MEEd
ASME Mechanical Engineering Education Summit
INDIA

ASME
SETTING THE STANDARD

ENGINEERING EDUCATION SEMINAR

ON ADDITIVE MANUFACTURING FOR SUSTAINABILITY &

ASME CHANDIGARH REGION SECTION LAUNCH

CONTENTS

EXECUTIVE SUMMARY

Additive Manufacturing for Sustainability Seminar

Date: April 8, 2025

Venue: CSIR-CSIO, Chandigarh

Organisers: ASME Foundation India, CSIR-CSIO

Sponsors: ASME Mechanical Engineering Education Summit (MEEd), Altair

The one-day engineering education seminar on "Additive Manufacturing for Sustainability" successfully brought together 140 participants, including academic leaders, researchers, and industry professionals from Chandigarh and Punjab.

The event focused on additive manufacturing applications across aerospace, healthcare, and energy sectors through invited talks, panel discussions, and practical demonstrations.

The seminar showcased the remarkable versatility of additive manufacturing, which spans an extraordinary range of applications. From everyday ceramic pottery and architectural innovations like 3D-printed post offices and housing solutions to high-performance rocket components and aircraft engine parts that withstand extreme conditions.

In healthcare, presentations highlighted groundbreaking applications including 3D-printed corneal transplants, experimental cancer treatment delivery systems, and organ-on-chip technologies for personalised medicine.

The most futuristic was the discussion of extraterrestrial applications, with researchers demonstrating how lunar regolith could be 3D-printed, potentially revolutionising space exploration.

Key Highlights:

- Aerospace Sector Transformation: Additive manufacturing (AM) is dramatically shortening development cycles from years to months. Companies like EtherealX are leveraging AM to develop reusable launch vehicles, with Indian manufacturers demonstrating competitiveness against global players like SpaceX.
- Construction Innovation: 3D Construction Printing (3DCP) has progressed beyond concept to real-world implementation in India, offering significant sustainability benefits through reduced material waste, labor requirements, and environmental impact.
- Industry Adoption Drivers: The shift toward AM is motivated by digital flexibility, unprecedented design freedom, sustainability advantages, digital inventory capabilities, material efficiency, faster production speeds, and simplified manufacturing processes.
- Integration Benefits: AM enables component consolidation (such as integrating injectors with cooling channels), simplifying manufacturing while improving system reliability.
- Future Directions: The industry is moving toward smart and autonomous manufacturing incorporating AI, 4D materials, and in-space production capabilities.
- Economic and Workforce Impact: AM reduces material and labor costs while shifting workforce demand from manual labor to high-skill digital and engineering roles.

The seminar successfully highlighted how AM's ability to design and fabricate complex structures with minimal waste and reduced energy consumption is transforming manufacturing across industries.

By bringing together academic and industry stakeholders, the event aimed to accelerate innovative thinking and adoption of additive manufacturing technologies, positioning it as a cornerstone of sustainable industrial development.

INAUGURAL SESSION

Dr. Suman Singh
Senior Principal Scientist (Advanced Materials & Instrumentation), CSIR-CSIO

Mr. Madhukar Sharma,
President & Director, AIPL

Dr. Naresh Chandra Murmu,
Director, CSIR-Central Mechanical Engineering Research Institute

Prof. Shantanu Bhattacharya
Director, CSIR-CSIO

Ms. Avni Malhotra,
Deputy Director, ASME Foundation India

The inaugural session of the Engineering Education Seminar on 'Additive Manufacturing for Sustainability' commenced with opening remarks by Dr. Suman Singh.

She stated that CSIO is recognized for its excellence in mechanical engineering innovations, smart manufacturing, precision engineering, and biomedical devices.

She added that the seminar, organised by CSIO and ASME Foundation India, emphasised the importance of traditional mechanical engineering education to address the lack of skilled professionals in the future.

"The collaboration aims to set an example of professionals working together to contribute to India's scientific and industrial growth."

Prof Bhattacharya welcomed attendees to the seminar, emphasising its transformative potential in design, production, and material use.

He highlighted that additive manufacturing offers customization, short supply chains, and the use of recycled and bio-based materials, aligning with the Sustainable Development Goals (SDGs).

Prof Bhattacharya acknowledged the dedicated team at CSIR-CSIO working on additive manufacturing of medical plants and discussed plans to expand into various sectors, including energy, with support from ASME.

He highlighted ASME's rich legacy and its role in shaping global engineering practices and commended the ASME Foundation India's commitment to equitable access to engineering education.

He also discussed the potential for future collaborations between ASME India, CSIR-CSIO, and ASME Foundation India for joint projects, workshops, and training programs to address contemporary engineering challenges.

Mr Sharma's talk focused on sustainability through mechanical engineering education.

He highlighted the 145-year history of ASME, founded **on April 7, 1880. ASME has 78,000 members globally,** with significant operations in India since 2008. He remarked that society has inspired multiple generations of engineers to advance technology and make the world safer and more sustainable.

ASME's standards, developed by international working groups, are updated regularly to incorporate new technologies. The society organises technical conferences, including the upcoming International Mechanical Engineering Congress in Hyderabad, featuring 700 technical presentations.

ASME's mission is to advance engineering knowledge, improve quality of life, and inspire students through experiential learning and technical conferences.

The main points from the presentation are as follows:

ASME Standards and Certification

- Oversees global codes and standards including the Boiler and Pressure Vessel Code (BPVC).
- Operates through boards, committees, subgroups, and working groups.
- Uses a transparent, consensus-based process accredited by ANSI.

Technical Divisions and Conferences

- ASME hosts various technical divisions such as 3D printing, pressure vessels and piping, and clean energy systems.
- These divisions organise technical conferences, student seminars, and masterclasses to inspire and educate engineers.
- The International Mechanical Engineering Congress & Exposition (IMECE) is being organised in India for the first time, with about 700 technical presentations.
- The conference covers diverse areas of engineering, including education, industry collaboration, and emerging technologies.

ASME's International Working Groups

- India has 9 International Working Groups that meet regularly to improve and update these standards.
- These committees help in interpreting and applying the standards, making them more understandable and relevant to practitioners.

Challenges in Engineering Education

- He emphasised the need to teach students differently to fit them for professional careers in engineering.
- Traditional branches like mechanical, electrical, and civil engineering are declining, but new challenges and problems are emerging.
- The learning content and teaching methodologies need to be adapted to prepare students for the future.
- ASME is committed to inspiring students and advancing engineering knowledge to address these challenges.

Emerging Technologies and Skill Development

- ASME is collaborating with the National Skill Development Corporation (NSDC) in developing skilling frameworks for emerging technologies like green hydrogen and additive manufacturing.
- Technical engineering communities within ASME focus on advancing research and solving engineering problems through technical conferences and workshops.
- Through TECs and learning programs, ASME continuously invests in future-ready engineers.

Ms. Malhotra highlighted the approach and key initiatives of the ASME Foundation India (AFI), a not-for-profit organisation.

ASME Foundation India, a year-old initiative supported by the American Society of Mechanical Engineers (ASME), focuses on empowering engineers and social innovators through educational programs, philanthropic work, and innovative competitions.

ASME Foundation India has 131 student sections with over 5,000 students, organising events like the EFx engineering festivals to bridge academic and industry gaps.

Education Programs and Initiatives

- The Foundation has three core branches: Education that Inspires, Careers that Matter, and Ideas that Innovate.
- The 'Education that Inspires' program involves engineering festivals with 131 student sections engaging over 11,000 students.

Innovation and Competitions

- The 'Ideas that Innovate' program encourages young engineering students and innovators to participate in competitions and fellowships.
- The foundation has linked its flagship ISHOW program to philanthropic initiatives, with one innovation, Sabjikothi, being tested in Bihar to assess its effectiveness.

MEEd Focus and Key Learnings

- The foundation also hosts a premier conference on mechanical engineering education called MEEd seminar.
- The conference brings together academicians, industry leaders, and government representatives to discuss key challenges and future trends in engineering education.
- The focus of the conference has evolved over the years, covering topics like the future of manufacturing, social impact, innovation and entrepreneurship.
- In 2025, the conference will explore topics such as additive manufacturing and sustainability, and drone technologies.
- The foundation has gathered key learnings from these conferences, which are highlighted on its official website.

Dr. Murmu's discussion focused on the evolution and benefits of additive manufacturing (AM), highlighting its efficiency over subtractive manufacturing.

He mapped the origins of additive manufacturing, starting in 1996, and the initial challenges of convincing authorities of its effectiveness.

Dr Murmu emphasised that the aerospace and medical sectors benefit from additive manufacturing's ability to create complex and optimised structures, reduction in material waste, design flexibility and lower energy consumption, while noting the challenges such as certification and standards.

Here are the key points from his presentation:

1. Fundamentals of Additive Manufacturing

- Defined as the layer-by-layer construction of objects using digital models.
- Contrasted with subtractive manufacturing, which results in material waste.

2. Sustainability Benefits

- Material Efficiency: Up to 90% less waste.
- Energy Conservation: 50–80% less energy usage.

- Localized Production: Reduces transportation emissions.
- Design Freedom: Enables complex geometries for optimised performance.

3. Sustainable Materials

- Use of biodegradable, recycled, and biomimetic materials.
- Circular economy integration via material reclamation and on-demand production.

4. Lifecycle and Environmental Impact

- Lower energy footprints compared to traditional methods.
- Positive impacts throughout the product life cycle, from digital prototyping to recyclability.

5. Applications and Case Studies

- Aerospace: 25% weight reduction, 63% less waste, 30% fuel savings.
- Medical Devices: Customized implants via patient-specific 3D data.

Key Insights

- **Environmental Impact:** AM significantly reduces carbon emissions and energy usage compared to CNC machining and die casting.
- **Circular Economy:** emphasises closed-loop systems and part replacement over product disposal.
- **Scalability and Speed:** AM is evolving to meet mass production needs with enhanced speed and material diversity.
- **Future Trends (2025–2030):** Expect widespread adoption of AI for sustainability optimisation, bio-based materials, and renewable energy integration in AM processes.

PLENARY TALK ON THE TRANSFORMATIVE IMPACT OF ADDITIVE MANUFACTURING

Mr. Yathiraj Kasal
General Manager & Business Head at Wipro 3D

In his plenary talk, Mr Kasal discussed the transformative impact of additive manufacturing (AM), commonly known as 3D printing and expressed enthusiasm about the environmental and social benefits of additive manufacturing.

The discussion covered AM's impact on industries like aerospace and dentistry, showcasing efficiency improvements and reduced environmental footprints.

The main points from the plenary talk are as follows:

Additive Manufacturing: Overview & Benefits

- Additive manufacturing involves layer-by-layer addition of materials like plastics, metals, or ceramics to create objects.
- It minimises waste by using material only where required, unlike traditional manufacturing methods.
- The technology supports the circular economy by conserving resources.

Applications of Additive Manufacturing

- **3D-printed fuel nozzles of LEAP aircraft engines:** He introduced the first-ever 3D-printed component for fuel nozzles, which increases efficiency and reduces carbon emissions. More than 2.5 lakh fuel nozzles have been printed and deployed in LEAP aircraft engines. The complex internal construction of these components was highlighted as state-of-the-art engineering.
- **First-ever 3D-printed metal component to reach space from India:** He discussed the first-ever 3D-printed metal component designed by ISRO scientists to reach space. The component unified 25 components into one. The benefits include weight reduction, efficiency improvement, and material savings.
- **Field Ready's portable 3D printers:** He highlighted AM's role in disaster relief, such as Field Ready's portable 3D printers.
- **Import substitution of chopper engine part:** He also highlighted the import substitution of a critical engine part of HAL chopper from France to India.

PS4 and PSLV Stage 4 Components

- He discussed the PSLV stage 4 component, which covers the payload in commercial launches, and is critical to any mission's success.
- The component was designed for additive manufacturing and successfully tested for endurance.

Digital Dentistry

- He introduced Align Technology's clear aligners for orthodontic applications.
- The traditional method of creating aligners involved multiple steps and waste.
- The new method uses digital scanning and reduces the cycle time and material waste.
- The benefits include faster delivery, reduced air miles, and improved efficiency in orthodontic treatments.

Challenges in 3D Printing

- The challenges of combining parts, avoiding joints, and the necessity of modular approaches for accessibility, repairability, and serviceability were discussed.
- Post-machining operations are required to create seamless joints and ensure smooth surfaces for functional requirements.

Impact of 3D Printing on Various Industries

- 3D printing is revolutionising various industries, including automotive, by using light parts in customised car applications from BMW to Mahindra.
- The technology is highlighted as a game-changer, offering immense potential for enhancing sustainability across metal, ceramic, and polymer sectors.

Role of Mechanical Engineers in AM Technology

- He emphasised the role of mechanical engineers in driving innovation and ensuring that 3D printing continues to evolve and contribute to a sustainable future.
- He called on all attendees to learn, unlearn, and relearn throughout their engineering journey.
- The expertise in material science, design, and system integration is crucial for advancing 3D printing technology.

COMPLIANT MECHANISM-BASED MICRO-3D PRINTING AND NATURE-INSPIRED MICRO-MANUFACTURING VIA SHAPING OF FLUIDS

Professor, Prasanna Gandhi

Professor, Mechanical Engineering (IIT Bombay)

The talk focused on innovative SLA (stereolithography) printing technologies at IIT Bombay, particularly micro-3D printing.

Key innovations included linear scanning with a mirror and lens system for high precision, compliant mechanisms to avoid friction and backlash, and resonant displacement amplification for low energy consumption.

Additionally, nature-inspired additive manufacturing was introduced, using fluidity to create complex, scalable structures. Applications include drug testing, blood-brain barrier studies, and biomedical research, highlighting the potential for personalized cancer treatments and advanced biological studies.

The main points of the talk are as follows:

Nature-Inspired Additive Manufacturing

- The motivation is to create patterns inspired by nature, which are scalable and have multiple branches fitting into each other.

- The process involves shaping fluid and retaining the shape, using liquid instability to create complex patterns.
- The innovation involves using shear thinning fluids to retain the shape and create repeatable patterns, which are scalable across different scales and fluids.

The talk explored the use of fluid shaping to create complex geometries such as fractals, vasculature-like structures, and honeycomb patterns inspired by natural systems. These forms are common in nature and are known for their efficiency and robustness.

Fractal geometries in particular offer several benefits:

- Enhanced heat and mass transfer
- High surface-area-to-volume ratio
- Structural stability
- Fault tolerance

Applications of Nature-Inspired Structures:

- **Drug Testing and Personalized Modifications:** The structures are used to create a micro-patterned array for drug testing. The process can create gradients of drug concentrations, which are useful for studying the killing of cancer cells.
- **Leaf-Mimicking Micropump (LMM):** A tiny pump designed using fractal vein patterns similar to real leaves.
- **Microfluidic Gradient Generator:** This application enables precise drug dilution for testing purposes.
- **Blood-Brain Barrier on Chip:** The structures are designed to mimic the natural blood-brain barrier, providing a realistic environment for research. The study aims to understand the mechanisms of the blood-brain barrier and its impact on drug delivery.

Additional Potential Applications

- Artificial lungs/gills
- Organ-on-chip technology
- Synthetic leaf development
- Cell sorting/plasma separation
- Chip cooling systems

REVOLUTIONISING HEALTHCARE: THE PROMISE OF 3D BIOPRINTING IN BIOMEDICINE

Dr. Falguni Pati

HOD - Biomedical Engineering and Associate Professor, IIT Hyderabad

Dr Falguni Pati presented a comprehensive analysis of 3D bioprinting technology. 3D bioprinting is an additive manufacturing technique that involves using living cells to create functional tissues and organs, starting with imaging modalities like MRI and ultrasound to reconstruct tissue structures.

Unlike conventional 3D printing, bioprinting involves living cells and biocompatible materials, requiring specialised approaches to maintain cell viability and functionality throughout the printing process.

The main points of the presentation are as follows:

Material Selection and Biocompatibility Testing

- The importance of biocompatibility testing for bioink materials was explained.
- The process of developing materials directly from tissues, such as discarded human or animal tissues, was described.
- The advantages of using patient-specific materials to avoid immune rejection was underlined.

Clinical Trials for Corneal Transplants

- He highlighted the clinical trial approval for development of a hydrogel from discarded tissues for human corneal transplants, which showed significant potential in preventing scar tissue.
- The integration of the bioprinted cornea in animal models was described, showing its ability to regenerate tissue.

Three-Dimensional Printing and Personalized Medicine

- He introduced the concept of three-dimensional printing for personalized medicine.
- The development of a novel composite material for tissue engineering was presented.
- The potential applications of the composite material in maxillofacial surgery were explained.

In Vitro Models for Drug Discovery

- He explained the use of in vitro models for drug discovery, reducing the need for animal testing.
- The development of a liver model for drug screening was described.
- The potential applications of these models in accelerating drug development and reducing costs was discussed.

Cancer Models and Bioprinting

- He demonstrated the development of bio-printed cancer models using patient-derived cells.
- The potential of bio-printed cancer models to improve drug development and personalized medicine was discussed.
- His team also created 3D-printed structures for bone regeneration.

Panelist-1

Dr Ajay M Sidpara,
Associate Professor,
Mechanical Engineering,
IIT Kanpur

Prof. Ramesh Singh,
G. K. Devarajulu Chair Professor,
Mechanical Engineering,
IIT Bombay

Mr. Anthony Vincent,
Additive Manufacturing
Consultant,
Medical JK Digital

Mr. Ramesha BS,
Head, Academic Initiatives,
Altair India

Dr. Kavya Shree,
Founding Chairwoman,
Indian Women in 3D Printing

Moderator

Prof. Shantanu Bhattacharya,
Director, CSIR-CSIO

HOW ADDITIVE MANUFACTURING IS USHERING IN A NEW ERA FOR MECHANICAL ENGINEERING IN ENERGY DOMAIN: OPPORTUNITIES, CHALLENGES AND FUTURE PROSPECTS

The roundtable discussion on ‘How Additive Manufacturing is ushering in a new era for Mechanical Engineering in Energy Domain: Opportunities, Challenges and Future Prospects’ explored the transformative potential of additive manufacturing in addressing critical needs in India’s energy sector.

It also focused on creating a regulatory framework for additive manufacturing using existing data from the industry and on sustainable manufacturing practices.

Sustainability was discussed in terms of energy efficiency, precision, and the importance of post-processing in additive manufacturing.

The main points of the discussion are as follows:

Challenges in Material Development and Certification for Additive Manufacturing

- **Limited Material Knowledge and Local Development:** Inadequate understanding of materials used in additive manufacturing, with a heavy reliance on imported materials due to limited local development.
- **Process-Related Defects and Anisotropy:** Inherent defects and anisotropic properties introduced during the additive manufacturing process pose reliability concerns.
- **Application-Specific Limitations:** Difficulties in using additively manufactured parts for critical applications such as rotating or load-bearing components.
- **Skilled Manpower Shortage:** Lack of trained professionals in designing specifically for additive manufacturing technologies.
- **High Costs and Regulatory Barriers:** Expensive material characterization and certification processes, along with complex and evolving regulatory frameworks.

Challenges in Post-Processing and Machining

- The panel explained the complexities of machining and finishing AM components, especially those with complex geometries.
- The discussion included the use of CNC programming and the challenges of handling intersecting blind walls.
- The panel highlighted the limitations of current machining and finishing processes and the potential of chemical treatments.

Strengthening Regulatory Frameworks and Enhancing Data Utilization in Additive Manufacturing

- The panel discussed the need to streamline the certification process and reduce the high costs involved, especially for the aerospace industry.
- The speakers also highlighted the need to work on developing materials for additive manufacturing within the country, as most materials are currently imported.
- They urged the creation of a master database of material characterization data that can be used by regulatory bodies to set minimum thresholds for part certification.

Advancing Post-Processing, Simulation, and Scalable Innovation

- Explore post-processing techniques for thin structures and complex components.
- Investigate the use of liquid-based polishing technologies for additive manufacturing parts.
- Develop simulation-driven concept generation and optimisation methods for different loading conditions.
- Establish an ecosystem for industry-academia collaboration and leverage simulation and data science tools.
- Explore the potential of wire-based processing with large robots for large-area printing.

Circular Manufacturing, Remanufacturing and Life Cycle Costs

- The panel deliberated on the importance of responsible consumption and how the manufacturing sector aligns with it through circular manufacturing.
- The panel introduced the concept of remanufacturing, which enables the repair and restoration of expensive components.
- The discussion covered the significant cost of mining, processing, and machining materials throughout a product's life cycle.
- Remanufacturing techniques promise high quality and efficiency compared to conventional methods.
- The potential of using recycled chips and machining chips in extrusion-based technologies was explored.

Education and Skill Sets for 3D Printing

- Develop a skill-based program to educate engineers on designing for additive manufacturing.
- Design for additive manufacturing (DfAM) as a primary skill for students entering the AM domain.
- Large format manufacturing in the additive manufacturing domain.
- Integration of AI and ML in generated design for AM.
- Specialised programs in the AM domain beyond existing M.Tech and certificate programs.

POLICIES FOR ADVANCED RESEARCH IN ADDITIVE MANUFACTURING FOR SPACE AND HEALTHCARE [PARAMARSH]

Panelist-2

Dr. Suryakumar S.,
Professor, Department of Mechanical & Aerospace Engineering,
IIT Hyderabad

Mr. Madhukar Sharma,
President & Director,
AIPL

Mr. Vishwanath Nayak,
Senior Principal Engineer,
GE Healthcare

Dr. Jaswinder Singh Saini,
Professor, Mechanical Engineering Department,
TIET, Patiala

Moderator

Dr. N. C. Murmu,
Director, CSIR-Central Mechanical

The ‘PARAMARSH’ panel discussion focused on the regulatory challenges and standards in additive manufacturing in healthcare and aerospace sectors. The discussion highlighted the need for standardised materials and processes to ensure quality and safety in medical and aerospace applications.

Key points included the need for customized processes and validation for different medical devices, such as imaging and ventilators, which require specific regulations.

Mr Sharma informed that the American Society of Mechanical Engineers (ASME) is working on extending geometric standards to additive manufacturing, addressing issues like geometric integrity and surface finish.

ASME's efforts in developing skilling frameworks and experiential learning programs were also explained, aiming to bridge the gap between hobbyist and industrial applications.

The panellists also discussed the integration of 3D printing in educational curricula to develop skilled labor.

The main points of the discussion are as follows:

Challenges in Healthcare and Space Additive Manufacturing

- The panel noted that the healthcare sector requires stringent patient outcomes and regulatory compliance, and therefore the additive manufacturing parts need to be neutral in behavior compared to conventional devices.
- The panel highlighted the unique regulatory and biocompatibility requirements for different types of medical devices including imaging, patient care, and ventilators, which makes compliance challenging.
- The panel also discussed the challenges of additive manufacturing in the space sector including different material requirements for extreme temperature variations and need for specialised materials that can withstand space conditions.

Material Development, Standardisation and Skill Development

- The panel discussed the importance of material development in India, noting the shift from importing raw materials to producing them locally and also highlighting that the quality and performance of locally produced materials compare favorably to those of imported ones.
- The role of standards in ensuring consistency and operator skills was addressed.
- The panel also noted the need for standardisation in processes and materials for aerospace and biomedical applications.
- The importance of quality control and non-destructive testing (NDT) was emphasised to ensure the integrity of components.
- The role of standards in facilitating reusability and interoperability of digital models was also explored.

Challenges in Geometric and Pressure Integrity

- The panel discussed the challenges in defining new symbols and model-based definitions for additive manufacturing.

- The differences in geometry and surface finish between additive and conventional manufacturing processes was explored and the need for new measurement systems and criteria to address these differences was emphasised.

Regulatory and Technological Considerations

- The panel explained the need for sustainable technologies that do not become obsolete before regulatory approval.
- The panel also emphasised the importance of scaling regulations across different devices.

Cultural and Technological Shifts

- The panel reviewed the need for changing cultural mindset from conventional manufacturing to additive manufacturing.
- Incorporating additive manufacturing in new product introductions (NPI).
- Need for standardisation in steps, skills, and individual components for additive manufacturing.
- The panel also highlighted the gap in skilled manpower trained in operating additive manufacturing equipment.

Educational and Skill Development Initiatives

- The panel talked about the introduction of additive manufacturing in university curricula.
- The conversation highlighted the need for specialised human resources for additive manufacturing.

Additive Manufacturing for Sustainability and Supportability

Sustainability Benefits:

- Reduced material waste compared to traditional manufacturing
- More efficient production processes
- Potential for lighter, optimised device designs

Supportability Advantages:

- Easier production of complex geometries
- Creation of parts with intricate internal structures
- Simplified replacement and maintenance of medical devices
- Potential for customized medical components

ADDITIVE MANUFACTURING IN THE INDIAN SPACE SECTOR : A START-UP PERSPECTIVE

Mr. Rishabh Shrivastava

Lead Engineer – Materials and Manufacturing
Ethereal Exploration Guild Private Limited (ETHEREALX)

The talk by Mr Shrivastava delved into the rapidly growing role of Additive Manufacturing (AM) in the Indian space sector, emphasising the transformative potential it holds for emerging private players.

Mr Shrivastava informed that EtherealX is developing the world's first fully reusable medium-lift launch vehicle. The vehicle, powered by a Stallion engine with 1.2 mega-newtons of thrust, has a payload capacity of 24.8 tonnes to lower earth orbit. EtherealX is also developing a test facility in Tamil Nadu for the Pegasus engine.

The main points from his presentation are as follows:

Government Support and Entrepreneur Ecosystem

- He discussed the role of government liberalization and regulatory bodies in supporting space startups.
- The Indian Space Research Organisation (ISRO) acts as a bridge between private startups and government support.

- The demand for space services is increasing, with India occupying only 2% of the $200 million global market.
- Entrepreneurs are now able to launch their own startups due to increased funding availability and support from venture capitalists.

Advantages of Additive Manufacturing in Space

- Additive manufacturing allows for complex geometries and design freedom, which is crucial for rocket engines.
- It reduces mass significantly, using thin wall structures and optimising materials like copper, chromium, and zirconium.
- Additive manufacturing enables rapid prototyping and iterative design changes, reducing lead times and costs.
- The technology allows for customization and tailoring of designs without significant investment or time.

Challenges of Additive Manufacturing

- The main challenge for startups is the availability of larger powder bed machines in India.
- Injectors and other components require a combination of additive and subtractive manufacturing techniques.

Sustainability and Innovation in Space Manufacturing

- Additive manufacturing is sustainable as it reduces waste and material usage.
- The technology is particularly useful for components like combustion chambers, heat exchangers, and structural brackets.
- Companies like Relativity Space are using additive manufacturing to print 75% of their vehicles, including propellant tanks and chambers.
- Multi-material printing and integration with AI are advancing the field, allowing for complex designs and efficient manufacturing.

CHANDIGARH PROFESSIONAL SECTION LAUNCH

Ms. Vaishnavi Soni,
Deputy Manager - Sections, ASME India

Ms. Vaishnavi Soni announced the launch of the ASME India Chandigarh Professional Section at the Engineering Education Seminar in CSIR-CSIO, emphasising its role in uniting engineers and mentoring students through their transition to professional careers.

ASME Professional Sections: Community Through Local Connections

ASME Professional Sections serve as vital local hubs that connect engineers within specific geographical areas. With over 150 professional sections operating across more than 20 countries, these communities augment and extend Society-level programs and activities through localized engagement.

The 'Local Connect' model enables members to access professional development, networking opportunities, and technical resources while building meaningful relationships with nearby colleagues who share their professional interests.

ASME Professional Sections in India: 9 Strategic Hubs Fostering Innovation and Collaboration

Chandigarh Section - Serving engineering professionals in Punjab and Chandigarh Union Territory

Gujarat Section - Connecting engineers in one of India's most industrialised states

India Section - Providing national coordination and leadership

Karnataka Section - Supporting technological advancement in India's silicon valley

Kerala Section - Empowering engineers in the country's highest literacy state

Maharashtra Section - Uniting professionals in India's industrial and financial powerhouse

Tamil Nadu Section - Driving engineering excellence in this manufacturing hub

Uttar Pradesh and Uttarakhand Section - Spanning two diverse states with rich engineering potential

Women In Engineering Interest Group

Dedicated to empower female engineers through mentorship and skill development, enhancing diversity in the engineering field

These professional sections form the backbone of ASME's presence in India, creating valuable networks that enhance professional development, knowledge exchange, and career advancement for engineers nationwide.

Chandigarh Section Leadership Team

Dr. Vijay Kumar Meena

Chair
Senior Principal Scientist, CSIR-CSIO

Dr. Jatinder Madan

Vice-Chair
Professor and Head, Mechanical Engineering, CCET Degree Wing

Dr. Virat Khanna

Secretary
Associate Professor, Chandigarh University

Dr. Neeraj Grover

Treasurer
Associate Professor & Associate Dean, Student Affairs, Thapar Institute of Engineering and Technology

Dr. Raj Kumar Pal

Member-at-large
Principal Scientist, CSIO-CSIR

Mr. Vickramjeet Singh Khurmi

Member-at-large
Senior Mechanical Engineer, BAPCO REFINING

Mr. Rajesh Kumar

Member-at-large
Professor, Panjab University


µ - Maker


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Engineering Education Seminar & ASME Chandigarh Region Section Launch
8-9 APRIL 2025
ADDITIVE MANUFACTURING FOR SUSTAINABILITY
ALTAIR


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CHAI PAR CHARCHA ON SUSTAINABILITY PLAN OF ASME CHANDIGARH SECTION

Dr. Vijay Kumar Meena, Senior Principal Scientist, CSIR-CSIO

The Chai Par Charcha on the Sustainability Plan of ASME Chandigarh Section was led by Dr Vijay Kumar Meena, Chair of ASME Chandigarh Section.

He discussed the strategies to enhance technical education and industry collaboration in the ASME Chandigarh Section which includes Punjab and Chandigarh.

The main points of the charcha are as follows:

Challenges and Opportunities in Technical Education

- Using standards and codes in everyday activities, particularly in product design, was emphasised.
- Punjab's robust manufacturing sector drives 92% of India's bicycle parts, 40% of hand tools, and 29% of tractor production.
- Education capacity of approx. 2,50,000 seats, reflecting strong human capital.
- Nearby institutes allow students to access their facilities, offering additional resources for academic and project-related activities.

Government Schemes and Industry Collaboration

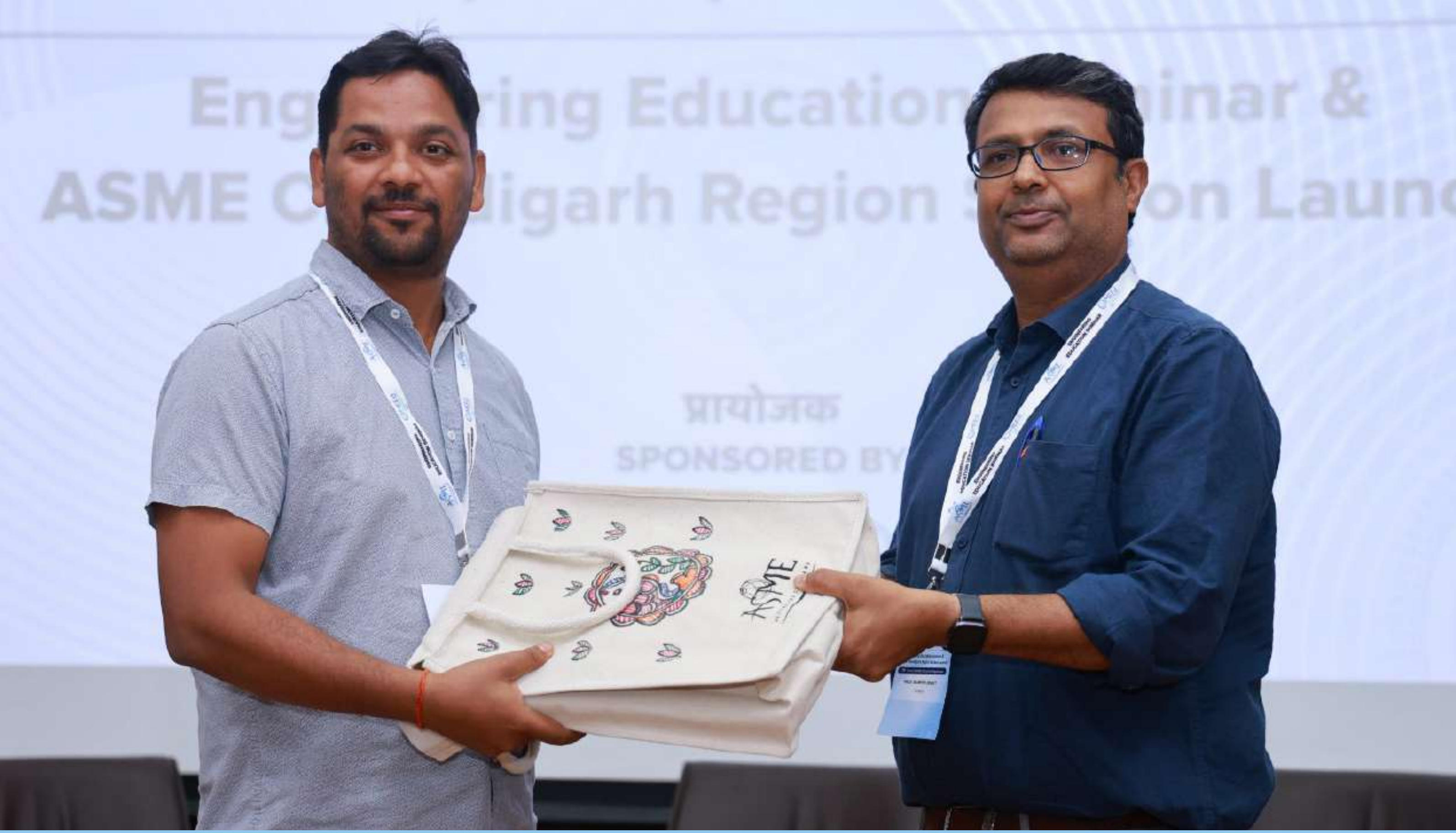
- Various government schemes and training programs are available to support student development and skill enhancement.
- Industries offer specialised training programs that provide practical experience and exposure to real-world applications.
- A closed LinkedIn group has been created to facilitate communication and regular updates between students and professionals, encouraging collaboration and knowledge exchange.

Industry Problems and Solutions

- Industry members often approach the section with specific problems, initiating a collaborative problem-solving process.
- These initial discussions frequently evolve into larger projects aimed at addressing and resolving key industry challenges.
- Industry-academia collaboration is highlighted as essential for driving innovations that benefit society as a whole.

Action Points

- Organise workshops and industry meets to enhance technical education.
- Develop industry-specific training programs to better align with the needs of the local manufacturing sector.
- Expand the ASME student sections and provide leadership support, seed funding, and volunteering opportunities.
- Explore opportunities for collaboration with certifying agencies to enable engineering professionals to use real-time standards.
- Reach out to local industries to identify problems that can be addressed through student projects and industry-academia collaboration.



MULTISCALE DESIGN AND FABRICATION FOR ENHANCED MATERIAL PERFORMANCE USING LASER-BASED AM TECHNIQUES

Dr. Sarvesh Mishra

Department of Mechanical Engineering
IIT Kanpur

Dr Sarvesh Mishra presented his research on multi-scale design and fabrication using laser-based additive manufacturing.

He discussed the development of octahedral lattice structures and explored multi-material printing.

Remarkably, his team developed lunar and Martian simulants for 3D printing as industrial simulants are costly and may not match real compositions, necessitating in-house development.

The research aims to enhance material performance and address complex geometries.

Multi-Scale Design and Fabrication for Enhanced Material Performance

- The focus is on reducing component weight by developing lattice structures with internal microstructures.
- Octahedral-based lattice bodies are used for their advantages in load-sustaining and high impact strength.
- He introduced novel shapes to improve joint design and avoid free ends, suitable for complex components.
- The development of geometries for aerospace and automotive industries is discussed, with a focus on internal curvatures and sharp boundaries.

Challenges of Multi-Material and Multi-Scale Printing

- The challenges of multi-material and multi-scale printing were discussed, including intermixing, defects and porosity at interfaces and turbulence.
- High-speed cameras are used to monitor printing processes and optimise parameters.
- The projects involve developing control strategies to avoid defects and improve print quality.

Space Additive Manufacturing and Lunar Simulants

- The LUNES project, aimed at developing simulants for lunar and Martian materials, was introduced.
- The project involved analyzing lunar soil and dust compositions to develop 3D printable simulants using conventional clay printers.
- The developed simulants are tested for composition and morphology, matching real lunar and Martian materials.

3D PRINTING IN CONSTRUCTION TECHNOLOGY – ADDITIVE MANUFACTURING FOR SUSTAINABILITY

Mr. Sanjeev Kumar

Sr. Manager – Additive Manufacturing
Adroitec Engineering Solutions Pvt. Ltd.

Mr Sanjeev Kumar explored the revolutionary role of 3D printing in the construction industry, with a particular focus on sustainability.

He said that the integration of advanced 3D printing technologies - spanning polymers, metals, ceramics, and concrete - is transforming conventional construction practices and with innovations such as extrusion-based concrete printing and machines like the Wasp CRANE, the technology facilitates sustainable development, cost efficiency, and design flexibility.

The main points of the talk are as follows:

Classification of 3D Printing Technologies

3D printing involves the creation of physical objects by depositing materials layer by layer directly from digital CAD models. Materials include:

POLYMERS	METALS
Thermoplastics, Thermosets	**Titanium, Aluminum**
CERAMICS	**COMPOSITES**
Zirconia, Alumina	**Carbon/Glass Fiber**

Each technology differs in material forms (filament, powder, resin), energy sources (thermal, UV, chemical), and application domains.

Concrete Printing (3DCP)

- 3D concrete printing (3DCP) is a form of additive manufacturing where concrete is deposited layer by layer.
- The process does not require framework or subsequent vibration, making it more efficient than traditional methods.
- Materials for 3DCP include binders (cement, clay, hydraulic lime), fine aggregates, and additives to enhance properties like cohesion and viscosity.

Sustainable 3D Printing and Case Studies

- He highlighted the potential of concrete printing (3DCP) for sustainable construction, citing projects like a 3D-printed post office in Bangalore and a villa in Pune, which was completed in 21 days.
- A case study was presented where a major brand used 3D printing to create stores in Dubai.

Advantages of 3D Printing in Construction

1. Environmental Benefits

- Reduces construction waste
- Minimizes pollution compared to traditional brick-making
- Lower carbon footprint

2. Cost Efficiency

- Reduces material costs
- Lowers labor expenses
- Decreases on-site construction time (e.g., a home built in just 21 days)

3. Design Flexibility

- Enables complex and intricate architectural designs
- Allows easy modification of shapes and structures
- Provides design freedom not possible with conventional methods

4. Structural Innovations

- Creates multi-layer walls for natural ventilation
- Enables embedding of energy supplies
- Provides better thermal insulation
- Allows for natural lighting integration

5. Construction Efficiency

- Eliminates need for traditional frameworks
- Enables just-in-time production
- Allows rapid infrastructure creation

6. Material Versatility

- Can use local raw materials
- Supports use of sustainable materials like natural fibers
- Allows mixing different materials for enhanced performance

7. Job Creation

- Generates high-end practical jobs in the construction sector
- Promotes technological innovation in building techniques

How likely are you to recommend this event to others (NPS)

(Following the seminar's objective, sessions, presentations, contents and speakers)

Promoters - 22
Passives - 8
Detractors - 0

The engineering education seminar on 'Additive Manufacturing for Sustainability' proved to be a resounding success, bringing together 140 participants from academia, research, and industry. The overwhelmingly positive feedback, as reflected in **the Net Promoter Score (NPS) of 73, indicates a high level of satisfaction with the seminar's objective, sessions, presentations, and speakers.** With 22 promoters, 8 passives, and zero detractors, the seminar clearly resonated strongly with attendees, making them highly likely to recommend it to others.

This strong positive response demonstrates that the collaborative effort between ASME Foundation India and CSIR-CSIO, supported by ASME MEEd and Altair, successfully created **a valuable platform for knowledge exchange** on sustainable additive manufacturing technologies. Additionally, the seminar's ability to engage such a diverse professional audience while maintaining high satisfaction levels also underscores its effectiveness in **advancing engineering education and fostering innovation in sustainable manufacturing practices.**