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सचिव

Prof. Manish R. Joshi
Secretary

D.O.No.2-62/2023(CPP-II)   30th October, 2023/8 कार्तिक, 1945

Subject: Regarding wider dissemination the "National Programme on Artificial Intelligence" (NPAI) to build momentum around Skilling in Artificial Intelligence (AI)

Respected Madam/Sir,

As you are aware, Artificial intelligence is the intelligence of machines or software, as opposed to the intelligence of humans or animals. It is also the field of study in computer science that develops and studies intelligent machines. "AI" may also refer to the machines themselves. To achieve the vision of India AI, the Ministry of Electronics & Information Technology (MeiTY) has undertaken the implementation of the "National Program on Artificial Intelligence" (NPAI). The objective of NPAI is to establish a comprehensive programme for leveraging transformative technologies to foster inclusion, innovation, and adoption for social impact. NPAI would encompass four broad pillars of the AI ecosystem, i.e. Skilling in AI, Responsible AI, Data Management Office and setting up the National Center on AI.

A committee was constituted to assess and analyze the status of existing NSQF aligned and approved AI related qualifications, devise strategies with timelines to upscale the AI-based skill courses and develop broad structure of courses on AI and Data Sciences. The committee prepared a report titled 'National Programme on Artificial Intelligence (NPAI) Skilling framework. The report provides a comprehensive overview of the current status of AI technologies across sectors and further need to align skilling initiatives. A copy of the report is attached.

The Higher Education Institutions are requested to widely disseminate the report among all the students and faculty to build momentum around skilling in Artificial Intelligence (AI).

With kind regards,

Yours sincerely,

(Manish Joshi)

Encl: As above

To
   The Vice-Chancellors of all Universities
   The Principals of all Colleges/Institutes

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ONE EARTH • ONE FAMILY • ONE FUTURE

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National Programme on Artificial Intelligence (NPAI) Skilling Framework

23rd June 2023

Committee on Creating Skilling Framework for AI

Table of Content

1. MEITY's Programme on Artificial Intelligence (NPAI)

Ministry of Electronics & Information Technology (MEITY) has launched an umbrella program "India AI" to drive convergence across multiple national level initiatives to catalyze the Artificial Intelligence innovation ecosystem in India. To achieve this vision of "India AI", MEITY has undertaken implementation of the National Program on Artificial Intelligence (NPAI). As part of this program, MEITY has requested Ministry of Skills Development & Entrepreneurship (MSDE) to create a plan for skill development for AI in India.

While AI may disrupt some jobs, new opportunities will arise, and the nature of work will evolve, adapting to these changes. It also requires a strong focus on continuous learning, reskilling, and embracing the potential of AI and generative AI as a tool for augmentation and efficiency. Therefore, prioritizing skilling at the national level becomes imperative to develop a strong, future-proof workforce to ensure employment opportunities, and build a relevant, robust, and skilled talent pool.

1.1 Vision of India AI

AI revolution in India is expected to be bigger than the IT revolution of India. However, to make that happen Skilling environment in India must gear-up. The vision set for India AI is:

    i.   Making India the Global AI Superpower

    ii.   Developing & catalyzing the AI Innovation & Start-up Ecosystem

    iii.   Creating large-scale Social Transformation leveraging the power of AI

    iv.   Creating a model of Responsible & Ethical AI – for India and the world

    v.   Getting India and its Workforce Ready for the AI Wave

This report will focus on point (v), making the workforce ready for the global AI wave. Report will also focus on ensuring that concepts of Ethical AI (iv) are embedded in the new trained AI trained manpower.

1.2 Objectives of India AI

AI is a 'Compute' intensive area, and a lot of support will be required even to build the desired infrastructure environment for AI. AI is also used along with a lot of other technology for the desired results. There will be a lot of cross-sectoral applications, where AI can be used for desired business benefits. These areas may also require multi-disciplinary knowledge.

Objectives laid down for the India AI mission are:

    i.   Ensuring access to quality datasets for AI Research & Innovations

    ii.   Ensuring the availability of skilled AI talent

    iii.   Making AI Compute and other critical infrastructure accessible

    iv.   Promoting Core & Applied AI Research in critical and cross-sectoral areas

    v.   Providing scale-up support to promising AI solutions

    vi.   Creating strong governance mechanisms for ensuring Responsible AI innovation

1.3   India AI Pillar

In line with the vision & objectives of India AI, NPAI has defined the following pillars of AI. This report is mainly focusing on 'Skilling in AI'. However, it also attempts to work on recommendations which will support the other pillars such as Governance/Adoptions, R &D etc. via skilling. Since most business applications where AI will be used will also require multiple other technologies like IOT etc., this report also proposes skills which use a combination of technologies together with AI, where skilling will be required.
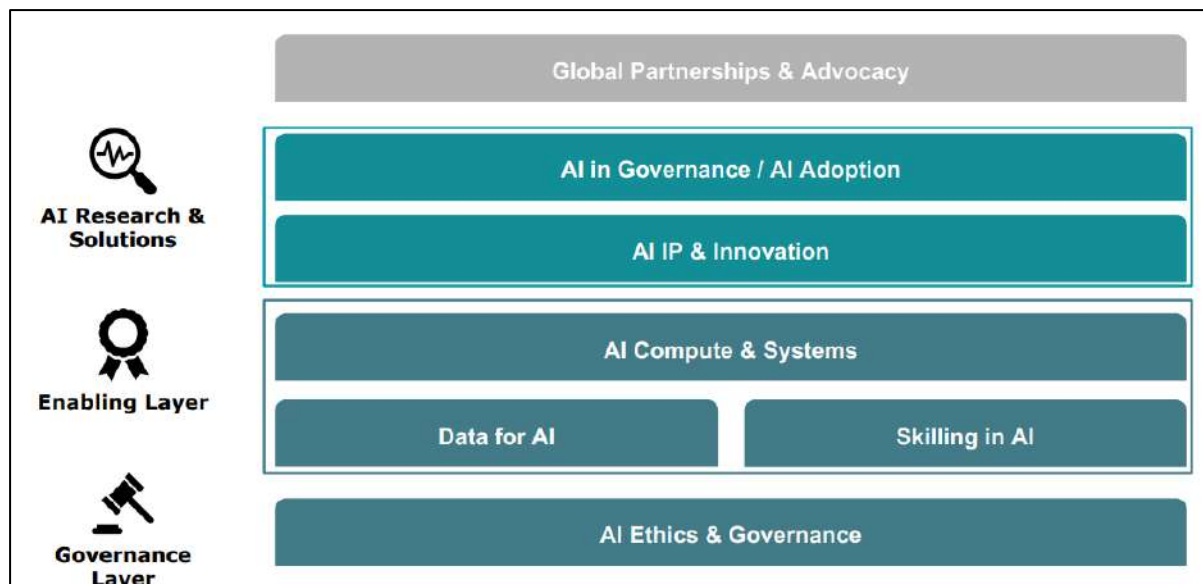
Some work has already been done for creating qualifications which will enable skilling environment in AI. This report provides a brief overview of skilling courses available in NQR (National Qualification Register) and with various EdTech companies. It also attempts to provide ideas on skills required for various job roles/competencies at various NSQF (National Skill Qualification Framework) levels.

Additionally, need of Ethical AI & Governance is not only proposed in India AI framework, but also is a requirement coming from all the CEOs of large companies, who have already plunged into this area.

Increased importance and mainstreaming of Information Security & Data Privacy management has led to the creation of the office of Chief Information Security Officer (CISO) and/or Data Protection Officer (DPO) across industries. Similarly, with growth in AI, an increase in demand is expected for AI Ethics and/ or Responsible AI officers who along with the legal teams can help in ensuring responsible development, use of AI and help solve the legal issues which may come-up as part of implementation of AI systems and their usage. This report presents this need but does not attempt to detail this and highlights the need for Responsible & Explainable AI.

During the start of the IT revolution, there was a worry that people would lose their jobs, however, IT created new types of jobs. Similarly, AI is also expected to create new types of jobs, and it is important to create the skill environment to manage that need. "Generative AI" is giving rise to a new type of job requirements and new products like ChatGpt/Bard etc. can support market research, hiring process, education and even web development & coding. But all this will also require training in the tools for effective output/usage. Generative AI is predicted to have the highest level (45-50%) of exposure in the office and administrative

support related tasks among all industries. Physically demanding professions & sectors such as in Construction and Maintenance industry, (6% and 4% respectively) have minimal exposure to such tools.

According to the World Economic Forum Future of Jobs report April 2023, **83 million jobs are projected to be lost and 69 million are projected to be created globally in the next five years**. This constitutes a reduction in employment of 14 million jobs. Indian labor market will witness a 22 per cent job churn, compared to 23 per cent worldwide. The churn in Indian labor markets will be led by technology-driven sectors like artificial intelligence and machine learning (38%), followed by data analysts and scientists (33%) and data entry clerks (32%). This also brings the need for upskilling the current workforce which is addressed as part of this report.

2. Constitution of Committee for Skilling in AI and Terms of Reference

To reinforce the 'Skilling in AI' component of NPAI, it has been decided by Ministry of Skill Development and Entrepreneurship (MSDE) to constitute a committee chaired by Executive Member, NCVET. The committee has members from MEITY, MSDE, DGT, NIELIT, CDAC, NSDC, Department of Higher Education, Department of School Education and various NCVET recognized Awarding Bodies.

The members of the committee are:

Serial	Name & Organisation	Committee Designation
Chairperson, AI Committee		
a)	NCVET	Dr Neena Pahuja, Chairperson of the Committee
Members, AI Committee		
b)	Vice Chairman, Higher Education, AICTE	Dr. Abhay Jere
c)	Director, MSDE	Shri Sandesh Tilekar
d)	Director, DGT	Shri Sanjay Kumar
e)	Executive Director, NIELIT	Dr. Yumnam Jayanta Singh
f)	Associate Director, CDAC	Ms. Kalpana Johari
g)	Vice President, IT, NSDC	Ms. Sreshtha Gupta
h)	Meity	
i)	School Education	Mr. RP Singh
j)	Strategy Team, NASSCOM	Shri Ankit Bose
k)	CEO, IT-ITES	Smt. Kirti Seth
l)	CEO, Telecom	Shri Arvind Bali
m)	CEO, Electronics	Smt. Abhilasha Gaur
n)	CEO, Automotive	Shri Arindam Lahiri
o)	CEO, Agriculture	Dr Satendra Arya
p)	Director, NCVET	Col. Santosh Kumar
NCVET Support Team		
a)	Consultant	Mr. Parkishit Yadav
b)	Consultant	Ms. Ratna Priya Kanchan

Terms of Reference (TOR) for the committee are as under:

a. To assess the current and future demand of AI trained manpower across sectors and review and analyze the status of existing NSQF aligned and approved AI related qualifications.

b. To prepare draft guidelines / instructions for reference by various Awarding Bodies and stakeholders with respect to creation and NSQF alignment of Core Artificial Intelligence (AI) and Cross Sectoral AI qualifications/ job roles.

c. Prepare an action plan along with timelines for the creation of various skill qualifications in AI across various sectors including the target learners who shall undertake these courses/qualifications.

d. Suggest strategies to upscale AI based skill courses through existing skill, education and other institutions including NCVET recognized ABs and Schools/colleges.

e. Identify the areas and sub-areas around AI (NLP, Computer Vision, Deep Learning, python, Neural Networks etc.) and its application across sectors where the skill courses can be developed for NSQF alignment, approval, and certifications.

f. Review and re-align (if required) the existing NSQF aligned qualifications in the domain of AI and associated disciplines.

g. Develop a basic course on basics of AI and Data Sciences which can be taught to all the students of ITIs.

h. Devise a strategy with proper timelines for the Training of Trainers to ensure an adequate supply of quality trainers for running the courses.

i. Devise the cost norms for running the courses related to AI. Any other item as deemed fit by committee.

j. The committee decided to add:

    i. Skilling in Generative AI for India & also for Global markets, as it is expected to impact Global markets. Generative AI can automate highly complex tasks. Due to its unprecedented capability to penetrate the 'Cognitive capabilities', it is expected to outperform humans in many skills. It has the potential to automate numerous human-aided tasks across industries.

    ii. The committee also decided to look at the AI related courses available from EdTech & Technology (local & global) companies to suggest a framework to reuse the existing content, to leapfrog in skilling/upskilling of AI.

    iii. The committee also worked on how AI can be used as part of various job roles for people with disabilities.

2.1   Summary of Recommendations

The National Programme on AI Skilling Framework is a comprehensive initiative led by the Ministry of Skill Development & Entrepreneurship (MSDE) and is aimed at equipping the nation with the necessary skills in Artificial Intelligence (AI) including Generative AI. This executive summary provides an overview of the key aspects covered in the document, emphasizing the critical importance of skilling.

As per recommendation, the skilling requirements in AI shall be Categorized under three broad categories**:** i) For "**All**": for the end users who require basic digital literacy skills to effectively use AI interfaces, & tools, understand responsible AI practices, and navigate potential pitfalls. ii) For "**Many**": this encompasses AI-empowered individuals who seek digital fluency to enhance productivity, utilize AI tools, and grasp AI applications in their respective fields. iii) For "**Few**": AI-skilled professionals who possess digital mastery, encompassing technical expertise in areas like coding, data analytics, machine learning,

cybersecurity, cloud computing, information security and other related technologies, enabling them to develop AI products and solutions across domains. This also includes specialized new areas such as Explainable AI, AI in legal & legal for AI, which will be created.

The report provides high level details of the courses that are existing and the ones that may be created to meet the future demand, both in IT industry & the other business verticals. This will involve establishing AI-focused training institutions, creating partnerships with industry leaders, fostering research and development, and promoting entrepreneurship in the AI domain, together with need to Collaborate with Ed-Tech partners. Some of the areas covered are:

a. Introduction to AI should start from the early school levels where children can be taught to use AI tools and be introduced to what AI is and recognize where it is being used.

b. There is a large amount of course material available from various sources. Along with creation, reuse of existing content should be encouraged and multiple modes like self-paced and blended, based on the audience can be leveraged.

c. Every course, small or big, must have a module on Ethical AI for a minimum of 10% of its duration. Ethical considerations, transparency, fairness, and privacy must be integrated into AI training programs to ensure that AI systems are developed and deployed responsibly.

d. Content can be categorized into three subgroups: for All, for Many, for Few as mentioned above.

e. The report provides a list of existing courses and stresses the need for flexibility of creating courses, as the tools of AI are still evolving and changing at very fast pace. The report also highlights a need for smaller modules in form of Micro-credentials & NOSs together with need of agility into the process of creating the newer courses. Based on the need, the learner should have flexibility to choose the module of his choice. It also suggests business vertical specific Cross-Sectoral courses that may be created by various awarding bodies (ABs) to use AI effectively in their verticals. It also suggests ways to teach the trainers & assessors for AI.

f. For ITIs courses, AI micro-credentials may be embedded in existing courses. With that a formal AI course of one year may be started. Details of Micro-credentials for embedding in the existing course have been provided, and the basic outline of a one-year course has also been given.

g. Industry used cases & best practices will also be part of the content.

h. Based on the category of the course, and the audience of the course, a proposal of cost norms has been provided. The current cost norms for AI skilling are inadequate to meet the futuristic skill requirements and challenges associated with AI. Higher cost norms are necessary to ensure quality training delivery, develop and sustain AI skilling programs, and meet the growing demand for skilled AI professionals. Adequate financial resources are crucial for fostering the nation's digital transformation goals and providing high-quality AI education.

i. Report also suggests ways to increase focus on R & D of AI and related technologies together with ways to democratize working knowledge of AI.

j. The report also provides a set of future job roles that AI is likely to create at various NSQF levels in different business verticals. It also attempts to bring-out newer roles which Generative AI may be able to create in the very near future.

k. It also brings out a list of already available courses with some EdTech and Technology majors and suggests reusing them.

l. Report also provides need for job roles for Legal fraternity and need for Explainable AI.

This framework provides a comprehensive roadmap for individuals and organizations to acquire and enhance their AI competencies. By defining the key skills, knowledge areas, and proficiency levels required in AI, the framework ensures a standardized and quality-driven approach to AI skilling. It enables the development of targeted training programs, certification and completion processes, and continuous learning opportunities. With the National AI Skilling Framework in place, India can unlock the full potential of AI, drive innovation, and create a highly skilled AI workforce that contributes to economic growth and technological advancement in the country.

AI basic education must start at the level of school education, to create young minds who are AI fluent tomorrow. This will require State and Central Boards to create course trainers. The report suggests a basic curriculum for different level of school students.

Regulatory bodies like NCVET, AICTE, and UGC can enable AI skilling by establishing guidelines and standards for AI education. They can encourage colleges to incorporate NHEQF/NSQF-aligned AI courses, develop faculty training programs, and provide support for infrastructure and resources. AICTE and UGC can also foster collaborations between academia and industry, facilitating internships, joint research projects, and industry-relevant curriculum development. The National Credit Framework (NCrF) plays a crucial role in ensuring uniform skilling in AI across colleges. By incorporating AI-related subjects and credits into the NCrF, colleges can follow a standardized curriculum and assessment process. This ensures that students, regardless of their institution, receive a consistent level of AI education.

2.2   Structure of the Report

The Report initially works on need and availability of skilling in AI and related technologies. It then creates a matrix of different types of needs of AI, including AI for all, and expands that need. It also brings in skilling need for newer products of Generative AI and AI as a Service (AI aaS). It then does to various verticals and brings out need for various roles, including for IT, Auto, logistics, healthcare, Agriculture & Defence. Report also has suggestions on infrastructure and cost norms desired for skilling. Report also has a section of Ethical AI, and even courses for legal fraternity to ensure Governance.

AI, Global Skilling Agenda/ frameworks focuses on efficient AI strategies that strengthens research capabilities, support business adoption and develop standards for its ethical use. AI Enabled technologies helps us to get an understanding of the other technologies that can be used together with AI. Creating an AI Ready Workforce as well as the current status of the AI Skilling emphasizes on the courses available as well as the new courses that needs to be developed so as to bring awareness among the skilling ecosystems. The list of current

courses available in the Skilling ecosystem on NQR, CDAC, AICTE accredited institutes, Ed-tech and Tech Organisations is provided for a better understanding.

The need of AI and the indicative need of AI courses along with the need of tools and the products of AI at various levels is very well elaborated. To create a standard structure and reusability of AI modules and knowledge, an indicative roadmap for technical expertise and level of manpower required is emphasised. The report also describes the life cycle for developing a qualification, the strategy for training trainers and teachers, training of assessors. At last, the suggested/ indicative career or the knowledge progression having the AI literacy for all, the courses offered for school students, ITI, IT and Non-IT Graduates, Working Professionals, Persons with Disabilities, Armed Forces Personnel along with the cost norms required for the AI Courses is described in respective sections. Currently the market is seeing a very slow uptake of AI projects in Industry. The report also works on a possible course of upskilling CXO's to increase that usage.

3. Artificial Intelligence Skilling Gap/Need

India being one of the fastest growing & largest economies of the world, it is imperative to work dedicatedly to harness the power of AI for sustained growth. India aims to create a robust AI ecosystem, including a national strategy aimed at leveraging AI for economic prosperity, sectoral progress & inclusive growth.

Efficient AI strategies that strengthen research capabilities, support business adoption, and develop standards for its **ethical use** will pave the way for effective integration of AI innovations in New India's growth.

AI in education systems will change the role of teachers significantly, requiring massive and continuous upskilling of teachers, stated in the report from United Nations Educational, Scientific and Cultural Organization's (UNESCO). The report **'2022 State of the Education Report (SOER) for India: Artificial Intelligence in Education'– '**Here, There and Everywhere' shows that AI will grow at the rate of 20.2% compound annual growth (CAGR). By 2030, AI in education systems will have contributed considerably to efforts to achieve sustainable development goals 4 in India, and AI will have helped address issues related to equality, equity, and inclusion in education. In its report, UNESCO also laid down a few recommendations for the future of AI in Indian education systems. UNESCO has recommended that India should consider the ethics of AI in education as an utmost priority and provide an overall regulatory framework for it. Effective public-private partnerships should be encouraged, and students and teachers should have access to the latest technology.

According to the State of Data Science & AI Skills In India "Data and The Art of Smart Intelligence" NASSCOM report released in February 2023:

i. India has an installed talent base of 4,20,000 professionals (as of August 2022) and a current demand of approximately 6,30,000.
ii. The current gap between demand and supply is approx. 51%.
iii. By 2024, the estimated demand for Artificial Intelligence/ Data Science professionals in India is expected to be over 1 million.
iv. Certain roles have a higher degree of demand supply disparity, ranging between 60% - 73%. Roles are as follows: ML Engineer, Data Scientist, DevOps Engineer and Data Architect.
v. 75 - 80% of the job openings in India currently falls between 0-5 years and 5–10-year experience bands.

The global artificial intelligence market size was valued at USD 136.55 billion in 2022 and is projected to expand at a compound annual growth rate (CAGR) of 37.3% from 2023 to 2030. The continuous research and innovation directed by tech giants are driving the adoption of advanced technologies in industry verticals, such as automotive, healthcare, retail, banking & finance, and manufacturing.

A 22% churn in the Indian job market is estimated in the next five years where artificial intelligence, machine learning and data segments are likely to emerge as top job producing areas, according to a study by the **World Economic Forum**. Advent of AI has accelerated this disruption to a pace that has not previously been seen, due to the wide range of capabilities it offers and speed at which it is developing.

In the IT sector, some traditional software developer roles are set to transition and at the same time, some new job roles are expected to arise as the technologies are increasingly adopted and deployed. A new area of users of Generative AI products has recently emerged as a need in the market. This has led to need for trainings at all levels for its usage for different business verticals and to create APIs (Application Program interface) to integrate existing applications with these Generative AI applications.
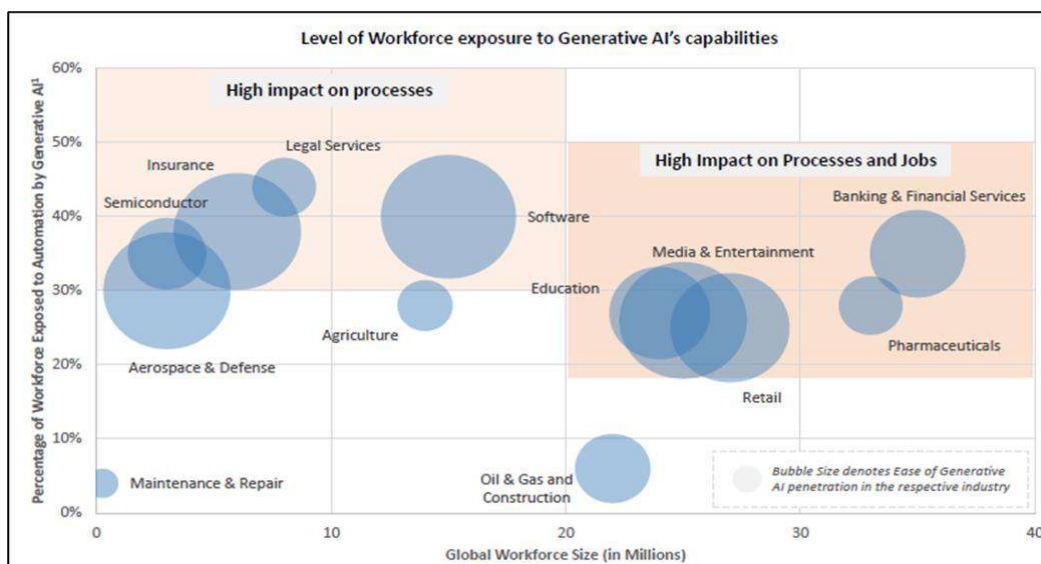
Source: Draup research

Impact of Generative AI would be felt across business functions. Not just routine bases tasks, Generative AI can impact highly complex processes. Marketing and Sales functions are expected to be the most impacted. ~37% of the US workforce in Advertising & Marketing will see impacted workloads due to Generative AI.
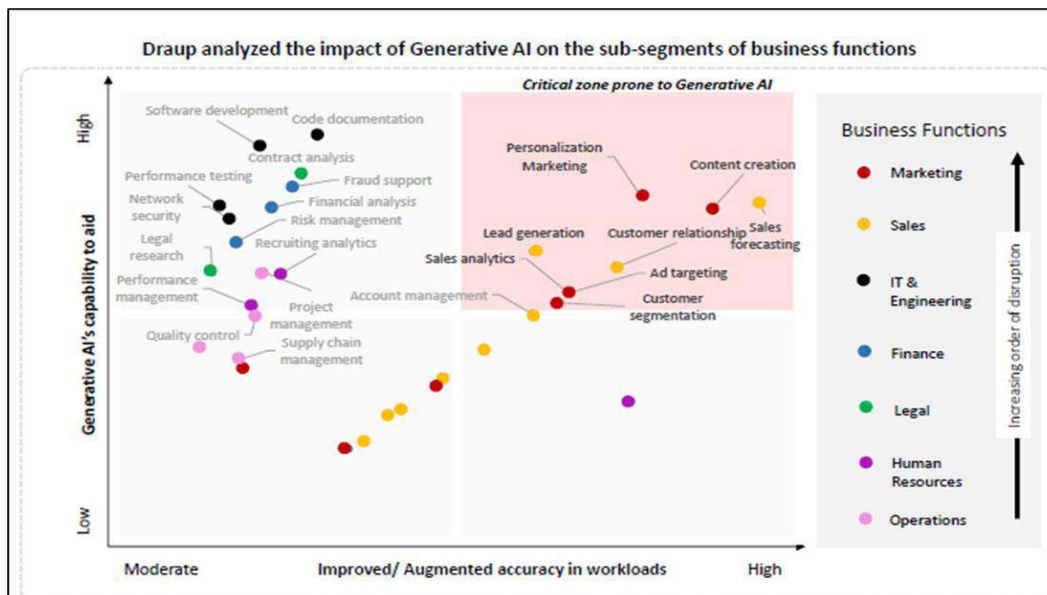
Source: Draup research

3.1   Defining Data Science, Machine Learning & AI

This section attempts to bring some basic differences between Data Science, Machine Learning & AI, which at time are used interchangeably.

Data Science	Machine Learning	Artificial Intelligence
i. The practice of organizing and analysing data to gain insights that may prove helpful for human decision-making. ii. Data science draws on multiple fields that include statistics, mathematics, and computer science.	i. A subcategory of AI that enables computer algorithms to automatically learn from data. ii. ML is the most common form of AI in real-world applications such as image recognition and natural language processing. iii. ML automates the process of analysing big data, allowing data scientists to focus on deriving useful insights	i. A concept referring to how computers and machines can demonstrate intelligent behaviour, learning capabilities, and self-awareness on a human level.
iii. Technologies/ tools such as Tableau, Big Data, Power BI, MATLAB to be used for this.	iv. Technologies such as Deep Learning to be used for this.	ii. Neural networks/Fuzzy Logic.

Skilling will be required to cater to work in all these above three disciplines.

3.2   AI Enabled/Supported Technologies

This section provides a summary of other technologies which are used together with AI to create usable systems/products. A combination of these will then be used for business transformations & solutions.

i. **Speech Recognition & Natural Language Processing (NLP)-** Speech recognition is a subset of Natural Language Processing, also known as Automatic Speech

Recognition (ASR), computer speech recognition, or speech-to-text, is a capability which enables a program to process human speech into a written format. It has its applications in almost all areas including office, healthcare, banking, marketing, learning & education and personalization in almost all disciplines. A large number of products including ChatGpt (Open AI) and Bard (Google) have already been launched and are already in use.

ii. **Robotic Process Automation**- Robotic process automation (RPA) is a software technology that makes it easy to build, deploy, and manage software robots that emulate human actions interacting with digital systems and software.

iii. **AIOT (Artificial Intelligence of things**)- The Artificial Intelligence of Things is the combination of Artificial intelligence technologies with the Internet of things infrastructure to achieve more efficient IoT operations, improve human-machine interactions and enhance data management and analytics. Artificial intelligence unlocks the true potential of IoT by enabling networks and devices to learn from past decisions, predict future activity, and continuously improve performance and decision-making capabilities.

iv. **Chat-Bot -** A software, which simulates human-like conversations with users via chat. Its key task is to answer user questions with instant messages.

v. **AI Analytics -** AI analytics is the product of automating data analysis, a traditionally time-consuming and people-intensive task, using the power of today's artificial intelligence and machine learning technologies.

vi. **Drone -** AI algorithms enable drones to perform tasks such as object recognition, navigation, and data analysis with greater speed and accuracy.

vii. **Electronic Design & VLSI -** Employing AI and machine learning (ML) algorithms in VLSI design and manufacturing reduces the time and effort for understanding and processing the data within and across different abstraction levels. It, in turn, improves the IC yield and reduces the manufacturing turnaround time.

   a. **Graphic Processing Units (GPUs):** GPUs are specialized processors that are designed for parallel processing. GPUs are often used to train and deploy AI models because they can significantly speed up the training process.

   b. **Tensor Processing Units (TPUs):** TPUs are specialized processors that are designed for machine learning. TPUs are often used to train and deploy AI models because they can be even faster than GPUs.

   c. **Software development kits (SDKs):** Software development kits (SDKs) provide the tools and libraries that are needed to develop AI and generative AI applications. SDKs can be used to simplify the development process and make it easier to build AI and generative AI applications.

viii. **Generative AI -** Generative AI is a type of artificial intelligence technology that can produce various types of content, including text, imagery, audio, and synthetic data.

ix. **Nano-technology -** Artificial Intelligence (AI) is a computer system that provides a machine with the ability to process information and make decisions. Nanotechnology

is the study of science, engineering, and technology of building extremely small things.

x. **Quantum Computing:** This would include quantum machine learning, a new field of research that is using quantum computers to develop new AI models that are far more powerful than traditional AI models.

xi. Other Supporting Technologies for Enabling AI:

    a. **Data Management System -** AI in data management refers to the use of machine learning algorithms and other intelligent techniques to automate a huge portion of the process that usually involved a lot of manual work. This can include tasks such as data cleaning, data analysis, and data enrichment.

    b. **Cloud Computing Services -** On existing cloud computing platforms, AI techniques deploy to deliver extra value. **SaaS (Software-as-a-Service)** companies incorporate AI technologies into larger software packages to give end-users more functionality.

    c. **Edge Computing -** Edge AI is the implementation of artificial intelligence in an edge computing environment. That means AI computations are done at the edge of a given network, usually on the device where the data is created for example, a camera or car, instead in a centralized cloud computing facility or offsite data centre.

4. Skilling in AI & for AI usage

4.1   National AI Skilling Framework (N AI SF)

AI technology is rapidly changing the way work is being done and how it will be done in the future. Some Skills that were relevant five years ago may not be relevant in today's time. In fact, the World Economic Forum estimates that by 2025, 85 million jobs may be displaced by machines. Also, 97 million new roles may emerge due to a new imperative for people and technology to work together. Never has there been a more urgent need for skilling sector to think ahead and provide their people with the resources to prepare for these new opportunities. Based on the current need, this report attempts to draw a skilling landscape for AI. However, this may change based on its usage and market forces. Some of the basic category of Skilling/Reskilling that is required may be categorised into:

    i. Skilling capsules for staying updated on changes around because of AI
    ii. Usage of tools such as Generative AI tools for productivity enhancement
    iii. Reskilling to use AI as job/learning enhancer together with 'AI product' sales & implementation managers & leaders.
    iv. Usage of AI to improve Human Interactions & Decision-making process in various business verticals.
    v. Developing innovative, services and applications using AI based solutions
    vi. Using AI for social good to solve complex problems and providing citizen services
    vii. Creating cutting edge intellectual property towards world class products

viii. AI related higher education including Research & Innovations and Products
ix. Creating Centres of Excellence (COEs) for increasing the reach of AI infrastructure, products & tools
x. Usage of AI for Risk analysis, Security & Safety
xi. AI Data Privacy, legal & Ethics experts with knowledge of 'Responsible & Explainable AI'

The following Framework will be used to create Skilling in AI for the global requirements:

Scale of Impact	Target Segment	Details	Learning Outcome	Assessment
All	AI Enabler	Awareness and training sessions	Enable population-level comfort with AI interfaces	Knowledge Based Assessment
	End User	UI nudges + help documents	Population-level comfort with AI interfaces	Knowledge Based Assessment
Many	Across Schools	Structured learning path on AI, Generative AI and its applications, and Responsible AI at the school level	Comfort with AI interface, what is AI, Basics of AI, AI based tools and applications for school projects	Badges/Quizzes
		Hackathon (like Smart India Hackathon for classes 6th -12th)	To Showcase talent and generate open innovation ideas	Hackathon Rankings
	Non-Engineering and Engineering (Non-IT) college students	Structured learning path on AI, Generative AI and its applications, and Responsible AI	Comfort with AI interface, what is AI, Basics of AI, AI based tools and applications connected to field of study	Badges/Quizzes/ Tests
		Foundational courses on the usage of AI, Generative AI tools & frameworks, and Responsible AI	Working knowledge of AI fundamentals, Ability to analyse situations where AI can be applied	Completions
		Cross -Sector/Multi-disciplinary courses	Application of AI in the specific domain	
		Hackathons (usage of AI)	Solutions demonstrating how AI is being used in a specific domain,	
	Engineering colleges and STEM (IT and Related)	Foundational courses on AI models, AI tools & frameworks, and Responsible AI	Working knowledge of AI fundamentals, Ability to analyze situations where AI can be applied, Data Science fundamentals, Programming fundamentals	Knowledge based assessments, sandboxes, projects, hackathons, internships, creating applications
		Hackathons (usage of AI)	Solutions demonstrating how AI is being used in a core engineering fields, IT or Mathematical models,	Participations in hackathons
	ITI/ Polytechnic	Foundational courses on the usage of AI, Generative AI tools & frameworks, and Responsible AI	Comfort with AI interface, what is AI, Basics of AI, AI based tools and applications connected to field of study	Badges
	Across	Structured learning path on AI,	Comfort with AI interface,	Badges

	Industry	Generative AI and its applications, and Responsible AI	what is AI, Basics of AI, AI based tools and applications connected to field of study	
		Foundational courses on the usage of AI, Generative AI tools & frameworks, and Responsible AI	Working knowledge of AI fundamentals, Ability to analyze situations where AI can be applied, Data Science fundamentals, Programming fundamentals	Badges and completions
		Industry application-based courses and Responsible AI	Role or customer specific skills	Badges and completions
		Industry Best Practices to apply AI in different fields of work	Basics of AI, Problem Identification, Process to identify AI based solutions, Process to identify data sources, Resource identification, Expert consultations, and industry use cases	Knowledge based assessment; Application based assessment
		Implementation Methodology, Change Management Process & Business Benefits of AI enabled systems	Evaluation ROI of AI projects, Change Management	Knowledge based assessment; Application based assessment
		Industry Hackathon	Generate Innovative solutions	
	Across Govt Departments	Structured learning path/learner sessions on AI, Generative AI, Responsible AI	AI for Digital Nagriks, AI applications for citizen services, AI ethics and governance, AI trends	Knowledge based assessment
Few	Engineering colleges and STEM (IT and Related)	Advanced courses on Large Language Model, AI models, AI tools & frameworks, and Responsible AI	Ability to design and build AI models and solutions	Badges and completions
		Development of AI tools/Products.	Ability to build AI based products	Badges and completions
		Hackathons/ Ideation	To Showcase talent and generate open innovation ideas	Participations in hackathons
	Technical Professionals	Advanced courses on AI tools & models, Generative AI, NLP, and Responsible AI AI Product creation (Detection/Prevention) AI Products for persons with special needs (like for Physically Disabled persons or Elders)	Ability to design and build AI models and solutions	Badges and completions

	AI as a Service (AIaaS)	Cloud-based service to provide AI infrastructure, including machine learning, natural language processing, and computer vision services to companies that want to avoid upfront costs of hardware and software	AIaaS enables organization to build AI services cost effectively by providing computing power, foundational models and data warehouses without high upfront costs of hardware and software	Application based assessments, Projects
	Legal & Governance Professions	Courses on Data Privacy, Cyber Security and Cyber theft related to AI implementation & usage. Explainable AI	Fundamentals of AI to understand how it works, Understanding of AI models, Key issues around governance of AI and liability	Knowledge based assessments
	Person With Disabilities	AI foundational courses + enabling communication & enhancing accessibility tools	Awareness of AI based accessibility tools, Build solutions for accessibility for different disabilities	Application based assessments

All: This category is the End User who uses the AI interfaces. This category needs to be skilled primarily on the usage of AI, responsible AI, and its pitfalls. This is Basic Digital Literacy that is essential for anyone to use digital technologies & AI effectively. The material needs to be in the language of the region, and extremely simple to teach.

Many: This category is the AI-empowered generation who use AI and Generative AI for better productivity and need to understand AI applications in their domain. These learners should be skilled in various tools and applications. This is Digital Fluency for people who will use technology as a productivity multiplier and learn to use it responsibly and safely. Digital Fluency is a way for people to use technology tools, make choices about how their data should be used, and understand foundational concepts of how technology works.

Few: This category of people are AI-skilled and competent people who focus on developing AI products and applications around AI. They need to have deep technical knowledge and should be skilled in both technical and domain. This is Digital Mastery that is needed by developers to build technology-based solutions. This could range from coding and programming skills to data analytics, building machine learning algorithms, cloud computing, cybersecurity and other technologies that work in tandem with each other. These are not limited to the IT world but would cut across all domains and industries. They may also be involved in creating AI enabled products or providing AI as a Service (AI-aaS).

**Key Points:**

i. For schools and colleges, it is critical that students are taught fundamental concepts while they are taught AI and Generative AI. This would ensure that the students have the critical base to work on tools, even when new tools are introduced.

ii. One shall look at short-term courses and learning pathways based on the targeted audience so that learners can be skilled quickly.

iii. One shall look at NOS and Micro-credentials for a new set of roles and also have a structure to enable tool-based qualification /NOS.

4.2 Current Status: AI Skilling

There are already several courses available on AI skilling, and newer courses are constantly getting created. In the government skilling ecosystem, there are courses available from Future Skills Prime, which is run by NASSCOM Sector Skill Council, NPTEL, Centre of Advance Studies (CDAC) and NIELIT. There are courses available at school level and a large number of courses also available in AICTE accredited institutions.
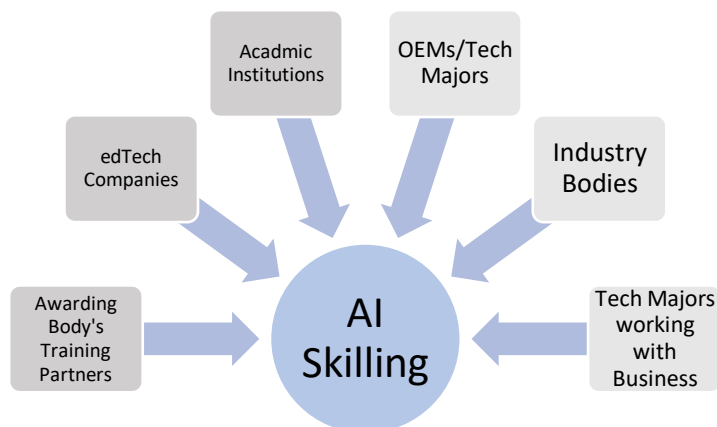
There are a lot of skilling courses available from some of the Ed-Tech companies such as Coursera, Udemy, Simplilearn etc. Also, some IT majors & associations conduct some courses with technology companies focused on specific business verticals.

4.3 Courses Available as part of Skilling in NQR

National Qualification Register (NQR) maintains a list of all the NSQF aligned courses in area of Skilling. Following is the list of courses on AI/ML, and its NSQF level in NQR:

SI. No.	Name of the Sector	Name of the Awarding Body	Name of the Qualifications	NSQF Level
1	IT-ITES	NASSCOM	AI " Machine Learning Engineer	7
2	IT-ITES	NASSCOM	AI " DevOps Engineer	6
3	IT-ITES	NASSCOM	AI - Database Administrator	6
4	IT-ITES	NASSCOM	AI " Solution Architect	7
5	IT-ITES	NASSCOM	AI " Data Architect	8
6	IT-ITES	NASSCOM	AI " Data Engineer	7
7	IT-ITES	NASSCOM	AI " Data Scientist	8
8	IT-ITES	NASSCOM	AI - Business Intelligence Analyst	6
9	IT-ITES	NASSCOM	AI " Data Quality Analyst	6
10	IT-ITES	NIELIT	Foundation course in Artificial Intelligence Applications	4
11	IT-ITES	NIELIT	Artificial Intelligence (AI) Associate (Upskilling)	4
12	IT-ITES	NIELIT	AI Development Associate	4
13	IT-ITES	NIELIT	Artificial Intelligence Assistant	3
14	IT-ITES	NIELIT	Artificial Intelligence Associate	4

15	IT-ITES	NIELIT	Artificial Intelligence Application Developer	4.5
16	Telecom	TSSC	AI & ML " Jr. Telecom Data Analyst	
17	Telecom	TSSC	Machine Learning (ML) Engineer	
18	Automotive	ASDC	Automotive Production Equipment Design Engineer	5
18	Automotive	ASDC	Automotive Product Design Lead Engineer	6
19	Automotive	ASDC	Automotive Prototype Manufacturing Lead Technician	5
20	Automotive	ASDC	Automotive Automation and Robotics Engineer	6
21	Automotive	ASDC	Automotive Robotics and Automation Simulation Engineer	6
22	Automotive	ASDC	Automotive Robotics and Automation Manager	7
23	Automotive	ASDC	Automotive Robotics System Integrator/Planner	6
24	Automotive	ASDC	Automotive Smart Manufacturing Engineer	6
25	Automotive	ASDC	Automotive Smart Manufacturing Specialist	7
26	Automotive	ASDC	Electric Vehicle Product Design Engineer	5
27	Automotive	ASDC	Automotive Additive Manufacturing Operator	3
28	Automotive	ASDC	Automotive Additive Manufacturing Technician	4
29	Automotive	ASDC	Automotive IIOT Application Engineer	5
30	Automotive	ASDC	Automotive IIOT Application Technician	4
31	Automotive	ASDC	Automotive Additive Manufacturing Engineer	6
32	Automotive	ASDC	Automotive Manufacturing Data Analyst	6
33	Automotive	ASDC	Automotive Dealership Data Analyst	6
34	Automotive	ASDC	Automotive Data Science Head	7
35	Automotive	ASDC	Automotive Smart Manufacturing Head	7
36	Automotive	ASDC	Automotive Flex Fuel Design Engineer	5.5
37	Electronics	ESSCI	Drone Manufacturing and Assembly Technician	4
38	Electronics	ESSCI	Drone Service Technician	4
39	Electronics	ESSCI	Embedded Full Stack IoT Analyst	5
40	Electronics	ESSCI	Embedded Product Design Engineer-Technical Lead	6
41	Electronics	ESSCI	Embedded Software Engineer	5
42	Electronics	ESSCI	EMS Operation & Maintenance Manager	6
43	Electronics	ESSCI	EMS Technician	4
44	Electronics	ESSCI	IoT Hardware Analyst	5
45	Electronics	ESSCI	Robotics Automation Lead	7
46	Electronics	ESSCI	VLSI Design Engineer	5

4.4   Courses available with Centre for Development of Advance Computing (CDAC)

Following is the list of courses available from CDAC in area of AI/ML

  i.   Post Graduate Diploma in Artificial Intelligence Duration (900+ hours)
 ii.   Post Graduate Diploma in Big Data analytics: Duration (900+ hours)
iii.   Specialised Programme in Machine Learning: Duration 6 weeks (offered under ITEC)
 iv.   Specialised Programme on Big Data Technologies and Machine Learning: Duration 8 weeks (offered under ITEC)

v. Specialised Programme in Artificial Intelligence: Duration 6 Weeks (offered under ITEC)
vi. Programme on Deep Learning: Duration 1 week (offered under ITEC)
vii. Two days Level-2 training on emerging technologies (Digital transformation through AI and Data Driven Decision Making) for Government officers through Capacity building commission.

4.5   Courses Available in AICTE accredited institutes/IITs

Some of the courses available from AICTE accredited institutes & leading IITs are:

i. Fundamentals of AI, ML
ii. Principles of AI and advanced AI
iii. Natural Language Processing & Computer Vision
iv. Computation Mathematics and Data Science
v. Certificate Program in Deep Learning & Machine Learning
vi. Deployable AI
    a. AI for Social Good
    b. Explainable & Transferable AI
    c. Private & Safe AI
    d. AI for Edge Computing & Applications
vii. Sports Science & Analytics
viii. Systems Biology & Medicine

These courses are typically of one semester duration, at **NHEQF level 5-7**, with 3-4 credits.

4.6   Courses Available with Ed-Tech & Tech-Organizations

Many Ed-Tech & Tech-driven organizations are offering courses on AI, ML and Data Science. These organizations have created courses for the individual learner, employees of companies or their clients. Some companies like Microsoft/Google have also created their product training together with the basic concept training on the subject together with its probable applications.

Few Courses, which are run by Ed-Tech companies, are given in the section:

S.no.	Course Area	Available Courses
1	Data Science	a) Machine Learning A-Z™: Hands-On Python & R In Data Science b) Data Science Professional Certificate c) Applied Data Science d) Post Graduate Program in Data Science
2	Machine Learning	a) Fundamentals of Deep Learning b) "Complete Tensorflow 2 and Keras Deep Learning Bootcamp" c) "Natural Language Processing with Deep Learning in Python" d) Applied Machine Learning for Healthcare e) Machine Learning DevOps Engineer f) AWS Machine Learning Engineer g) Practical Deep Learning for Coders h) Post Graduate Program in Artificial Intelligence and Machine Learning
3	Artificial Intelligence	a) Foundation Course of AI b) Deep Learning A-Z™: Hands-On Artificial Neural Networks c) AI Programming with Python d) Artificial Intelligence for Trading e) AI Product Manager

		f) AI for Business Leaders
		g) AI for Healthcare

There are courses available on Generative AI tools such as ChatGpt /Bard via OpenAI/Google. Some of the above courses are available via Future Skill Prime also. A detailed list of these courses available via Future Skill Prime is given in Annexure A.

4.7 Proposed Model to use existing Courses of Ed-tech Companies/Technology Majors:

To be able to use the existing courses, where some of them are already available via Future Skills Prime, require them to be **NSQF aligned** to be mainstreamed into the skilling environment. This may be handled via:

i. **Collaborative Partnerships**: Existing ABs may form strategic partnerships with these Ed-tech company's/technology majors to create and deliver specialized courses aligned with the country's skill requirements. They can collaborate to identify in-demand skills and develop comprehensive curriculum and training modules.

ii. **Course Customization**: The ABs can work with Ed-Tech platforms to customize existing courses or create new ones specifically tailored to address the needs of learners, both for local & global needs. This customization can include regional language support, culturally relevant content, and local& industry-specific case studies.

iii. **Accessible and Affordable Learning**: With government schemes and CSR initiatives, the Ed-Tech platforms can offer subsidized or free access to courses for learners from economically disadvantaged backgrounds & create some free for all content.

iv. **Recognition and Certification**: Collaboration with Ed-Tech companies may also be established for industry-recognized certification programs. This will help in creating a database of persons with the required skills.

v. **Trainer Development Programs:** Ed-Tech companies can partner with the skilling eco-system to train and certify a pool of skilled trainers. These trainers can then be deployed across the country to deliver the courses in offline or blended learning models, ensuring effective skilling at scale.

All these courses can come in form of qualifications or NOS or Micro-credentials, with a defined set of learning outcomes and assessment methodologies.

4.8 Timeline for Skilling in AI

On immediate bases, basic knowledge courses on AI need & hygiene including ethics to be created and made available for "All", including school students, college students and working professionals. Courses to be started for IT-students and upskilling in AI courses. These courses can be made available via on-line learning mode. Courses need to be created/reused for the technology students and tech company employees on AI. Additionally, key sectors and areas can be picked, where AI has significant potential and demand together with a thorough analysis of each sector to determine the specific AI skills required within a time frame. For example, some sectors such as Medical Diagnosis, Personalized medication, BFSI, Information Security, Predictive Maintenance etc. may be picked-up on immediate bases.

This also brings in need to establish partnerships with industry experts, professionals, and academia to develop comprehensive AI curriculum for each sector. Designing of courses shall be in a continuous timeframe, that covers both theoretical concepts and practical

applications of AI in specific sectors. Courses should also be ensuring that the curriculum includes hands-on projects, case studies, and real-world examples to enhance practical skills. Feedback may be gathered from learners, instructors and industry to refine and improve the curriculum/courses over a period of time. Qualifications may also be developed in a pilot phase for each sector in collaboration with selected industry associations to start with.

Monitoring the performance and outcomes of learners who have completed the AI skill qualifications shall also be in a continuous timeframe so as to analyse the evolving AI landscape and make necessary updates to the curriculum and qualifications to stay current/ updated.

i. Action Plan for Qualifications:

S.No	Name of Awarding Body	Action Plan	Timeline
1)	NIELIT	1. Artificial Intelligence using Python 2. Machine Leaning using Python 3. Capacity Building in AI 4. Awareness program in Emerging Tech 5. PG Diploma in Data Analytics and Artificial Intelligence 6. Machine Learning using Python 7. AI and ML 8. AI using Python-course1 9. AI using Python-course2 10. Data Analysis using Python Internship Programm 11. Data Analysis using ML Internship Programm 12. Certificate Course in Data Science using Python & R 13. Online Certificate Course in Machine Learning 14. Online Certificate Course in Python Programming 15. Certificate course in AI 16. Bridge course in AI / FSK Prime 17. Cyber Security using AI 18. AI by Intel 19. Internship in Data Science using Python Programming 20. Industrial Training and Internship in Machine Learning using Python 21. Machine learning using Phythin 22. Convolutional Neural Network/AI for Agriculture. 23. Prompt Engineers	3-4 Months
2)	Telecom Sector Skill Council	1. Cloud Computing – Sr. Analyst 2. IOT data Analyst 3. Data Flow Optimisation 4. Network Performance Analyst 5. Predictive Maintenance Technician 6. Fraud Detection Analyst 7. RF Optimization and Capacity	5-6 Months
3)	IT-ITES Nasscom	10 qualifications of AI-Big data Analytics.	6 Months
4)	Electronics Sector Skills Council of India	1. Embedded Full Stack IoT Analyst 2. Embedded Software Engineer 3. Embedded Product Design 4. Engineer - Technical Lead 5. IoT Hardware Analyst	Feb'2024 - Sep '2024

		6. VLSI Design Engineer
		7. Assembly Line Operator
		8. Assembly Supervisor
		9. Smartphone Assembly Technician
		10. EMS Technician
		11. EMS Operation & Maintenance Manager
		12. Battery System Assembly Operator
		13. Drone Manufacturing & Assembly Technician
		14. Drone Service Technician
		15. Robotics Automation Lead
		16. Customer Care Executive
		17. IT Coordinator in School
		18. Remote Helpdesk Technician

ii. Action Plan for Training of Trainers:

S.No	Name of Awarding Body	Action Plan	Timeline
1)	**NIELIT**	100 Trainers are available from 46 centres.	One week for refresh
2)	**IT-ITeS Nasscom**	Introduced a framework for the selection of Master Trainers.	Started

5. AI and AI Enabled Technologies Matrix Table:

In this section, an indicative roadmap for **Technical Expertise and Level of Manpower Required.** To creating a standard structure and reusability of AI modules & knowledge, the various sectors are divided in following areas/ groups:

i. Telecommunications, Electronics, IT-ITES, Information Security & Instrumentation
ii. Automotive, Defence, Railways, Aerospace & Aviation Production.
iii. Agriculture Production, Quality Management & its Supply Chain Vertical
iv. Logistics and Transportation, Supply Chain Management.
v. Process Manufacturing Sector: Steel, Mining, Oil & Gas, Glass & Ceramics, Hydrocarbon & Green Jobs
vi. Healthcare & Life Sciences
vii. BFSI Vertical, where AI can be extensively used for Risk & Fraud analysis.
viii. Sectors with Personalized services such as Media, Education, Apparel, Gems & Jewellery, Beauty & Wellness, Leather, Domestic Worker, Rehabilitation, Sports, Tourism
ix. Construction, Paint & Coating, Smart Cities, Water & Plumbing
x. AI for Physically Disabled

In each of the above business groups, there can be common Micro-Credential/NOSs for usage of basic technologies, together with a specific Micro-Credential/NOS focusing on specific business vertical requirements. In this section, the skilling requirements for the first 3 groups in provided. A broad outline of skills/ roles that may be created in future in the specific sectors is given in the section 9.

As in most business verticals, AI is used with other support technologies. Hence, there will be a need for creating a workforce, which not only understands AI, but is also able to understand and use other emerging technologies such as Cloud Computing, Big Data Analysis, Cybersecurity, IOT, Edge computing, Additive Manufacturing(3D) etc. Following parameters are ensured in all the above-mentioned group while creating the matrix table:

   a. NSQF levels from 2.5-8 are suggested along with the indicative job roles at each level.
   b. These job roles are mapped to various AI and AI enabled/enabling technologies.
   c. Mapping these levels and technologies forms a matrix.
   d. This matrix provides us with a roadmap or a possible way of creating a new job role pertaining to industry needs.

In the following tables:

⌾	To depict preliminary knowledge of AI technologies at various levels
✔	To depict the advance/ expertise knowledge of AI and AI enabled technologies.

5.1 Technical Expertise and Level of Manpower Required for IT-ITES, Telecommunications, Electronics, Information Security & Instrumentation

NSQF level	AI-Technology (Enabled) / Job Roles	Machine Learning/ Deep Learning	Neural Network	Fuzzy Logic	Speech Recognition /Voice Recognition	RPA	AIoT	Analytics	Chatbot	AR/ VR	Drone	VLSI	Generative AI	Nano-technology
2.5-3	Technician/Testing Assistant/Operator/User				✓	✓	✓		✓	✓	✓	✓		
3.5-4	Technician/ Repairer/Executive/Programmer/Electronic Mechanic				✓	✓	✓		✓	✓	✓	✓		
4.5-5	Engineer/Mechanic/Supervisor/Product Tester	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
5.5-6	Robotic Programming/Application Developer	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
6.5-7	Sr. Engineer/Sr. Manager/ Mgmt. Executive/ Sr. Analyst/ Supply Chain Lead	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
7-8	Area Manager/ Operations Head/ Sales Head/ VP/ Branch Head	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Note: This table includes following sectors: **Telecommunication, Electronics, IT-ITES, Information Security & Instrumentation.**
The above-mentioned technologies may/ may not be used directly with the respective job roles.

Technical Expertise and Level of Manpower Required for Manufacturing Sectors such as Automotive, Railways Production, Aerospace & Aviation Production, Defense Production

NSQF level	AI-Technology (Enabled) / Job Roles	Machine Learning/ Deep Learning	Neural Network	Fuzzy Logic	Speech Recognition/ Voice Recognition	RPA	AIoT	Analytics	Chatbot	AR/VR	Drone	Manufacturing & Design Technology
2.5-3	Operator/Executive/ Assistant/ Driver/ Controller/ Clerk				○	○	○		○	○	○	
3.5-4	Associate/Handler/ Surveyor/Technician				○	○	○		○	○	○	
4.5-5	Supervisor/Specialist/ Sr. Technician/ Assistant Manager/ Team Lead	●			●	●	●	●	●	●	●	●
5.5-6	Engineer/Manager/ Analyst / Scientist/ Inventory Manager	●	●	●	●	●	●	●	●	●	●	●
6.5-7	Sr. Engineer/Sr. Manager/ Mgmt. Executive/ Sr. Analyst/ Design Planner/ Supply Chain Lead	●	●	●	●	●	●	●	●	●	●	●
7-8	Area Manager/ Operations Head/ Sales Head/ VP/ Branch Head	●	○	○	○	○	○	○	○	○	○	○

5.3 Technical Expertise and Level of Manpower Required for Agriculture Production, Quality Management & its Supply Chain Vertical

NSQF level	AI-Technology (Enabled) / Job Roles	Machine Learning/ Deep Learning	Neural Network	Fuzzy Logic	Speech Recognition /Voice Recognition	RPA	AIoT	Analytics	Chat bot	AR/ VR	Drone	AI in Precision Farming	AIoT (Smart farming)	Nano-technology
2.5-3	Lab Assistant/ Farm Worker						○						○	
3.5-4	Progressive Farmer/ Field Officer/ Operator/ Fabricator/ Technician/ Processor					○	○		○	○	○	○	○	
4.5-5	Service Provider/ Tech Enabler/ Cold Storage/ Demonstrator/Maintenance Provider/ Supervisor/				●	●	●	●	●	●	●	●	●	
5.5-6	Scientist/ Analyst/ Microbiologist/ Breeder/ Farm Management/ Warehouse Manager	●	●	●	●	●	●	●	●	●	●	●	●	●
6.5-7	Sr. Engineer/Sr. Manager/ Mgmt. Executive/ Sr. Analyst/ Supply Chain Lead	●	●	●	●	●	●	●	●	●	●	●	●	●
7-8	Area Manager/ Operations Head/ Sales Head/ VP/ Branch Head	●	○	○	○	○	○	○	○	○	○	○	○	○

6. Summary of New Job Roles

6.1　AI as a Service (AIaaS)

Artificial Intelligence (AI) as a service has the potential to significantly impact the skilling sector by democratizing the reach of AI and providing innovative solutions and tools to enhance learning experiences, improve skill development, and streamline various processes. It can be utilized across various sectors to enhance efficiency, improve decision-making processes, and drive innovation.

i. **Healthcare**: AIaaS can be deployed to analyse medical data and assist in diagnosing diseases, predicting outcomes, and personalizing treatment plans. Various administrative tasks can be automated, such as:

    a) Symptom & Allergy Analysers and Disease Prediction
    b) Personalized Medication & Prosthetic Limbs/implants
    c) Predicting Re-admission cases in hospitals
    d) Resource Planning & Optimization
    e) Robotic Surgery
    f) Radiology Interface with Natural Language Processing (NLP)
    g) Clinical Analysis & Drug Discovery

ii. **Finance**: AIaaS can be utilized for fraud detection, risk assessment, and algorithmic trading. It can analyse large volumes of financial data in real-time, identify patterns, and make predictions. AI algorithms can also be used for credit scoring, loan underwriting, and financial planning.

iii. **Retail**: AIaaS can help retailers optimize inventory management by analysing historical sales data, demand patterns, and market trends. It can enable personalized product recommendations for customers, improve pricing strategies, and enhance inventory management &supply chain management through predictive analytics.

iv. **Manufacturing**: AIaaS can optimize production processes by leveraging machine learning algorithms to identify bottlenecks, predict equipment failures, and improve overall efficiency. It can also be used for quality control, defect detection, and predictive maintenance.

v. **Logistics**: AIaaS can be applied to autonomous vehicles for navigation, route optimization, and object recognition. It can help optimize logistics and fleet management, enhance traffic control systems, and improve overall safety.

vi. **Energy**: AIaaS can optimize energy consumption by analysing data from smart grids and sensors. It can predict energy demand, manage power distribution, and identify energy-saving opportunities.

vii. **Agriculture**: AIaaS can assist in crop monitoring, disease detection, and yield prediction. It can analyse satellite imagery, weather data, and soil conditions to optimize irrigation, fertilization, and pest control processes.

viii. **Learning & Assessment**

    a. **Personalized Learning**: AI can analyze learner data and generate personalized recommendations, content, and assessments based on individual strengths, weaknesses, and learning styles. Adaptive learning platforms powered by AI can tailor educational content to the specific needs of learners, making the skilling process more efficient and effective.

    b. **Virtual Reality and Augmented Reality**: AI can be combined with virtual reality (VR) and augmented reality (AR) technologies to create immersive learning experiences. VR/AR simulations can be used to practice real-world skills, such as medical procedures or industrial operations, in a safe and controlled environment.

c. **Skill Assessment and Certification**: AI can automate and streamline the process of skill assessment and certification. Natural language processing (NLP) algorithms can be used to evaluate written responses and provide instant feedback. AI-powered proctoring systems can monitor exams remotely, ensuring integrity and preventing cheating.

d. **Intelligent Content Creation**: AI can assist in the creation of high-quality personalized educational content. Natural language generation (NLG) algorithms can automatically generate lesson plans, and interactive exercises.

e. **Predictive Analytics for Skill Demand**: AI algorithms can analyze labor market data, job postings, and economic trends to predict future skill requirements.

f. **Career Guidance and Job Matching**: AI-based career guidance systems can analyze individual skills, preferences, and labor market data to provide personalized career recommendations. AI algorithms can also match job seekers with suitable employment opportunities by matching their skills and qualifications with job requirements.

However, it's important to note that while AI brings numerous benefits to the skilling sector, it also raises **ethical considerations**, such as privacy, **bias**, and transparency. Ensuring proper safeguards and human oversight is crucial to maintain the integrity and fairness of AI-driven skilling solutions. A new concept of "Explainable AI" is parallelly emerging which covers such issues.

7. Suggested Knowledge Progression

This section attempts to provide detailed recommendations of courses that may be adopted at various suggested levels.

7.1 Basic AI literacy for All

This should also cover basic usage of popular Generative AI tools to improve learning & productivity.

All	Indicative Qualification/Micro-credential	Hours
NSQF Level (1-2)	a) What is AI b) Using AI tools including Generative AI to create pictures, music, documents, websites and for education. c) Need of Ethics in AI	7.5

7.2 Courses for Many: for School Students

The curriculum in schools should be age appropriate and cover fundamental concepts of AI, including machine learning, data handling, programming, and ethical considerations. The content should be designed to engage students and encourage the practical application of AI principles. Faculty development programs is a must and should focus on enhancing teachers' understanding of AI concepts, teaching methodologies, and the use of technology in AI education. They should also provide guidance to update National Curriculum Framework (NCF) to incorporate AI into existing subjects or as a standalone module.

Class	Indicative Qualification/Micro-credential	Hours (60)

6-8 NSQF Level (1-2)	a) What is AI b) Using AI tools (including Generative AI tools) to create pictures, music, documents, websites and for education. c) Need of Ethics in AI	7.5
9-10 NSQF Level (2-3)	a) Fundamental concepts of AI and using AI tools b) Ethics in AI c) Using ML in art or music or deploying reinforcement learning in games d) Introduction to AI programming with mini project	22.5
11-12 NSQF Level (3-4)	a) Maths and Statistics for AI b) AI libraries, tools, and frameworks c) Applications of AI, such as NLP, Computer Vision d) Usage of AI tools for basic AI applications e) Need for handling Data Security & Privacy f) Incorporating Ethics in AI software	30

7.3   Courses for Many: ITI & Non-IT Graduates

The skilling process can concentrate on the broader understanding of AI, its ethical implications, and its impact on various sectors. The curriculum can cover AI fundamentals, AI-related policies, ethical considerations, and critical thinking skills necessary for informed decision. The following course may be embedded in the existing courses.

NOSs	Indicative Performance Criteria	Indicative Duration (150)
Introduction to AI	a) Human Intelligence b) Artificial Intelligence c) Why Do We Need AI? d) What are Key Components of AI? e) Generative AI tools f) Future of AI	30 hrs
Types of Learning	a) Human Learning Process b) Computer or Machine Learning c) Learning Human Abilities	15 hrs
Data	a) Introduction to Data b) Datasets & Types of Data c) Database, Data Science and Big Data	15 hrs
Application of AI	a) IOT b) Robot and Automation c) Chatbot, Speech/ Audio Recognition d) Fraud detection and prevention	30 hrs
Problem Solving & Decision Making	a) Introduction to Problem Solving b) Searching/Sorting & Algorithmic Techniques	30 hrs
Cybersecurity and Risk Management	a) Fundamentals of cybersecurity b) Different types of Malwares and threats c) Issues related to cyber theft & Preventions	15 hrs

NOSs	Indicative Performance Criteria	Indicative Duration (1200 hrs)
Ethics and AI	a) Ethics and AI	15 hrs

To make ITI courses aspirational, the following broad structure for a one-year ITI course of AI is also proposed. They will come at NSQF levels 2.5 to 4.

NOSs	Indicative Performance Criteria	Indicative Duration (1200 hrs)
Introduction to AI	a) Human Intelligence b) Artificial Intelligence c) Why Do We Need AI? d) What are Key Components of AI? e) Future of AI	60 hrs
Basics of Programming for AI	a) Programming languages like Python or Java b) Basics of Data Structure c) Low Code No- Code d) Basics of Git-Hub	120 hrs
Support Technologies for AI	a) Concepts on Cloud Computing b) Fundamentals of Internet of Things c) Intelligent Internet of Things d) Introduction to usage of Generative AI tools for learning & productivity improvement e) 3D printing f) Augmented Reality (AR)	180 hrs
Types of Learning	a) Human Learning Process b) Computer or Machine Learning	30 hrs
Data	a) Introduction to Data b) Datasets & Types of Data c) Database, Data Science, SQL and Big Data d) Difference between Data Science, ML & AI and applications	60 hrs
ML	a) Applications of ML b) Project	120 hrs
Application of AI	a) Data collection from IOT b) Edge Computing Concept c) Robot and Automation d) Chat-bot, Speech/ Audio Recognition e) Fraud detection and prevention	90 hrs
AI for Customer Service	a) AI for Personalization b) Customer Segmentation c) AI for Chat-bots d) AI for Customer Centricity	60 hrs
Problem Solving & Decision Making	a) Introduction to Problem Solving b) Design Thinking Approach c) Searching/Sorting & Algorithmic	120 hrs

		Techniques	
	d)	Project/Problem solution	
Generative AI	a)	Using ChatGpt for education	120 hrs
	b)	Using ChatGpt/Bard for website design	
	c)	Basics of Prompt Engineering	
	d)	Project	
Cybersecurity and Risk Management	a)	Fundamentals of cybersecurity	60 hrs
	b)	Different types of Malwares and threats	
	c)	Issues related to cyber theft & Preventions	
Ethics and AI	a)	Ethics and AI	30 hrs
Usage of AI in Governance	a)	Data Privacy & IPR	30 hrs
	b)	Responsible AI	
Employability Skills			120 hrs

7.4 Courses for Many: IT Graduates

Other than the courses given in section on basics of AI, IT graduates may be given options of choosing courses as described in the available list of courses for AICTE or from any of the NSQF aligned courses as part of NQR. The skilling process can focus on in-depth technical knowledge of AI algorithms, machine learning, deep learning, and data analytics. The curriculum may additionally have emphasized on mathematics, statistics, programming languages, and practical application of AI tools. Collaboration with Ed-Tech partners and industry can provide access to cutting-edge technologies, real-world projects, and expert guidance, enabling students to gain hands-on experience.

The AI development also should demonstrate transparency & accountability and inclusion. As the tools & developments of these tools mature, it is also expected that the best practices & solutions across the industries also to be made available for future developments.

Market Requirement Users at Various Levels	AI Tools/Products
Engineering Students (IT)	i. Knowledge of Opensource tools/libraries such as TensorFlow/ Python /Scala. ii. Users of MATLAB /R, SAS iii. Integration of Generative AI applications with User applications, Regional/Natural Language Interface, Robotic Process Automation, Drone Application, Artificial Intelligence of Things
Working Professionals in IT sector	i. Tools such as Azure AI(Microsoft), Watson Studio (IBM), AWS SageMaker ML services, Vertex AI (Google platform), to build, deploy and scale ii. Usage of Generative AI tools with business systems
Working Professionals in Electronics Sector	i. Neural Networks, Parallel & Edge computing ii. GPGPU Architecture iii. AI relevant software's iv. NVIDIA Jetson/Jetson Nano, Hardware and

	facilities planning, ML/DL algorithms on hardware	

7.5 For Working Professionals in Manufacturing Sector

In the manufacturing sector, AI can be used in equipment Maintenance, Quality Control, Inventory & Warehouse Management, Supply Chain Optimization & Risk Management, Design & Product development Process for manufacturing, Demand Planning and even Price forecasting. Some Manufacturing units are using it for Energy Management, Tracking workers' health and failure probability modelling. This set of courses cover basic concepts and prepare the manpower on these concepts to use these techniques.

NOSs	Indicative Performance Criteria	Indicative Duration (30 hrs)
Introduction to AI	a. Human Intelligence b. Artificial Intelligence c. Why Do We Need AI? d. What are Key Components of AI? e. Future of AI in their business vertical	7.5 hrs
Emerging Technologies	a. IOT b. Robot and Automation c. Chat-bot d. Speech/ Audio Recognition e. Fraud detection and prevention	7.5 hrs
Implementation of AI in their organization	a. AI usage in the business verticals b. Availability of Tools & usage c. Global Best practices	7.5 hrs
Cybersecurity and Risk Management	a. Fundamentals of cybersecurity b. Different types of Malwares and threats c. Issues related to cyber theft. d. Preventions	4.5 hrs
Ethics & Explainable AI	a. Ethics and AI, b. Explainable AI	

7.6 For Working Professionals in Service Sectors

In service sector, AI is already getting used for Customer Segmentation & related services such as preventive interventions for customer acquisition & retention. Fraud detection & prevention is another area together with personalization where work is already happening with usage of AI.

NOSs	Indicative Performance Criteria	Indicative Duration (30 hrs)

Introduction to AI	a. Human Intelligence b. Artificial Intelligence c. Why Do We Need AI? d. What are Key Components of AI? e. AI in Customer Service/Personalization	7.5 hrs
Emerging Technologies	a. IOT b. Personalization & Customer Service and role of AI in that. c. Speech/ Audio Recognition d. Fraud detection and Prevention	7.5 hrs
Implementation of AI in their organization	a. AI usage in the business verticals b. Availability of Tools & usage c. Global Best practices	7.5 hrs
Cybersecurity and Risk Management	a. Fundamentals of cybersecurity b. Different types of Malwares and threats c. Issues related to cyber theft. d. Preventions	4.5 hrs
Ethics & Explainable AI	a. Ethics and AI, b. Explainable AI	3 hrs

7.7   AI for Person with Disabilities

AI has the potential to create an inclusive skilling ecosystem which can greatly enhance the lives of people with disabilities (PwD) by providing innovative tools and products that cater to their specific needs. Some products that have already been created are: Intelligent Walking stick for people with extremely low vision / blind, personalized learning platforms for people with cognitive disability. Others include speech improvement tools for people with Speech Disability etc.

Few ways in which AI can be utilized by the trainers'/ training partners in this context:

i. **Adaptive/Assistive Learning Platforms**: AI-powered adaptive/assistive learning platforms can customize learning experiences based on individual needs and preferences. These platforms can assess learner's strengths and weaknesses, create content accordingly and provide personalized recommendations for skill development.

ii. **Computer Vision Systems, Speech Recognition and Natural Language Processing (NLP)**: These technologies can assist individuals with speech or hearing impairments.

iii. **Virtual Reality (VR) and Augmented Reality (AR):** VR and AR technologies, when combined with AI, can create immersive training environments to simulate real-world safe scenarios.

iv. **Prosthetics and Exoskeletons**: AI can improve the functionality of prosthetic limbs and exoskeletons by enabling them to adapt to users' movements and provide more natural control. Machine learning algorithms can learn from users' actions and adjust the prosthetic or exoskeleton accordingly.

v. **Cognitive Assistance**: AI can support individuals with cognitive disabilities by providing reminders, prompts, and organizational tools. Intelligent personal assistants can help manage schedules, set reminders, and provide guidance for daily activities.

By leveraging AI tools and products, the skilling ecosystem can become more accessible, personalized, and empowering for individuals with disabilities, helping them acquire new skills and enhance their employability.

7.8 For Governance & Services Sector (including Government)

Skilling in AI for governance and service areas can have a significant impact on improving various aspects of society. Here's an overview of how AI can be applied to the following areas:

i.   **Traffic light management & Public Transport Planning**: AI can optimize traffic light timings based on real-time traffic data to reduce congestion and improve traffic flow. AI can also optimize public transport schedules based on demand patterns, reducing wait times and improving efficiency

ii. **Security:** AI-powered surveillance systems can detect and analyze suspicious activities, enhancing security measures in public spaces.

iii. **Safety of women, children, and elders**: AI can be used for developing safety applications, such as panic buttons and location tracking, to ensure the safety of vulnerable groups.

iv. **Unauthorized Construction:** AI can help in monitoring and identifying unauthorized constructions through satellite imagery and data analysis.

v.   **Road Safety and Condition**: AI algorithms can analyze road condition data and detect potential hazards, enabling authorities to prioritize maintenance efforts and reduce accidents.

vi. **Power and Water consumption**: AI can optimize power and water distribution networks by analysing consumption patterns, predicting demand, and suggesting efficient usage strategies.

vii. **Disaster Management**: AI can aid in early detection and prediction of natural disasters, enabling proactive measures for evacuation, resource allocation, and recovery planning.

viii. **Epidemic situation:** AI algorithms can analyse data from various sources to track the spread of diseases, predict outbreaks, and support decision-making for public health interventions.

ix. **Weather prediction**: AI techniques like machine learning can improve weather forecasting accuracy by analysing vast amounts of data from weather stations, satellites, and historical records.

x.   **Safety of National Highways:** AI-powered monitoring systems can identify potential dangers on highways, such as accidents or obstructions, and alert authorities for prompt action.

xi. **Optimization of National Waterways**: AI can help optimize vessel routing, navigation, and cargo management on waterways, improving efficiency and reducing transportation costs.

xii. **Waste Management**: AI can assist in waste sorting, recycling, and waste collection route optimization to improve efficiency and reduce environmental impact.

xiii. **Pollution**: AI can analyse sensor data and satellite imagery to monitor air and water quality, helping identify pollution sources and develop mitigation strategies.

xiv. **Skill and education planning**: AI can analyse labor market trends, skill gaps, and educational data to provide insights for skill development programs and education planning.

These applications demonstrate the potential of AI in various governance and service areas. However, it's important to address ethical considerations, data privacy, and potential biases when implementing AI systems in these domains.

Skilling in AI for the government departments is already being imparted. Skilling in AI is a continuous process, these courses need to be updated with time. A foundational course created by NASSCOM on Gen AI is listed as follow:

NOSs	Indicative Performance Criteria	Indicative Duration (2 hrs)
Introduction to AI	a. What is AI? b. History of AI c. Current Situation of AI	15 minutes
Introduction to GenAI	a. What is Gen AI b. History of Gen AI c. Current Situation of Gen AI	15 minutes
Gen AI tools	a. Hands on session with Gen AI tools	1 hour
Responsible AI	a. Privacy b. Data Security c. Ethics	30 minutes

7.9 For Armed Forces Personnel- Defense Sector

Skilling in AI for the army involves developing expertise in various domains that are relevant to military applications. Other than training in basics of AI, as detailed above, some identified areas where skilling for defence personnel in AI can be done are:

i.   **Autonomous Systems**: Autonomous systems, such as unmanned aerial vehicles (UAVs), unmanned ground vehicles (UGVs), and autonomous submarines, play a crucial role in modern warfare. Skilling in AI for autonomy involves understanding algorithms for navigation, obstacle avoidance, decision-making, and mission planning.

ii. **Predictive Analytics**: It uses AI techniques to analyse large volumes of data and make predictions about future events or outcomes. In the military context, it can be applied to areas like predictive maintenance of equipment, predicting troop movements, identifying potential threats, and forecasting logistics requirements.

iii. **Computer Vision for Surveillance**: Computer vision techniques enable the analysis and interpretation of visual data, which is particularly useful for surveillance applications. Skilling in computer vision algorithms for object detection, tracking, and behaviour analysis can help in identifying potential threats, monitoring borders, and enhancing situational awareness.

iv. **Natural Language Processing for Intelligence Analysis**: Natural Language Processing (NLP) techniques can assist in processing and analysing vast amounts of textual data to extract relevant intelligence. Skilling in NLP algorithms for information extraction, sentiment analysis, and text summarization can aid in processing intelligence reports, monitoring social media for situational awareness, and extracting actionable insights from textual data.

v.   **Threat Detection and Cybersecurity**: Skilling in AI-based threat detection and cybersecurity techniques is crucial for military operations. This involves understanding anomaly detection algorithms, network intrusion detection systems, threat intelligence analysis, and cybersecurity defence mechanisms to protect sensitive military systems and networks.

vi. **Decision Support Systems**: AI can provide decision support systems that assist military commanders in making informed decisions. Skilling in AI techniques for decision support, including machine learning algorithms for risk analysis, simulation modelling, and optimization, can aid in planning military operations, resource allocation, and logistics management.

vii. **Ethical and Legal Considerations**: As with any AI application, ethical and legal considerations are paramount in military contexts. Skilling in understanding the ethical implications of AI, addressing biases and discrimination, ensuring transparency and accountability, and adhering to legal frameworks is crucial for responsible use of AI in the army.

To develop skills in these areas, individuals can pursue specialized training programs, participate in military-specific AI research projects, attend workshops and conferences on defence technology and collaborate with experts in the field.

7.10 For Working Professionals in Legal Sector

AI training for legal professionals can be in two areas.

a) To support legal queries that arise because of AI, which will need them to understand the concepts of "Explainable AI". For example, to understand cases that may arise because of usage of Autonomous Vehicles or any Biases in system.

b) To support the Legal system & Processes. AI can aid in the generation of outcomes for legal investigations and agreement evaluations. This characteristic of AI programming can be extremely beneficial to legal industry.

Few law firms in India have been using "**Kira**," a machine learning program. This AI-based software is used to analyse legal papers, locate, and spot any potentially dangerous areas and extract provisions from various legal documents. The Ministry of Commerce and Industry has also established an AI task force with a vision "to embed AI in our Economic, Political and Legal thought processes so that there is the systematic capability to support the goal of India becoming one of the leaders of AI-rich economies". According to a Thomson Reuters report, about 82% of law firms (across US, UK and Canada) believed that Generative AI can be used by legal professionals.

Potential Areas for Law Sector to use AI:

i. **Contract Review**- AI systems that can automatically ingest proposed contracts, evaluate them in detail using natural language processing (NLP) technology, and determine which parts are acceptable and which aren't.

ii. **Analytics**- Natural Language Process (NLP) powered solutions are being developed that extract and contextualize critical information of law contracts, making it simple for all the stakeholders to grasp the nature of the company's commitments. Law firms will be able to track when the contracts are up for renewal, allowing them to take advantage of revenue opportunities.

iii. **Litigation Prediction**- Machine Learning Models can be used/ developed to anticipate the outcomes of the pending cases, using the relevant fact of the case as inputs.

iv. **Legal Research**- It is an area where machine intelligence and AI technology such as Natural Language Process can be used to reduce the labour-intensive procedure of research work.

v. **AI based Servicing/ Solutions**- With the help of Machine learning and NLP, Law firms can approach their clients with fresh ideas and more genuine and cost-effective legal solutions.

vi. **Legal Mechanism using machine learning**- Lawyers can obtain information points from prior or past instances of the case using Artificial Intelligence technologies. They can also utilize this data to keep track of the judge's instructions and forecasts.

vii. **Documenting Mechanism**- Different types of AI based software's can be used in the legal industry to develop papers that aid in the collection of data and information.

Use of AI technologies such as Generative AI for above use cases requires legal professionals to stay updated on new technologies and develop adaptability and proficiency in working with these applications. This includes identifying services where the use of Generative AI would add value to costs and enhance efficiency. It is essential to recognize and address the associated risks while gaining proficiency in the ability to use such applications. Two significant risks in this context are accuracy and confidentiality, which they need to address in parallel.

7.11 For CXOs

For any Digital transformation or implementation of AI tool/project, it is very important that the buy-in and support comes from top. The CXOs program on AI needs to train them in basic AI ethics, its importance and changes it will bring at the governance levels. An indicative program may be designed as:

NOSs	Indicative Performance Criteria	Indicative Duration (30 hrs)
Introduction to AI	a. Human Intelligence b. Artificial Intelligence c. Why Do We Need AI? d. What are Key Components of AI? e. Future of AI	7.5 hrs
Emerging Technologies	a. IOT b. Robot and Automation c. Chatbot d. Speech/ Audio Recognition e. Fraud detection and prevention	7.5 hrs
Implementation of AI in their organization	a. Human Learning Process b. Computer or Machine Learning c. Learning Human Abilities	3 hrs
Cybersecurity and Risk Management	a. Fundamentals of cybersecurity b. Different types of Malwares and threats c. Issues related to cyber theft. d. Preventions	4.5 hrs
Ethics & AI for Governance	a. Possibilities of biases in AI b. Ethics and AI, c. Explainable AI & Governance and legal issues	7.5 hrs

7.12 AI Skilling in Education

i. AI and Generative AI have had a significant impact on education, revolutionizing various aspects of the learning process and offering new opportunities for both students and educators. Here are some key impacts of AI in education:

a. **Personalized Learning**: AI enables personalized learning experiences by analysing vast amounts of data on individual student's learning patterns, preferences, and strengths. It can provide tailored content, adaptive assessments, and feedback to cater to each student's specific needs, promoting more effective learning outcomes.

b. **Intelligent Tutoring Systems**: AI-powered intelligent tutoring systems can act as virtual tutors, guiding students through interactive lessons, providing explanations, and offering immediate feedback. These systems can adapt to individual learning styles, pace, and skill levels, enhancing the learning experience and knowledge retention.

c. **Automated Grading and Feedback**: AI can automate the grading process for assignments, quizzes, and exams, saving educators time and effort. It can provide instant feedback to students, highlighting areas of improvement and offering targeted suggestions for further study.

d. **Enhanced Accessibility**: AI technologies can make education more accessible to diverse learners. For students with disabilities, AI-powered tools like speech-to-text, text-to-speech, and assistive learning platforms can provide customized support, enabling them to participate more effectively in the educational process.

e. **Intelligent Content Creation**: AI can assist educators in developing interactive and engaging educational content. It can generate lesson plans, create educational materials, and design immersive simulations or virtual reality experiences, fostering creativity and enhancing the learning experience.

f. **AI-proctored assessments** have emerged as a valuable tool in education, providing a secure and efficient means of evaluating student knowledge and skills remotely. By leveraging advanced technologies such as facial recognition, eye-tracking, and keystroke analysis, AI proctoring ensures the integrity of exams and assessments while preserving convenience and flexibility for both students and educators. It offers several advantages, including preventing cheating through real-time monitoring, flagging suspicious behaviour or anomalies, and analyzing patterns to identify potential irregularities.

ii. Generative AI, which involves the creation of new content by AI systems, further expands the possibilities in education. It can:

a. **Content Generation**: Generative AI can automatically create educational resources such as textbooks, quizzes, and exercises. This can help educators save time and effort in curriculum development, while also ensuring the availability of up-to-date and high-quality learning materials.

b. **Language Translation**: Generative AI models excel in language processing tasks, including translation. They can assist in breaking down language barriers by providing real-time translation services for students and teachers, facilitating global collaboration and cross-cultural learning.

c. **Creative Projects and Simulations**: Generative AI can be used to develop simulations and interactive experiences that enhance students' creativity and problem-solving skills. It can generate virtual environments, characters, or scenarios for project-based learning, fostering innovation and critical thinking.

iii. To leverage the potential of AI and Generative AI in education, several skills are required:

a. **Data Literacy**: Educators and administrators should possess a basic understanding of data collection, analysis, and interpretation. This knowledge will help them make informed decisions about using AI tools and leveraging student data effectively.

b. **Technological Proficiency**: Familiarity with AI tools, learning management systems, and data analytics platforms is essential for educators to integrate AI into their teaching practices successfully.

c. **Pedagogical Adaptability**: Educators need to adapt their instructional strategies to incorporate AI-powered tools effectively. They should be able to leverage AI to create personalized learning experiences, offer individualized feedback, and design engaging activities that align with educational goals.

d. **Ethical Considerations**: Understanding the ethical implications of AI in education is crucial. Educators should be aware of issues such as data privacy, algorithmic bias, and the responsible use of AI technologies to ensure equitable and fair learning environments.

e. **Continuous Learning**: Given the rapid advancements in AI, educators should embrace a growth mindset and engage in ongoing professional development to stay updated on AI-related developments and best practices in educational technology.

By acquiring these skills, educators can harness the power of AI and generative AI to enhance the educational experience, promote better learning outcomes, and prepare students for the challenges of the future.

8. Ethical AI NOS

Like the 'Employability Skills' are part of every NSQF Aligned skilling qualification, a NOS/ Micro-credential on 'Ethical AI & Explainable AI (as required)' shall be part of every AI course.

Ethical artificial intelligence (AI) refers to the development and use of AI systems in a responsible and morally acceptable manner. It involves ensuring that AI technologies align with ethical principles and values, protect human rights, and minimize potential harms.

Here are some key points for using AI responsibly:

i. **Fairness and Bias**: AI systems should be designed and trained to avoid bias and discrimination based on factors like race, gender, or ethnicity. Developers should carefully select training data, regularly evaluate, and address biases, and promote transparency in algorithmic decision-making.

ii. **Transparency**: AI systems should be transparent and explainable to users. Understanding how AI arrives at its decisions helps build trust and enables users to assess and challenge outcomes. Techniques like interpretability and explainable AI can be used to provide explanations for AI decisions.

iii. **Privacy and Data Protection**: AI applications often involve the collection and processing of large amounts of data. Protecting user privacy and ensuring data security are crucial. Organizations should comply with relevant data protection regulations, implement robust security measures, and obtain informed consent when collecting and using personal data.

iv. **Accountability and Responsibility**: Clear lines of accountability and responsibility need to be established when developing and deploying AI systems. Developers, organizations, and users should understand who is responsible for the actions and decisions made by AI systems and be prepared to address any potential negative impacts.

v. **Human Oversight**: AI systems should be designed to work collaboratively with humans, rather than replacing them. Humans should have the ability to intervene, override, or question AI decisions when necessary. Human oversight helps prevent potential errors or biases and ensures ethical decision-making.

vi. **Social Impact**: Consideration of the broader societal impact of AI is essential. Developers and organizations should evaluate and mitigate potential negative consequences on employment, economic inequality, and social dynamics. Engaging with diverse stakeholders and soliciting public input can help address these concerns.

vii. **Continuous Learning and Adaptation:** AI systems should be continually monitored and improved to address evolving ethical challenges. Developers should stay updated with the latest research and best practices, actively seek user feedback, and be willing to iterate and modify the AI system to align with ethical considerations.

In summary, ethical AI requires a multidimensional approach that considers fairness, transparency, privacy, accountability, human oversight, social impact, testing, and continuous improvement. By

integrating these principles into AI development and deployment processes, one may ensure that AI technologies are used responsibly and contribute positively to society.

Sl. No.	Level	Suggested Hours of NOS/Micro-Credential on Ethical/ Responsible AI
1	2.5-4(User)	2-3
2	4-8 User	7.5-15
3	3-4(Creator)	7.5-15
4	4-6 Creator	15 -30
5	7-8 Creator	60+ (including a NOS of Explainable AI)

The course /NOS of Responsible AI covering the following may also cater as below.

a. Maintenance of Privacy guidelines as the GOI laws
b. Non-infringement of IPRs
c. Avoidance of any biases which can be social or political.
d. Avoidance of proliferation of any misinformation

The AI development also should demonstrate transparency & accountability and inclusion. As the tools & developments of these tools mature, it is also expected that the best practices & solutions across the industries also to be made available for future developments.

Sl. No.	NSQF/ LEVEL	SKILL IDENTITY	SKILL DESCRIPTION	COURSE DESCRIPTION	COURSE OBJECTIVE
1.	1-3 (Basic Awareness)	AI Novice	The AI Novice is a beginner in the field of AI, typically a high school student or an undergraduate fresher.	1. Introduction to AI and Responsible AI 2. Basic comprehension of nine principles of Responsible AI	1. To foster an understanding of the basic concepts of AI and Responsible AI 2. To use popular GenAI tools 3. To introduce principles of Responsible AI and their importance 4. To help students recognize situations where Responsible AI principles apply.
2.	3-4 (AI Applied Knowledge and Operations Understanding)	AI Practitioner	The AI Practitioner can be an undergraduate or graduate student focused on AI or a junior professional in the field.	**1.** As above **2.** Recognizing and understanding situations where Responsible AI principles apply **3.** Practical exercises and case studies to identify potential Responsible AI issues. **4.** Learning basic operations in AI with the application of Responsible AI principles	1. To deepen the understanding of AI systems and the application of Responsible AI principles in their design and operation 2. To leverage GenAI tools for solution based content generation or productivity enhancement 3. To use practical exercises and case studies for identifying and handling ethical issues in AI 4. To offer practical experience in AI operations incorporating Responsible AI principles
3.	4-6 (AI Specialization and Project Management)	AI Specialist	The AI Specialist is likely a graduate student or a mid-level professional specializing AI.	1. As above 2. Detailed study of different AI systems and the application of Responsible AI principles in their design and function 3. In-depth study of specific Responsible AI principles 4. Case studies to understand real-world application of Responsible AI principles 5. Managing AI projects while	1. As above 2. To be able to leverage Large Language Models (LLMs), Foundational models to build Conversational AI solutions and other applications of AI 3. To use real-world case studies for learning the practical application of Responsible AI principles

#	Level	Role	Description	Content	Objectives
				ensuring adherence to Responsible AI principles.	
4.	**6-8 (Advanced Study and Leadership)**	AI Strategist	The AI Strategist could be a senior professional, C-level executive, or a researcher undertaking a PhD in AI.	1. As above 2. Recognizing and understanding situations where Responsible AI principles apply 3. Detailed study of different AI systems and the application of Responsible AI principles in their design and function (optional) 4. In-depth study of specific Responsible AI principles 5. Comprehensive research on the scope and challenges of Responsible AI principles 6. Strategy building and leadership for the implementation of Responsible AI principles. 7. Mentoring and training others in Responsible AI implementation. 8. How AI can be used for Risk Management & Governance	1. To facilitate comprehensive research on the scope and challenges of Responsible AI principles 2. To prepare learners for leadership roles in the implementation of Responsible AI principles 3. To equip learners with the skills needed to mentor and train others in Responsible AI principles.

9. Sector Wise Analysis of Job Roles

This section talks about the identified areas/ job roles in which a component of AI and AI enabled technologies can be incorporated. It is important to note that job roles are emerging as fast as the technology is evolving. This list is expected to change rapidly and underscores the importance of creating a flexible structure that can use building blocks of competencies (NOSs) that can be 'stacked' to suit the emerging need.

The following section attempts to list the new age job roles that will be created by usage of AI in different industries. The table also lists the indicative NSQF levels at which these roles will be used.

NSQF Level	AI Job/Product	Business Verticals (Indicative)
6-8	Dynamic Pricing, Route Optimizations	Logistics, Retail, Agriculture, Warehouse Management, Manufacturing, Healthcare, Aviation, Food, Leather
	Predictive Analysis, Dynamic production Planning / Estimations, Performance Management	Auto, Aviation, Manufacturing Setups, Insurance, Healthcare, Agriculture
	Sales forecast, Market Segmentation, Lead Generation, Personalized Marketing	All Sectors
	Quality Control	All Sectors
	Performance Management, Employee Retention	All sectors
	Customer Focus, Personalized Service	Media, Education, Healthcare, Agriculture, Beauty, Apparel, Food, Gems & Jewelry, Leather
	Image Analysis	Sports, Healthcare, Media, Agriculture, Defense
3-8	Fraud /Vulnerabilities Detection	Banks, Information Security, Smart Cities, Security
3-8	Security Services	Defense, Smart Cities, Personal Security Services
3-8	Education	Media, Virtual Prototyping, Digital Twins, Sports
3-8	Industry 4.0/5.0	Digital Twins, Planning, Precision Agriculture
3-7	AI enabled Drones	Logistics (Surveillance & Delivery), Agriculture, Aviation & Defense, Telecommunication, Oil & Gas, Media, Tourism (Surveillance), Healthcare, Defense
3-7	Robotics	Healthcare, Warehouse, Manufacturing, Defense, Quality Control, Agriculture
3-7	Personalization	Design, Education, Drugs, Healthcare, Food, Apparel & Beauty, Sports, Entertainment, BFSI
3-6	Chatbot Support (Customer Support)	All Sectors

9.1   IT-ITES

Some Job roles/courses for IT ITES sectors are mentioned in above sections. This section gives list of job roles that have been created in IT ITES because of latest change in technology

S. No	New Areas/ Qualifications/ Job Roles (Names are indicative)	AI Technologies Involved	Proposed NSQF level
1	Prompt Engineer for Generative AI	A Prompt Engineer is a professional who specializes in developing, refining, and optimizing AI-generated text prompts to ensure they are accurate, engaging and relevant for various applications.	4-7
2	Generative AI Engineer	A Generative AI Engineer is a specialized type of artificial intelligence (AI) professional focused on designing, developing, and implementing Generative AI models and algorithms. These models and algorithms are used to create new data samples, patterns, or content based on existing data or inputs.	6-7
3	Generative AI Applied Researcher	Develops algorithms and models based on state-of-the-art computer vision and machine learning advancements, especially in the areas of generative AI (e.g., image, video, or 3d generation)	5-7
4	AI Bias Engineer	An AI Bias Engineer or AI Ethicist is someone who studies the biasness, ethical implications of AI and helps guide the development and use of technology in a responsible and ethical manner.	5-7
5	NLP Developer/Engineer	NLP engineers create devices and systems that understand human language. These developers are responsible for software development to build communication between everyday human language and a computer's ability to process and analyse Natural Language Data.	5-7
6	Computer Vision Engineer	This is a position that lies at the intersection of machine learning and artificial intelligence. Computer Vision Engineers, as the name suggests, help computers see through with the help of mathematical architectures in code and machine learning. Together with Drones & Edge computing, this can be used for Security Services	5-7
7	Intrusion Detection & Prevention	AI is already getting used for Information Security Services, and its scope of usage can be further explained.	4-7

9.2 Electronics Sector

S. No	New Areas/ Qualifications/ Job Roles (Names are indicative)	AI technologies involved	Proposed NSQF level

1	Assembly Line Operator	AI Based Instrument/Component Detect System	3
2	Assembly Supervisor	An AI Supervisor uses the AI Related software to learn about methods to analyse tasks	5
3	Battery System Assembly Operator	AI software for Assembly line, Predictive Maintenance of Battery	4
4	Customer Care Executive	Chat Bot, Speech to Text, Personalizes user Experience, Predictive Insights	4
5	Drone Manufacturing & Assembly Technician	AI Based Instrument/Component Detect System- Using sensors and Actuators	4
6	Drone Service Technician	Predictive Assembly AI Based Instrument/Component Detect System- Using sensors and Actuators	4
7	Embedded Full Stack IoT Analyst	Embedded AI & IOT	5
8	Embedded Software Engineer	Embedded AI & IOT	5
9	Embedded Product Design Engineer-Technical Lead	Embedded AI & IOT	6
10	EMS Operation & Maintenance Manager	Predictive Maintenance & Resource Optimisation	6
11	EMS Technician	Defect & Quality Management	4
12	IoT Hardware Analyst	AIOT'S Goal is to create more efficient IOT operations, Improve human-machine Interactions	5
13	IT Coordinator in School	Chat Bot, Speech to Text, AI Tools	4
14	Remote Helpdesk Technician	Chat Bot, Automatic Problem solver, Speech to Text, Personalizes user Experience, Predictive Insights	3
15	Robotics Automation Lead	AI robots use different AI Technologies such as Machine learning, computer vision, RL Learning etc.	7
16	Smartphone Assembly Technician	AI Based Instrument/Component Detect System	4
17	VLSI Design Engineer	Tackle issues of various multiple design stages AI Technic are used in VLSI Design Automation	5

9.3 Aerospace and Aviation

S. No	New Areas/ Qualifications/ Job Roles (Names are	AI technologies Involved	Proposed NSQF level

		indicative)		
1	Airline Customer Service Executive	Airlines solving customer queries using Chat bots which are AI powered, to minimize the errors.	4
2	Airline Reservation Agent	More complex bookings can be handled by reservation agents by integrating the airline portal with AI, voice recognition & fraud detection.	4
3	Airline Security Executive	AI has improved the efficiency of equipment like threat detection, screening efficiency and facial recognition which can detect potential threats.	4
4	Airline Ground Support Equipment Operator	Turn Around Time, loading and unloading and taxiing the aircraft can be done more efficiently with the help of AI.	4
5	Airline Flight Load Controller	AI can automate the load calculation process by considering various factors such as passenger weight, baggage weight, and fuel consumption.	4
6	Airport Cargo Operations Assistant	AI- Powered logistics systems can optimize the movement of cargo from pickup to delivery, reducing errors and delays while improving efficiency, with smart cargo tracking which can provide real-time visibility into cargo shipments.	3
7	Drone Multi Rotor Operator	AI can be used to control drones so that they can fly autonomously	4
8	Aircraft Airframe & Powerplant Technician	AI can help technicians to identify errors without missing out any suspicious components and will aid technicians in troubleshooting it effectively.	5
9	Aircraft Freight Optimisation Analyst		6
10	Aircraft Resources Optimisation- Analyst	In India, some airlines have begun to use AI for energy and rate optimisation. This scope can be further explained.	6
11	Aircraft Predictive Maintenance		6

9.4 Automotive Sector

The use cases of AI in Auto Industry are in roles for

    i. Driver Assistance & Monitoring
    ii. Demand Planning & vehicle (preventive) Maintenance
    iii. Warehouse Management & Inventory Controls
    iv. Customer Support & improvement of experience
    v. Customer segmentation & vehicle Design
    vi. Quality Control
    vii. Insurance
    viii. Supply Chain Management
    ix. Energy Usage Optimisation

x. Connected Cars & Autonomous Vehicles

Some of the indicative job roles that may be created are:

S. No	New Areas/ Qualifications/ Job Roles (Names are indicative)	AI technologies involved	Proposed NSQF level
1 Driver Assistance	Autonomous Driver Assistance System (ADAS)	Automatic emergency braking, pedestrian detection, surround view, parking assist, driver drowsiness detection, and gaze detection are among the many ADAS applications that assist drivers with safety-critical functionality to reduce car accidents and save lives. Sensor fusion, like how the human brain process information, combines large amounts of data with the help of image recognition software, ultrasound sensors, lidar, and radar.	5.5- 6
2	Product Design, Prototype Manufacturing and Additive Manufacturing	ML algorithms can be utilized for prototyping products and simulation. Digital Twins may be used which are more cost-effective than physical prototypes. They help engineers analyse how specific designs can impact the vehicle's performance.	3 - 6
3	Smart Manufacturing & Qualification	Usage of digital twin technology offers a more cost-effective method for testing the car, or a part of the car using the virtual twin to gain a deeper understanding of the performance of the real-world product. Twin technology can also be used for testing fixes, modifications, or repairs. In addition to the obvious cost savings, companies may save time and reduce defects in the final product. The use of AI in automotive manufacturing makes the production processes smarter and more efficient. Some of the applications of AI in manufacturing include forecasting component failures, predicting demand for components and managing inventory, using collaborative robots for heavy material handling, etc. Highly accurate anomaly detection algorithms can detect issues down to a fraction of a millimeter. Predictive analytics can be used to evaluate whether a flawed part can be reworked or needs to be scrapped.	5 - 7
4	Data Analytics, customer planning	This can be used for enhanced user experience in the Manufacturing environment as well as Auto Dealer environment. It includes predictive analytics for maintenance of machines and vehicles. Use of data analytics	5 - 7

| | | in productivity and quality improvements is as common as use of the data analytics models for understanding and predicting customer preferences in sales scenarios | |

9.5 Agriculture Sector

AI-skilled professionals with domain expertise in agronomy, crop science, or agricultural practices can develop AI models that address specific challenges faced by farmers, leading to optimized crop production and sustainable farming practices. The following job roles may be developed in the area of Agriculture.

S. No	New Areas/ Qualifications/ Job Roles (Names are indicative)	AI Technologies involved	Proposed NSQF level
1	Farm Manager	Use of AI/IoT Based applications for farm management/Animal Husbandry/Fisheries	6
2	Agri Produce Supply Chain/ Warehouse Officer /Manager	Use of IoT /AI for handling Agri Crop	4-6
3	Farm Produce Grader/Sorter/Packager Or Farm Produce Primary Processor	Use of AI and computer vision in quality grading, sorting and packaging of farm produce	3-5
4	Farm Planner	Use of AI for micro-level field planning	4
5	Kisan Drone Operator	Use of drones for pesticides spray and for market surveillance	4
8	Precision Farming Technician /Manager	Use of Geographic Information System (GIS), Global Positioning System (GPS), drones, a variety of sensors, and relevant computer software to collect and analyse different types of data from agricultural fields.	5-7
9	Agri Robotic Machine Operator	Use of robots for crop harvesting; Use Robots for Irrigating and fertilizing crops	4
10	Milking Machine/Robot Operator	Use of robots for milking	4
11	Electronic Trading Supervisor-Agri Commodity	Use of Universal Agricultural Marketplace for trading of produce	5
12	Agri Advisory Service Provider	Use of mobile and cloud-based technology to offer bouquet of agricultural services such as best practices, alert services, weather forecasts, Agricultural input aggregation, Agri supply chain management services	5
13	Agri App Demonstrator/	Use of different types of "Apps" in	4.5

S. No	New Areas/ Qualifications/ Job Roles (Names are indicative)	AI technologies Involved	Proposed NSQF level
	User /Tech Marketer	agriculture.	
14	Agri Sensor Installer	Install different types of sensors, cameras and devices in the agricultural fields.	4

9.6   Logistics and Transportation Sector

S. No	New Areas/ Qualifications/ Job Roles (Names are indicative)	AI technologies Involved	Proposed NSQF level
1	Automated Warehousing Associate/ Executive/ Manger/ Supervisor	• Warehouse robots handling • Damage detection/ visual inspection/ quality control • Product localization and Identification • Predictive maintenance	3-7
2	Warehouse AI Analyst	• Dynamic pricing • Freight & Container management • Route optimization	5-7
3	Drone Planner & Operator	• Usage of drones for inventory management, • Warehouse surveillance, Over Dimensional Cargo (ODC) and last-mile delivery, • Automated guided vehicles, automated sortation systems, shipment load monitoring, and • Defense applications	4-6
4	Multi-mode Operation Optimisation	Will be required for Gati Shakti.	5-7
5	Container /Freight Optimisation		4-7

9.7   Management Sector

S. No	New Areas/ Qualifications/ Job Roles (Names are indicative)	AI technologies involved	Proposed NSQF level
1	Recruitment and Talent Acquisition- Assistant /Manager	• Candidate Screening • Employee Engagement & Retention • Performance Management • Chatbots • Sentiment & Bias Analysis	3-6
2	Private Security Executive/Manager	• Video Surveillance with built-in edge computing for anomaly detection. • Facial Recognition to identify potential	3-5

S. No	New Areas/ Qualifications/ Job Roles (Names are indicative)	AI technologies involved	Proposed NSQF level
		threats.	
3	Data Analyst	• Data Annotation & Analysis • Workflow Automation • Predictive Analytics • Natural Language Processing (NLP) • Social Media Analyst	6
4	Customer Service Executive/Manager	AI-powered chatbots can be used to handle customer inquiries and support requests	3-5

9.8 Telecom Sector

S. No	New Areas/ Qualifications/ Job Roles (Names are indicative)	AI technologies involved	Proposed NSQF level
1	Cloud Computing – Jr. Analyst	AI and machine learning will help to develop applications for testing and identification of the bugs and support to fix them and ensure the optimum performance.	5
2	IOT data Analyst	May be used for smart city or tracking as part of security services.	4-6
3	Data Flow/Bandwidth usage Optimisation	Based on the customer demand of content, may create systems to create local Cache of data	4-6

9.9 Retail Sector

S. No	New Areas/ Qualifications/ Job Roles (Names are indicative)	AI technologies involved	Proposed NSQF level
1	Online/Offline Store Experience Planner	Decision of product display	4-6
2	Retail Business Intelligence Analyst	Availability of products/ stock based on customer need	4-6
3	Customer Tech Trainers	Support customers to use technology with helpdesk/ videos	4-5
4	Retail Data Security Manager		5-7
5	Online Retail Entrepreneur/Head	Planning offline/ online store	5-7
6	Digital Marketing Freelancers	Creating marketing campaign which may be online/ offline	4-6
8	Omni Channel Distributor		4-7

9	Personal Fashion Stylist	AI can be used to pick personalise apparels/ beauty products.	5-6
10	Smart Home Specialist		4-7
11	Retail Buyer & Merchandiser		4-7
12	Hub Manager (eCommerce)	Can use Robotics and AI for inventory & warehouse management	4-6
13	Retail e-Warehouse Manager		5-7
14	Product/ Service e-Tailing		4-7
15	Digital Commerce for Retailers		5-7
16	Service Diagnostic Specialist	Based in various customer feedback & required processes. May use AI for Diagnostic	4-6
17	Transport Optimization Specialist		5-7

9.10 Healthcare Sector

S. No	New Areas/ Qualifications/ Job Roles (Names are indicative)	AI Technologies involved	Proposed NSQF level
1	Healthcare Data-Entry Expert/Natural Language Translation/ Transcription	Curates, cleans, scrubs and structures data from a variety of internal and external sources into the system that feeds AI models with the data they need to perform the tasks required at a hospital or health system.	4-5
2	Healthcare AI Lead/ Scientist	Explore potential opportunities, develop a cogent AI strategy	5-7
3	Healthcare AI Analyst	• AI supported Diagnostics including Imaging such as Retina Scan, X-rays, CT scans, and MRI scans. • AI-Powered Caregiver for tasks such as physiotherapy, mobility, medication management, and meal preparation. • AI-Powered EHR Systems to analyze and interpret healthcare for helping in more accurate diagnoses, develop personalized treatment plans, and improve patient outcomes.	5-7
4	AI for Invasive Devices, Personalized Implants, Prosthetic Limbs	AI can be used effectively for creating personalised experience of devices	5-7

5	Personalized Medicine/ Specialized care by Genome Sequencing	Evidence based personalise care plans	5-7
6	Robotic Surgery	This helps in improving precision and accuracy in surgery	6-7

9.11 Banking, Financial and Insurance Sector

S. No	New Areas/ Qualifications/ Job Roles (Names are indicative)	AI Technologies involved	Proposed NSQF level
1	Customer Service Executive/Manager	Tools like ChatGPT/ Bard can be used to handle customer inquiries, support requests & customer experience analytics	3-5
2	Financial Data Analyst	• Data Annotation & Analysis • Market Trend Prediction • Client Default Risk Prediction • Workflow Automation	6
3	Security Manager	Fraud detection, money-laundering/ monitoring	6
4	Talent Acquisition Manager	• Candidate Screening • Employee Engagement & Retention • Performance Management • Chatbots/ChatGPT tool-based Sentiment & Bias Analysis	3-5
5	Risk/Compliance Manager	Data privacy, security & dealing with ethical use of AI	6
6	AI Model Risk Manager	Regulatory Compliance on AI model risk	6
7	Personalised Insurance Plan	AI can be used to create personalised Insurance Plan	5-7

9.12 Sports Sector

S. No	New Areas/ Qualifications/ Job Roles (Names are indicative)	AI Technologies involved	Proposed NSQF level
1	Sports Performance Analyst	Can analyse vast amounts of data from games, including player movements, tactics, and strategies, to provide valuable insights	6
2	Virtual Simulation & Training Instructor	Instructor can use virtual simulations which can adapt and provide real-time feedback, helping athletes learn and adjust their techniques.	5

3	Sports Data Analyst & Scientist	Analysts can collect, analyse, and interpret sports data using AI tools and techniques	6-7
4	Sports Technologist	Develop and manage AI-powered systems for performance tracking, virtual simulations, athlete monitoring	6
5	Sports AI Entrepreneur	Can identify opportunities to disrupt the market with AI-driven solutions, such as wearable devices, fan engagement platforms, or athlete performance platforms.	6

9.13 Media & Entertainment Sector

S. No	New Areas/ Qualifications/ Job Roles (Names are indicative)	AI Technologies involved	Proposed NSQF level
1	AI Content Creator	AI content creators use natural language processing and machine learning techniques to create articles, videos, and other media content	4-6
2	AI Media Strategist	AI media strategists develop and implement AI-driven marketing and advertising strategies for media organizations	5-7
3	AI Video Editor	Work with video content, applying AI techniques to enhance visual effects, trim footage, and generate personalized video content	4-7
4	AI Social Media Manager	AI social media managers leverage AI technologies to analyze social media data, track user engagement, and identify emerging trends	5-7
5	AI UX Designer	They design intuitive interfaces, develop conversational AI chatbots, and use machine learning algorithms to personalize user experiences and improve engagement.	5-7
6	AI Film / TV producer	They shall work alongside content creators to enhance storytelling and production efficiency using AI tools and techniques	5-7
7	AI Music Composer	They use machine learning models to analyze music patterns, generate melodies, and assist in the production of soundtracks for films, TV shows, and other forms of media	4-7
8	AI Game Designer	They use machine learning algorithms to create adaptive gameplay experiences.	4-7

9.14 Beauty & Wellness Sector

S. No	New Areas/ Qualifications/ Job Roles (Names are indicative)	AI Technologies involved	Proposed NSQF level
1	AI Skincare Product Developer	AI skincare product developers can utilize AI algorithms to analyze skin data, identify patterns, and create personalized skincare formulations	6-7
2	AI Beauty Advisor	AI beauty advisors provide personalized recommendations to customers based on their skin type, concerns, and preferences.	5-6
3	AI Hair Stylist	AI hair stylists may leverage computer vision and AI algorithms to simulate different hairstyles. They use augmented reality (AR) and AI-powered apps to provide virtual hair makeovers, allowing customers to visualize different styles before finalizing a look.	4-5
4	AI Cosmetics Color Matcher	AI cosmetics color matchers use computer vision and AI algorithms to analyze skin tones and recommend suitable makeup shades	4-5
5	AI Nail Art Technician/ Designer	They use computer vision algorithms to virtually apply and customize nail polish colors and designs, allowing customers to visualize different options	3-5
6	AI Beauty Data Analyst	AI beauty data analysts collect and analyze large volumes of beauty-related data to extract insights and trends	4-6

9.15 Power Sector

S. No	New Areas/ Qualifications/ Job Roles (Names are indicative)	AI Technologies involved	Proposed NSQF level
1	Energy Analyst	AI energy analysts leverage AI algorithms to analyse energy data, identify patterns, and optimize energy generation and consumption	5-6
2	Grid Engineer	They work on optimizing power flow, fault detection, and grid stability using AI techniques.	5-7
3	Power Plant Operator	They may use machine learning algorithms to optimize plant performance, detect anomalies and automate processes to improve efficiency and reduce operational costs.	5-7
4	Demand Response Manager	They develop AI-based demand response strategies, analyze demand patterns, and implement automated systems to manage and balance energy loads	5-7

S. No	New Areas/ Qualifications/ Job Roles (Names are indicative)	AI Technologies involved	Proposed NSQF level
5	Power Cybersecurity Specialist	They use AI algorithms for real-time monitoring, detection and predictive analysis to identify and mitigate potential cybersecurity risks to power grids and energy infrastructure	5-7
6	Power Plant safety Planner	Uses AI for Planning preventive maintenance and safety of power equipment	5-7

9.16 Iron and Steel Sector

S. No	New Areas/ Qualifications/ Job Roles (Names are indicative)	AI Technologies involved	Proposed NSQF level
1	AI Process Engineer	They analyse production data, monitor equipment performance, and use machine learning models to predict and prevent equipment failures, improve energy efficiency, and optimize production parameters.	6
2	AI Quality Control Specialist	They may use AI algorithms to analyse steel quality data and identify defects or anomalies	6
3	AI Steel Design Engineer	They may use machine learning to analyse structural requirements, recommend suitable steel grades and optimize designs for cost-efficiency, durability, and safety	6
4	AI Safety/Maintenance Technician	They use AI algorithms to analyze equipment sensor data, detect potential failures, and schedule maintenance activities	5
5	Blast Furnace-Process Control Engineer	AI technology plays a crucial role of data integration, human-machine interaction & operational intelligence to minimise the operational cost, reduce fuel consumption, optimise the overall efficiency of the blast furnace.	5.5
6	Steel Plant - Continuous Casting Operator	AI technology optimize the productivity and Quality of output product and safety standards.	4.0
7	Sintering Mill-Operator	AI assisted control unit helps data integration & operational intelligence for effective control of sub systems, timely supply of the process information.	4.0
8	Ladle Refining Furnace -Operator	AI based deep learning software helps providing ladle furnace operators predictions of ladle and tundish temperatures.	4.0
9	Spectroscopy-	AI-assisted image analysis to detect grain	4.5

	Inspector	boundaries in microstructures that have very inhomogeneous grain structures with accuracy, reliability and reproducibility.	

9.17 Oil & Gas Sector

S. No	New Areas/ Qualifications/ Job Roles (Names are indicative)	AI Technologies involved	Proposed NSQF level
1	Robotics Engineer	They work on creating autonomous robots for various applications, such as inspection, maintenance, and hazardous environment exploration, using AI technologies like computer vision and machine learning.	6
2	Geoscientist/ Reservoir Engineer	They shall work on developing AI-based tools to enhance exploration and reservoir management activities.	6
3	Process Optimization Engineer	They develop and implement advanced control strategies to maximize production efficiency, minimize energy consumption, and reduce waste.	6
4	Safety Analyst	They analyze data from various sensors and surveillance systems to identify potential safety risks and develop AI-based solutions for early detection of safety hazards.	6

9.18 Green Jobs Sector

S. No	New Areas/ Qualifications/ Job Roles (Names are indicative)	AI technologies involved	Proposed NSQF level
1	Solar PV Business Development/ Development Executive/ Engineer /Evaluation Specialist/ Designer /Manager	• Predictive Analysis & Optimization of operation and maintenance of photovoltaic (PV) power plants by detecting and classifying anomalies, predicting failures, and scheduling maintenance activities. • Real-time monitoring data such as power output, temperature, and weather information for identify the common fault class patterns. • To provide grid operators and engineers with real-time analysis and visualization capabilities of the electric power system.	4-6

		• To predict the electric load one day in advance in areas that have large amounts of behind-the-meter solar project. That information guide operators to manage the electric grid more efficiently and cost-effectively.	
2	CMS Assessor/ Engineer/Site Surveyor - Wind Power Plant	• AI can help improve efficiency by accurately forecasting data about wind speed, height, direction, and other factors to determine the most efficient way to generate electricity from a wind turbine. • Predictive Maintenance • Using AI, wind turbines can control themselves and adjust based on weather patterns and temperature changes. This will allow them to produce more energy without little to no human intervention or supervision.	5-6
3	Supervisor/Plant Head / Manger Operations and Maintenance Compressed Biogas/Waste to Energy	AI and Machine learning can generate data that are hard to be measured directly, improving traditional models of biomass conversion, and overcoming the challenges of traditional computing techniques for bioenergy supply chain and optimization.	5-7
4	Customer Engagement Specialist	Optimisation of their energy consumption by changing their usage habits.	5
5	Microgrid Engineer	Use AI and ML to manage energy flow and optimise energy usage. Microgrids are becoming popular because they can provide energy security during emergencies and can integrate renewables into the energy grid more easily than traditional energy grids.	6
6	Power Theft and Energy Fraud Detection-Analyst/ Engineer	AI and ML help to bring out possible cases of Fraud/theft of energy & other resources.	5-7

10.   Proposed Cost Norms for AI Skilling

The current common norms for skill development need to be updated to accommodate niche skills like AI and Generative AI. Since AI and Generative AI are the new-age skills, getting master trainers and trainers in remote locations may be difficult. The current common norms should look at higher costs per hour of student training and also look at travel, boarding and loading costs.

The average cost of a trainer comes to around Rs. 2000 to 2500 per hour for classroom training and Rs. 1200 to 1800 per hour for virtual instructor training. The average training duration is considered at 80 to 100 hours to arrive at this cost. The typical batch size is around 20 to 25 learners. In some cases, where the group and training is specialized, the cost may be more.

The typical cost for a physical classroom model could vary between Rs. 80 per hour per student to Rs. 150 per hour per student. In case of Virtual instruction-led model, the cost would be between Rs. 50 per hour per student to Rs. 90 per hour per student. In the case of physical offline classes, travel, boarding and loading would be extra.

Category	Course Type	Cost Norms
All: This category is the End User who uses the AI tools & interfaces. This category needs to be skilled primarily on the usage of AI, responsible AI, and its pitfalls. This is Basic Digital Literacy that is essential for anyone to use digital technologies effectively. The material needs to be in the language of the region, and extremely simple to teach.	Online/ Blended	Rs.80/ Hr/ Candidate
Many: This category is the AI-empowered generation who use AI and Generative AI for better productivity and need to understand AI applications in their domain. These learners should be skilled in various tools and applications. This is Digital Fluency for people who will use technology as a productivity multiplier and learn to use it responsibly and safely.	Online/ Blended/ Virtual Teaching Required Tutor interface	Rs.100/ Hr/ Candidate
Few: This category of people are AI-skilled and competent people who focus on developing AI products and applications around AI. They need to have deep technical knowledge and should be skilled in both technical and domain. This could range from coding and programming skills to data analytics, building machine learning algorithms, cloud computing, cybersecurity and other technologies that work in tandem with each other. These are not limited to the IT world but would cut across all domains and industries. They may also be involved in creating AI enabled products or providing AI as a Service (AI-AAS).	Online/ Blended/ Virtual Teaching/ **Physical** Required Tutor interface	Rs.150/ Hr/ Candidate

For students with limited access to in-person opportunities, online education is critical hence appropriate funding should be granted for the development of the online course contents for the basic and advance levels to facilitate equitable access and opportunity to AI education, training, and workforce development across India.

The training for professionals' ranges from an introductory course to hands-on training for those who have certain prerequisites and want to become hands-on practitioners.

Partner	Rate per Trainer Per hour – Instructor Led Training (Classroom)	Rate per Trainer Per hour – Virtual Instructor led Training (virtual)	Miscellaneous
Partner 1	₹ 1500	₹ 1000	Local trainers might not be available so travel+ lodging + boarding might
Partner 2	₹ 2000	₹ 1100	

Partner 3	₹ 3000	₹ 2000	be extra.
Partner 4	₹ 1800	₹ 1500	Assuming total training hours = 80 to 100 hrs.

Cost norms for supporting the corporates and industry (partially funding for the learners):

i. **Corporate subsidy**: AI infra and sector specific solution providers should be on boarded to offer solution specific discounted courses.
ii. **Corporate training / upskilling:** Upskilling programs for establishments to pay for the cost of the courses and subsidise the training for fresh candidates.
iii. **Soft loans**: Banks and FIs to be roped in for easier loans due to the higher employability resulting from these trainings.
iv. **CSR**: CSR funds to be tapped into to run specific trainings.
v. **Scholarships**: Scholarship programs to promote skilling focussing on job roles most impacted by AI

11. Training & Process Readiness

11.1 Infrastructure Requirements

As AI moves beyond experimentation towards adoption, it will demand significant computing and infrastructure resources. As the technology becomes more complex and resource-demanding in a world increasingly impacted by AI, finding cost-effective environments to run the intensive processes will be both a requirement and a competitive advantage. Building an artificial intelligence infrastructure requires a serious look at storage, networking, and AI data storage needs, combined with deliberate and strategic planning. Few of the infrastructure requirements to consider are:

i. **Hardware**: AI courses often involve computationally intensive tasks, such as training and running AI models. Therefore, a need for high-performance hardware, including powerful CPUs, GPUs, and memory, to handle the computational demands of AI algorithms effectively. This can be considered by setting up dedicated workstations or servers with sufficient processing power.
ii. **Software**: A range of AI and AI enabled software tools and frameworks for teaching AI concepts and implementing AI algorithms would be required. Programming languages like Python, MATLAB, SAS, R, machine learning libraries like Tensor-Flow are a few of the software's required.
iii. **Datasets**: AI courses typically involve working with real-world datasets for training and evaluating models. Ensure that you have a repository of diverse and relevant datasets that students can access. These datasets should cover various domains, such as computer vision, natural language processing, or reinforcement learning.
iv. **Cloud Computing**: Cloud computing services can be beneficial, especially for resource-intensive tasks like training large-scale AI models. Some cloud environment offer scalable computing resources and pre-configured AI services. This enables students to access powerful infrastructure without the need for extensive hardware investments.
v. **Internet**: A stable and high-speed internet connection is crucial for accessing online learning resources, collaborating on projects, and downloading large datasets or software packages. Ensure that your infrastructure has reliable internet connectivity to support the needs of the trainees.
vi. **Cloud Storage**: As AI courses involve working with large datasets, you need sufficient storage

capacity to store and manage the data. Consider setting up a centralized storage system or utilizing cloud storage solutions to accommodate the requirements of the course.

vii. **Innovation Lab, Incubation Center & Center of Excellence**- These labs will help in democratizing the usage of AI. By bringing together vast amounts of datasets with advanced AI solutions, these labs will aim to create new AI models and applications that can augment a learner's capabilities and build an AI ready skilling workforce.

The software-defined infrastructure approach helps streamline management, simplify operations, increase flexibility, and better utilize resources. It also facilitates the process of automating administrative operations by supporting such deployment methodologies as infrastructure as code.

			Training	Inference
Basic	Hardware	CPU	Intel i5 (minimum) or similar	Intel i5 (minimum) or similar
		GPU	Shared GPU	---
		HDD/RAM	500GB/16GB	500GB/16GB
		Internet Speed	100 MBPS	100 MBPS
	Software		OS: Windows or Linux DS package : Jupyter Notebook, Git, Python/R,Tensorflow/PyTorch, Pandas DB : Sql , no Sql Visualisation : plotly, matplotlib, Qlikview, Grafana, PowerBI	OS: Windows or Linux DS package - Jupyter Notebook, Git, Python/R,Tensorflow/PyTorch, Pandas DB : Sql , no Sql Visualisation : plotly, matplotlib, Qlikview, Grafana, PowerBI
Advance	Hardware	CPU	Intel i7 (minimum) or similar	Intel i7 (minimum) or similar
		GPU	1 to 2 GPU	--
		HDD/RAM	500GB/32GB	500GB/32GB
		Internet Speed	300 MBPS	300 MBPS
	Software		OS: Windows or Linux DS package : Jupyter Notebook, Git, Python/R,Tensorflow/PyTorch, Pandas, PySpark Virtualization Layer: Docker DB: Sql, no Sql Visualisation : plotly, matplotlib, Qlikview, Grafana, PowerBI,	OS: Windows or Linux DS package : Jupyter Notebook, Git, Python/R,Tensorflow/PyTorch, Pandas, PySpark, Virtualization Layer: Docker DB: Sql, no Sql Visualisation : plotly, matplotlib, Qlikview, Grafana, PowerBI

Since the infrastructure required for work on AI has significant costs, it is proposed that Government may create Centers of Excellence (COE) with the required infrastructure in collaboration with technology providers and make it available for learners. This will help in democratizing learning in AI.

11.2 Process and Framework of a Qualification

As technology continues to advance rapidly, it is imperative that the NSQF framework should adapt efficiently to the changes in job roles, skill requirements, emerging tools, and newer versions of technology. The framework also needs to adapt to the fast-changing pace in technology and its dissipation.
Some of the suggestions are:

i. **Industry Validation Process:** While formal industry validation is important, market demand of a course may also be considered f6or Industry validation. Also, the number of industry validations required for these courses may be lower, making the NSQF alignment process more agile and responsive.

ii. **Duration of Skilling Programs:** To accommodate diverse learning needs and varying skill requirements, it is essential to include very short-duration programs within the NSQF framework.

The micro credential structure has enabled courses of 7.5-hour duration, but some tools and their upgrades can be taught in less than that with massive impact on productivity. This flexibility in duration will enable individuals to quickly acquire specific skills and certifications, catering to the evolving demands of the job market.

    a. **Changes due to Newer Versions and Advancements:** To accommodate changes because of new versions, Awarding Bodies (ABs) may be allowed to do up to 20% changes in the course by self-declaration.

    b. **Tool-Specific Skilling Derived from Generic Skilling**: Generic skilling forms the foundation for acquiring skills across various tools and technologies. However, tool-specific skills are often essential in specific job roles or industries. The OEM training allowed as part of the NSQF alignment process can enable this.

iii. **NOS/Micro-Credential Building:** Given the horizonal nature of AI and other future technologies, the framework shall focus on building short micro-credentials and focused NOSs.

By incorporating these recommendations into the NSQF alignment process, one may achieve a more agile and flexible framework that addresses the dynamic nature of technology, industry requirements, and emerging tools. This flexibility will empower individuals to acquire the skills needed to meet evolving job demands, enhancing their employability and contributing to the overall growth of the workforce.

11.3 Training of Trainers

Developing Trainers and Trainees capable of training in AI will be crucial to achieve India's ambitions of becoming a global AI superpower. However, the known challenges of Availability, Cost & Time need to be addressed together with it.

Strategy of Training Trainers and Teachers

To ensure effective training for trainers and assessors in India, it is crucial to explore innovative, non-traditional methods along with classroom-based training. Blended learning combines online and offline resources, allowing trainers and assessors to learn at their own pace. Experiential learning through workshops, simulations, and case studies fosters problem-solving and critical thinking. Peer learning promotes knowledge exchange and best practices, while project-based learning encourages reflection and real-world application of skills. These non-traditional approaches enhance professional growth and effectiveness in training and assessment practices.

i. **Identify the target audience**- This could include teachers, students, professionals, or anyone else who wants to learn about AI and have good communication skills. The profiles may include:

    a. Teachers and Trainers with a background in STEM or Computer Science

    b. Teachers with a background in education technology.

    c. Experienced professionals or Self-taught experts

ii. **Develop a curriculum.** This could include:

    a. The basics of AI, such as machine learning and natural language processing, as well as more advanced topics, such as deep learning and reinforcement learning.

    b. Responsible & Explainable AI

    c. Pedagogical training including how to teach. This will help in making the training relevant to the needs of teachers and trainers.

    d. Transversal skills e.g., Critical thinking, Problem Solving, Collaboration, Project Management

    e. Usage of Popular AI tools or Software Development Kits and resources

    f. Assessments Process

iii. **Implement the training program**. This would include:

    a. **Identify Master Trainers** - these are likely to be existing faculty members who can conduct these programs. An adequate number will be required to scale the program. Some industry experts may also be invited.

    b. **Delivery method** - in person, online, or through a combination of both.

    c. Funding & Incentivisation

    d. **Program Implementation** – identify and agency that will create and drive the implementation program.

    e. **Feedback loop** – building in a feedback mechanism for continuous improvement and updation.

iv. **Market the training program-** To encourage people to participate they need to know about the program and its benefits. These needs:

    a. A marketing campaign and an information dissemination campaign

    b. Partner with teachers' associations or organisations

    c. Policies that ensure a certain critical mass of teachers and faculty in academia get upskilled.

11.4 Training of Assessors

Assessments for AI will broadly fall into 4 categories:

i. **Knowledge Based Assessments**: These are likely to be MCQ based or sandboxes that are auto assessed. This requires SMEs that create these assessments following the principles of robust assessment design. This will require proctors who can be trained in administering these assessments. They can be administered using formative & summative assessment, as per the need.

ii. **Application Based Assessments**: These will be done by college/ undergraduate students and will be assessed by college faculty in conjunction with industry partners who will set up established norms and rubrics for assessment. The assessors will be trained by the industry or as per norms of the institution.

iii. **Industry certifications**: Will be done as per industry or OEM norms.

iv. **Projects/ Hackathons/ Internships**: These assessments shall be industry led and are specific projects that will require training as per the objectives of the project.

12.   Suggested Future Steps

To ensure the effective usage of AI in skilling ecosystem following future steps can be considered

i. **Establishment of outcomes**: Clearly define the desired outcomes and objectives of using AI in skilling programs. Determine the specific skills to be developed, the target learners, and the expected impact on learners' knowledge and abilities.

ii. **Usage of reliable data**: AI algorithms rely on data to make predictions and recommendations. Ensure that the data used to train AI models is reliable and relevant to the skills taught. Avoid bias in data selection and consider including a wide range of perspectives and experiences. There is also need for bringing all benefits of AI in different industries to improve its usage.

iii. **Regular evaluation and updation of AI models**: Regularly assess the performance of AI models used in skilling programs. Monitor their accuracy, effectiveness, and fairness to identify any biases or shortcomings. Collect feedback from learners and instructors to make necessary changes/ improvements.

iv. **Encourage learners' engagement**: AI can support learner engagement by offering personalized recommendations and adaptive learning pathways. Empower learners to take ownership of their learning process by allowing them to set goals, track progress, and provide input on the AI-enabled tools and platforms used.

v. **Ensuring transparency**: Promote transparency in the use of AI algorithms in skilling programs. Provide clear explanations of how AI is being used, the decision-making process behind recommendation and the limitations of the technology.

vi. **Address ethical considerations**: Consider the ethical implications of using AI in skilling. Ensure **data privacy,** security, and confidentiality.

vii. **Guidelines for usage**: Establish guidelines and policies for the responsible and ethical use of AI in skilling programs.

viii. **Training of trainers/ instructors**: Provide ongoing training and support to trainers on how to effectively leverage AI tools and platforms. Help them understand the potential and limitations of AI.

ix. **Promote accessibility and inclusivity**: Ensure that AI-powered skilling programs are accessible to all learners, including **those with disabilities** or diverse learning needs. Consider accessibility features such as alternative formats, closed captioning, and compatibility with assistive technologies.

x. **Staying updated with emerging AI technologies**: Keep abreast of the latest developments and advancements in AI and its applications in skilling. Stay connected with research communities, industry experts and relevant conferences or workshops to stay updated on best practices.

By following these steps, you can maximize the benefits of AI in skilling while addressing ethical considerations and ensuring an inclusive and effective learning experience for all learners and trainers.

Every new Technology has its benefits. In case of AI, there is already a hype of expected job losses that may come with it. It is also important to start a campaign on new jobs that AI may create and also how India can become global skill destination for AI. The report provides a list of job roles, based on technology tools that are available today. But since the world of AI is changing quite fast, newer job roles may emerge based on newer technology that may come tomorrow.

Additionally, although there is a lot of hype on how AI can change industry solutions, adoption & adaption of newer AI solution is still low. This needs to be increased by focusing on AI literacy for All and also having more CXO level courses.

12.1 Legal Issues to be Addressed while developing AI Courses

There are several key legal issues that should be addressed during the training of AI systems. These include:

i. **Data privacy**: AI systems typically require large amounts of data to train and improve their algorithms. This data can include personal information, such as names, addresses, and phone numbers. Companies that use AI systems must ensure that they comply with all applicable data privacy laws, such as the General Data Protection Regulation (GDPR) in the European Union.

ii. **Intellectual property**: AI systems can be protected by intellectual property laws, such as copyright, patent, and trademark law. Companies that develop AI systems must ensure that they properly protect their intellectual property rights.

iii. **Liability**: AI systems can make mistakes, which can lead to harm to individuals or businesses. Companies that use AI systems must be prepared to defend themselves against lawsuits alleging negligence or product liability.

iv. **Discrimination**: AI systems can be used to make decisions that could have a discriminatory impact on individuals or groups. Companies that use AI systems must take steps to mitigate the risk of discrimination & biases.

v. **Transparency and Explainable AI**: Companies that use AI systems must be transparent about how the systems work and how they make decisions. This includes providing information about the data that is used to train the systems, the algorithms that are used to make decisions, and the accuracy of the systems.

Companies that develop and use AI systems should consult with legal counsel to ensure that they are following all applicable laws and regulations.

Here are some additional tips for addressing legal issues during AI training:

a. **Get consent**: If any personal data is used to train your AI system, it is important to obtain consent from the individuals whose data is being collected.

b. **Use a privacy policy**: There is need for a privacy policy that explains how to collect, use, and share personal data.

c. **Secure your data**: Steps to be taken to secure the data that is collected to prevent unauthorized access, use, or disclosure.

d. **Monitor your system**: AI systems shall be monitored to identify and address any potential problems.

e. **Keep records**: It is important to maintain records of AI system's training data, algorithms, and decisions.

f. **Bias:** AI systems can be biased, either intentionally or unintentionally. This can lead to discrimination against certain groups of people. Coursework should cover how to identify and mitigate bias in AI systems.

13.   Annexure A: Links to other courses, Free tutorials, Open Source, and Labs

13.1 Courses available under Digital 101

Digital skilling and awareness are crucial across industries to adapt to new technologies and drive innovation. Professionals need to develop an awareness of emerging technologies such as artificial intelligence (AI), big data analytics (BDA), Internet of Things (IoT), cloud computing, 3D printing, augmented reality/virtual reality (AR/VR), robotic process automation (RPA), blockchain, web and mobile, and cybersecurity. This includes understanding the fundamentals, applications, and implications of these technologies in their respective industries. A few examples of Digital literacy that would be required in various industries are listed below.

- Healthcare Industry: Require digital awareness for data analysis and bioinformatics tools.
- Manufacturing Industry: Need digital skills for 3D modelling and data analytics tools.
- Financial Services Industry: awareness of digital payment systems and cybersecurity measures
- Retail and E-commerce Industry: digital skills for social media marketing
- Energy and Utility Industry: digital skills for energy management systems, IoT-based monitoring, and data analytics for energy optimization.

To address this gap, IT-ITES Nasscom has designed the Digital 101 – 30 hours new age skill awareness program. 30 hours of structured learning paths will help learners build a comprehensive understanding of various digital concepts and technologies. The program aims to equip learners with the principles, tools, and frameworks crucial in today's digital ecosystem, covering foundational knowledge in the areas of 10 emerging technologies: artificial intelligence, big data analytics, cybersecurity, cloud computing, blockchain, internet of things, web & mobile development and marketing, 3D printing, robotic process automation, and augmented reality/virtual reality.

Features and Content

The various learning pathways under each technology are listed below.

Module 1 – AI/BDA

Pathway Title	Technology	Duration	Link

Pathway Title	Technology	Duration	Link
An overview of artificial intelligence	Artificial Intelligence	00:35	https://learn.futureskillsprime.in/pathways/an-overview-of-artificial-intelligence-this-pathway-is-designed
Introduction to machine learning	Artificial Intelligence	00:32	https://learn.futureskillsprime.in/pathways/ECL-83efd530-9c88-4acd-a725-91c0fb300744
Introduction to deep learning	Artificial Intelligence	00:35	https://learn.futureskillsprime.in/pathways/ECL-7f42ab36-f756-4a68-969b-a4d11668b051
ChatGPT	Artificial Intelligence	00:37	https://learn.futureskillsprime.in/pathways/ECL-1c3b1af4-3d7f-4828-a538-32950cd20af4
GPT-4	Artificial Intelligence	00:31	https://learn.futureskillsprime.in/Pathways/gpt
ChatGPT in Marketing	Artificial Intelligence	00:33	https://learn.futureskillsprime.in/Pathways/chatgpt-in-marketing-in
Open AI tools- AI Text Classifier	Artificial Intelligence	00:33	https://learn.futureskillsprime.in/pathways/ECL-2f0762f4-f6c5-4074-9a23-b2d65ddff9d8
Open AI tools- Point E	Artificial Intelligence	00:27	https://learn.futureskillsprime.in/pathways/ECL-dc6b46b6-3355-48d9-9423-95e2812046f8
Open AI tools- DALLE	Artificial Intelligence	00:30	https://learn.futureskillsprime.in/pathways/ECL-32be504a-d126-4fa4-b3f5-336da90cf864
Applications of artificial intelligence	Artificial Intelligence	00:30	https://learn.futureskillsprime.in/pathways/ECL-58848f7a-7815-43b1-bbdc-4a63db4acf86
Intelligent wearables and bionics	Artificial Intelligence	00:35	https://learn.futureskillsprime.in/pathways/ECL-d69ebbfe-53c3-470f-a41e-fab5859b115c
Ai in electric vehicles (evs)	Artificial Intelligence	00:30	https://learn.futureskillsprime.in/pathways/ECL-51eb1e3a-1c6b-4643-8728-62238c7dbe31
Ai and metaverse	Artificial Intelligence	00:34	https://learn.futureskillsprime.in/pathways/ECL-bb92e461-c9ec-449e-9f0a-2d91b047386e
Impact of artificial intelligence on workforce and workplace	Artificial Intelligence	00:37	https://learn.futureskillsprime.in/pathways/ECL-ef07ebed-03d3-4dee-8219-399114e1ed07
Future of artificial intelligence in various industries	Artificial Intelligence	00:34	https://learn.futureskillsprime.in/pathways/ECL-a32899bf-e5cf-4986-80b3-00b885309c81
Edge ai / tinyml	Artificial Intelligence	00:35	https://learn.futureskillsprime.in/pathways/ECL-068b3497-4e10-4a15-b246-0a8fae017fcf
Quantum computing	Artificial Intelligence	00:35	https://learn.futureskillsprime.in/pathways/ECL-da944d09-5a78-454f-8f5b-a9abf8e273ae
Evolution of big data analytics	Big Data Analytics	00:28	https://learn.futureskillsprime.in/pathways/ECL-f39ff1a8-979c-4ed7-88f4-70d91eb1f5f8
An overview of big data analytics	Big Data Analytics	00:26	https://learn.futureskillsprime.in/pathways/ECL-404f7ef5-92cc-4a92-8900-afe3f28f7072
Applications of big data analytics	Big Data Analytics	00:38	https://learn.futureskillsprime.in/pathways/ECL-44ac1a42-9281-4183-8d04-82d2c3748bd4
Database management for data science	Big Data Analytics	00:27	https://learn.futureskillsprime.in/pathways/ECL-3d40a5f7-20c1-4806-8787-95fa78310143

Module 2 – Internet of Things

Pathway Title	Technology	Duration	Link
Getting started with internet of things	Internet Of Things	00:34	https://learn.futureskillsprime.in/pathways/ECL-651f951a-e732-4d32-91af-1361cdf8a1ac
Applications of iot	Internet Of Things	00:30	https://learn.futureskillsprime.in/pathways/ECL-01153e2d-ac72-4072-9de2-b9d8fab95a59
Industrial internet of things or iiot	Internet Of Things	00:37	https://learn.futureskillsprime.in/pathways/ECL-f4128784-6678-44e7-94ef-03e4a7460c81
Digital payments	Internet Of Things	00:34	https://learn.futureskillsprime.in/pathways/ECL-2599901c-bbec-4e8d-a3a8-22364238d84e

Module 3 – Cloud Computing

Pathway Title	Technology	Duration	Link
An overview of cloud computing	Cloud Computing	00:35	https://learn.futureskillsprime.in/pathways/ECL-f12c5c61-2e88-4a47-a5fd-906f0bf7c346
Applications of cloud computing	Cloud Computing	00:26	https://learn.futureskillsprime.in/pathways/ECL-5ea482e6-70d3-41a4-840b-d4a2935ff997
Service models in cloud computing	Cloud Computing	00:32	https://learn.futureskillsprime.in/pathways/ECL-03b7bd54-2525-48c1-a733-90e031001e6d
Popular software tools and techniques used in cloud computing	Cloud Computing	00:35	https://learn.futureskillsprime.in/pathways/ECL-b39eec58-d5e0-40fe-a3cf-6a3f5b2e743c

Module 4 – Cybersecurity

Pathway Title	Technology	Duration	Link
An overview of cybersecurity	Cybersecurity	00:34	https://learn.futureskillsprime.in/pathways/ECL-dabad4b6-22e8-4c7e-a1da-05d65ed26c0d
Applications of cybersecurity	Cybersecurity	00:28	https://learn.futureskillsprime.in/pathways/ECL-4152841e-59ff-4bab-995f-15f0cb8edec3
Types of cyber attacks	Cybersecurity	00:27	https://learn.futureskillsprime.in/pathways/ECL-df504c04-6599-46e5-a9bb-e522c169a3b0
Data privacy and user data control	Cybersecurity	00:33	https://learn.futureskillsprime.in/pathways/ECL-79f4cf37-15a6-4c6a-b38f-d23dcea11c79
Deepfake	Cybersecurity	00:34	https://learn.futureskillsprime.in/pathways/ECL-e5022f3d-bca7-4ccd-bdaf-3c4ed2b30f6e

Module 5 – Blockchain

Pathway Title	Technology	Duration	Link
Evolution of blockchain	Blockchain	00:35	https://learn.futureskillsprime.in/pathways/ECL-821b9fb3-b329-44b8-b44c-c1c6248dbdc1
Getting started with blockchain	Blockchain	00:27	https://learn.futureskillsprime.in/pathways/ECL-be5dc3ab-c564-4f29-9e18-3bf65aaeed09
Applications of blockchain in finance industry	Blockchain	00:30	https://learn.futureskillsprime.in/pathways/ECL-73ab978d-26c4-47c5-8a19-088ee3dad24c
Impact of blockchain on workforce & workplace	Blockchain	00:32	https://learn.futureskillsprime.in/pathways/ECL-987402a7-6aeb-48ab-9ece-12cdbca7db9d

Module 6 – RPA

Pathway Title	Technology	Duration	Link
Getting started with robotic process automation	RPA	00:35	https://learn.futureskillsprime.in/pathways/ECL-d20d1100-597b-4add-b2a6-9c4d7d1dd82c
3 core technologies of robotic process automation	RPA	00:34	https://learn.futureskillsprime.in/pathways/ECL-737fc481-2865-48cc-af48-9ba80a2a1b7d
Applications of robotic process automation in banking & insurance industry	RPA	00:38	https://learn.futureskillsprime.in/pathways/ECL-7b760d53-69a7-4f7c-a08f-324b8be1626b

Module 7 – Web, Mobile Development & Marketing

Pathway Title	Technology	Duration	Link
Getting started with web, mobile development and marketing	Web, Mobile Development & Marketing	00:37	https://learn.futureskillsprime.in/pathways/ECL-6b15d91e-fe4d-4e11-aedd-b6fc49b08396
5ds of digital marketing	Web, Mobile Development & Marketing	00:30	https://learn.futureskillsprime.in/pathways/ECL-a09af12f-aa8c-4b1b-9603-af7dc8e37166
Digital storytelling	Web, Mobile Development & Marketing	00:36	https://learn.futureskillsprime.in/pathways/ECL-5edb6358-e97e-43ab-9743-dab5bcac8c20

Module 8 – 3D Printing & Modelling

Pathway Title	Technology	Duration	Link
Getting started with 3d printing & modeling	3d Printing & Modeling	00:37	https://learn.futureskillsprime.in/pathways/ECL-d90e6424-4ef7-48ff-a046-2fbddd0f95a6
Digital manufacturing	3d Printing & Modeling	00:35	https://learn.futureskillsprime.in/pathways/ECL-fee42364-2264-4cf0-b867-21c0f9dab5fb
Future of 3d printing & modeling in various industries	3d Printing & Modeling	00:35	https://learn.futureskillsprime.in/pathways/ECL-962794cf-1c83-4a05-8af2-aa3943511b7a

Module 9 – Augmented Reality & Virtual Reality

Pathway Title	Technology	Duration	Link
Getting started with augmented reality and virtual reality	Augmented Reality & Virtual Reality	00:35	https://learn.futureskillsprime.in/pathways/ECL-c4218fe7-78ac-4fb2-8d44-0a41d1786e6f
Pre-requisites for augmented reality & virtual reality	Augmented Reality & Virtual Reality	00:26	https://learn.futureskillsprime.in/pathways/ECL-7d2b29ee-e99b-4003-bb91-6a53f03947c3
Metaverse	Augmented Reality &	00:33	https://learn.futureskillsprime.in/pathways/ECL-42ac6410-

| | Virtual Reality | | f59a-4f06-ae12-60f7f912caea |
| Applications of augmented reality & virtual reality in banking & insurance | Augmented Reality & Virtual Reality | 00:36 | https://learn.futureskillsprime.in/pathways/ECL-c2321e68-bf9d-49f4-9d96-ef02e4414d7d |

Digital 101 Assessment

Once the learner finishes the entire journey, they can take up a mock assessment and then attempt the final assessment in order to earn an SSC Nasscom certificate. They must obtain 50% or above to obtain their certificate.

13.2 Current STEM/Robotic Summer/Winter Special Course at NIELIT for KIDS

Group & Class	Course Duration	Course Outline
Group-A (Class III-VI)	5 days (20 hours)	i. Typing in English, Assamese and Hindi and changing of KEY Input type ii. Modelling of Craft paper Robots. iii. Fundamentals of Robotics iv. Scratch Programming v. Introduction to lego Mindstorm EV3 vi. Lego Mindstrom interface with PC, tablet, mobile with block coding vii. Building different models with motors and sensors viii. Programming and navigating robots using lego mindstrom for Running & Dancing ix. Basics of 3D printing technology
Group-B (Class VII-X)	5 days (20 hours)	i. Scratch Programming ii. Lego Mindstrom interface with PC, tablet, mobile with block coding iii. Introduction of different types of sensors and motors iv. Basic of Electronics Components v. Basic of Arduino Board vi. 3D printing Technology vii. Production of demo of Scratch viii. Production of 3D products ix. Basic of Drone