BREAKOUT SESSIONS

The aim of the BREAKOUT sessions was to identify skills, pathways, priorities, barriers, and near-term and long-term solutions that are required in developing a diverse, robust artificial intelligence (AI) workforce.

The themes for the sessions included (i) AI, data science training for industry 4.0; (ii) Undergraduate level AI programme and curriculum development; (iii) Graduate level programmes – computer science focussed; and (iv) Graduate level programmes – other engineering/research focussed. The challenges were identified, and solutions and recommendations were proposed. A summary is provided here.

Graduate level programmes (computer science focussed)

⇒ Challenge: It is difficult to find competent faculty and teachers.
⇒ Solution: Introduce joint faculty positions; rethink faculty hiring norms; redesign training of trainers.
⇒ Challenge: The quality of undergraduate (UG) students is poor.
⇒ Solution: Reform the UG programmes; reform GATE and other tests; tier 1 institutions must collaborate with tier 2 and tier 3.
⇒ Challenge: The existing programs do not scale.
⇒ Solution: Introduce an AI stream in every MTech programme; introduce an Applied AI course for all; leverage online/hybrid courses better.
⇒ Challenge: Lack of availability of quality 'India' data.

⇒ Solution: Concerted effort has to made to make clean 'India' data available to everyone.

⇒ Challenge: Insufficient inclusion and diversity.

⇒ Solution: Innovative and drastic measures are required. Put in place a policy by which incentives are provided to make inclusion and diversity an integral part of the system.

⇒ Challenge: PhD students are dwindling in numbers.

⇒ Solution: Inspire talented students from the UG stage itself.

⇒ Challenge: Graduates are not industry-ready; certification courses are a failure.

⇒ Solution: There should be tighter collaborations and feedback mechanism between industry and academia. Classes must be much more engaging with innovative projects. Internships may need to be mandatory, with clearly specified goals.

Undergraduate level AI programme and curriculum development

⇒ Identify tools that would be needed in the long run and provide it in the UG programme.

⇒ There must be more rigour in the basic topics (foundational courses) such as programming, calculus, linear algebra, probability and statistics; breadth courses (physics/chemistry/biology/electronics/engineering); artificial intelligence and machine learning, data structures, numerical methods, optimisation, statistical methods; computer systems, automata theory, computability; discrete mathematics; stochastic processes.

⇒ The focus must be on domain-specific courses such as deep learning, data mining and visualisation, robotics, data analytics, Internet of Things (IoT), information theory, big-data analytics, quantum computation, healthcare analytics, bioinformatics, natural language processing (NLP) and applications.

⇒ Include ethics/policy/law and society courses; these courses can be embedded/full/standalone.

⇒ There must be a strong humanities programme.

⇒ There must be inclusivity and diversity.

⇒ There must be co-mentoring by faculty from the US and India.

⇒ There must be adequate infrastructure to be able to offer advanced courses at scale (not piecemeal by each Institute).

⇒ A curriculum with grounded humanities/social aspects must be developed; it must not just have a STEM (science, technology, engineering, mathematics)-intensive

focus. There must be emphasis on real-world societal problems, and not just have an algorithmic focus.

⇒ Institutional resources could be made available to all students outside of the Institution.

⇒ There must be gender diversity with more role models in research-based activities (conference speakers, conference organising committees).

⇒ The trainers must be trained.

AI, Data Science training for industry 4.0

The workforce can be classified into:
(1) Business leaders, who need to be aware of AI.
(2) Technical leaders, who need to do the hands-on part of AI.
(3) Government, who will be enablers and provide resources.
(4) End users, who need to know how AI is potentially going to work.

⇒ The chief experience officers (CXOs) and senior executives in various companies should be aware of the opportunities and limitations of AI. They should also understand the issues around AI ethics.

⇒ The middle management should understand the full life cycle of AI projects, such as problem formulation and data sourcing, so that they can execute AI projects.

⇒ The data/AI engineers and scientists should have exposure to Cloud and DevOps.

⇒ For Government officials, AI should be designed separately: how can AI be leveraged to address societal challenges?

Skillset gap

Challenges

⇒ Existing data scientists use AI as a black-box and application program interface (API). They find it hard to design their own algorithms, and identify appropriate models.

⇒ There is insufficient specialised curriculum for existing developers who want to upskill themselves.

⇒ There is a lack of hands-on experience for fresh graduates.

Solutions

⇒ Design different curricula for different strata of employees (CXOs, executives, mid-level, entry-level, end users/consumers).

⇒ Degrees, diplomas, and certifications could be partially online. How do you offer them at scale while retaining trust (credibility of the courses to the potential employers)?

⇒ Ingrain hands-on learning in the AI courses by collaborating with reputed AI practitioners from industry.

⇒ Incentivise internships in industry for existing university students.

⇒ Incorporate courses that teach end-to-end problem-solving using AI.

⇒ Create a curriculum with multiple entry–exit points that will enable existing professionals to upskill.

⇒ Create awareness programmes for business executives to help them identify AI opportunities, and for sales executives to understand AI insights.

⇒ Design certification programs for Government employees to increase AI capacity in the Government.

⇒ Create a repository of representative industry-relevant AI problems that can be used to judge the merit of employees and incentivise using such a platform.

Data gap

Challenges

⇒ There is a lack of diverse, locally-relevant data.

⇒ There is a need for easily-accessible data sources.

⇒ There are ethical concerns in sharing and using data.

⇒ There is a lack of safe spaces where data can be shared among universities, industry and Government.

Solutions

⇒ Create locally-relevant datasets by collaborating with industries, Government, and universities.

⇒ Focus on diversity and ethical concerns.

⇒ Create a safe space for different sources of data coming from diverse sources.

⇒ Make non-private data accessible from Government.

⇒ Increase AI capacity in Governments.

Graduate level programmes – other engineering/research focussed

The following topics were addressed:

⇒ What does it mean to have a domain-centred graduate training programme, especially when one is talking about other engineering research-focussed disciplines?

⇒ What does it mean by capacity building of students and professors?

$\Rightarrow$ What does industry want?

$\Rightarrow$ Ethics and policy in training.

$\Rightarrow$ Diversity and inclusion.

Structure of the domain-centred programme

Problem statement

$\Rightarrow$ How should the AI/DS (data science) programmes be structured to enable the learners to take up the challenges particular to a domain?

Suggested solutions

$\Rightarrow$ Identify the domain-specific needs.

$\Rightarrow$ Evaluate the available resources (including the workforce) to offer AI/DS programmes.

$\Rightarrow$ If needed, encourage and facilitate using AI/DS in the final year projects.

$\Rightarrow$ The academic curriculum of each programme should also include the introductory courses of DS.

$\Rightarrow$ Consider decentralising the departments of data science and artificial intelligence into a de facto component of a domain and see how opportunities can be created within that domain.

$\Rightarrow$ Focus on capacity building of professors and students.

Problem statement

$\Rightarrow$ How can the quality of professors be improved so that they can produce the next generation of students in the AI/DS domain?

$\Rightarrow$ How do we produce students trained in domain-specific problems?

$\Rightarrow$ How can we reduce the unemployment rate of graduates?

Suggested solutions

For professor-training programmes

$\Rightarrow$ Joint programmes should be offered by both the US and Indian institutes. The mode could be online or in-person, though the hybrid mode is preferred.

$\Rightarrow$ A dedicated Centre of Excellence can be created to offer faculty development programmes (FDPs); if needed, the Centre can be partnered with India-focussed EdTech companies. This can be a possible call for the India–US AI programme.

$\Rightarrow$ The FDP Centre can associate with experts from institutes from India and the US.

$\Rightarrow$ More funds should be allocated to FDPs and the expert members' remuneration should be at par with the industry pay.

$\Rightarrow$ Better infrastructure (e.g. hardware, facilities) will enable the teachers to deliver knowledge to learners effectively.

$\Rightarrow$ Better administrative (with less bureaucratic/impractical compliances) support will also help FDPs.

<u>For student-training programmes</u>

⇒ A two-year Indo–US hybrid mode Masters' programme.

⇒ The first year to be entirely taught online by both Indian and US faculty and the second year in India with a six-month project in a specific domain.

⇒ Five key areas/domain to be identified with the coordinating institution and principal investigator (PI), both in India and the US.

⇒ The Indian and US PI/institution need to get a group of teachers from a group of institutions from their respective geographies.

⇒ A possible fellowship for Masters' students through the Indo-U.S. Science & Technology Forum.

⇒ Affiliation and awarding of degree by one Indian institution.

<u>Industry requirements</u>

Problem statement

⇒ The industry needs more operations-savvy people while academia is focussed on a long-term strategic vision. This gap needs to be bridged.

⇒ The idea here is to be aware of the market opportunities and pain points (specific problems faced by current and prospective customers) and develop solutions.

Suggested solutions

⇒ Curate context/problem statements-centred training and opportunities.

⇒ The funding for science and technology research is abysmal, so funds must be made available for such research.

⇒ The data commons needs to be set up with public support instead of private support.

⇒ The development programmes can be offered in association with US universities.

⇒ The public–private partnerships between employers and students need to be enhanced.

⇒ The academicians should reach out to companies and collaborate with them based on their inputs.