader with technological supremacy and self-reliance. If India has to be a strong export base with minimum 10% share in global exports by 2047 and be a World's innovation and invention hub, investment in education is a mandatory pre requisite.

53.    **GERD Ratio:**        India's Gross Expenditure on Research and Development (GERD) ratio, which is the percentage of GDP spent on R&D, was 0.7% in 2020-21, according to the latest available data from the Ministry of Science and Technology, Government of India. This is lower than the average for high-income countries, which was 2.4% in 2018. In order to become a world-class innovation and invention hub, India would need to significantly increase its investment in R&D. While there is no specific target for the GERD ratio that would guarantee success in innovation, a commonly cited benchmark is 2-3% of GDP.

54. ~~According to a report by the World Intellectual Property Organization (WIPO),~~ India would need to increase its R&D spending by approximately $90 billion over the next five years to become a world-class innovation hub. This would require a combination of government investment, private sector investment, and international partnerships. To achieve this, India has taken several steps in recent years to promote innovation and R&D, including increasing funding for R&D, promoting entrepreneurship and startup culture, and collaborating with international partners. However, more efforts are needed to create an enabling ecosystem for innovation and R&D, including improving the quality of education and research infrastructure, promoting collaboration between academia and industry, and creating supportive policy frameworks.

55. **Indian Government needs to invest atleast 100 billion USD over next 5 years in pure cutting-edge next gen technologies. Out of this atleast 60% of the investment should be purely allocated for development of native digital technologies in the sphere of Quantum and AI.**

56. **Technology prioritization:** Innovation and invention are primarily driven by intelligence, whether it be human or machine. However, the proportion of contributions from human intelligence compared to machine intelligence is decreasing rapidly. In the near future, the contribution of human intellect may become insignificant. The issue with intelligence is that any "Zero Day Vector" that emerges within it cannot be detected through a particular method or process. As a result, **it is essential that digital intelligence be entirely indigenous**. The Chat GPT-3.0 is an example of a machine that has confirmed our concerns about its ability to generate content superior to humans. GPT-4.0 already has unimaginable capabilities that most of us cannot even comprehend, and the competition between Google and Microsoft to enhance these Large Language Models will increase their capabilities even more quickly. **Whoever crosses the singularity first will essentially deprive everyone else of the opportunity to catch up, similar to the nuclear arms race of the previous century**.

57. **Investing in Quantum Computing and Indigenous Intelligence Frameworks (IIF) should be our top priorities, as they are the most critical technology areas**. There is no other technology that holds the same level of importance or significance as these two. IIFs will soon reach a point where they can help humans develop the next generation of Quantum Computes, enabling the IIFs to self-evolve and naturally integrate into a mutually resonant framework. This will pave the way for the next generation of Quantum Intelligence to evolve in a self-contained loop. If this occurs, the possibility of accelerating research and development in every domain, and generating new concepts, processes, and outcomes beyond the ability of human intellect, is high.

58.    Wwe need to segregate these technologies as a priority group with a short, medium and long-term plan for the next 25 years. The need for investment required for developing these indigenous frameworks beyond the Government controlled ecosystem like PSU & DRDO labs, therefore shall be significant. There is a need to create special research zones to encourage private players to undertake R&D in this technology domain, so that a massive campaign to develop these cutting-edge technologies is undertaken to begin with as a short-term measure.

## LONG TERM OBJECTIVES

59.    The Long-term Objective for the year 2047 can be summed up as follows

(a)    **SuShiksha :**    Establishing an educational infrastructure that can provide quality education to at least 150 million Indians. The educational system should prioritize developing core faculties of individuals and focus on employability rather than just fulfilling academic requirements. The assessment system should be credible, reliable, objective, authentic, and transparent, instead of just delivering content as is the current norm.

(b)    The **"Eklavya Model"** of education, which provides every student access to a personalized digital guru of their choice and a curriculum that leverages their capabilities, should be considered. Free access to educational content and scholarships for high levels of achievement and performance should be provided to motivate students to achieve greater scholarly milestones. This will ultimately lead to a higher level of intellect in the overall population of the nation.

(c)    **Swasthya :**    In the next 25 years, healthcare should prioritize patient-centered, personalized, preventive, and technology-integrated care. This includes personalized medicine, telemedicine, wearable technology, artificial intelligence, preventive medicine, and integrated care. Access to quality healthcare should be governed by a robust insurance system on a blockchain, with a focus on traditional and holistic care. Digital technologies should be used to ensure transparency and minimize human intervention. Chemical dependence should be reduced in favor of naturally available cures, except for extreme and rare cases.

(d)    **Sevan :**    In the next 25 years, consumption and production should be more sustainable and circular, with a focus on reducing waste and emissions. This

includes reducing the use of non-renewable resources and shifting towards renewable energy sources. The production process should prioritize eco-friendly and ethical practices, such as reducing water usage and carbon emissions, promoting fair labor practices, and reducing plastic waste. The consumption patterns should shift towards more sustainable and responsible choices, such as reducing single-use plastics, choosing products with eco-friendly packaging, and promoting a circular economy. This requires a shift towards a more conscious and responsible approach towards consumption and production, with collaboration between businesses, governments, and consumers. Digital Transformation with state-of-the-art technologies shall significantly be able to achieve the stated objectives in this domain.

(e)    **Shristi :**    Overall, the next 25 years could be a critical period in determining the future of the environment, climate, and ecosystem, and concerted efforts would be required to address the challenges and promote sustainability. Digital technologies could address a lot of these challenges.

(f)    **Soochna :**    Control of the Information space and the narrative is very important to be a global leader and technology giant. India should focus on building a robust digital infrastructure, promoting research and development, and fostering a culture of innovation and entrepreneurship. Additionally, India should prioritize cybersecurity and data privacy to ensure the safe and secure use of information technology. The ultimate goal should be to leverage information technology to drive economic growth, improve the quality of life for citizens, and contribute to global development.

(g)    **Suraksha :**  India has no choice but to compulsorily embark on  an indigenization mission for all requirements of its defense forces. Considering the extensive intelligensisation of technology and the unreliability that comes alongwith COTS AI product, India needs to develop indigenous systems for its own use and become a net exporter of such technologies to its friendly nations.

## VISION ROADMAP to 2047

60.    In order to achieve self-reliance and total indigenization of technologies and be a Global leader with total technology Independence the implementation roadmap shall be as follows.

(a)    In Principle Acceptance of the Definitions of this Draft Document

(b)    Approval of the Vision Definition Document by the Competent Authority.

(b)      Formation of a Group of Experts (GoE) under TIFAC for drafting the Vision Detail Document

(c)      Acceptance and Approval of the Vision Detail Document

(d)      Drafting the Design document with aid of Consultants and Industry Experts alongwith the GoE of the Detail Document.

(e)      Acceptance and Approval of the Design Document for Vision 2047 by the Competent Authority

(f)      Drafting the Vision Delivery Document by Core group of Experts (CGoE) as constituted by the Competent authority

(g)      Implementation of the Vision Roadmap by a special project cell under the Niti Aayog, which shall supervise and converge all efforts under one umbrella body though a unified platform breaking the existing siloed approach.

## CONCLUSION

61.      In conclusion, creating a comprehensive vision roadmap for a country like India requires careful planning and execution. The roadmap plan needs to be divided into four stages: the Definition, Detail, Design, and Delivery documents. Each stage needs to be approved and accepted before moving to the next stage. With a clear and well-defined vision roadmap plan, India can achieve its long-term objectives and deliver tangible results. By 2047, India can become a global leader in technology, education, healthcare, infrastructure, and other areas. It is essential to continue working towards this vision and making progress towards achieving these goals for a better and brighter future for all.

62.      Artificial intelligence (AI) has the potential to revolutionize industries and transform societies. As one of the world's largest and fastest-growing economies, India needs to prioritize AI research and development to remain competitive and maintain its position as a global leader. Controlling AI and achieving singularity, which is the point at which AI surpasses human intelligence, can provide significant advantages to a country like India. It can lead to advancements in fields such as healthcare, transportation, and education, improving the quality of life for millions of people.

63.      If India does not prioritize AI and achieve singularity before other countries, it risks falling behind in terms of economic growth, technological advancements, and global competitiveness. Therefore, it is crucial for India to control AI and achieve singularity before anyone else does to secure its position as a global leader and reap the benefits of AI technology for its people.

64. The race for AI singularity is unlike any other, such as the nuclear or space technology race, as it offers no second chance or additional time for India to develop at its own pace. Thus, it is crucial to comprehend the threat posed by this technology domain and capitalize on the opportunity available today to commence the development of an Indigenous Intelligence Framework.

65. The framework suggested in this document is intended for creating a vision document must ensure clarity in the execution process, while the nebulous and amorphous aspect of the vision shall only pertain to the extent of the breakthrough achievements that identified technologies may bring. Nonetheless, the direction and conviction of our Technology vision will be vivid right from the outset.

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**ENCL & ANNEXURES**

**ANNEX 1:** Program Schedule for 06th and 07th Feb

**ANNEX 2:** List of Attendees