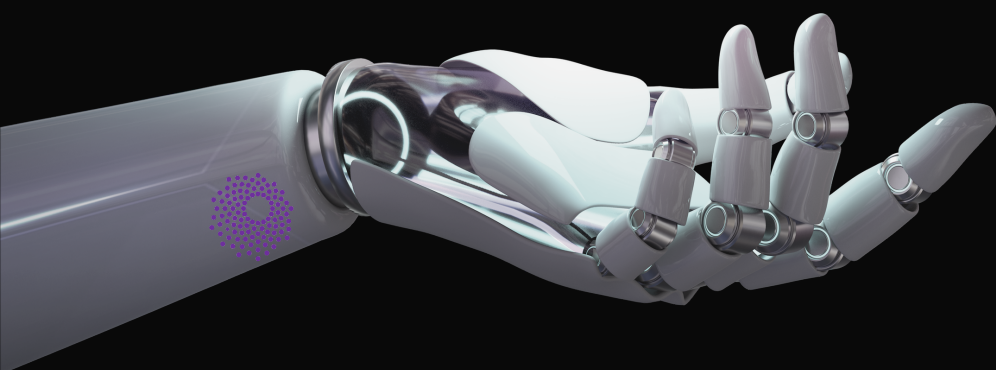


COAL MINING.

Net Zero
Coal to gas
Coal to liquid





. An IIT Alumni Council initiative .

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**COAL TECH
COUNCIL**

The Investment Committee Note
has been compiled by the Coal
Tech Advisory of Forum, on behalf
of IIT Alumni Council.

Forum is the anchor organisation of the MegaScope mission of the IIT Alumni Council.

The CTC (Coal Tech Council) received inputs from the AI/ML, Autonomous vehicle/Robotics and Climate Change scientists from the MegaResearch Mission.

The project structuring and evaluation were done with the assistance of the MegaFund Mission team members.



Investment Committee Note

Created by: MegaScope Forum Team

Submitted to: MegaFund Deal Team

Date: April 1, 2022

Project Outlay USD 4 billion

Coal output: 35 million tpa (non metallurgical)

OB Removal: 65 million tpa

Pricing: Import equivalence

Market: Domestic Indian

Segment: Base Load Electricity

Ancillary units

Carbon sequestration for
aviation fuel Coal bed methane
for CNG vehicles

MegaResearch Mission



The MegaResearch Task Force on next gen mining was led by Prof Jyoti Joglekar (Machine Learning), Dr Rohinton Dehmubed (Communications) and Prof Rakesh Nagi (Robotics)

MegaScope Mission

The MegaScope Task Force was led by Dr Mahesh Uppal (Data Policy), Prof Srivatsa Naidu (Neural systems), Dheeraj Rathi (Project Finance) and Ankit Lekhra (IPR)

MegaFund Mission

The MegaFund Task Force was led by Deepak Amin (Microfinance), Satish Mehta (Social Fund) and Rakesh Seth (Capital Markets)





Climate Change Objective

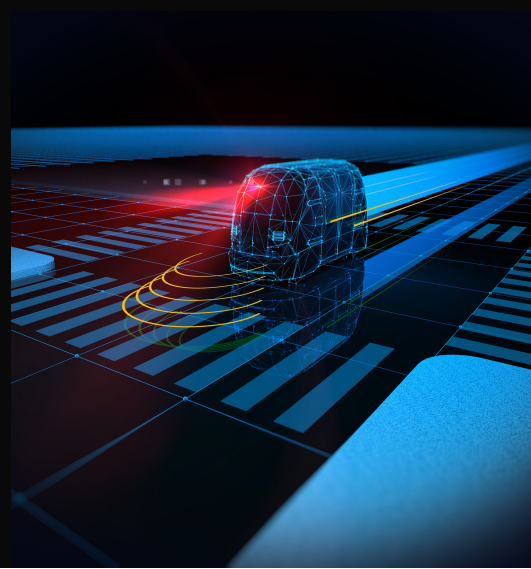
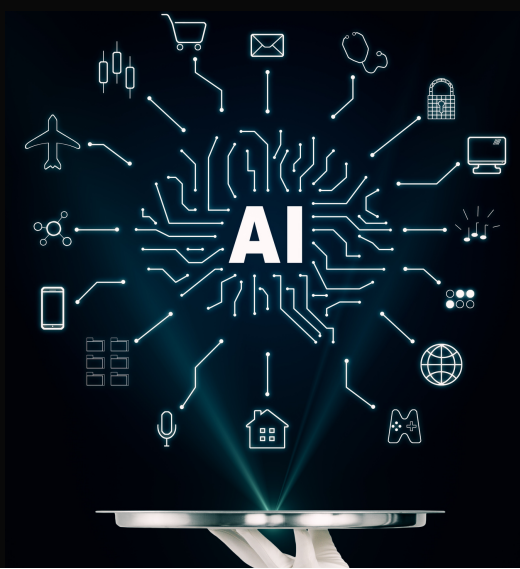
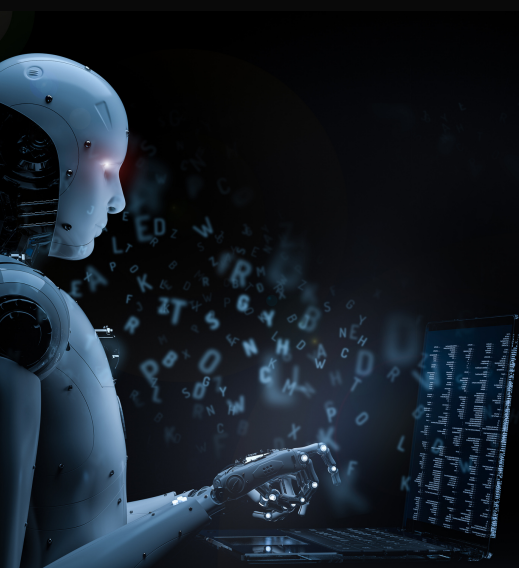
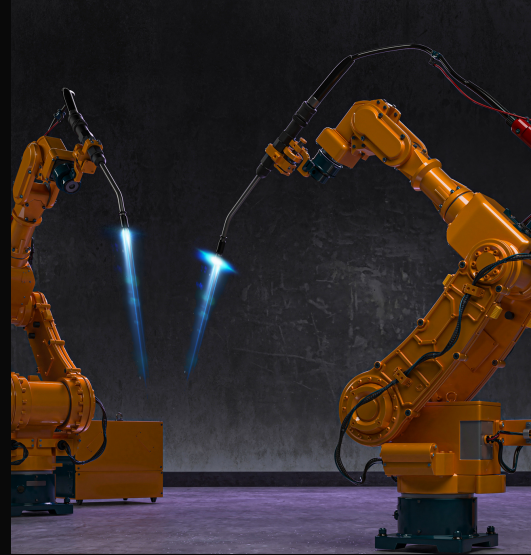
To make coal mining and coal based power generation net zero from a greenhouse gas perspective.

Production Objective

To substitute imports and to export coal to neighbouring countries. To monetise underground mines.

Technology Objective

To increase productivity through automation and to enhance viability through coal to gas and coal to liquid paradigms.



Autonomous Mining

Autonomous robotised mines have five key advantages - lower costs, faster production, avoidance of human hazard, greener and flexible operations.



Carbon Sequesterisation

Long term continuation of coal as a key energy source is dependent on the coal seller or consumers ability to make emissions zero.

Coal Bed Methane

Underground coal mines can be innovatively repurposed to become large producers of coal bed methane which can ride on the CNG supply chain for transportation.



Coal India deploys 100m boom draglines with 24 cu.m. bucket capacity and 240 ton capacity dumpers to move material to the railheads.

150 and 190 ton dumpers are manufactured domestically and one startup will soon supply indigenous draglines.

India Coal Overview

Coal is the primary fossil fuel of India and constitutes 55% of India's energy basket. Coal based power generation accounts for around 70% of electricity produced in India. Coal is abundant, available and affordable. Around 85% of India's coal is produced by Coal India, a listed corporate controlled by the Government of India under the Coal Ministry. Coal India produces around 600 million tpa of coal, a lot of it is high ash and low calorific value.

Overburden removal is around 2x the coal output. Surface miners account for an indicative 50% of the output. Around 95% output is from open pit mines. Coal India plans to substitute the 200+ mtpa import through mine developers and operators who would produce 160+ mtpa.

Coal prices in India are among the lowest in the world. So is the cost of production. As a result, Coal India makes an annual profit in excess of USD 2 billion.



Capacity expansion projects with a total outlay in excess of Rs 100,000 crores are currently underway. Annual revenue net of taxes is around Rs 100,000 crores – and over 50% of the costs are manpower costs.

Contracting and outsourcing costs are around 33% of the direct manpower cost. CIL has around 250,000 blue collar staff and around 15,000 officers. Annual reduction is an indicative 5% pa.

Sustainability Overview

Coal India is enhancing sustainability by water recover, plantations, solar power and surface mining. It spends over Rs 500 crores on CSR projects. They include Rs 250+ crores of covid relief and Rs20 crores for Thalassemia screening.

Underground mines which account for under 10% of the production and over 40% of the workforce are being phased out. Wage costs are high because of continuous increases driven by the Pay Commissions.





Strategic Imperatives

Increase production and reduce imports through use of five basic concepts:

Continuous mining using dragline integration with looped pods till railhead.

Autonomous mining on 24/7 basis using robotised equipment and deep learning.

Digital Twin technology for maintenance, operations, flexible manufacturing and consumption point integration.

Bio-methanation to extract CNG equivalent from out of service underground coal mines for use in transportation/ CNG vehicles/ hydrogen/ electricity production in pursuance of coal to gas objectives.

Carbon sequesterisation to produce aviation fuel from waste gases of thermal power plants in pursuance of coal to liquid objectives.

Digital Mining Challenge

Current workflow is non-optimal and obsolete in light of modern developments in robotics, cobotics and artificial intelligence based paradigms.

Next gen draglines can feed coal directly into looped pods which can travel upto railhead in 10 feet diameter concrete pipes – placed on the ground, overhead or underground. These pipes are similar to concrete pipes used in urban areas for sewage disposal.

The transport pods are powered by hydrogen fuel cells and do not require track electrification. Induction drives are used for traction. No batteries are required.



interactivity



Digital Mining Solution

Overall architecture developed by a IIT Alumni Council MegaIncubator startup group has been optimised for 5000 tons coal per hour in a single pit. Total cost of production with delivery at rail head is Rs 3000 per ton. Production is 24/7, 365 days a year. Production rate is flexible from zero to 5000 tph.

Annual production expected assuming 2:1 OBR is 30 million tpa per pit (assuming suitable size, reserves etc). The mining plan is designed for 25 year excavation rather than the 250+ years excavation model followed by Indian mining companies since British days.





Autonomous Operations

Open pit mining is a task entirely suited for robotic fully autonomous operations. Since there is no traffic and people/cattle can be kept out of the operating areas, self-driving vehicles are relatively simple.

The workflow has been simplified to have digital intelligent deep learning based draglines directly feed into transport pods. The pods thereafter navigate themselves to the loop entrance – similar to the rovers sent to mars and the moon.

The pods then concatenate into a chain of pods which are hyperlooped towards the railhead using fuel cell-powered induction drives with ZERO moving parts on the traction side. Passive wheels are provided for support during movement.

The autonomous operations technology for the pods has been developed in silicon valley by an IIT Alumni team which uses fibre based movement tracking and 5G IOT technologies.





**Digital twin
technologies**

Digital Twin Technology



All elements of the mining operation involve operating on digital twins. Actions of the digital twins are replicated by the robots with a slight delay to allow for corrections and avoidance of failures.

The digital twin technology is used at the system level, sub system level and the component level. The technology thus facilitates optimal operations, preventive maintenance and accident avoidance at its core.

The digital twin technology is greatly facilitated by developments in areas such as Web 3.0, computer vision, 3D displays and high computational capacity systems.

By using these advanced systems, it is possible to create a digital replica of the entire mine along with its geological features and all equipment located in the mine. A dome camera set up can take a high resolution 3D voxel plot video of the mine.



Biomethanation



CIL has several underground coal mines which are either unviable or out of service for other reasons. There are over 200 such mines in India. These mines have rich coal reserves which are difficult to excavate and bring to the surface. In areas like Meghalaya, rat hole mining has been banned for various reasons including risk to the miners.

India has an established end to end ecosystem for compressed natural gas. However India is a large importer of natural gas for a variety of applications -

from transportation to power generation to fertiliser production. Natural gas can also be feedstock for hydrogen production.

The IIT Alumni Council's engineered biomolecule incubator has developed bacteria based enzymatic solutions which can convert the underground coal into methane. This methane can be pumped out and used as a CNG replacement. The CNG can also be used for super heating or power generation applications using a local gas turbine or engine.



Carbon Sequestration

Several applications of coal including thermal power plants produce copious amounts of high temperature carbon dioxide from boilers. This carbon dioxide can be super heated and converted into a kerosene like fossil fuel equivalent. This can be used as aviation fuel for civilian aircraft. The process is net zero as it

extracts the CO₂ from the atmosphere and converts it into aviation fuel. The IIT Alumni Council has sponsored development work in this area using a combination of solar thermal and gas based super heating for production of the aviation fuel. Startups in Switzerland have also commercialised this process.





Total Capcost Estimate

Rs 140,000 crores

Implementation Time

36 months

Annual Import Substitution

Rs 60,000 crores

Financial Overview : Mining Automation

Mining Capacity: 30 million tons pa

OB Removal: 65 million tons pa.

Operation: 24/7, 365 days

Workflow: Walking dragline to feed automated pod which hyperloops to railhead.

Automation: Completely autonomous operation

Surveillance: Satellite feed every two hours, stationery edge tower cameras forming dome structure so as to give 3D virtual reality image continuously for digital twin purposes. Individual hyperspectral feed for continuous monitoring of coal quality. Raman effect spectrosopes robot arm held for monitoring of coal OB separation, ash content and calorific value. Semi-circular dome to be completed over open pit with hyperspectral cameras using long stay blimps tethered from ground locations or from dragline cabin.

Capital cost estimate: Rs 35,000 crores



Biomethanation

Methane capacity	10,000 tons per day (on 100% methane basis)
Total mine heads	100
Annual production	3 million tons
Distribution	Compressed gas pipeline or cylinders
Alternate use	Excess gas fed into 75 MW gas engines for power generation
Expected gas revenue	Rs 150 Billion (Rs 15000 crores)
Capital cost estimate	Rs 40,000 crores.*

Sequesterisation

Aviation fuel	10,000 tons per day
Annual production	2.5 million tons
Expected revenue	Rs 300 billion (Rs 30,000 crores)
Capital cost estimate	Rs 65,000 crores*

**subject to detailed project report final findings. Figures are indicative and tentative*



. An IIT Alumni Council initiative .

Recognising the role of technology and technologists, India became the first country to permit engineers to be full partners in a CA firm.

THIS STORY IS FROM JULY 1, 2017

PM Modi wants 4 Indian accounting firms in world's Big 8 by 2022

PTI / Jul 1, 2017, 21:15 IST



ARTICLES



PM Modi wants 4 Indian accounting firms in world's Big 8 by 2022



Kitten food and nutrition: Here is the complete guide to follow f...



MP: Ajay Singh writes to PM Narendra Modi on farmers' suicides



India asks for access to Kulbhushan Jadhav again



Courtesy: Twitter/ANI

KEY HIGHLIGHTS

- Modi said the signature of a chartered accountant is more powerful than even that of a Prime Minister
- Referring to the 'Big 4', the PM said that it is sad that there are no accounting firms among the top global players.



Forum is the anchor organisation under the MegaScope mission. Forum aspires to make world class professional services available to three segments.

Institutions of national importance such as NPC, CIL, NMDC, ONGC, SBI - to enable Atmanirbhar Bharat through import substitution.

Startups and MSME enterprises - to enable ease of business through automated compliances

Governments and philanthropic bodies



The Forum aspires to become larger than any of the Big4 accounting firms or Big5 consulting firms on three metrics - client base, revenue and overall market share.

The Forum acts as a digital platform which aspires to spawn a nationwide network of professional services firms with a strong technology DNA.

The price performance of the services offered by the network is significantly superior to that offered by the standalone integrated firms on account of automation and "uber" - isation.

The Forum is organised by industry groups and functional areas. The resources of the Forum are distributed across the matrix. The functional areas are: (3x3)

Consulting

- Strategy & performance
- Systems, supply chain and process
- Staffing, HRD and org structure

Govt./Regulatory/ Compliance

- Filings, compliance, regulatory
- Financial advisory and control
- Feasibility and decision support

Technology

- Technology evaluation
- Technology development
- Technology deployment



The Forum is organised by industry groups and functional areas.
The industry groups are: (3x3)

Transformational

- Telecom, computing and technology
- Transportation, including advanced fuels
- Fintech and banking with financial inclusion

Survival

- Agriculture, water and wasteland revival
- Health, longevity and biotechnology
- Energy including renewables and nuclear

Traditional

- Habitats, construction and climate change
- Defence including drones and space
- Manufacturing and industry



The Forum Council comprises of heads of three mission organisations, three industry groups and three chapter heads: (3x3)

Mission Organisation Representatives

- Dr Mahesh Uppal . MegaResearch
- Satish Mehta . MegaFund
- P. Balaji . MegaReach

Industry Group Representatives

- Arun Seth . Telecom
- Sanjay Nagi . Defence
- Habitats . Anil Sharma

Chapter Representatives

- Sunil Hali . New York
- Sanjiv Goyal . Silicon Valley
- Ashish Deo . London

President's Office

Ravi Sharma
Ankit Lekhra (IPR)
Dheeraj Rathi (Regulatory)



The Forum is a non-profit
manned by IIT Alumni from
India and overseas.

WORKING BASIS

1. Free of cost
for social ventures of
national significance
and internal working
groups
2. Niti Aayog terms for
professionals
on short term
engagements
3. United Nations terms for
global engagements

OUT OF POCKET EXPENSES

4. Borne by alumni in
their individual capacity
for philanthropic work
5. Niti Ayog terms for
domestic work. UNDP
terms for overseas work
6. External experts from
the MegaResearch
initiative are billed at
USD 1000 per diem

The Forum does not take
any fees or share of fees for any work
done. Coordination, documentation and
collection services are offered at cost.



IIT Alumni Council was launched on Independence Day 2019 as the anchor organisation for a global movement of IIT Alumni who were committed to

- ▶ **SUPPORTING**
socio-economic development of India through technological and financial interventions
- ▶ **PROMOTING**
Brand India and Brand IIT Alumni, and
- ▶ **IMPLEMENTING**
venture capital and startup paradigms for the above

IIT Alumni Council is a privately funded independent and autonomous non-profit organisation, registered under Section 8 of the Indian Companies Act

How it all began

...

It was a simple thought that stoked this movement in the year 2017:

'Can we as alumni shift our focus from merely looking after the 'well-off' alumni or "well funded" alma mater, to serving the country?

Not as donors but as solution providers to pressing socio-economic challenges.

United, we can act as a force multiplier like no other community can.



It is high time that we catalysed & enabled greater reach of technology to solve complex national challenges.





IIT Alumni Council is now the largest global body of alumni across all the twenty-three IITs and partnering Universities. The IIT Alumni Council aspires to align Alumni resources towards catalysing India's technological renaissance for a digital society. The member alumni actively participate in social ventures that are configured to solve key national challenges through the deployment of appropriate technologies using the well-proven venture capital funded start-up format.



Ravi Sharma
President &
Chief Volunteer

Mission

To impact on innovation for the social sector.

To create appropriate institutions and strengthen them in terms of capacity and competence to help diffuse appropriate technologies for maximum impact in the shortest possible time. To seed self sustaining ecosystems in key areas like research education, preventive healthcare, climate change, government advisory and venture funding.



from its natural surrounding such that it seems to evolve from the site and merge back in

FORM



VIEW



Participation

As we move out of the pandemic, the Council will revert to its original chosen path of catalysing the growth of a deeptech ecosystem that would help solve national challenges through the widespread deployment of key frontier and exponential technologies.

The IIT Alumni Council is now the largest body of IIT Alumni interested in nation building through technological and financial interventions. The Council has over 25,000 members organised as six communities.

The MegaSpheres initiative of the IIT Alumni Council has organised its members across six communities. Three of these have been actively engaged in this project.

MegaResearch: Scientists and academicians.

MegaScope: self employed IIT Alumni engaged in advisory work.

MegaFund: professionals and entrepreneurs from capital markets, private equity and investment banking.





Objective

IIT Alumni Council was set up to mobilize and direct the professional, financial & technological resources of IIT Alumni to address complex challenges facing Indians and to build India as a global brand.

The IIT Alumni Council primarily relies on financial resources contributed by its members.





Priority Areas

IIT Alumni Council mobilizes financial and technological interventions in emerging areas of the economy (such as deep science startups) and in emerging technologies (such as artificial intelligence). Focus areas are segmented into foundational, frontier and exponential technologies needed by social ventures to solve national challenges.





Overview

The IIT Alumni Council is the main umbrella organisation which identifies and onboards interested alumni and independent entities for participation in solving problems that have been identified by the various working groups and task forces.

IIT Alumni Council is currently addressing a defined set of national challenges which include improving the:

- quality of life.
- ease of doing business.
- research ecosystem.
- deep-tech startup ecosystem.





Mission Organisations

The IIT Alumni Council aspires to support a large number of mission organisations, and is currently supporting six mission organisations:

FOUNDATION

to support infrastructure and pilot projects.

INSTITUTE

to support research commercialisation

FUND

to support startups in the areas identified for intervention

FORUM

to provide compliance, growth and advisory services

ALUMNI

to identify necessary resources from among alumni

INCUBATOR

to support partnering startups





Constituent Entities

The Council supports independent and autonomous alumni initiatives at two levels - mission organisations and incubated startups. Mission organisations are partner organisations that are signatories to the Council's charter and use the Council brands. The actual entities created, acquired, or supported for executing the initiatives under the missions are independent of the mission organisations but part of a loosely formed consortium. They align with the objectives and governance framework of the mission organisation.





Consortium Members

The IIT Alumni Council is designed to co-operate more than compete with organisations and entities which are working in the identified problem areas.

The Council aligns with entities in a consortium format to create a larger entity comprising of synergised entities that work towards the common goal of solving a national problem.

Each of the mission organisations identifies and align with synergistic organisations that have a presence in India as long as they are professionally managed and board run.





Incubated startups

The IIT Alumni Council is closely aligned with the startup movement in India.

The key areas addressed by the Council include health tech (with a focus on healthy longevity), food tech (with a focus on plant-based nutrition), research (with a focus on doctoral level education and commercialisation of research), climate change (with a focus on sustainability and transportation) etc. Supported incubators are in the accelerator format and provide roaming across physical incubators and patient capital funding.





Key differentiators

The Council is distinct from alumni associations and related bodies focused on the welfare of the alumni and the progress of the institute. IIT Alumni Council sees IIT alumni and their parent organisations as resources to address important national problems.



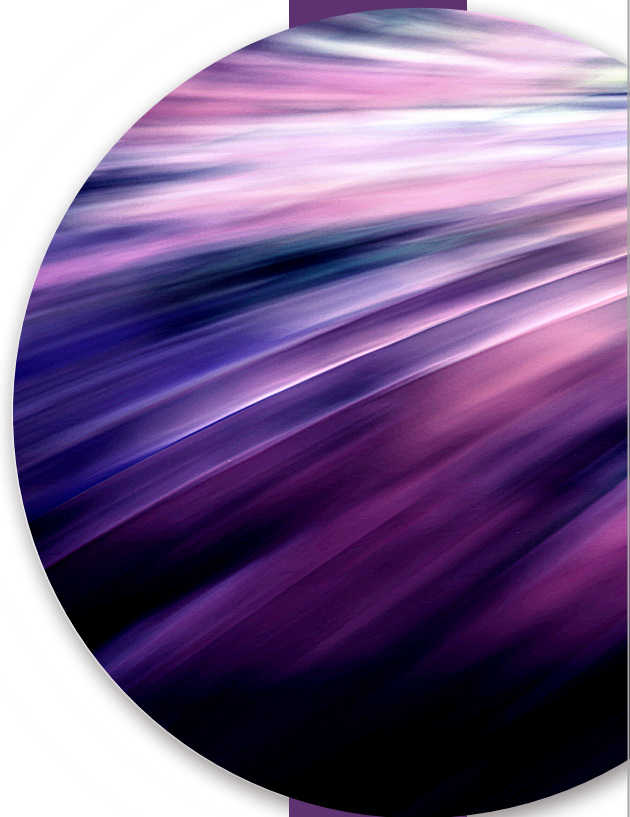
IIT Alumni Council is a private body. It has implemented systems to ensure focus, transparency, and accountability only to its members and contributors. Council initiatives are funded by commercial capital or private capital from alumni entities. Private capital includes CSR-type capital.





Structure

IIT Alumni Council is structured as a movement. It is not a conventional organisation built on a strong control and command structure but a movement without rigid hierarchies and structure. Its various units are conceived as independent and autonomous programmes allowing for flexibility in conceptualisation, operations, and management.





Systems

IIT Alumni Council does not have any central command since it is structured as a movement. This necessitates an organisation structure that ties up loosely connected entities with strong digital information systems - both for decision making and financial management. This is achieved by centralising the compliance functions and regulatory filings. The IIT Alumni entities that are linked in the federation format do not avail of any tax concessions or public funds





Governance

IIT Alumni Council has been designed with a federation structure in a format that requires minimal centralised control or management. Each arm of the organisation is independent and autonomous. These arms use branding and logos which are the property of the IIT Alumni Council. If any entity is found to be in violation of the ground rules and first principles of the movement, then the right to use the branding and related collateral is withdrawn. No fees are charged for usage of the brand, logos and other related collateral from the partner organisations.



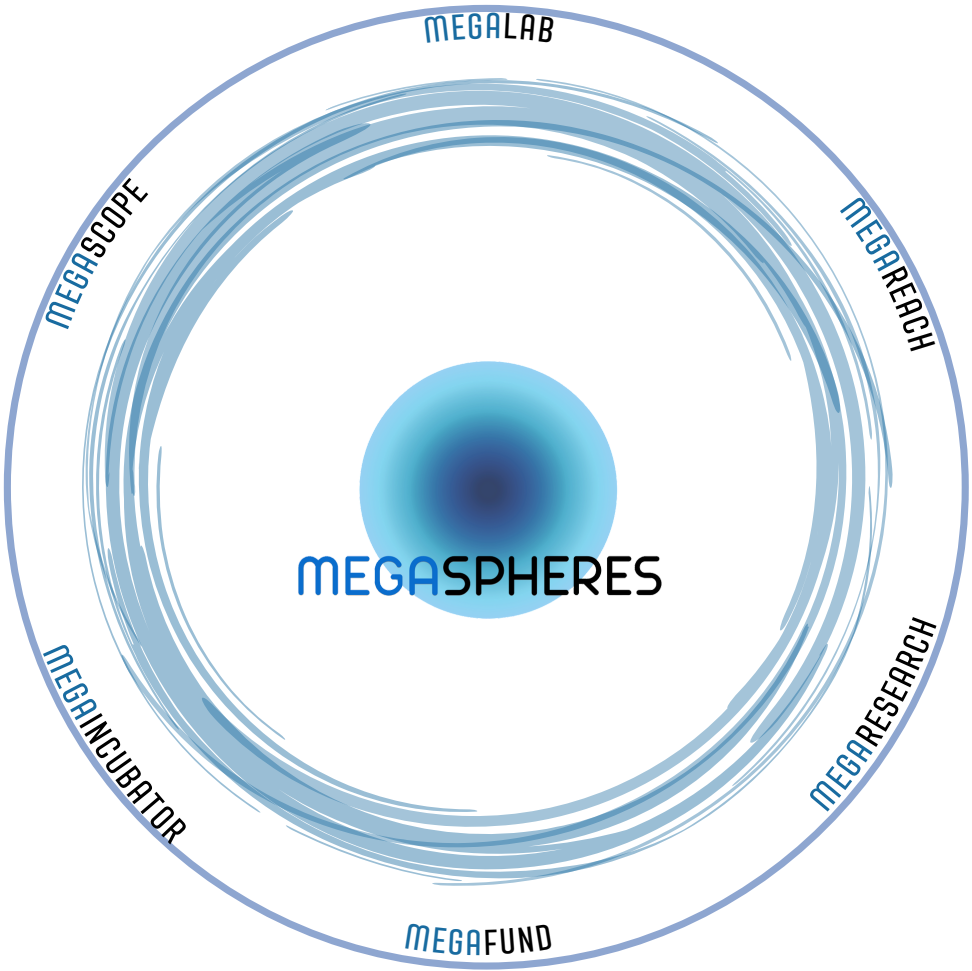


Transformation through Technology

The MegaSpheres initiative was created in 2021 to act as an umbrella for the various spheres in which IIT Alumni play a lead/mega role globally. The ambition was to build the largest private social initiative in India.

The first six spheres that were identified for support were:

Health	MegaLab
Venture Capital	MegaFund
Accelerator	MegaIncubator
Advisory	MegaScope
Outreach	MegaReach
Research	MegaResearch



At a macro level, the MegaSphere initiative impacts various spheres of human activity - be it work, play, relationships, love, family, travel, study etc - which get inflected by emerging Web 3.0 paradigms in areas like digital health, digital finance, climate change etc.

Web 3.0 - which is built around ubiquitous connectivity and immersive virtual world interactions - will disrupt existing digital paradigms, evolving a whole new ecosystem around them.

The six mission organisations under the MegaSpheres initiative are synchronised to be mutually exclusive and collectively exhaustive so as to achieve the platform goal of achieving national transformation for socio-economic progress through appropriate technological and financial interventions.



Whilst the IIT Alumni Council started off as an umbrella body of IIT Alumni, in keeping with its inclusive approach, it has actively encouraged alumni of other premium universities to partner in its activities - at both the alumni as well as the institute level.

The macro objective was to maximise the resources available to the social ventures being pursued. Several state and central universities have aligned with the objectives of the IIT Alumni Council. This has increased the addressable universe of alumni from the five lac IIT Alumni to over one crore other premium college alumni.



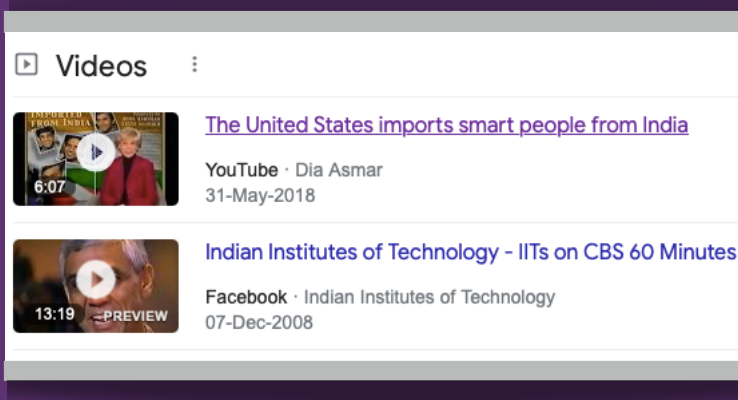
Journey ahead

As we emerge out of the pandemic, the Council has now reverted to its original chosen path of catalysing the growth of deeptech ecosystems to help solve national challenges by deploying key frontier and exponential technologies in startups.



Glide path

The Alumni Council is pursuing a technology intensive model which uses paradigms from the startup and venture capital world to disrupt the social sector. For the supported entities to be self sustaining and internally fuelled in the long term - the focus is on ventures where benefit created is captured in the long term revenue - either as profitability or as valuation in the startups.



Given that this was an outward oriented alumni body, which was not engaged in donating to the alma mater or to fellow alumni, it was felt that there should be clarity on the role of the organisation, its interlinkage with the IITs and its governance structure. It was the first time that an entity had been created which was both global and had alumni of all the 23 IITs.

Accordingly, given the scale and nature of the Council, a press release was issued jointly by the 23 directors of the IITs to clarify the linkage of the Council with the IITs explicitly.

Strategy Council

Internal Members

Prof Jyoti Joglekar

Prof Rakesh Nagi

Dr Rohinton Dehmubed

Dr Arindam Bose

Alumni Members

Pawan Kumar

Sunil Goyal

Sanjiv Goyal

Anil Kejriwal

External Members

Dr Mufazzal Lakadawala

Christina Watson

Mrinalini Gupta

Vikesh Mehta

Events

Ashok Singh

Sandeep Nigam

Forum refers to PanIIT Forum, an Indian non-profit company registered under Section 8 of the Companies Act, its network of member firms, and their related entities. Forum and each of its member firms are legally separate and independent entities. Forum does not provide direct paid services to clients.

Please see www.megascope.in for a more detailed description of Forum and its member firms.

This material is prepared by the Coal Technology Council appointed by the Forum. The Council was manned by a group of alumni drawn from various mission organisations of the IIT Alumni Council. The group included experts in the area AI/ML, robotics, coal gasification, biotechnology, mining, civil engineering, chemistry, geology, finance, regulation, public policy etc. None of the Council members have received any remuneration for the services rendered. No sponsorship or fee has been received for the same.

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