ASME
SETTING THE STANDARD

2026 REPORT

Engineering Education Seminar on *Integrating* Systems Thinking into Mechanical Engineering

24 June 2026

IIT Delhi- Research & Innovation Park Auditorium

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MEEd
ASME Mechanical Engineering Education Summit
INDIA

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EXECUTIVE SUMMARY

This report captures the key messages, examples, and implications from the ASME Engineering Education Seminar on Systems Thinking. It is intended to support follow-up discussions with academic institutions, industry partners, regulators, and ASME stakeholders on how systems thinking can be embedded into mechanical engineering education in India.

The ASME Engineering Education (MEEd) Seminar, held on June 24, 2026, at the IIT Delhi Research and Innovation Park, brought together over 100 faculty members, students, industry practitioners, startup founders, and academic leaders to discuss how systems thinking can be embedded into modern mechanical engineering education. The seminar positioned systems thinking not as an optional enrichment topic, but as a necessary capability for engineers working in complex, multidisciplinary, and socially embedded environments.

Throughout the day-long sessions, a clear consensus emerged: while industry has long practiced systems thinking out of necessity, academia must now transition from treating it as a choice to recognizing it as a mandatory competency.

As products evolve into complex, "self-aware" cyber-physical systems from 9-bar espresso machines to nuclear submarines, future engineers must possess the ability to "zoom out" and manage the interconnections between technology, society, and the environment.

The seminar featured diverse success stories, including the development of bionic limbs, advanced thermal cooling for space, and autonomous defense interceptors, all of which proved that multidisciplinary collaboration is the goldmine of modern innovation.

The forum ultimately framed systems thinking as both an educational priority and an institutional responsibility. Speakers called for assessment reform, greater emphasis on project-based learning, structured faculty development, and stronger industry-academia collaboration, including a proposed shift toward a 70% project-based and 30% paper-based assessment model to improve industry readiness among future Indian engineers.

Across the sessions, three shared conclusions emerged. First, systems thinking is no longer a niche capability; it is becoming a core engineering competency. Second, curriculum reform must be matched by assessment reform, faculty development, and stronger industry engagement. Third, India has a strong base of examples—from smart-city projects and defense systems to bionic devices and thermal management startups—that can be used to teach systems thinking through locally relevant engineering problems.

INAUGURAL SESSION AND CHIEF GUEST ADDRESS

Welcome Address by ASME India Leadership and Institutional Context

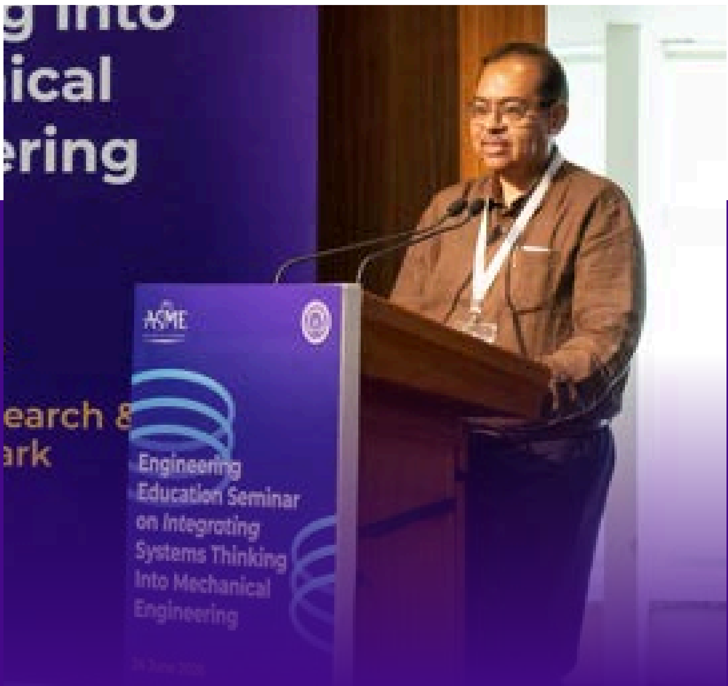
Mr. Madhukar Sharma, *President and Director- ASME India Private Limited*
Ms. Avni Malhotra, *Deputy Director- ASME Foundation India*

The inaugural session established the foundational role of the American Society of Mechanical Engineers (ASME) in shaping global safety and technical standards since 1880. With over 85,000 members across 135 countries, ASME remains a primary driver of technical excellence and standard-setting. Mr. Madhukar Sharma emphasized that while mechanical engineering has been fundamental to human progress for centuries, the modern world demands a discipline- agnostic, integrative approach.

He cited the Delhi Metro Rail Corporation (DMRC) as a premier example of a “sociotechnical system.” This infrastructure successfully balances complex engineering with human factors and societal needs. Mr. Sharma noted that for educators, this seminar is a prompt to rethink pedagogy. For students, it is an opportunity to expand intellectual boundaries beyond traditional disciplines.

Ms. Avni Malhotra detailed the philanthropic and educational initiatives of the ASME Foundation India.

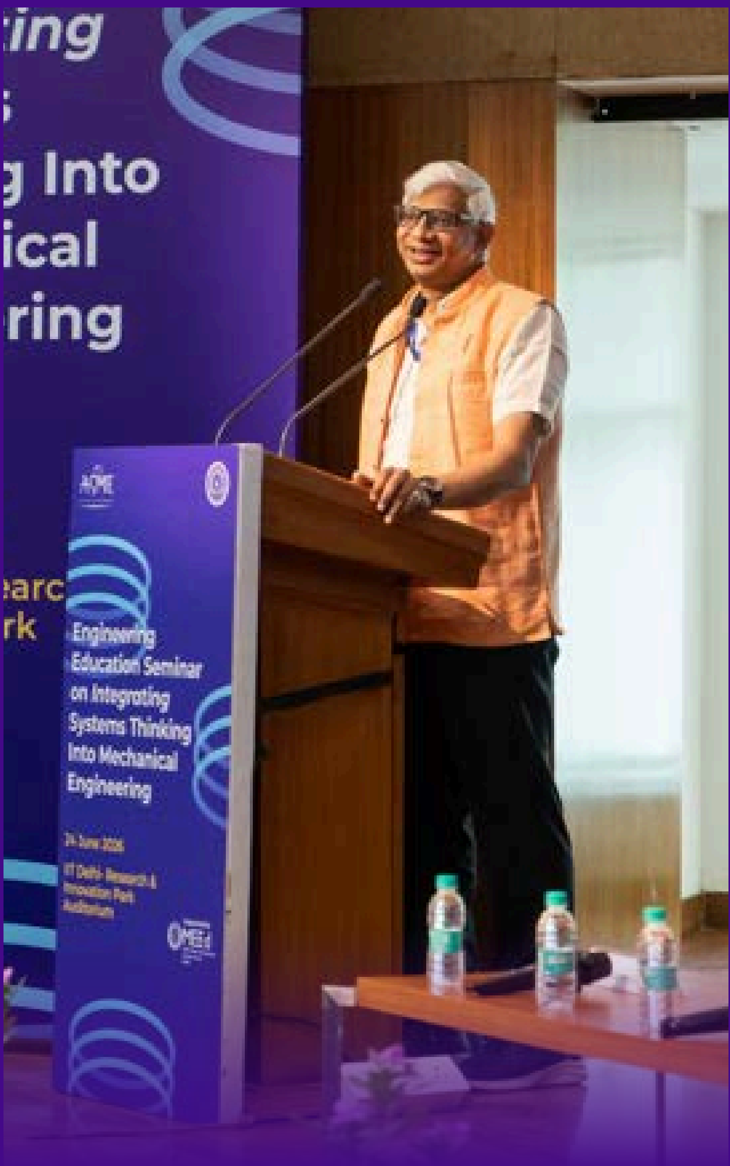
These include:
Engineering Festivals (EFx): Student-centric events fostering practical skill development.
MEEd (Mechanical Engineering Education Seminars): Forums designed to identify and close the gaps between academic curricula and industry requirements.
ISHOW: A global hardware innovation showcase providing seed funding and evaluation for engineering startups.
STEM Projects: Community engagement programs introducing first-generation graduates to the potential of mechanical engineering.



Chief Guest Address: Reforming Assessment and Aspiration

Dr. Abhay Jere,
Managing Director and CEO- Dexit Global Limited

Dr. Abhay Jere, a leader whose career trajectory spans pharmacy, chemical engineering, IT, innovation, and policy, delivered a compelling critique of the current state of technical education. He drew upon his extensive experience, including his tenure as Vice Chairman of the All India Council for Technical Education (AICTE) and Chief Innovation Officer for the Ministry of Education's Innovation Cell. Dr. Jere identified a significant disconnect: while curricula are frequently updated to incorporate buzzwords like AI and Robotics, the fundamental assessment methodologies remain largely unchanged. He argued that traditional question-paper-based exams, which assign minimal credit to project work, fail to equip students with the holistic systems thinking vital for modern engineering. This archaic assessment system, he warned, inadvertently encourages students to revert to outdated learning habits.

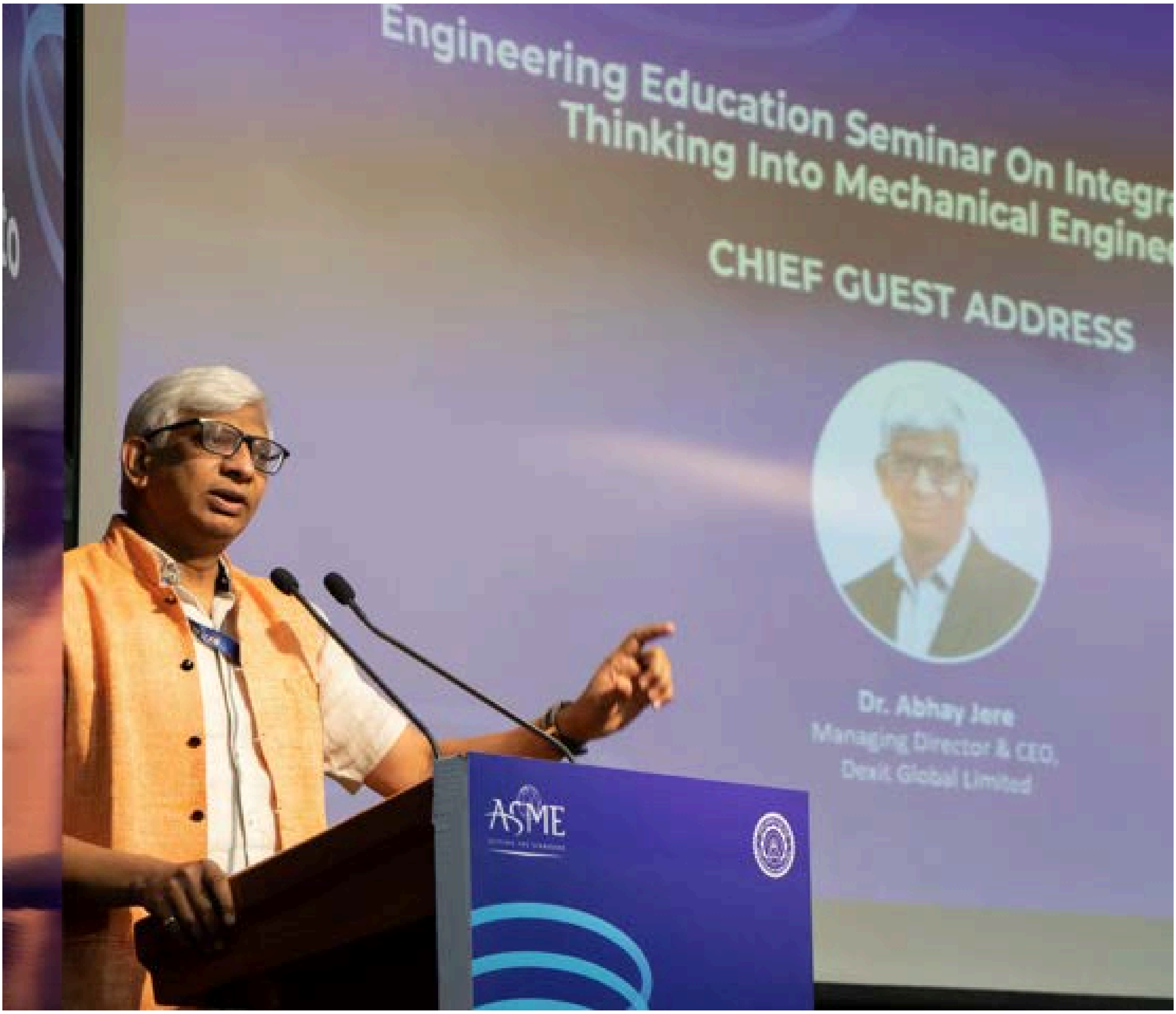


Addressing the "Aspirational Gap" and Redefining Career Trajectories

A pivotal point of Dr. Jere's address was the perceived lack of aspiration among bright students towards core engineering disciplines like mechanical engineering. He presented compelling data from AICTE, indicating that while CS and IT programs attract a large number of students, a significant cohort still enters mechanical engineering. However, the "brightest of students" are increasingly drawn to IT. He attributed this to a pervasive focus on short-term financial gains and career aspirations, heavily influenced by social media and peer perception. Dr. Jere recounted a successful experiment conducted with CBSE schools, where a detailed, long-term (20-30 year) career trajectory analysis comparing automobile engineering with CS was presented. This demonstration revealed that while CS might offer higher initial salaries, mechanical engineering careers often achieve greater financial and professional fulfillment over time. He strongly advocated for ASME to undertake similar awareness campaigns at the school level, involving parents, to highlight the enduring relevance and potential growth in core engineering fields.

The Imperative of Systems Thinking: Beyond "Zooming In" to "Zooming Out"

Dr. Jere articulated that while engineering curricula are improving, they often teach students to "zoom in" on components, failing to cultivate the ability to "zoom out" and understand the larger system. He illustrated this with a personal anecdote about leading an R&D team at Persistent Systems to build an "I Doctor" kiosk. This ambitious project involved a multidisciplinary team of mechanical engineers, biologists, and doctors. Dr. Jere identified the project's most critical asset not as the specialist with the deepest knowledge, but as the "Systems Coordinator", an individual who could bridge communication gaps, understand different disciplinary jargons, and synthesize diverse inputs to guide the team effectively. This person, he explained, had implicitly developed a systems approach. He lamented that current curricula, focused on depth rather than breadth, do not adequately foster such crucial "breadth-oriented" or "systems-oriented" individuals. Dr. Jere concluded by urging ASME to develop concrete recommendations for curriculum integration and teacher training, offering his full support to facilitate the adoption of these reforms by regulatory bodies like AICTE. He emphasized that meaningful change requires a comprehensive model, including teacher training, to counteract the tendency to revert to rote learning, especially when assessments remain traditional.



PERSPECTIVES FROM INDUSTRY PRACTITIONERS

Lifecycle Thinking and Cross-Domain Integration

Dr. B Gurumoorthy,
Chief Executive – SID, IISc Bangalore

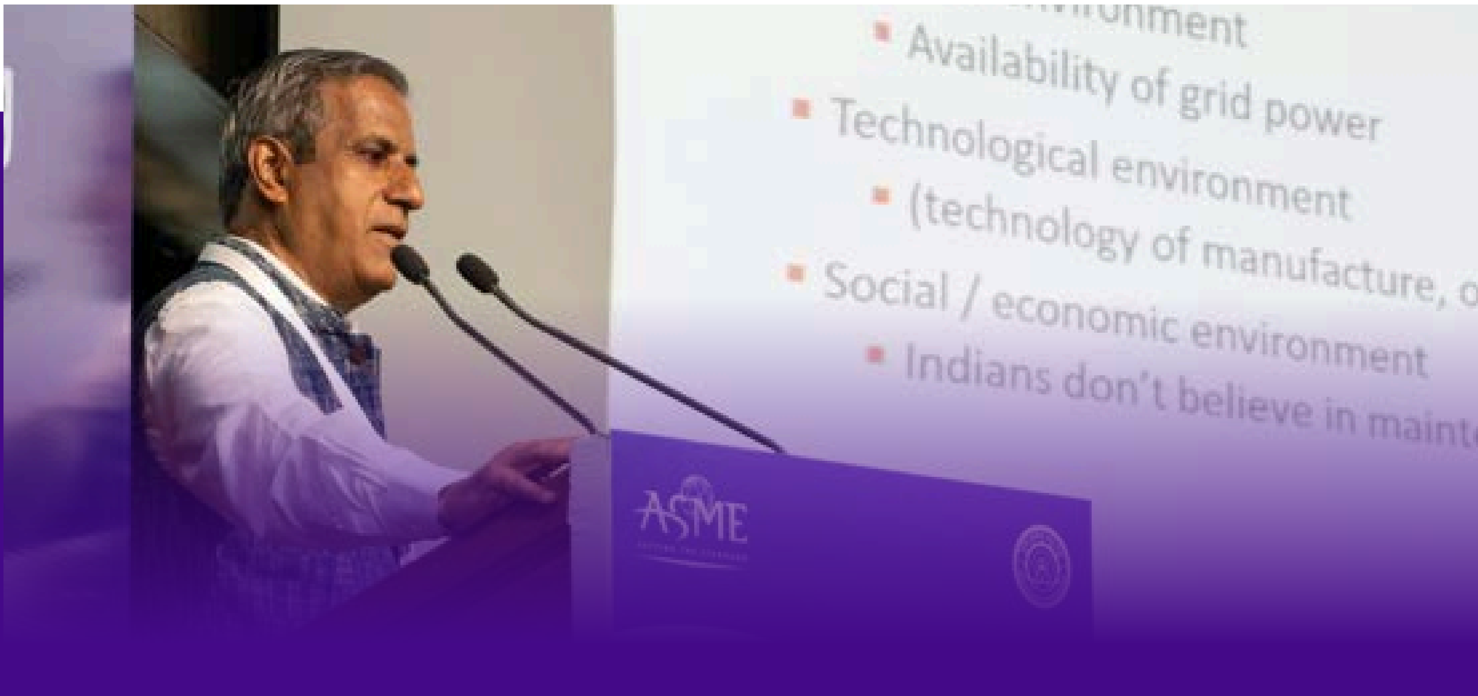
The Imperative of Multidisciplinary Engagement
Dr. Gurumoorthy opened the session by emphasizing that systems engineering requires the ability to lead across multiple domains. He argued that engineers must move beyond the "silo" mindset to engage with the entire lifecycle of a product. A common failure in engineering is the lack of foresight regarding what happens to a product years after it is commissioned.

Resolving Domain Conflicts
Using the example of a **Traveling Wave Tube (TWT)**, Dr. Gurumoorthy illustrated the inherent conflicts between disciplines.

1. **Mechanical vs. RF:** Mechanical designers optimize material placement for structural integrity, while Radio Frequency (RF) engineers require empty space for signal amplification.
2. **Spatial Constraints:** In aircraft design, space in the fuselage cavity is contested; structural engineers may see empty space as an opportunity for storage, while systems engineers must reserve it for landing gear movement.

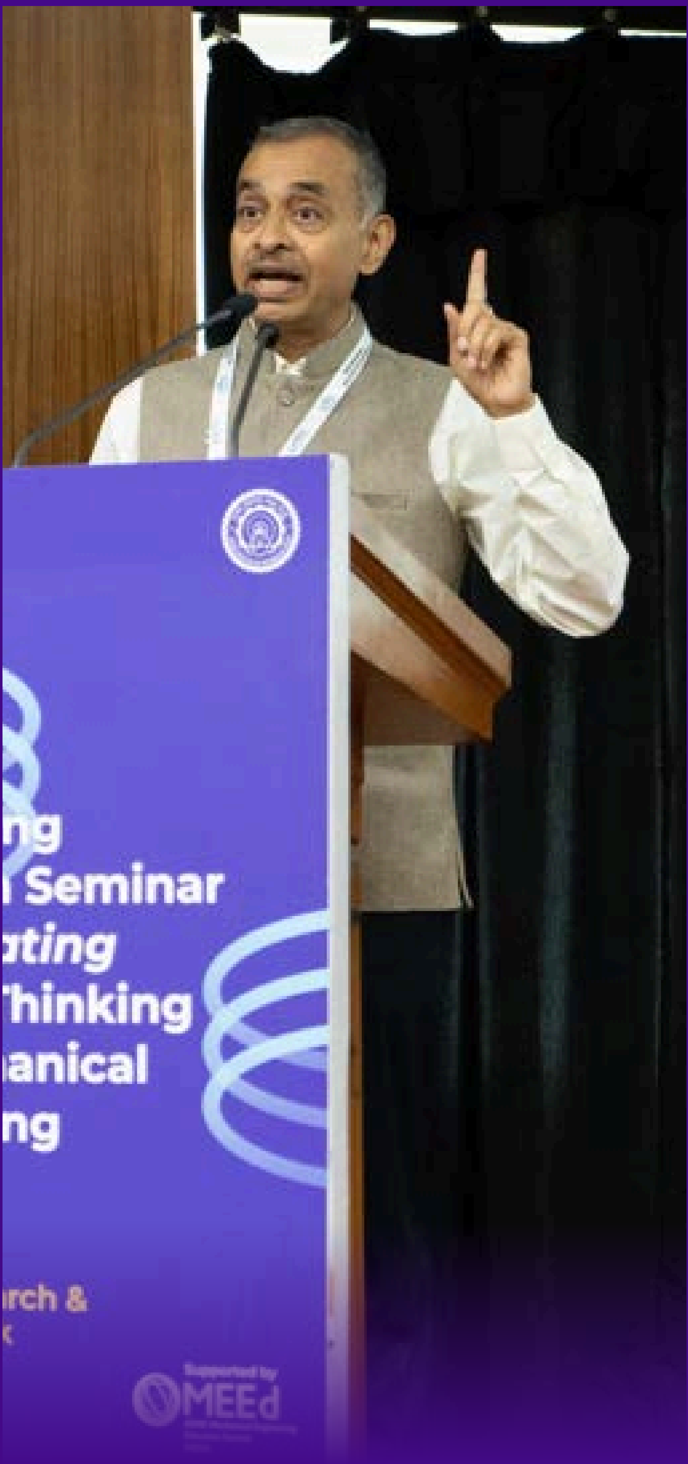
The Social and Lifecycle Context
Dr. Gurumoorthy provided a striking example of lifecycle failure in pharmaceutical packaging. When an expiry date is printed only on one side of a blister pack, the information is lost once the first few pills are consumed. He also highlighted the "social element" of design using the success of **Tata Motors** in the Indian commercial vehicle market. Unlike multinational competitors, Tata Motors understood the Indian environment, specifically the habits of overloading, lack of maintenance, and poor road conditions and built a robust support structure to handle these realities.

Technical Risk Management
He advocated for the use of **Technology Readiness Levels (TRL)** to iron out multidisciplinary issues. He cited the **Hubble Telescope** as a success story of systems thinking; an independent audit caught critical errors in solar array control mechanisms and radiation shielding before launch. These issues arose because two different teams had not integrated their findings during the design phase.



Warships as a System of Systems

Commodore (Dr) Pramod R Kulkarni,
Pro-Vice Chancellor- REVA University



Complexity in Naval Engineering
Commodore Kulkarni presented the warship and the nuclear submarine as the ultimate examples of a "System of Systems." A warship requires the integration of 16 distinct systems, including weaponry, propulsion, electrical systems, human factors, and cost management.

The Design Spiral and Timeline
Naval design is an iterative process known as the **"Design Spiral"** where designers converge on a solution through stages of concept exploration and functional design.
The timeline for these projects is immense:

1. **Design and Construction:** 10 to 20 years.
2. **Service Life:** 35 to 45 years.
3. **Obsolescence Management:** While a ship's hull may last 40 years, its electronics become obsolete quickly, requiring periodic "Mid-Life Upgrades."

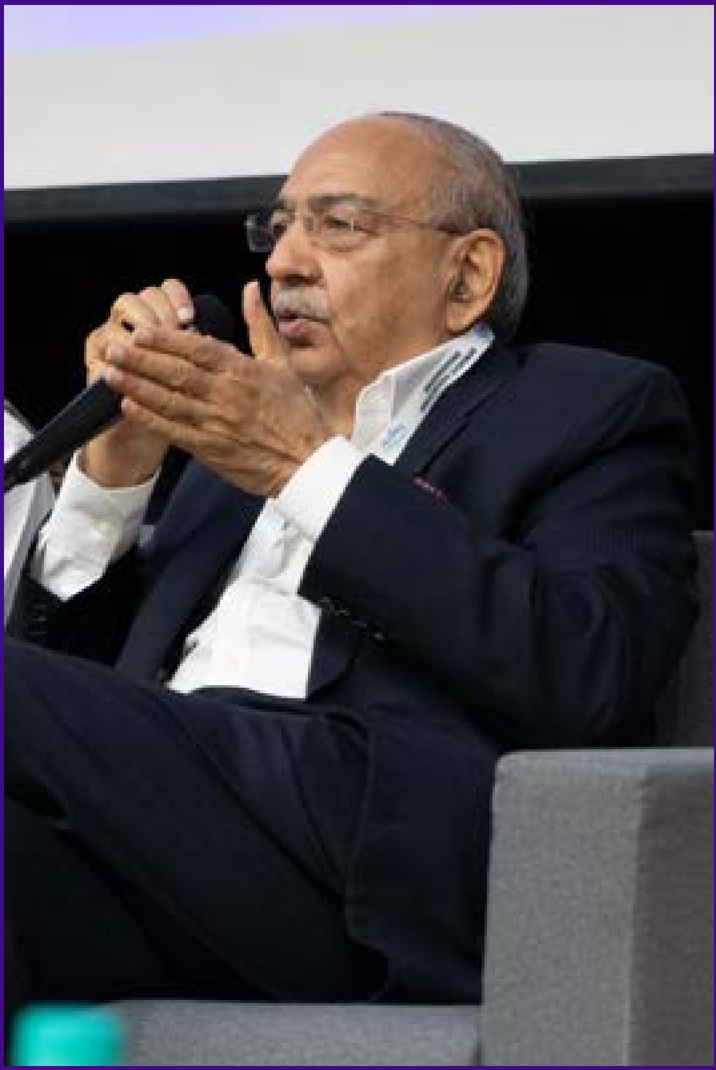
The Criticality of Weight and Stability
A central challenge in naval systems engineering is **Weight Estimation and Control,** specifically the management of the **Center of Gravity (CG).**

1. **Metacentric Height:** High-school physics principles determine whether a ship remains stable or capsizes.
2. **The Growth Margin:** Designers must conceptualize modifications 40 years in advance. If new radars or weapons (top-weight) are added without a "growth margin," the CG rises, making the ship unstable.
3. **Case Studies in Early Retirement:** He noted that the US Navy was forced to retire Oliver Hazard Perry-class frigates and Ticonderoga-class cruisers decades early because they ran out of weight margins for modernization.

Political and Financial Stakes
Because these projects consume a significant portion of national resources, the US Congress now monitors parameters like the Center of Gravity. Commodore Kulkarni concluded that a mechanical engineer in this field must have a "working knowledge" of finance, electronics, and organizational behavior to manage the "handshake" areas between complex system puzzles.

Global Competitiveness: The "Center of Excellence" Model in Education

Mr. Pravin K Purang
Independent Director, Schneider Electric Infrastructure Ltd.



The Need for Speed in Education
Mr. Purang, an IIT Delhi alumnus and former MD of Royal Enfield, argued that while the world has changed tremendously in the last decade, the pace of educational reform remains too slow. The primary purpose of a university is to create value for society, which requires students to be "industry-ready" upon graduation.

The "Center of Excellence" (CoE) Model
He proposed moving away from traditional, isolated teaching toward a model of **"Collaboration in Competition."**

1. **Specialization:** Not every university needs to be an expert in every field. Instead, universities should collaborate to form Centers of Excellence in specific areas like AI or sustainable mobility.
2. **Industry Marriage:** Industry engagement should not wait for graduation. It should begin as early as the second or third year of the engineering program.

Continuous Professional Development
Mr. Purang highlighted that in the corporate world, professionals, including Managing Directors, undergo at least 15 days of training annually to remain relevant. He suggested that university faculty must also be given the time and resources to enhance their excellence and stay abreast of global technological shifts. He concluded that India’s global competitiveness depends on the university's ability to move away from traditional degree-granting toward building integrated, multidisciplinary expertise.

ACADEMIC INSIGHTS

From Simple Problems to Population-Scale Solutions

Dr. K. V. Gangadharan,
Professor of Mechanical Engineering, NITK Surathkal

The Pedagogy of Problem Definition

Dr. Gangadharan argued that systems thinking must be integrated into the classroom as an everyday activity rather than a terminal elective. Using the "Think-Pair-Share" methodology, he demonstrated how a simple problem: "My neck is paining; help me" can be transformed through systems thinking.

1. **Contextual Reframing:** By adding constraints (a village setting, mud roads, no electricity, and the need to fetch water), students move from recommending medical solutions to engineering hardware, such as a "water-roller" that removes the load from the head.
2. **Kinematics in Practice:** This exercise teaches 3rd-semester students Kinematics of Machines and Statics by analyzing why existing solutions work and how repositioning a load can change a human life.

Multidisciplinary Course Projects

1. Smart City Simulation: In the 6th semester, students from seven different departments collaborate to design a miniature smart city, integrating communication, transportation, and electronics.
2. Socially Driven Engineering: He highlighted projects where students interviewed local stakeholders (plumbers, carpenters, forest rangers) to build tailored solutions. This led to the development of a silent Electric Vehicle (EV) for forest surveillance, equipped with integrated searchlights, GPS, and solar charging to overcome the limitations of traditional, noisy internal combustion engines.

Scaling Through Virtual Labs

To scale experiential learning to a national level, Dr. Gangadharan detailed the Virtual Labs project, funded by the Ministry of Education. This initiative provides digital simulations of basic engineering principles, allowing students to experience competent application before entering physical labs. He concluded that systems thinking is possible in any engineering college, regardless of institutional tier, provided the faculty reorients their own mental models.

Environmental Systems and Mental Models

Prof. Jay Dhariwal,
Associate Professor, Department of Design, IIT Delhi

Beyond Linear Thinking
Prof. Dhariwal said that his varied background in energy engineering and industrial design is a commitment to solving complex societal problems. He noted that while linear thinking seeks immediate solutions to visible problems, systems thinking recognizes that all components are interconnected.

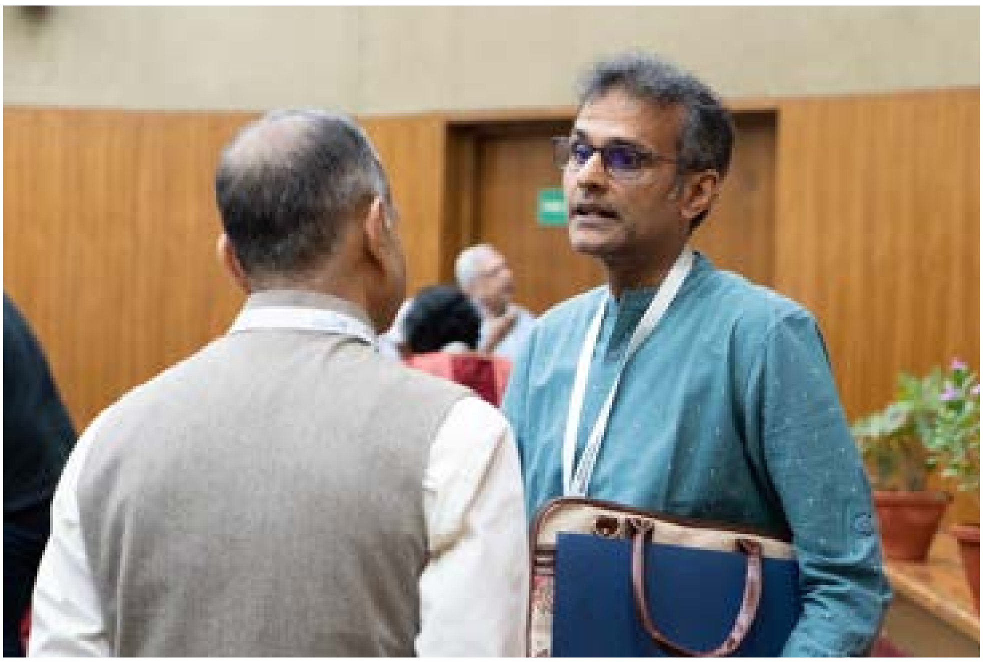
The Iceberg Model and Mental Models
He introduced the **Iceberg Model** to explain how deep-seated structures govern visible events:

1. **Events:** A visible problem, such as poor air quality.
2. **Patterns:** Recognizing that the air quality is poor year after year.
3. **Structures:** The vehicular emission standards and urban planning that cause the pattern.
4. **Mental Models:** The underlying beliefs, such as "the Earth is an infinite reservoir" or "I need to use my car regardless of emissions."

Prof. Dhariwal emphasized that to bring about massive change, engineers must understand and potentially change the mental models of society.

Quantifying Global Challenges
Using the **Urban Heat Island Effect** as an example, he explained how an individual solution (installing an AC) creates an unintended consequence (making the city hotter). He demonstrated a **System Dynamics Simulation,** partially built with AI, to quantify the feedback loops of atmospheric CO_2.

1. **Reinforcing Loops:** Higher CO_2 leads to higher temperatures, which reduces forest cover, leading to even higher CO_2 levels.
2. **Global Optimality:** Prof. Dhariwal argued that engineers must move from local optimization to global optimization, using qualitative insights to drive quantitative simulations that can predict environmental catastrophes before they occur.



The Industry Paradox

Prof. Mohit Law,
Professor of Mechanical Engineering, IIT Kanpur

Prof. Law posed a fundamental question: "Who teaches systems thinking?" He used a standard **Espresso Machine** to illustrate that the industry has been practicing systems thinking for decades.

1. **The Espresso Machine:** A small, affordable device that integrates thermodynamics, heat transfer, fluid mechanics, structural design, and electronics to generate 9 bars of pressure instantaneously.
2. **The CNC Machine:** A highly complex system where performance is optimized across several sub-assemblies.

He noted that while the industry builds products by integrating these disciplines, the university experience remains siloed, teaching thermodynamics, fluid mechanics, and controls in separate, disconnected semesters.

The Challenge of Modern Curricula

Prof. Law questioned whether universities should pivot to teaching systems thinking or leave it to the industry. He highlighted the "Data Science" challenge:

1. Modern products are "self-aware" - they use sensors to decide when to shut down or adjust.
2. Teaching this requires integrating data science, probability, and linear algebra into an already crowded 4-year mechanical engineering degree.

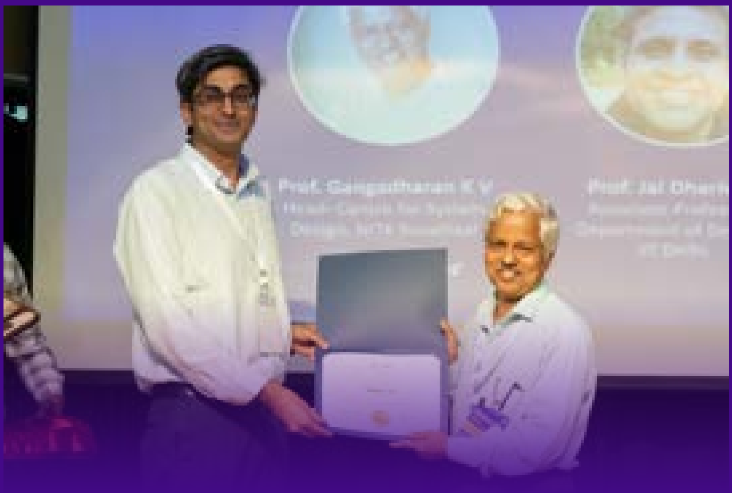
Technical Deep-Dive: The Spindle

He challenged the audience to consider the design of a **Machine Tool Spindle,** which he described as a "painful" multidisciplinary achievement:

1. **Mechanical/Electrical:** A motor supported by bearings.
2. **Heat & Fluid Flow:** Friction generates heat, leading to thermal expansion and growth; cooling fluids must be managed without entering the motor.
3. **Control/Sensing:** Electronics must control speed and position while data science models process sensor data to predict failure.

Re-evaluating Fundamentals

Prof. Law argued that while students cannot "shed their fundamentals," the university must find a way to graduate engineers who can think at a systems level. He noted that currently, regulatory bodies like AICTE offer courses in "Design Thinking" but lack a comprehensive "Systems Thinking" framework. He left the audience with an open question: Who will lead the reform and train the faculty to build engineers capable of creating such integrated products?



STARTUPS AND STUDENT PROJECTS: REAL-WORLD APPLICATIONS

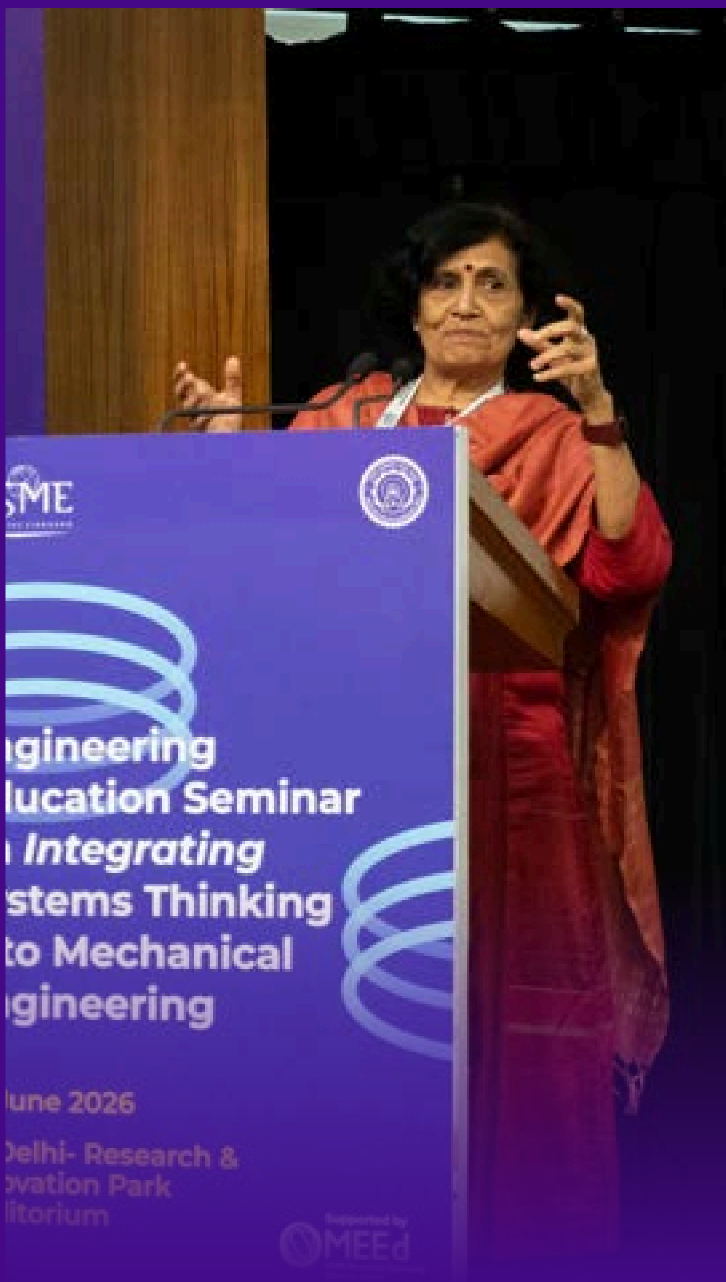
Startups Session

The Institutional Ecosystem

Dr. Rajul K Gajjar,
Vice Chancellor, Gujarat Technological University

Dr. Gajjar detailed the evolution of the startup ecosystem at Gujarat Technological University (GTU), which oversees 468 institutions. By consolidating various Technology Business Incubators (TBIs) and funding bodies under "GTU Innovation Council," the university created a unified "system of systems." This mature environment has led to a significant surge in intellectual property and campus-based startups:

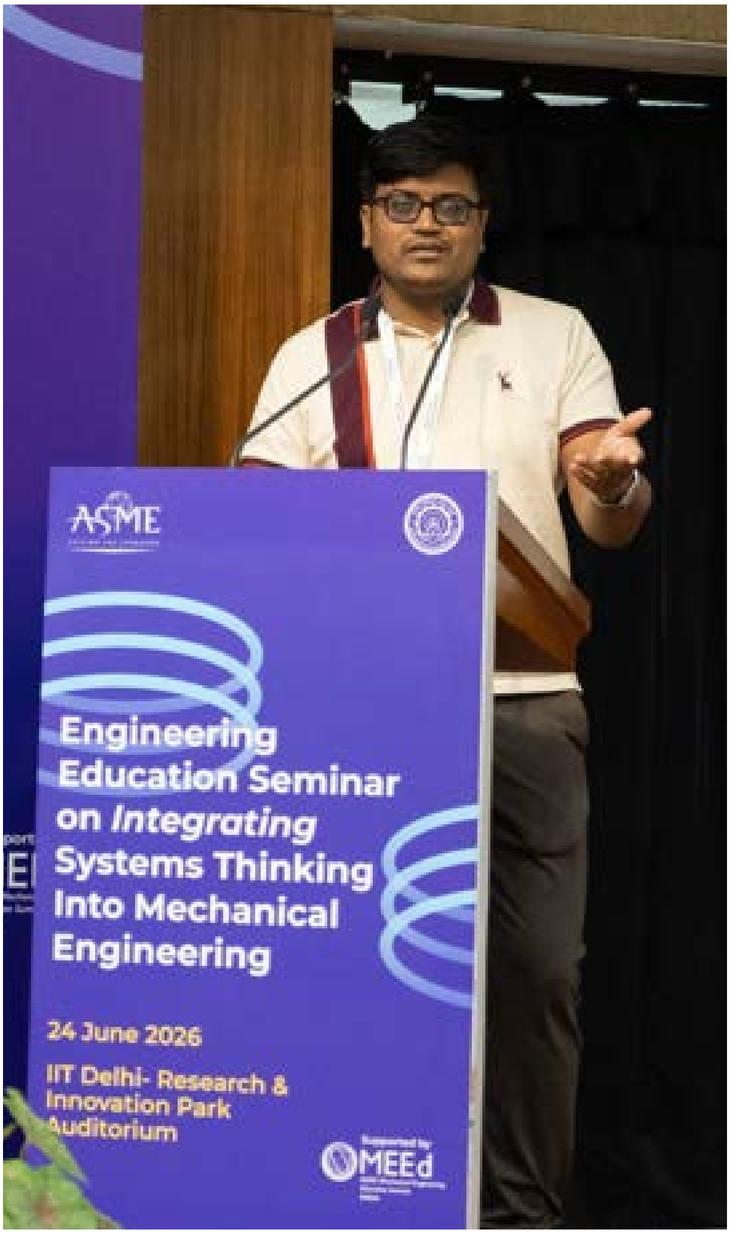
1. **Patents:** Thousands of awareness programs have led to a high volume of filings; GTU now prioritizes patents over traditional publications in Ph.D. theses.
2. **Technology Transfer:** Over 26 technologies have successfully moved from lab to commercial industry.
3. **Policy Support:** The Student Startup and Innovation Policy (SSIP) provides up to ₹2.5 lakhs for early-stage prototyping, encouraging students to "think out of the box" without the fear of failure.



Curriculum Integration and Assessment Reform
Dr. Gajjar highlighted a critical shift in pedagogy: Students can now swap traditional professional electives for full-semester startup internships (TRL-3 and above). She advocated for a drastic change in assessment, proposing a **70% project-based and 30% paper-based model.** This approach moves away from rote attendance toward evaluating leadership, teamwork, and persistence.

Advanced Thermal Management and Design Philosophy

Mr. Bhimashankar Wangaskar,
Founder & CEO, Thermistance Technologies



The Genesis of Thermistance

A winner of the **ASME ISHOW 2023,** Thermistance was founded to address a critical gap in the Indian market: the lack of indigenous high-end cooling solutions. Mr. Wangaskar recounted how a ₹2 crore infrared camera became dysfunctional due to a faulty cooling system. When the manufacturer quoted ₹25 lakhs for a repair that cost only a fraction in parts, he recognized a goldmine opportunity for an Indian thermal management company.

Strategic Growth and Manufacturing

Thermistance now operates an 8,000-square-foot semi-automatic manufacturing plant in Pune.

1. **Customization for Geography:** India's extreme temperature variations from sub-zero in the North to 52°C in the South require bespoke cooling solutions for EVs, data centers, and satellites.
2. **Impact on Agriculture:** The company's two-phase cooling technology is implemented in solar pumping systems, ensuring uninterrupted operation for farmers despite electricity voltage fluctuations.
3. **Workforce Excellence:** Mr. Wangaskar emphasized that every engineer in his 25-person team must handle CNC programming and machine operations personally. He noted that value creation is a long-term journey.

Bionic Solutions and Human-Machine Interfaces

Mr. Nishant Agarwal,
Founder & CEO, Lifeandlimb.ai

Disrupting the Prosthetics Market
Mr. Agarwal addressed the "silent crisis" of limb loss in India, where 3 million people undergo amputations annually. Currently, the market is dominated by expensive imports costing between ₹10 lakhs and ₹37 lakhs. Lifeandlimb.ai bridges this gap with its flagship product, **BionicLi,** which retails at ₹3.25 lakhs.

Technical Innovations in Myoelectrics
The system uses Electromyography (EMG) to extract minute electrical currents (.7 milliamps) from the residual limb, which a microcontroller then translates into motor movements.

1. **Adaptive Grasp:** The bionic hand features a patented mechanism that allows fingers to adapt to different shapes, such as a ball or a door handle.
2. **Localized Production:** 95% of the components are manufactured in India, reducing the "downtime" and service costs often associated with imported medical devices.
3. **Future Vision:** The company aims to move beyond prosthetics into broader robotics and human-machine interfaces, including EMG biosensors for remote vehicle control in defense and space applications.

Student Projects

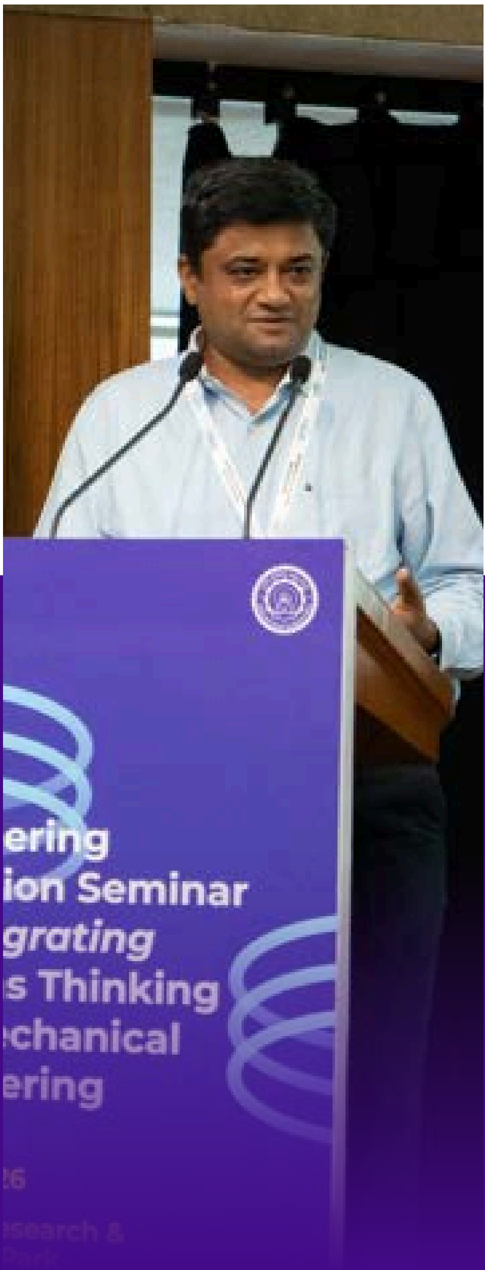
Reimagining Student Projects as Systems Labs

Dr. Kaushal A Desai,
Professor, IIT Jodhpur

The Traditional Project Paradox
Dr. Desai identified a recurring failure in engineering education: the evaluative dead-end. In traditional settings, a student builds a hypothesis to satisfy a faculty requirement, earns a grade, and the project is promptly forgotten. He argued that this fails to connect students with societal impact.

Global Benchmarks in Manufacturing Education
He cited two transformative models:

1. **The MIT "Lego" Model:** A first-year course that uses 3D printing and Lego to teach unconstrained design. It moves students from "childhood hands-on learning" to software interfaced systems thinking.
2. **The Clemson "Toy Car" Model:** A 3rd-year automotive course where students manufacture every component of a car. The "Aha!" moment occurs during assembly and performance testing, where students realize that a slight misalignment in one part causes a total system failure.



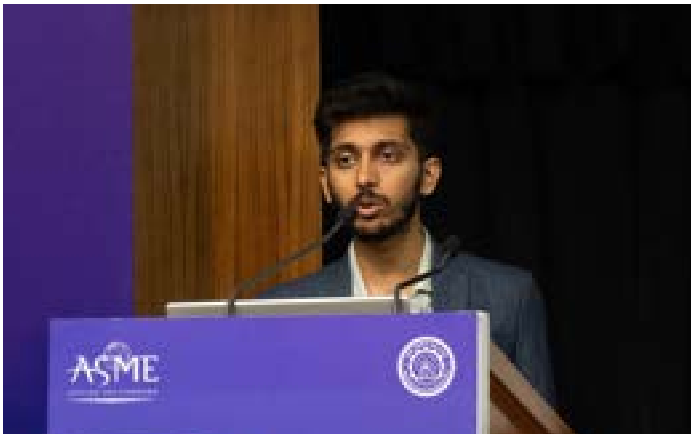
The Baroreceptor Case Study
Dr. Desai shared his research on a programmable "Baroreceptor Collar," used to monitor heart-rate regulation in diabetic patients. This project integrated anatomy, mechanical engineering, and clinical testing. He observed that the students involved were never tired because they were solving a real-world problem. This systems-level approach transformed Dr. Desai's own perspective as a researcher, moving him from a process-focus to a system-focus.

From Student Project to Defense Tech

Mr. Sahaj Rastogi,
Co-Founder & CEO, 7RD.AI

Breaking Down Hard Problems
Mr. Rastogi's startup, 7RD.AI, evolved from his undergraduate work on Autonomous Underwater Vehicles (AUVs) at Delhi Technological University (DTU). The company now develops **Autonomous Counter-Drone Systems** for the Indian Defense Forces. He shared a four-step framework for breaking down "hard" system problems:

1. **Map the Problem:** Engage directly with users (e.g., BSF vs. Indian Air Force) to understand that a drone at the border requires a different intercept strategy than one at an airfield.
2. **Define Constraints:** Account for speed, temperature, and Radar Cross-Section (RCS) from day one.
3. **Decompose Technology:** Divide the stack into Electronics (onboard compute), Coding (tracking algorithms), and Design (CAD/CFD).
4. **Prototype and Iterate:** "Ideate fast, build fast, break fast."



The Economics of Defense
He highlighted a critical first principles problem: the cost-benefit of interception. It is unsustainable to use a $1,000,000 missile to take out a $20,000 drone. 7RD.AI focuses on creating affordable, carbon-fiber interceptor systems that use material science to remain "stealthy" to enemy radar.

Echolens: Restoring Dignity Through Engineering

Mr. Rehaan Malhotra and Mr. Kairav Bajaj,
Co-Founders, Echolens

Dismantling Social Stigma

The Echolens project addresses the 90% failure rate in hearing aid adoption, which the founders attribute to social stigma rather than technical failure. By “hijacking” a fashionable lifestyle accessory: spectacles, the team has embedded assistive technology in a form factor that users are proud to wear.

Bone Conduction Technology

Unlike traditional aids that amplify sound into the ear canal, Echolens uses **Behind-the-Ear.**

Bone Conduction:

1. **Mechanical Vibration:** Sound is converted into mechanical vibrations and delivered to the mastoid bone.
2. **Bypassing Damage:** This allows individuals with eardrum or middle-ear damage to perceive sound directly through the cochlea via skull vibrations.
3. **Engineering Challenges:** The team moved from off-the-shelf breakout boards to a custom PCB to reduce the footprint. They utilized TR-90 thermoplastic for the frames to ensure "elastic memory" and medical-grade liquid silicon pads to match acoustic impedance between the transducer and the skin, reducing unwanted frame vibrations.

The founders concluded that "Echolens is not just a hearing device; it is a step toward restoring human dignity through engineering precision."

THE MANDATE FOR SYSTEMS THINKING

Dr. PVM Rao,
Professor, Departments of Design and Mechanical Engineering, IIT Delhi

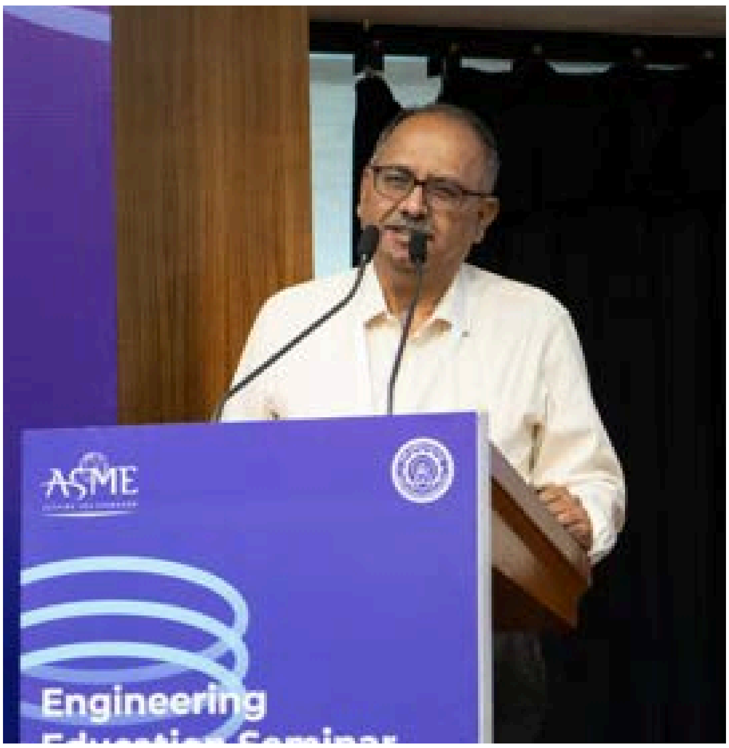
To conclude, Dr. PVM Rao observed that systems thinking is no longer an elective luxury but a mandatory requirement for the modern engineer. He noted that in the professional landscape, two distinct paths have emerged: students equipped with a systems perspective will be the preferred leaders in corporate hierarchies and the most successful founders in the startup ecosystem. While specialists provide depth, the "Systems Thinker" provides the breadth necessary to lead organizations.

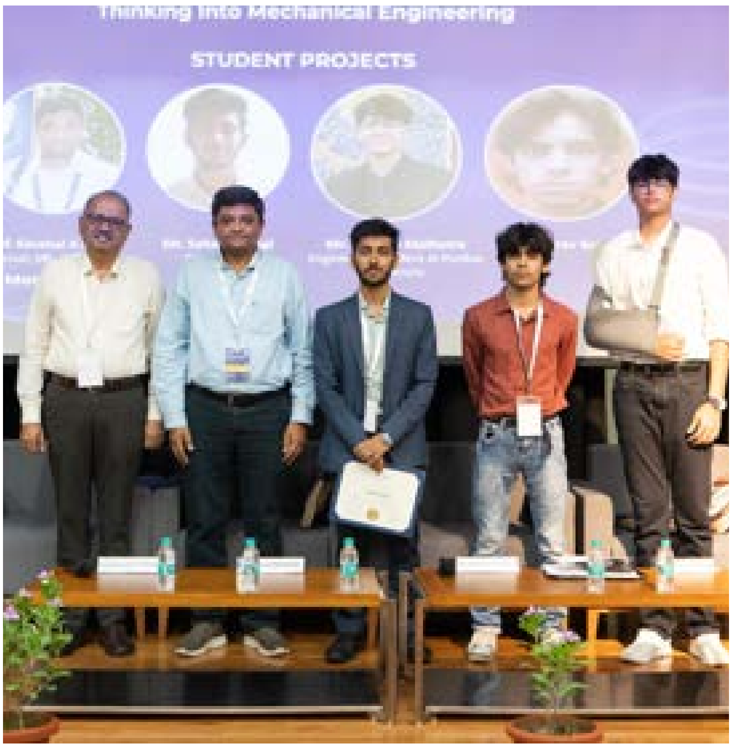
Practical Pedagogical Strategies

Dr. Rao addressed the feasibility of integrating these complex concepts into diverse educational frameworks, from IITs to state universities. He shared two powerful examples of how systems thinking can be taught experientially:

1. **The Glider Exercise:** Over the last 12 years, IIT Delhi has seen **10,000 students** participate in a one-day glider-building workshop. When a glider fails to fly, the student is forced to analyze the system holistically: questioning the science (physics of flight), the design (geometry), and the manufacturing (assembly).
2. **GD&T and Source Analysis:** When a machined component fails to meet its tolerances, students are encouraged to identify the **16 distinct sources of error.** This process links metrology, machining, and design, forcing the student to understand the relationship between a single process and the final product performance.

Recommended next steps include developing a concise ASME position note on systems thinking in mechanical engineering education, convening a faculty working group to define teachable modules and assessment models, engaging AICTE and leading universities on pilot adoption, and documenting Indian case studies that can be used in classroom instruction.





KEY TAKEAWAYS FROM ASME ENGINEERING EDUCATION SEMINAR ON INTEGRATING SYSTEMS THINKING INTO MECHANICAL ENGINEERING:

1. **Systems Thinking as a Mandatory Educational Competency:** Systems thinking must transition from an optional enrichment elective to a mandatory core competency in engineering education, equipping students to handle complex, multidisciplinary cyber-physical systems.

2. **Inculcating Lifecycle Thinking:** Engineers must look past immediate design constraints and embrace lifecycle thinking, anticipating future product failure, maintenance habits, and environmental impacts. Effective engineering requires understanding stakeholder needs, lifecycle impacts, sustainability, local operating conditions, and human behavior alongside technical performance.

3. **Bridging the "Zoom In"vs. "Zoom Out"Gap:** While modern curricula excel at teaching students to "zoom in" on individual technical components, they must do more to train "Systems Coordinators" who can "zoom out" to synthesize diverse inputs and understand larger systems.

4. **Managing "System of Systems" Complexity:** There are many situations, such as naval warship design, where engineers need to manage iterative design spirals, long project timelines, and strict physical or financial constraints.

5. **Multidisciplinary Collaboration: A Prerequisite for Addressing Real-World Engineering Challenges:** Successful innovations in defense, healthcare, manufacturing, mobility, and infrastructure demonstrate that breakthrough solutions emerge when engineers work across mechanical, electrical, electronics, software, design, management, and social science disciplines.

6. **Assessment Reform: An Essential Part of Curriculum Reform:** In project-based, multidisciplinary courses, project-specific assessment should replace an overreliance on traditional examinations.

7. **Embedding Systems Thinking Throughout the Curriculum:** Classroom activities, design exercises, virtual laboratories, smart-city projects, and experiential learning can progressively develop systems thinking from the first year onward. Startups provide powerful models for experiential systems learning.

8. **Experiential Learning Exercises to Introduce Systems Thinking Early in Academic Programs:** Faculty can teach holistic engineering principles using simple, hands-on product building exercises and real-world testing to force students to connect science, design, and manufacturing.

9. **Faculty Development for Successful Implementation of Systems Thinking Approach:** Educators require continuous professional development, exposure to industrial practice, and new pedagogical approaches to effectively teach systems thinking and multidisciplinary systems concepts.

10. **Opportunity for India to Lead in Systems Oriented Engineering Education:** By leveraging indigenous case studies, strengthening innovation ecosystems, partnering with industry and regulators, and adopting systems thinking across teaching, assessment, and research, Indian engineering institutions can better prepare graduates for future technological and societal challenges.

HOW LIKELY ARE YOU TO RECOMMEND THIS EVENT TO OTHERS (NPS)?

Registration & Attendance

- Total Registered: 164
- Total Attended: 107
- Conversion Rate: 65%

Net Promoter Score (NPS) for MEEd Delhi
66
The engineering education seminar on **'Integrating Systems Thinking into Mechanical Engineering'** proved to be a significant success, drawing 107 participants from across the academic and industrial spectrum. The **Net Promoter Score (NPS) of 66** reflects a high level of satisfaction and demonstrates that the seminar's focus on multidisciplinary lifecycles and holistic design resonated strongly with the audience.
This positive feedback validates the collaborative efforts of **ASME Foundation India and IIT Delhi.** The score underscores the seminar's effectiveness in providing a valuable platform for knowledge exchange, successfully bridging the gap between traditional engineering fundamentals and the complex, interconnected demands of modern industry. Attendees indicated a high likelihood of recommending future MEEd initiatives, reinforcing the value of systems thinking in the evolving engineering curriculum.