

**CONSUMER PROTECTION ASSOCIATION
HIMMATNAGAR
DIST. : SABARKANTHA
GUJARAT**



**Comments
On**

**Leveraging Artificial Intelligence and Big Data in
Telecommunication Sector**

Introduction :

The telecom sector has experienced several automation phases. While previous connections were still made manually by switching cables, hardware later automated this work. These features no longer need specific hardware but are virtually defined through software.

The telecommunication industry is riding the waves of the tech revolution and digital transformation to offer a wider variety of services to its consumers. However, consumers in today's digital world will not be happy with run-of-the-mill products and services – they also demand a better quality of services and more responsive service providers. Data-driven insights relied on solutions powered by AI and ML can help telecom providers fulfill these expectations.

Most of the current AI applications focus on improving specific parameters.

These are strictly defined applications such as:

1. Optimizing the Parameters of a Radio Signal
2. Power Management and
3. Quality of Transmission Estimation

AI and ML are disrupting and transforming businesses. Telecommunications companies can leverage these technologies to improve customer retention, enable self-service, improve equipment maintenance, and reduce operational costs at the same time.

The use of Artificial Intelligence in telecommunications can help solve several complex and sometimes long problematic issues and at the same time yield tons of added value to both consumers and operators alike. The latter has always been collecting substantial amounts of telemetry and service usage statistics, but most of it never got used in a meaningful way due to the lack of the right software.

With AI, this massive array of previously unused data can be turned into fertile soil for growing new services, improving the quality of existing ones, taking customer experience to a new level, and optimizing business operations. According to relatively recent studies, AI in telecom companies will be generating nearly 11 billion dollars by 2025 — a staggering amount that is likely to keep growing as the scope of AI applications expands.

The complexity of communications networks seems to increase inexorably with the deployment of new services, such as software-defined wide area networking (SD-WAN), and new technology paradigms, such as network functions virtualization (NFV). To meet ever rising customer expectations, communication service providers need to increase the intelligence of their network operations, planning and optimization.

Artificial intelligence (AI) and machine learning (ML) will be key to automating network operations and enhancing the customer experience. Although “ Big Data “ analytics is already widespread in the telecom industry, it is typically conducted in batch, after the fact, and used to manually update rules and policies. In order to move to real time closed loop automation, CSPs need systems that are capable to learning autonomously. That is only possible with AI/ML.

AI/ML techniques are beginning to emerge in the networking domain to address the challenges of virtualization and cloud computing. Network automation platforms such as the open networking Automation Platform (ONAP) will need to incorporate AI techniques to deliver efficient, timely and reliable operations.

As technology advances, previous benchmarks that defined artificial intelligence become outdated. For example, machines that calculate basic functions or recognize text through optical character recognition are no longer considered to embody artificial intelligence, since this function is now taken for granted as an inherent computer function.

ISSUES FOR CONSULTATION

Q.1. What may be the most appropriate definition of Artificial Intelligence (AI)? What are the broad requirements to develop and deploy AI models in a telecom sector? Whether any major challenges are faced by the telecom service providers in adopting AI? Please justify your response with rationale and global practices, if any.

Comments :

Definition of Artificial Intelligence (AI) :

1. The founding father of AI, Alan Turing, defines this discipline as: **“AI is the science and engineering of making intelligent machines, especially intelligent computer programs.”**

Alan Turing’s definition would have fallen under the category of “systems that act like humans.”

In these definitions, the concept of intelligence refers to some kind of ability to plan, reason and learn, sense and build some kind of perception of knowledge and communicate in natural language.

At its simplest form, artificial intelligence is a field, which combines computer science and robust datasets, to enable problem-solving. It also encompasses sub-fields of machine learning and deep learning, which are frequently mentioned in conjunction with artificial intelligence.

These disciplines are comprised of AI algorithms which seek to create expert systems which make predictions or classifications based on input data.

2. " It is the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable."

– John McCarthy

3. Stuart Russell and Peter Norving in his book " Artificial Intelligence : A Modern Approach " , which becomes one of the leading textbook in study of AI , they delve into four potential goals or definition of AI, which differentiates computer system on the basis of rationality and thinking VS. Acting.

(i) Human approach:

- Systems that think like humans
- Systems that act like humans

(ii) Ideal approach:

- Systems that think rationally
- Systems that act rationally

4. **Artificial intelligence (AI)**, the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings.

The term is frequently applied to the project of developing systems endowed with the intellectual processes characteristic of humans,

such as the ability to reason, discover meaning, generalize, or learn from past experience.

5. Artificial intelligence is the simulation of human intelligence processes by machines, especially computer systems. Specific applications of AI include expert systems, natural language processing, speech recognition and machine vision.

6. In the simplest terms, AI which stands for artificial intelligence refers to systems or machines that mimic human intelligence to perform tasks and can iteratively improve themselves based on the information they collect.

7. **Artificial intelligence (AI)**, the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings. The term is frequently applied to the project of developing systems endowed with the intellectual processes characteristic of humans, such as the ability to reason, discover meaning, generalize, or learn from past experience.

8. AI is not a single technology. It is an umbrella term that includes any type of software or hardware component that supports machine learning, computer vision, natural language understanding (NLU) and natural language processing (NLP).

9. Artificial intelligence leverages computers and machines to mimic the problem-solving and decision-making capabilities of the human mind.

In these definitions, the concept of intelligence refers to some kind of ability to plan, reason and learn, sense and build some kind of perception of knowledge and communicate in natural language.

10. Artificial Intelligence is the ability of a computer program to learn and think.

11. *Some general definitions*

- (i) “Artificial intelligence is a computerized system that exhibits behaviour that is commonly thought of as requiring intelligence.”
- (ii) “Artificial Intelligence is the science of making machines do things that would require intelligence if done by man.”

In nutshell :

What is intelligence?

Psychologists generally do not characterize human intelligence by just one trait but by the combination of many diverse abilities. Research in AI has focused chiefly on the following components of intelligence:

learning,
reasoning,
problem solving,
perception, and
using language

In general terms, AI refers to a broad field of science encompassing not only computer science but also psychology, philosophy, linguistics and other areas. AI is concerned with getting computers to do tasks that would normally

require human intelligence. Having said that, there are many points of view on AI and many definitions exist.

Artificial intelligence (AI) refers to the simulation of human intelligence in machines that are programmed to think like humans and mimic their actions. The term may also be applied to any machine that exhibits traits associated with a human mind such as learning and problem-solving.

The ideal characteristic of artificial intelligence is its ability to rationalize and take actions that have the best chance of achieving a specific goal. A subset of artificial intelligence is machine learning (ML), which refers to the concept that computer programs can automatically learn from and adapt to new data without being assisted by humans. Deep learning techniques enable this automatic learning through the absorption of huge amounts of unstructured data such as text, images, or video.

Artificial intelligence is the simulation of human intelligence processes by machines, especially computer systems. Specific applications of AI include expert systems, natural language processing, speech recognition and machine vision.

Q. What are the broad requirements to develop and deploy AI models in a telecom sector?

AI needs a framework and how they will develop their AI – based products and services in future. AI is just a tool and is neutral in itself. It is therefore up to the service provider to use them positively without ignoring the

risks and to deal with them responsibly. The framework should have self binding guidelines like :

1. Responsibility : They should clearly define who will be responsible. Like :

- Financial or civil penalties
- Should damage compensated accordingly?
- AI system and their use should follow the law and order

2. Careful :

They should treat AI with care. They should subject their AI system to law and order.

3. Supportive :

They should focus on their customers. They should simplify AI and enrich the lives of their customer.

4. Transparent :

They should stand for transparency. A completely different kind of transparency is needed and possibly a checked by independent third parties.

5. Safe for Data security and Data Protection :

They should offer security. Customer data should be protected against unauthorized external access.

6. Reliability

7. Trusting

8. Co-operative and

9. Explanatory

10. There should be a Panic button, which ensure that one can intervene if something goes wrong.

Traditionally IT system in Telecom usually monitor the service calls and reports to assigned employee and so on. The critical factors in development and Deployment of AI models in Telecom sectors are :

1. Affordability :

The key for business proposition is the affordability of the AI platform. The research projects and the startup companies can make a credible impact in AI development with its cost effective rollout.

2. Robust design/architecture :

The coding framework and system design is especially important in terms of Anti hacking and Anti redundancy characteristics. Even the documentation control and change management of the product manual is crucial for future resolutions and products updates.

3. Ease in deployment :

The AI product should be adaptable with the existing market technologies and infrastructure for easy deployment. It should take minimum or no change to the existing infrastructure and resources of the company.

4. Flexible structure :

Careful thought must be applied during the product development for accommodation of any future updates to the system structure. It helps in automating more process parameters in future as per the dynamic business/process requirements.

5. Availability of the Network endpoints :

In today's complex networks every end points availability is extremely critical to avail maximum productivity. The typical endpoints are server, network switches, routers etc..

6. Storage space availability :

Data is invaluable asset to any organization. To storage the data, one need enough high available, scalable and reliable storage capacity. It is better to have data classification along with retention policy.

7. Application Program Interface (API) availability :

With every changing needs with its agile nature, API has become a key component in Application Architecture. As most of the organizations started adopting micro services architecture as part of cloud transformation, API availability become even more critical.

8. Monitoring.

Other Causes are :

1. Inability to recognize the need for AI - 23%
2. Unstructured or incomplete data - 19%
3. Need for additional technical expertise - 18%
4. Liability to identify appropriate business cases. - 17%
5. Technical integration - 08%

Q. Whether any major challenges are faced by the telecom service providers in adopting AI?

Today's Telecom service providers (CSPs) face both internal and external challenges.

Poor Network Management

Global traffic and the need for more network equipment are growing dramatically, resulting in more complex and costly network management.

Lack of Data Analysis

Telecoms struggle to leverage the vast amounts of data collected from their massive customer bases over the years. Data may be fragmented or stored across different systems, unstructured and uncategorized, or simply incomplete and not very useful.

High Costs

Following massive investments in infrastructure and digitalization, industry analysts expect telecoms' global operating expenditures to increase by billions of dollars. Many telecoms face a financial crunch and must find ways to improve their bottom lines.

Crowded Marketplace

Telecom customers are demanding higher quality services and better customer experience (CX) and are known to be especially susceptible to churn when their needs are not met.

TOP CHALLENGES OF USING AI IN TELECOM AND HOW TO SOLVE THEM

Even though the global AI in telecommunication market is growing rapidly, implementing it can still be tricky for many businesses. Besides being unable to recognize the need for AI or identify appropriate business use cases, the most common challenges of implementing AI in telecoms are as follows :

1. Unstructured or incomplete data

Implementing an AI system without access to relevant data is a fruitless endeavor. Many organizations struggle with data collection because of several common issues:

- **Fragmented data** : Data is collected and stored by different systems without a single unified database from where it can be accessed.

- **Unstructured data** : A big mass of uncategorized data without any context or explanation of what it is related to is not very useful to any AI algorithm.
- **Incomplete data** : Using data with missing components can lead to inconsistent or faulty learning by the AI system.

Solution : Since AI algorithms require clean well-structured data, around **80% of the time of any ML project is dedicated to ETL** (extracting, transforming, loading) and data cleanup. Therefore, it is important to put an appropriate big data engineering ecosystem in place that will collect, integrate, store, and process data from numerous siloed data sources.

2. Need for additional technical expertise

AI is a relatively new technology. With limited local talent, building an in-house team can take a significant amount of time and yield little result.

3. Technical integration

Old legacy systems are one of the most common reasons.

Q.2. Whether the big data in the telecom sector may be utilized for developing AI models? For efficient and effective handling of big data, whether there is a need for adoption of special programming models or software frameworks? Please justify your response with suitable examples and global practices, if any.

Comments : **Yes.**

Big data and Artificial Intelligence have a synergistic relationship. It goes hand in hand. Without data, there would be no artificial intelligence. Without artificial intelligence, all the raw data wouldn't be usable, as there would be no way to process it efficiently, let alone in real time. Data preparation is much easier with the use of AI tools. AI requires a massive sale of data to learn and improve decision making processes and big data analytics leverages AI for better data analysis. With this convergence, one can more easily leverage advanced analytics capabilities like augmented or predictive analytics and more efficiently surface actionable insights from the vast stores of data. With big data AI powered analytics, one can empower their users with the intuitive tools and robust technologies they need to extract high-value insights from data, fostering data literacy across the organization while reaping the benefits of becoming a truly data-driven organization.

The ultimate goals of AI are as follows:

- Reasoning
- Automated learning and scheduling
- Machine learning
- Natural language processing (the ability to understand human speech as it is spoken)
- Computer vision (the ability to extract accurate information from an image or series of images)
- Robotics
- General intelligence

For these AI fields to mature, their AI algorithms will require massive amounts of data. Natural language processing, for example, will not be possible without millions of samplings of human speech, recorded and broken down into a format that AI engines can more easily process.

Big data will continue to grow larger as AI becomes a more viable option for automating more tasks — and AI will become a larger field as more data is available for learning and analysis.

By bringing together big data and AI technology, companies can improve business performance and efficiency by:

- Analyzing consumer behavior and automating customer segmentation
- Personalizing and optimizing the performance of digital marketing campaigns
- Using intelligent decision support systems fueled by big data, AI, and predictive analytics

AI can assist users in all phases of the big data cycle, or the processes involved in the aggregation, storage, and retrieval of diverse types of data from various sources. These include :

- Data management,
- Pattern management,
- Context management,
- Decision management,
- Action management,

- Goal management, and
- Risk management.

AI can identify data types, find possible connections among datasets, and recognize knowledge using natural language processing. It can be used to automate and accelerate data preparation tasks, including the generation of data models, and assist in data exploration. It can learn common human error patterns, detecting and resolving potential flaws in information. And it can learn by watching how the user interacts with an analytics program, surfacing unexpected insights from massive datasets fast. AI can also learn subtle differences in meaning, or context-specific nuances, in order to help users better understand numeric data sources. And it can alert users to anomalies or unexpected patterns in data, actively monitoring events and identifying potential threats from system logs or social networking data, for example.

Synergy in Technology Innovation :

Big data and artificial intelligence are also linked in terms of research and technological innovation for each field. Big data technology uses AI theories and methods and AI relies on large volumes of data and the supporting big data technologies to improve and evolve decision making capabilities.

Q. For efficient and effective handling of big data, whether there is a need for adoption of special programming models or software frameworks?

Comments : **Yes.**

1. In the age of Internet of Things and social media platforms, novel programming models and systems were proposed for collecting and analyzing huge amounts of data in a reasonable time, by leveraging high performance computers and parallel and distributed algorithms. However, the ability to generate and gather data is increasing in a constant and drastic way, which poses a series of challenges to the current solutions aimed at processing, storing and analyzing Big Data. Due to this, current frameworks are expected to be constantly improved for coping with such challenges, allowing the effective extraction of useful knowledge in several application domains. Furthermore, the novel Exascale systems pose new requirements for addressing architectures composed of a very large number of cores. In particular, in the near future, existing frameworks will have to address a wide range of issues related to energy consumption, scheduling, data distribution and access, communication and synchronization, in order to enable the scalable implementation of real Big Data analysis applications
2. Big Data on the one hand it opens up to several opportunities to extract useful information and produce valuable knowledge for science, economy, health, and society, on the other hand, its volume and speed are overwhelming the ability to use it.
3. In this scenario, data mining and machine learning have grown over the past decades as two research and technology fields that provided several different techniques and algorithms to automatically extract hidden, unknown, but potential value from massive repositories. However,

sequential data analysis algorithms are not feasible for extracting useful models and patterns from huge volumes of data in a reasonable time. For this reason, high performance computers, such as many and multi-core systems, Clouds, and multi-clusters, along with parallel and distributed algorithms and systems are required by data scientists to tackle Big Data issues.

4. In the age of the Internet of Things and social media platforms, huge amounts of digital data are generated by and collected from many sources, including sensors, mobile devices, wearable trackers and security cameras. This data, commonly referred to as Big Data, is challenging current storage, processing, and analysis capabilities. New models, languages, systems and algorithms continue to be developed to effectively collect, store, analyze and learn from Big Data. Most of the recent surveys provide a global analysis of the tools that are used in the main phases of Big Data management (generation, acquisition, storage, querying and visualization of data). Differently, the work should analyze and reviews parallel and distributed paradigms, languages and systems used today to analyze and learn from Big Data on scalable computers. In particular, it should provide an in-depth analysis of the properties of the main parallel programming paradigms and, through programming examples. Furthermore, there should be discussion and comparison with the different systems by highlighting the main features of each of them, their diffusion (community of developers and users) and the main advantages and disadvantages of using them to implement Big Data analysis applications. The final goal of the work should be to help designers and developers in identifying and

selecting the best/appropriate programming solution based on their skills, hardware availability, application domains and purposes, and also considering the support provided by the developer community.

5. The programming feature comparison should be based on three main criteria that assess the suitability of each framework in supporting parallel and distributed programming:
 - (i) type of parallelism that describes how a system allows for expressing parallel operations;
 - (ii) level of abstraction that refers to their programming capabilities for hiding low-level details; and
 - (iii) class of applications that describes the most common application domain of a system.
6. Through the analysis, comparison and programming examples the developers can find a useful way to identify and select the best solution based on their skills, hardware availability, application domains and purposes, and the support provided by the developer community.
7. The work should be presented in the following main aspects:
 - (i) They should focus their attention on systems that are widespread and used by a large number of users around the world, by analyzing their characteristics and describing their peculiarities;
 - (ii) The showed data analysis examples should be supported by diagrams and code snippets, for all the frameworks they considered; and

- (iii) They should provide a broad comparison of frameworks based on different principles, such as programming aspects, size of the developer community and diffusion in the IT world, strengths and weaknesses of each framework.
8. Such systems should be compared according to several criteria concerning three main aspects:
 - (i) Their features,
 - (ii) Diffusion and
 - (iii) The advantages/disadvantages of using them.
 9. The analysis of each system should be carried out with the discussion of a programming example and code snippets to better show the potential and limitations of each one.
 10. The final aim should be to support users, designers and developers in identifying and selecting the best solution according to:
 - (i) their skills in terms of programming capabilities and knowledge of languages;
 - (ii) hardware availability;
 - (iii) application domain and purposes; and
 11. Support provided by the software community, concerning both the availability of multi-language APIs, project maintenance on GitHub

repository and the availability of solutions for problems in Q&A platforms such as, for example, Stack Overflow or Memory Exceptions.

Q.3. Whether deployment of 5G and beyond technologies will help to accelerate adoption of AI in all the sectors and vice versa? Please justify your response with suitable illustrations including global practices, if any.

Comments : **Yes.**

5G and AI are both mutual enablers. 5G provides the infrastructure massive amounts of data required for successful AI. These will enable companies to grow on the growth wave, keeping their investors, customers, and employees happy.

The technology leaders surveyed said 5G will benefit areas like telemedicine, including remote surgery and health record transmissions (24%), remote learning and education (20%), personal and professional day-to-day communications (15%), entertainment, sports and live events streaming (14%), manufacturing and assembly (13%), transportation and traffic control (7%), carbon footprint reduction and energy efficiency (5%), and farming and agriculture (2%).

As for industry sectors most impacted by technology in 2022, technology leaders surveyed cited manufacturing (25%), financial services (19%), healthcare (16%) and energy (13%). As compared to the beginning of 2021, 92% of respondents agreed that implementing smart building technologies that benefit sustainability, decarbonization and energy savings has become a top priority for their organization.

The 5G will deliver superior performance and greater efficiency. 5G will provide faster speed, lower latency, and connect a very high density of sensors. 5G will offer a high-performance wireless infrastructure that makes it easier to modify factory layouts and connect all sensors and machinery with near real-time connectivity. These characteristics will make mobile networks reliable enough to support mission-critical systems and enable revolutionary bandwidth and latency-sensitive applications like Virtual Reality (VR), Augmented Reality (AR), Extended Reality (XR), the Industrial Internet of Things (IIoT), Intelligent Video Analytics (IVA), and, Artificial Intelligence (AI).

AI and 5G are two disruptive technologies set to become the engines of a new technological revolution. The most exciting application for 5G, AI, is expected to put forth many exciting and unique use cases which will create new revenue streams. AI has already been integrated into networks to reduce capital expenditure, optimize network performance and generate new revenue streams. It is now expected that 5G enables AI by providing high-quality, cost-effective, and reliable connectivity leveraging edge computing. 5G and AI have excellent individual capability across numerous verticals. AI and 5G, both individually, are revolutionizing industries and enabling new experiences. Their combination is expected to be transformative and will support each other in accelerating their adoption. AI will have a huge impact on several important 5G network management areas, like enhanced service quality, simplified deployment, higher network efficiency, and improved network security.

The promising use cases for 5G and AI together are limitless. The most prominent place where AI and 5G can already work together is in smart phones. Today, most of smart phones' 5G and AI capabilities revolve around the camera,

photos filters, or AR applications like Snap chat. For example, the Google Photos app combines the power of 5G and AI cloud and improves the sorting and recognition of objects as the photos get uploaded on a real-time basis. Also, the current use of these technologies within the voice assistants sphere has improved the speed of speech-to-text and verbal search queries. This is expected to get faster, responsive, and more powerful with the low latency and high speed of 5G.

The automotive industry is also speculating big on 5G connectivity and its potential when combined with AI. Today, every major car manufacturer has developed its own autonomous vehicle virtually. Some manufacturers are already testing self-driving vehicles. These autonomous vehicles rely on sensors to detect their surroundings continuously. They first identify and classify the information (perception), followed by acting on the information through autonomous vehicle control.

AI is expected to become an essential component in managing data communications, critical for efficient power generation and consumption. This could be a possible application for AI and 5G, although the energy sector appears to be following a moderate adoption of 5G because utilities' unwillingness to test new technologies.

The use of sensor technology, like in the energy sector, is already being adopted in the agriculture sector through IoT devices that enable the farmers to better measure significant factors such as moisture, fertilization, control pests, and weather patterns.

AI in healthcare offers new approaches to solve health challenges. The combination of fast data speeds and AI could improve healthcare quality, particularly when AI is used to detect diseases or reduce costs. Other applications

in healthcare that would require high speed connectivity include remote-control surgery, real-time remote monitoring, and downloading large data files, as the healthcare industry generates a massive amount of data daily.

In the education sector, the dual combination of 5G and AI is making education through virtual reality possible. This requires high bandwidth and low latency for optimal performance. Reduced download speeds with 5G can free teachers to use their time in other areas. IoT devices can also be used to automate administrative tasks.

Q.4. Do you think that a number of terminologies such as Trustworthy AI, Responsible AI, Explainable AI etc. have evolved to describe various aspects of AI but they overlap and do not have any standardized meanings? If yes, whether there is a need to define or harmonize these terms? Please justify your response with rationale and global practices, if any.

Comments : **Yes.**

The standardization landscape is rich and complex, because of the variety of standards and the organizations producing them. Standards define some specific characteristics for a specific item (which may be, for instance, a material, a product, a procedure, a process or a service), in order to make such an item meet certain well-defined objectives (which may relate, for instance, to performance or interoperability). We have also seen that they do not aim to fully characterize the items they are dealing with, but just to accurately define the minimum set of characteristics to ensure the defined objectives are met.

CODE OF GOOD PRACTICE FOR THE DEVELOPMENT OF STANDARDS :

Standardization is based on a set of fundamental principles and mechanisms to foster the production of fair standards. These principles have been identified by the World Trade Organization's (WTO) Committee of Technical Barriers to Trade (TBT) (WTO 2000) and are fulfilled by the recognized Standards Development Organization (SDOs). Other SDOs tend to apply these principles in their methodology as well. The principles cover notions such as :

- Openness,
- Transparency,
- Impartiality,
- Consensus,
- Efficiency,
- Relevance,
- Development, and
- Coherence.

Respecting these principles is especially important for standards to be referenced by regulations. This explains why authorities often prefer to mandate and use standards published by recognized Standard Development Organization (SDOs), which fully adhere to these principles. Indeed, industrial alliances have their own set of rules and usually prefer the faster adoption of their specifications, as compared to SDO standards. Membership and participation of experts are restricted to a specific industry group, which results in a lower level of enforcement of fundamental principles such as openness and transparency.

Standards must be clear and unambiguous. This implies that it need to have a well-defined structure, to help customer retrieve relevant information. The language must be plain and sentences must be meaningful and as short and concise as possible. Usage of lists, tables, pictures and specialized notations (i.e. special formalisms to describe requirements) should be strongly encouraged, as it adds clarity to the requirements. Though specialized notations may be obscure to newcomers, they are expected to be clear to target readers with the required expertise.

References to other standards should be carefully organized, so that it is possible to distinguish normative references (i.e., other documents that are directly referenced within normative provisions in the main body of the standard) from informative references (that provide additional information for clarification purposes).

Standard Development Organization (SDOs) take specific measures to make their standards effectively fit the above-listed scopes and objectives, which means ensuring that it is clear, unambiguous and not unnecessarily over-prescriptive, and that they only stress the essential requirements for the compliance of the item they are addressing. In order to ensure that standards have the above-listed characteristics, SDOs can define their own guidelines and rules to steer the standards writing process.

The main characteristics of SDOs:

- They should work by building consensus among participants; they follow self-imposed formal standards development procedures to guarantee consensus building and quality deliverables.
- SDO standardization effort benefits innovation, trade and environment; yet there are risks of disadvantages, which SDOs need to manage.
- The standardization landscape is crowded. There are many SDOs, with no hierarchical relationship, whose activities may overlap; however, SDOs work to set up liaisons or common standardization initiatives. SDOs may be roughly classified by geographical coverage, by type of affiliates and by technical scope of activities.
- Each SDO should set its own specific internal processes to develop standards; nevertheless, different SDO processes have common features that allow a generic standard document life cycle to be drawn up.

STANDARD MAINTENANCE TO UPDATE, EVOLVE OR WITHDRAW STANDARD CONTENT :

Standards have to be kept updated in order to ensure that they remain relevant in the context of changing market or regulatory needs, and new scientific and technological developments. This is an important part of the viability of a working standard. Some SDOs trigger an automatic review of the validity of the standard after a pre-defined period, for instance every five or ten years. Corrections may be needed at different levels. Such corrections may include technical or editorial corrections of inconsistencies, issues in the concept or content of the standard, extension of the standard's domain of use, and evolution of the technology and/or of other standards in the committee or in peer technical bodies. If the need for corrections or maintenance of the standard is identified

during the review or because flaws are discovered, the whole process is restarted to publish an amendment, update the standard, create a new standard, withdraw an obsolete standard, or downgrade the current standard to an inactive status. If the standard is referenced in a regulatory text, the procedure takes into account the transition period required to amend the reference.

Q.5. Which are the applications of AI and BD already being used by the TSPs in their networks to improve Quality of Service, Traffic Management, Spectrum Management and for Security purposes? Please list out all such applications along with the level of maturity of such applications. Please specify whether they are at trial stage or pilot stage or have reached the deployment stage? Details should include type of AI models, methods to access data, and procedures to ensure quality of data.

Comments : **No Comments.**

Q.6. What are the major challenges faced by the telecom industry, including policy and regulatory, in developing, deploying, and scaling applications of AI listed in the response to Q.5? How can such challenges be overcome? Please justify your response with rationale and suitable examples, if any.

Comments : **No Comments.**

Q.7. In which areas of other sectors including broadcasting, existing and future capabilities of the telecom networks can be used to leverage AI and BD? Please justify your response with rationale and suitable examples if any.

Comments :

It's hard to say how the technology will develop, but most experts see those "commonsense" tasks becoming even easier for computers to process. That means robots will become extremely useful in everyday life. This is a transition that will take years across different sectors of the workforce. Fast processes and lots of clean data are key to the success of AI.

Some of the most standard uses of AI are machine learning, cyber security, customer relationship management, internet searches and Digital personal assistants.

"AI is starting to make what was once considered impossible possible, like driverless cars.

Graphic processing units (GPUs) are also going to get faster, improving the applications of artificial intelligence software across the board.

1. Hotel Industry :

We sees AI on the cusp of revolutionizing familiar activities like dining. AI could be used by a restaurant to decide which music to play based on the interests of the guests in attendance. Artificial intelligence could even alter the appearance of the wallpaper based on what the technology anticipates the aesthetic preferences of the crowd might be.

2. AI will take digital technology out of the two-dimensional, screen-imprisoned form to which people have grown accustomed. We foresees that the primary user interface will become the physical environment surrounding an individual.

3. “We’ve always relied on a two-dimensional display to play a game or interact with a webpage or read an e-book,” with the help of Artificial intelligence and a combination of the Internet of Things, the display won’t be the main interface – the environment will be. One will see people designing experiences around them, whether it’s in connected buildings or connected boardrooms. These will be 3D experiences one can actually feel.”

4. The structure of the workforce is changing. It allows us to really create a knowledge-based economy and leverage that to create better automation for a better form of life. It might be a little bit theoretical, but I think if you have to worry about artificial intelligence and robots replacing our jobs, it’s probably algorithms replacing white-collar jobs such as business analysts, hedge fund managers and lawyers etc..

5. Service Sector :

- (i) Predicting the desired products for consumers
- (ii) Making customer service hassle free using AI
- (iii) Using Behavior Analytics to create smooth virtual experience.
- (iv) Discovering AI Enabled customer insights.

6. Financial Sector :

AI may present particular risks of consumer protection, such as risks of biased, unfair or discriminatory consumer results, or data management and usage concerns. While many of the potential risks associated with AI in finance are not unique to AI, the use of AI could amplify such vulnerabilities given the extent of complexity of the techniques employed, the dynamic adaptability of AI-based models and their level of autonomy for the most advanced AI applications.

Finance has always needed one of the most precise forms of computing systems in place for a myriad of its purposes. As far as AI and ML are concerned, the finance sector would rely heavily on the systems powered by these technologies to detect fraudulent transactions and pave the way for safer and more secure online transactions. It can also predict the rise and fall of stock values in the market and help financial advisers with ideal investment plans.

Artificial Intelligence is mainly used to analyze patterns within large data sets. Therefore, it is no surprise that it's often used in trading. AI-powered computers can swiftly, effectively, and efficiently sift through data faster than humans. This greatly expedites the whole analysis process and saves large chunks of time.

7. Health care sector

Artificial intelligence is already arriving as a game changer in the healthcare sector. IBM's cognitive supercomputer was able to quickly diagnose the presence of a rare type of leukemia in a patient that even doctors could not do after months of study. There are algorithms and systems that aid in the detection and treatment of chronic ailments, and with electronic health records in place, artificial intelligence and machine learning systems are only making personalized healthcare a reality today. Also predictive healthcare is slowly gaining momentum as well.

A virtual nurse is a fantastic example of Artificial Intelligence in healthcare. It uses Natural Language Processing, speech recognition, Machine Learning, and

wireless integration with various medical devices such as blood pressure cuffs to provide effective medical assistance to patients.

Following key features his virtual nurse provides:

- Scheduling an appointment
- Nurse Line
- ER Direction
- Self-care
- Clinical advice

Apart from this the AI is useful in :

- For better diagnosis
 - Preventing disease moving to higher stage
 - Effective treatment
 - Research Field
 - Telemedicine
 - Wrong diagnoses are a significant problem in the medical sector. AI can help doctors in avoiding these errors by providing them with relevant databases and recommendations. It can analyze the database of patients with similar symptoms and suggest the treatment that was the most successful in those cases.
 - Many major organizations, including IBM and Microsoft, are collaborating with medical institutions to solve the various problems present in the healthcare sector.
 - AI can also help in reducing medical costs by preventing diseases beforehand and helping doctors in making better diagnoses.
8. Algorithmic trading and High frequency trading activities in stock exchanges.
 9. Socio Cultural polarization

10. The unstructured and noisy nature of the text data often poses significant challenges for organization in leveraging them for decision making. Text mining methods and techniques may be employed to quantitatively analyze the large database.
11. Artificial Intelligence has significantly altered the very nature of our modern business practice. The fascination towards non-living entities “ Thinking and Acting “ with human intelligence is still fresh and exciting. This trend puts more emphasis on Anthropomorphic AI. AI can help brand practioners engage their customers more with their Anthropomorphic brands. In near future machine can be more effective in communicating band information with consumers when the machine knows how to interact with consumers emotional state e.g. through their face and body.
12. Hyper parameter in the area of machine learning.
13. Education

Artificial intelligence plays a huge role in every aspect of education.

- Artificial intelligence can make sure that every educational software is customized according to the student’s needs and capabilities.
- Education will now be available to everybody sitting across the globe without any language barriers.
- While there are several concerns that once AI becomes more prevalent, the people doing manual labour will lose their jobs. While AI has the ability to do several menial tasks, they are meant to complement these workers and not replace them. AI is just a machine, and it will require human assistance.

14. Chat Boats
15. Automated grading
16. Agriculture sector

17. Transport sector :

Autopilot helps the human operator and assists them in heading in the right direction. A pilot of a modern aircraft usually works for 7 minutes; the autopilot handles most of the steering of the plane. This allows the pilots to focus on other more important areas of the flight, such as the weather and the trajectory of the plane.

Another area where the future scope of AI is quite broad is driverless cars. Many companies are developing autonomous vehicles, which will rely heavily on AI and ML to operate optimally. Experts believe self-driving cars will bring many long-term and short-term benefits, including lower emissions and enhanced road safety. For example, self-driving cars will be free from human errors, which account for 90% of traffic accidents. Many companies, including Tesla and Uber, are developing these vehicles.

Smart cars have already made their way to the markets. Back in 2015, the implementation of AI-driven systems in cars and vehicles was just 8% but by 2025, the rates are expected to jump to 109%. Connected cars are the in-thing in the automobile industry right now, where predictive mechanisms accurately tell drivers the probable malfunctioning of spare parts, routes and driving directions, emergency and disaster prevention protocols and more.

Siemens Mobility has tested a prototype A.I. monitoring system through traffic cameras. Here the product alters the traffic lights and controls the traffic based on real-time road congestion. This directly helps in reducing traffic-related incidents and also helps in minimizing road

congestion. Through this smart system, there will be a reduction in redundant traffic, enhanced road safety, and also reduced wait times

18. Home :

AI has found a special place in people's homes in the form of Smart Home Assistants. Amazon Echo and Google Home are popular smart home devices that let you perform various tasks with just voice commands.

There's a lot of room left for improvement, but surely, the scope of AI in the smart home sector is booming.

19. AI in Cyber security

20. Manufacturing Industry :

The manufacturing industry has tons of aspects that AI-based bots or systems could fix. From robot-driven assembly lines to intelligent systems that can predict the malfunctioning of machinery, AI would become inevitable for the manufacturing industries. It could also remove redundant skill sets and engage employees in meaningful work. AI-based bots or machines would also assist in solving supply-chain concerns over a wide geographical location, minimizing the shipping and delivery timing of online products.

The BMW Group uses automated image recognition for quality checks, and inspections to eliminate pseudo-defects to ensure there are no deviations from the target despite no actual faults. This has resulted in them achieving high levels of precision in manufacturing.

21. Data Analysis

22. AI in Science and Research :

AI is making lots of progress in the scientific sector. Artificial Intelligence can handle large quantities of data and processes it quicker than human minds. This makes it perfect for research where the sources contain high data volumes.

23. Advertising

Instead of spending thousands of dollars on a campaign to test if it would be effective for a set pool of target audience, AI-powered systems would efficiently simulate the campaign with past data in hand and deliver precise results. This would be a game changer in marketing as brands and businesses would have a sure-shot avenue to place their money. Reaching out to potential customers, generating leads and converting them to sales, identifying the market share of a new product before launch, and competition research could all become easier with smart sentiment analysis tools and techniques.

24. The retail Industry :

The retail industry has transformed its supply chain with digital twin technology, object tracking, GPS based fleet management, IoT data capturing etc..

25. Governance Sector.

Q.8. Whether risks and concerns such as privacy, security, bias, unethical use of AI etc. are restricting or likely to restrict the adoption of AI? List out all such risks and concerns associated with the adoption of AI. Please justify your response with rationale and suitable examples, if any.

Comments : **Yes.**

Algorithmic transparency and explainability, clarity on liability, accountability and oversight, bias and discrimination, and privacy are ethical and regulatory questions that have been raised.

In the policy paper - AI Sector Deal - the UK proposes four grand challenges:

- (i) AI and Data Economy,
- (ii) Future Mobility,
- (iii) Clean Growth, and
- (iv) Ageing Society.

The Pan Canadian Artificial Intelligence Strategy focuses on developing global thought leadership on the economic, ethical, policy, and legal implications of advances in artificial intelligence. (Ref. <https://www.cifar.ca/ai/pan-canadian-artificial-intelligence-strategy>)

Without adequate institutional planning, there is a risk of national strategies being too monolithic in nature. Without sufficient supporting mechanisms in the form of national institutions which would drive the AI research and innovation, capacity building and re-skilling of workforce to adapt to changing technological trends, building regulatory capacity to address new and emerging issues which may disrupt traditional forms of regulation and finally, creation of an environment of monetary support both from the public and private sector it becomes difficult to implement a national strategy and actualize the potentials of AI . As stated above, there is also a need for identification of key national policy problems which can

be addressed by the use of AI, and the creation of a framework with institutional actors to articulate the appropriate plan of action to address the problems using AI.

The National Roadmap for Artificial Intelligence by NITI Aayog proposes the creation of a National AI marketplace that is comprised of a data marketplace, data annotation marketplace, and deployable model marketplace/solutions marketplace. In particular, it is envisioned that the data marketplace would be based on blockchain technology and have the features of: traceability, access controls, compliance with local and international regulations, and robust price discovery mechanism for data.

Re-thinking Intellectual Property Regimes :

Going forward it will be important to develop an intellectual property framework that encourages innovation. AI systems are trained by reading, viewing, and listening to copies of human-created works. These resources such as books, articles, photographs, films, videos, and audio recordings are all key subjects of copyright protection. Copyright law grants exclusive rights to copyright owners, including the right to reproduce their works in copies, and one who violates one of those exclusive rights “is an infringer of copyright. The enterprise of AI is, to this extent, designed to conflict with tenets of copyright law, and after the attempted ‘democratization’ of copyrighted content by the advent of the Internet, AI poses the latest challenge to copyright law. At the centre of this challenge is the fact that it remains an open question whether a copy made to train AI is a “copy” under copyright law, and consequently whether such a copy is an

infringement. The fractured jurisprudence on copyright law is likely to pose interesting legal questions with newer use cases of AI. For instance, Google has developed a technique called federated learning, popularly referred to as on-device ML, in which training data is localized to the originating mobile device rather than copying data to a centralized server. The key copyright questions here is whether decentralized training data stored in random access memory (RAM) would be considered as “copies”? There are also suggestions that copies made for the purpose of training of machine learning systems may be so trivial or de minimize that they may not qualify as infringement. For any industry to flourish, there needs to be legal and regulatory clarity and it is imperative that these copyright questions emerging out of use of AI be addressed soon.

AI Networking Infrastructure :

Organizations will need to upgrade their networks in a bid to upgrade and optimize efficiencies of scale. Scalability must be undertaken on a high priority which will require a high-bandwidth, low latency and creative architecture, which requires appropriate last mile data curation enforcement.

Awareness, Education, and Reskilling :

Encouraging AI research :

This can be achieved by collaborations between the government and large companies to promote accessibility and encourage innovation through greater R&D spending. The Government of Karnataka, for instance, is collaborating with

NASSCOM to set up a Centre of Excellence for Data Science and Artificial Intelligence (CoE-DS&AI) on a public-private partnership model to “accelerate the ecosystem in Karnataka by providing the impetus for the development of data science and artificial intelligence across the country.” Similar centres could be incubated in hospitals and medical colleges in India. Principles of public funded research such as FOSS, open standards, and open data should be core to government initiatives to encourage research. The Niti Aayog report proposes a two tier integrated approach towards accelerating research, but is currently silent on these principles. (<https://cis-india.org/internet-governance/blog/niti-aayog-discussion-paper-an-aspirational-steptowards-india2019s-ai-policy>).

Coordinated Implementation :

Key sectors in India need to begin to take steps to consider sector wide coordination in implementing AI. Potential stress and system wide vulnerabilities would need to be considered when undertaking this. Sectoral regulators such as RBI, TRAI, and the Medical Council of India are ideally placed to lead this coordination.

Lack of AI and cloud computing infrastructure:

AI and cloud are inseparable because AI is data hungry and cloud is the only viable solution. There are endless possibilities to scale up AI with its convergence with cloud computing. However, despite the potential, India lacks access to specialized compute and storage facilities which forms the backbone of AI.

Lack of integrity and ethics with AI and ML solutions:

With the advent of AI products and algorithms and their increasing role in decision making, ethics and morality have emerged as a major challenge for the AI solution providers. An AI algorithms work based on training given to it, meaning the AI solution predicts instances based on the data being fed into it and based on the self-learning capability. However, in a few instances, the AI algorithm overlooks the correctness of the data and give an ambiguous result. It is also possible for the results to be skewed due to tampering of the dataset itself.

Q.9. What measures are suggested to be taken to address the risks and concerns listed in response to Q.8? Which are the areas where regulatory interventions may help to address these risks and concerns? Please justify your response with rationale and suitable examples, if any.

Comments :

Develop contextual standard benchmarks to assess quality of algorithms :

In part because of the nascency of the development and implementation of AI, towards enabling effective assessments of algorithms to understand impact and informing selection by institutions adopting solutions, standard benchmarks can help in assessing quality and appropriateness of algorithms. It may be most effective to define such benchmarks at a sectoral level (finance etc.) or by technology and solution (facial recognition etc.). Ideally, these efforts would be led by the government in collaboration with multiple stakeholders.

Appropriate certification mechanisms :

Appropriate certificate mechanisms will be important in ensuring the quality of AI solutions. A significant barrier to the adoption of AI in some sectors in India is acceptability of results, which include direct results arrived at using AI technologies as well as opinions provided by practitioners that are influenced/aided by AI technologies. For instance, start-ups in the healthcare sectors often find that they are asked to show proof of a clinical trial when presenting their products to doctors and hospitals, yet clinical trials are expensive, time consuming and inappropriate forms of certification for medical devices and digital health platforms. Startups also face difficulty in conducting clinical trials as there is lack of a clear regulation to adhere to. They believe that while clinical trials are a necessity with respect to drugs, the process often results in obsolescence of the technology by the time it is approved in the context of AI. Yet, medical practitioners are less trusting towards startups who do not have approval from a national or international authority. A possible and partial solution suggested by these startups is to enable doctors to partner with them to conduct clinical trials together. However, such partnerships cannot be at the expense of rigour, and adequate protections need to be built in the enabling regulation.

Q.10. What measures do you suggest to instill trust and confidence regarding a robust and safe AI system among customers, TSPs and other related entities/stakeholders? Whether adopting general principles such as Responsible AI and ethical principles at the time of designing and operationalizing the AI models will help in developing ethical solutions and instilling trust and confidence in the users? What may be such principles and who should formulate these and how compliance can be ensured? Please justify your response with rationale and suitable examples, if any.

Comments :

Transparency is everything :

Until recently, there has been too much focus on what AI can do and not how it does it. Today's organizations must be able to demonstrate that their systems and algorithms are responsible, fair, ethical and explainable. In a word, that their AI is trustworthy.

High-profile cases of misuse of AI by global technology firms have dented consumer trust in AI. The subsequent fallout has also raised greater global awareness of the broader issues around the use of data and our personal information.

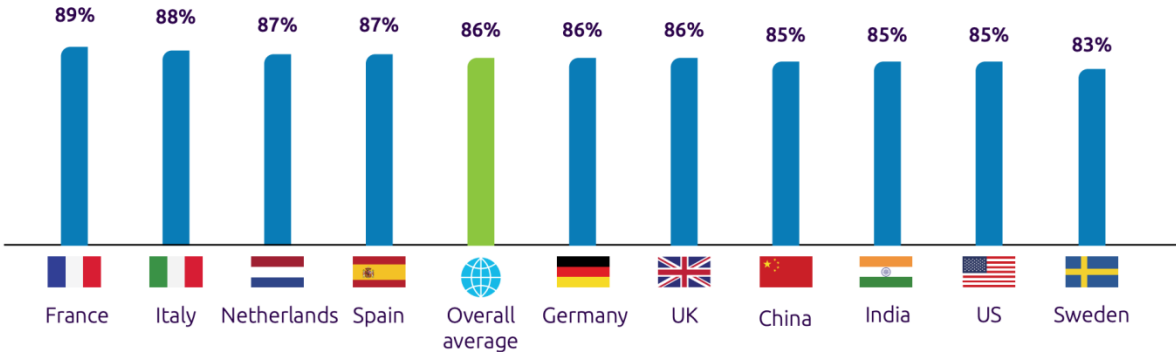
Trust in technology can no longer be assumed – it must be earned. In this sense, organizations must think of their technology as 'guilty until proven innocent'. The onus is on them to proactively demonstrate the responsible use of their technology to the world and to be prepared to explain and justify decisions made by those systems when required. Here we have the right to meaningful information about the logic, significance and envisaged consequences of automated decisions or what is also called 'the right to explanation', as laid out in the EU's General Data Protection Regulation (GDPR). Businesses must consider how they apply these technologies – only using personal information when it is needed and with the user's consent. By building these principles into AI as it is developed, businesses can ensure that it is ethical and transparent from the outset.

We are already seeing the impact of this transition to ethical AI. A recent Capgemini study found that 62% of consumers placed more trust in a company whose AI was understood to be ethical, while 61% were more likely to refer that

company to friends and family, and 59% showed more loyalty to that company. Those who openly communicate in this way about how their technology works are more likely to be trusted by consumers to use AI to its full potential.

Nearly nine in ten organizations across countries have encountered ethical issues resulting from the use of AI

In the last 2-3 years, have the below issues resulting from the use and implementation of AI systems, been brought to your attention? (percentage of executives, by country)



We presented over 40 cases where ethical issues could arise from the use of AI, to executives across sectors. We asked them whether they encountered these issues in the last 2-3 years.
Source: Capgemini Research Institute, Ethics in AI executive survey, N = 1,580 executives, 510 organizations

Consumers create a huge amount of data. By 2025, we will be creating an estimated 463 exabytes every day. And that is only going to increase – the oft quoted formula is that 90% of the data that has ever been created was created in the last two years. AI-driven systems have been invented to help turn some of this information into recognizable benefits for the people who create that data – making our lives work for us.

But AI is a technical and complicated tool. The trust that is needed for it to be most effective will come when consumers see and feel it's real-world benefits in action. In this sense, trust can be a key differentiator – a competitive advantage

for businesses. Only those who are trusted to operate AI will be able to maximize the benefits of its value-added services in years to come. Not only can AI deliver safety for consumers online or revolutionize their shopping experiences; it is also revolutionizing farming as well as giving the environment a new lease of life. For those that get it right, the possibilities are endless.

At times of such uncertainty, it can be difficult to look too far ahead. But now is the time for business leaders to take a step back and look at the bigger picture. The landscape has changed, and that change is permanent. Our digital futures have been brought forward and society will continue to demand higher levels of transparency in the way that AI is used to solve new challenges.

Responsible development of, and engendering trust in, technology will be crucial to business success in the 'next normal' – but more importantly, to building a world that is more prosperous and more equal for all.

Q.11. Whether there is a need of telecom/ICT sector specific or a common authority or a body or an institution to check and ensure compliance of national level and sector specific requirements for AI? If yes, what should be the composition, roles and responsibilities of such authority or body or institution? Please justify your response with rationale and suitable examples or best practices, if any.

Comments : **Yes.**

Q.12. In response to Q.11, if yes, under which present legal framework or law such authority or body or institution can be constituted and what kind of

amendments will be required in the said law? Or whether a new law to handle AI and related technologies is a better option? Please justify your response with rationale and suitable examples or best practices, if any.

Comments : **No Comments.**

Q.13. Whether telecom/ICT industry is facing constraints such as access to data, lack of computing infrastructure, lack of standards, and R&D in the adoption of AI and BD technologies? Please list out all such constraints with adequate details.

Comments : **Yes.**

Q.14. What measures are required to make data and computing infrastructure available and accessible to developers and also to make data/AI models interoperable and compatible? Please respond along with examples, best practices and explanatory notes.

Comments : **No Comments.**

Q.15. Whether there is a gap between requirement and availability of skilled AI workforce? If so, what measures are required to be taken to ensure availability of adequate skilled workforce in AI domain? Please respond along with suggestions with supporting details and best practices.

Comments : **Yes.**

With expansion in the labour force in electronics equipment manufacturing through the recently introduced production-linked incentive (PLI) scheme, the industry has also identified the lack of skilled workforce which has triggered a

large demand for upskilling of current workers and skilling of fresh workers.

The Department of Telecommunications also said that India is expected to receive an investment of about Rs 3,300 crore from 31 domestic and multinational companies over a period of four years under the ambitious manufacturing scheme that may employ as many as 40,000 individuals in the telecom sector.

The overall success of AI will rest on how a large and complicated country like India meanders towards becoming future-ready. If India fails to smoothly ride the AI wave that is taking shape in the developed world, it will be a setback for the AI revolution. For India to succeed, it needs concrete measures that go beyond the ongoing policy discussions.

Considering technologies like IoT, AI, machine learning, big data, cloud computing, and robotic process automation, India would roughly require about 22 million workers to skill or upskill themselves to match industry demand by 2025.

1. India is poised to become a global supplier for both electronics and human resource and to achieve this, there would be a need to create an extended skill network with both industry and academia participation. We feel that an alignment of education and vocational training is the ideal impetus required to bridge this skill-gap.

2. With half of the country's population below the age of 25, a pertinent step would be to prepare the young workforce by exposing them to the tech-enabled future of work with AI interfaces, machine learning, and increased automation. Online training programs, inclusion of AI and automation in the existing education

curriculum, and corporate training programs for new hires can achieve this without much structural change and investment. For this, the political leadership also needs a better understanding of automation technologies and their implications for the Indian economy.

3. The need of the hour for policymakers is to emphasize immediate formal skill training while also undertaking systemic changes in Education sector.

Q.16. What initiatives do you suggest to democratize data required to develop AI models in the telecom sector? Please justify your response with rationale and suitable examples, if any.

Comments : No Comments.

Q.17. Whether the authority or body or institution as suggested in response to Q.11 may also be entrusted with the task to manage and oversee collection, cataloguing and storage of data? Whether such authority or body or institution need to be entrusted to generate and make available synthetic data? Please justify your response with rationale and suitable examples, if any.

Comments : No Comments.

Q.18. Whether the legal framework as envisaged in para 3.5.3 and Q.12 should also enable and provide for digitalization, sharing and monetization for effective use of the data in AI without affecting privacy and security of the data? Please justify your response with rationale and suitable examples, if any.

Comments : **Yes.**

Q.19. (a) Which are the currently used privacy enhancing and privacy preserving technologies facilitating adoption of AI and BD? Are there any challenges in using these technologies? How these challenges can be addressed?

(b) Which are the potential technologies likely to be available in near future to further strengthen privacy?

Please justify your response with rationale and suitable examples, if any.

Comments : **No Comments**

Q.20. Whether the list of technologies provided in response to Q.19 are adequate to handle all the perceived risks and concerns in the AI domain? Or is there a need to develop new privacy preserving architecture? Please justify your response with rationale and suitable examples, if any.

Comments : **No Comments.**

Q.21. Whether the next generation telecom network architectures such as AI at edge, federated learning, TinyML or their combination can offer solutions to meet both privacy as well as intelligence requirements? Please justify your response with rationale and suitable examples, if any.

Comments : **No Comments.**

Q.22. What type of technological advancements are happening for running the AI models on the end user devices to overcome constraints in respect of processor, memory, battery etc.? Whether special tools, programming languages, and skills are required to be developed to build such AI models? Please justify your response with rationale and suitable examples,

if any.

Comments : **No Comments.**

Q.23. Considering availability of new privacy preserving architectures as suggested in response to Q.19 and Q.20, what is the likelihood of emergence of new business and operational models? Whether such models will raise issues related to ownership and responsibilities? What do you suggest to address these issues? Please justify your response with rationale and suitable examples, if any.

Comments : **No Comments.**

Q.24. Whether the concept of “Operator Platform” would help in providing AI based solutions in a unified and more equitable manner? Apart from popular federated use cases of edge cloud federation, Cloud XR, Cloud Gaming, whether this concept may also be applied for public service delivery and in making public policies that are data-driven? Whether there is a need to take initiatives for developing and demonstrating advantages of concept of “Operator Platform”? If so, what steps and measures are suggested to launch such initiatives? Please justify your response with rationale and suitable examples, if any.

Comments : **No Comments.**

Q.25. Whether there is a need to create AI-specific infrastructure for the purpose of startups and enterprises in the telecom sector to develop and run AI models in an optimized manner? Whether such an infrastructure should cover various real-world scenarios such as cloud AI, edge AI and on-device AI? Please justify your response with rationale and suitable examples, if

any.

Comments : Yes.

Q.26. Whether the emerging trends of development of foundational AI models such as GPT-3, Gopher etc. are leading to democratization of AI space by offering fine-tuned or derived AI models? Whether such a trend will also help in reducing costs for the AI developers? Whether similar approach will help in development of large-scale AI model for the telecom sector? Please justify your response with rationale and suitable examples, if any.

Comments : No Comments.

Q.27. Whether there is a need to establish experimental campuses where startups, innovators, and researchers can develop or demonstrate technological capabilities, innovative business and operational models? Whether participation of users at the time of design and development is also required for enhancing the chances of success of products or solutions? Whether such a setup will reduce the burden on developers and enable them to focus on their core competence areas? Please justify your response with rationale and suitable examples, if any.

Comments : Yes.

Q.28. Whether experiments are required to be backed by regulatory provisions such as regulatory sandbox to protect experimenters from any violation of existing regulations? Whether participation of government entities or authorities during experimentation will help them to learn and identify changes required in the existing regulations or introducing new

regulations? Please justify your response with rationale and suitable examples, if any.

Comments : Yes.

Q.29. In response to Q.27 and Q.28, whether establishing such a campus under government patronage will enable easy accessibility of public resources such as spectrum, numbering and other resources to the researchers? Whether it would be in mutual interest of established private players as well as startups, innovators and enterprises to participate in such experiments? Please justify your response with rationale and suitable examples, if any.

Comments : Yes.

Q.30. Whether active participation in the international challenge programs such as ITU AI/ML 5G challenge will help India's telecom industry in adopting AI? Whether similar programs are also required to be launched at the national level? Whether such programs will help to curate problem statements or help in enabling, creating, training and deploying AI/ML models for Indian telecom networks? What steps or measures do you suggest to encourage active participation at international level and setting up of such programs at national level? Please justify your response with rationale and suitable examples, if any.

Comments : Yes.

Q.31. Whether AI/ML developers should launch bounty programs to establish trust in the public about robustness of measures taken by them to protect privacy in their products or solutions? Whether conduction of such programs will help companies or firms to improve their products or

solutions? Whether such programs should be conducted under the supervision of the government or an institution established/assigned for this purpose? Please justify your response with rationale and suitable examples, if any.

Comments : Yes.

Q.32. Whether the telecom industry is required to adopt a Machine Learning Operations (MLOps) environment to develop, train, validate and store ML models? Whether there is also a need to establish a DataOps feature store to help MLOps for training purposes? What standardization is required in terms of interoperability and compatibility for MLOps to function in a federated manner? Please justify your response with rationale and suitable examples, if any.

Comments : No Comments.

Q.33. Whether active participation in the international bootcamp programs such as MIT Bootcamps, Design Thinking Bootcamp by Stanford University etc. will help India's telecom industry workforce to find international developers community, navigate challenges and learn from experiences of others? Whether similar programs are also required to be launched at the national level? What steps or measures do you suggest to encourage active participation at the international level and setting up of such programs at the national level? Please justify your response with rationale and suitable examples, if any.

Comments : No Comments.

Q.34. Whether the courses or programs related to AI/ML currently being offered by various institutions and universities in India are adequate to meet the

capacity and competence required to develop and deploy AI solutions or products in the telecom networks? If not, what additional steps or measures are suggested to fill the gap? Please justify your response with rationale and suitable examples, if any.

Comments : No. Mentioned above.

Q.35. Whether establishing a system for accreditation of AI products and solutions will help buyers to purchase such solutions or products? If yes, what should be the process of accreditation and who should be authorized or assigned with the task of accrediting such products or solutions? Please justify your response with rationale and suitable examples, if any.

Comments : Yes.

Q.36. Whether creating a framework to prepare a list of prequalified suppliers of AI products or solutions will help industry including government agencies to procure AI products or solutions? Whether there is a need to formulate a standard Code of Conduct or guidelines for AI related procurements? What should be the typical elements of such a Code of Conduct or guidelines including guidelines on trusted source and who should be tasked to formulate such a Code of Conduct or guidelines? Please justify your response with rationale and suitable examples, if any.

Comments : Yes.

Q.37. Whether there is a need to prepare and publish a compendium of guidance, toolkits and use cases related to AI and BD, to foster adoption in the telecom sector? If yes, what should be the process to prepare such a compendium and who should be assigned this task? Please justify your response with rationale and global best practices, if any.

Comments : **Yes.**

Service Providers should be assigned this task.

Q.38. Whether there is a need to establish telecom industry-academia linkages specifically for AI and BD to accelerate the development and deployment of AI products and solutions? Whether there is a need to establish Centres of Excellence (CoEs) for this purpose or it can be achieved by enhancing the role of existing TCoE? Please justify your response with rationale and global best practices, if any.

Comments : **Yes.**

Q.39. Whether there is a need to establish telecom industry-academia linkages specifically for AI and BD for AI related skill development? Please give the suggestions for strengthening the industry-academia linkages for identification of the skill development courses. Please justify your response with rationale and global best practices, if any.

Comments : **Yes.**

Q.40. Any other issue which is relevant to this subject? Please suggest with justification.

Comments : **No.**