Engineers Conclave - 2024

Sep 26-27, 2024
DRDL, Hyderabad

PROCEEDINGS & RECOMMENDATIONS

Organized by
Indian National Academy of Engineering (INAE)
In collaboration with
Hyderabad chapter of INAE
Supported by
Defence Research and Development Organization (DRDO)

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Theme-I: Additive Manufacturing for Defence Applications

Theme-II: Defence Manufacturing Technologies

TECHNICAL PROGRAMME

DAY-1: Thursday, 26th September 2024	
0830 – 0915 hrs.	**Registration**
0915 – 1000 hrs.	**Inaugural Session - Seminar Hall**
	• Lighting of lamp and Invocation • Welcome Address by **Shri G A Srinivasa Murthy**, Director, Defence Research & Development Laboratory (DRDL), Hyderabad • Address by **Shri U Raja Babu**, Director General – Missiles and Strategic Systems (DG - MSS) • Presidential Address by **Prof Indranil Manna**, President INAE • Address by Guest of Honour - **Dr. Samir V Kamat**, Secretary DDR&D and Chairman DRDO, Ministry of Defence, Govt. of India • Address by Chief Guest - **Dr. Anil Kakodkar**, Former President, INAE; Chancellor, Homi Bhabha National Institute; Member, AEC; Chairman, Rajiv Gandhi Science & Technology Commission, Govt. of Maharashtra; Former Chairman, AEC • Vote of Thanks by **Dr. Jaiteerth R Joshi**, Program Director, DRDL, Hyderabad & Convener EC-2024
1000 – 1045 hrs.	**1st Plenary Talk – Venue : Seminar Hall** **Digital Manufacturing Technologies Industry 4.0 and Beyond** **Shri JD Patil,** Vice-President, INAE Member of Executive Committee of Management and Advisor (PES & LTSCT) to CMD - L&T, Former Whole Time Director, L&T; Trustee of L&T Employee Trust; Director, L&T Semi-Conductor Technologies Limited; Chairman - L&T

	MBDA Missile Systems Limited; Founding Chairman – Society of Indian Defence Manufacturers **Session Chair: Dr. BN Suresh**, Former President, INAE and Chancellor, Indian Institute of Space Science & Technology (IIST), Thiruvananthapuram and Honorary Distinguished Professor, ISRO; Formerly Director, Vikram Sarabhai Space Centre, Trivandrum and Formerly Member, Space Commission and Founder Director, Indian Institute of Space & Technology (IIST), Trivandrum	
1045 – 1130 hrs.	**High Tea – Venue : Diamond Square**	
	Parallel Technical Sessions on the Two Themes	
1130 to 1300 hrs.	**Session I**	
Theme I: Additive Manufacturing (AM) for Defence Applications **Venue : Seminar Hall**		**Theme II: Defence Manufacturing Technologies** **Venue : Auditorium**
Session – I A: Alloy Development **Session Chair:** ***Prof K. Bhanu Sankara Rao****, Professor of Practice IIT, Hyderabad*		**Session – I B: Ground Based Defence Systems** **Session Chair:** ***Dr. Sanak Mishra****, Former President, INAE; Member of Governing Board, Steel Research & Technology Mission of India*
Title: Additively Manufactured Metallic Materials: Current status and future needs *Speaker:* ***Prof. Satyam Suwas****, IISc, Bengaluru*		**Title**: Armoured Vehicles *Speaker:* ***Shri Nikhil Dhanuka****, Deputy General Manager, TATA Advanced Systems, Mumbai*
Title: Trends in Alloy Development for Additive Manufacturing *Speaker:* ***Prof. GD Janakiram****, IIT, Hyderabad*		**Title**: Evolution of Main Battle Tank *Speaker:* ***Shri Sanjay Dwivedi,*** *CMD, Armoured Vehicles Nigam Ltd. (AVNL), Avadi, Chennai*
Title: ICME approach for accelerated development of AM alloy components *Speaker:* ***Prof. G Phanikumar****, IIT, Madras*		**Title**: Development Journey of First Indigenous Light Tank and Way forward *Speaker:* ***Shri Arun T Ramchandani****- EVP & Head L&T Precision Engineering Systems IC, Larsen & Toubro, Mumbai*
1300 – 1400 hrs.	**Lunch – Venue : Diamond Square**	
1400 – 1530 hrs.	**Session II**	
Theme I: Additive Manufacturing (AM) for Defence Applications **Venue : Seminar Hall**		**Theme II: Defence Manufacturing Technologies** **Venue : Auditorium**
Session – II A: Processing of Powders **Session Chair:** ***Dr. R. Balamurali-krishnan,*** *Director, Defence Metallurgical*		**Session – II B:Aerospace Defence Systems** **Session Chair:** ***Dr. R.K. Tyagi****, Former*

Research Laboratory (DMRL), Hyderabad	*Chairman, Hindustan Aeronautics Limited*
Title: Development of Powders for Additive Manufacturing *Speaker:* ***Dr. R Vijay****, Director, ARCI, Hyderabad*	**Title**: Transcending the Fixed Wing Aircraft Segment *Speaker:* ***Shri Jayakrishnan****, Chief Executive Officer, Bangalore Complex, Hindustan Aeronautics Limited (HAL), Bengaluru*
Title: Plasma Rotating Electrode Process Powders for Additive Manufacturing and Strategic Materials Sustainability *Speaker:* ***Prof. G. Appa Rao****, University of Hyderabad*	**Title**: Civil Aeronautics at CSIR-NAL: Achievements and Challenges *Speaker:* ***Shri Vineet Kumar,*** *Chief Scientist & Head, RNCAC, CSIR-NAL, Bengaluru*
Title: Emerging Trends in Processing of Powders *Speaker:* ***Shri Sachin Shrikant Malgave,*** *Senior Manager (R&D) INDO-MIM Private Limited, Bengaluru*	**Title**: Helicopters *Speaker:* ***Shri M Rajendran,*** *General Manager (Tech.), Helicopter Complex, Hindustan Aeronautics Limited*
1530 – 1600 hrs.	**High Tea – Venue : Diamond Square**
1600 – 1730 hrs.	**Session III**
Theme I: Additive Manufacturing (AM) for Defence Applications **Venue : Seminar Hall**	**Theme II: Defence Manufacturing Technologies** **Venue : Auditorium**
Session – III A: Design of AM Machines **Session Chair:** ***Dr. Nagahanumaiah****, Director, Central Manufacturing Technology Institute (CMTI), Bengaluru*	**Session – III B: Aerospace Defence Systems** **Session Chair:** ***Dr. Y Sreenivas Rao****, Distinguished Seientist, Director General, Naval Systems & Materials (NS & M)*
Title: Electron Beam Hybrid Manufacturing *Speaker:* ***Prof.KP Karunakaran****, IIT Bombay*	**Title**: State-of-Art Technologies in Maritime Sectors *Speaker:* ***Shri Pankaj Chadha****, Vice President & Head - Marine Platforms, Equipment & Systems, L&T*
Title: Indigenous Development of AM Machines *Speaker:****Dr. Vishwas Ramadas Puttige,*** *Director & CEO, AMACE Solutions, Bengaluru*	**Title**: Aircraft Carrier *Speaker:* ***Rear Admiral Bimal Kumar,*** *Indian Navy, New Delhi*
Title: Real time laser beam shaping and defectsmonitoring in laser powder bed fusion additivemanufacturing process *Speaker:* ***Prof. Murugaiyan Amirthalingam****, IIT Madras*	**Title**: Weapons Manufacturing (Torpedoes, Missile etc.) *Speaker:* ***Shri M Ravi****, Executive Director (Unit Head-KBU, IBU & PSG), Bharat Dynamics Limited (BDL), Hyderabad*

1730 – 1830 hrs.	**2nd Plenary Talk - Venue : Seminar Hall** **An Overview of Challenges in Additive Manufacturing** **Prof. Amaresh Chakrabarti,** Senior Professor & Chairman of Centre for Product Design and Manufacturing, IISc, Bengaluru
	Session Chair: Dr. PS Goel, Former President, INAE & Honorary Distinguished Professor, ISRO Hqrs. & Raja Ramanna Chair Visiting Professor, National Institute of Advanced Studies (NIAS), Bengaluru and formerly Director, ISRO Satellite Centre; Secretary, Ministry of Earth Science and Chairman RAC/DRDO
1900 - 2000 hrs.	**Cultural Program – Venue : Auditorium**
2000 hrs onwards	**Dinner – Venue : Diamond Square**

DAY-2: Friday, 27th September 2024	
Parallel Technical Sessions on the two Themes	
0900 – 1130 hrs.	**Session IV**
Theme I: Additive Manufacturing (AM) for Defence Applications **Venue : Seminar Hall**	**Theme II: Defence Manufacturing Technologies** **Venue : Auditorium**
Session-IVA: DfAM, Qualification, Certification and Applications **Session Chair: *Shri APVS Prasad*,** *Chief Executive (CE), Centre for Military Airworthiness & Certification (CEMILAC), Bengaluru*	**Session – IV B: Advanced Manufacturing Facility for Defence Applications** **Session Chair: *Dr. SK Jha***, *Chairman and Managing Director at Mishra Dhatu Nigam Limited, Hyderabad*
Title: Design for Additive Manufacturing *Speaker: **Prof. G. Saravana Kumar**, IIT Madras*	**Title**: Drones- Medium Altitude Long Endurance/Medium Endurance *Speaker: **Air Vice Marshal KVR Raju, VM (Retd.)** General Manager, Adani Defence & Aerospace, Bengaluru*
Title: Evolving trends and challenges in application of laser powder bed fusion based additive manufacturing for industrial and strategic contexts *Speaker: **Dr. U Chandrashekar**, Vice Chancellor, Godavari Global University, GIET, Rajahmundry, AP*	**Title**: Advanced Artillery Guns *Speaker: **Dr. Rajkumar Singh**, Senior Director, Kalyani Centre for Technology & Innovation, R&D of Bharat Forge Ltd., Pune*
Title: Challenges in Qualification and Certification of AM Products for Space Applications *Speaker: **Dr. SV Surya Narayana Murty**, VSSC*	**Title**: Mission Systems *Speaker: **Shri Anil Sogi,** General Manager (EW &Avionics) Bharat Electronics Limited, Bengaluru*

Title: Inspection and Quality Control for Additive Manufacturing in Defence Applications: Status, Trends & Challenges *Speaker:* ***Dr. Shyamsunder Mandayam****, M/s. Azeriri Pvt. Ltd., Bengaluru*	**Title**: Advance Alloys for Defence Manufacturing *Speaker:* ***Shri T Muthukumar****, Director (Production & Marketing), Mishra Dhatu Nigam Ltd. (MIDHANI), Hyderabad*
Title: Applications of AM in Healthcare and Medicine *Speaker:* ***Mr. Santosh Kumar Balivada****, CEO, Centre of Additive Manufacturing, AMTZ*	**Title**: Collaborative Manufacturing Partnerships for Actuation System Innovation *Speaker:* ***Shri Maneck Eddie Behramkamdin****, Vice- President, Godrej Aerospace, Mumbai*
Title: Challenges and Opportunities for Additive Manufacturing in Defence Applications *Speaker:* ***Dr. John Rozario Jegaraj****, Scientist F & Head, Centre for Additive Manufacturing, DRDL, Hyderabad*	**Title**: Eco-friendly Coating Technologies for Aerospace Applications *Speaker:* ***Dr. Harish C Barshilia****, Chief Scientist and Head, Surface Engineering Division, CSIR-National Aerospace Laboratories, Bengaluru*
1130 – 1200 hrs.	**High Tea Venue : Diamond Square**
1200 – 1330 hrs.	**Parallel Panel Discussion Session on the two Themes**
Theme I: Additive Manufacturing (AM) for Defence Applications **Venue : Seminar Hall**	**Theme II: Defence Manufacturing Technologies** **Venue : Auditorium**
Coordinator: Dr. G Madhusudhan Reddy, Former Outstanding Scientist and Director, DMRL, Hyderabad **Session Chairs**	**Coordinator: Shri Jitendra J Jadhav**, Director General, Aeronautical Development Agency, Bengaluru **Session Chairs**
1330 – 1430 hrs.	**Lunch – Venue : Diamond Square**
1430 – 1600 hrs.	**Valedictory Session to bring out the recommendations for respective themesVenue : Seminar Hall**
• Introductory Remarks by **Prof Indranil Manna**, President, INAE • **Summing up** of Technical Sessions of two Themes by respective Coordinators • **Theme-I**: Additive Manufacturing by **Dr. G Madhusudhan Reddy,** Former Outstanding Scientist and Director, DMRL, Hyderabad • **Theme-II**: Defence Manufacturing by **Shri Jitendra J Jadhav**, Director General, Aeronautical Development Agency, Bengaluru • Address by Co-Chair, Valedictory Session: **Shri G A Srinivasa Murthy,** Director, Defence Research & Development Laboratory (DRDL) • Address by Chairman, Valedictory Session: **Dr. G Satheesh Reddy,** Former Scientific Advisor to Raksha Mantri & Former Secretary DD R&D and Chairman DRDO • Vote of Thanks by Lt Col Shobhit Rai (Retd), Offg. Executive Director, INAE	
1600 – 1630 hrs.– High TEA – Venue : Diamond Square	

Introduction

Indian National Academy of Engineering (INAE) plays a crucial role in planning the country's development through engineering and technological advancements with one of its flagship events being the Engineers Conclave. The Engineers Conclave-2024 was held at Hyderabad during September 26-27, 2024 at the Defence Research and Development Laboratory (DRDL), Hyderabad with DRDO as a principal sponsor. The Engineers Conclave serves as a platform for engineers to convene, deliberate, and propose engineering solutions to pressing national issues. The Engineers Conclave-2024 event comprised of two themes - one on *Additive Manufacturing for Defence Applications* through the host organization DRDO and the other on *Defence Manufacturing Technologies* coordinated through INAE. This Conclave was executed with the primary objective of identifying national issues, deliberating upon them, and proposing engineering solutions.

Additive Manufacturing (AM) has emerged as an effective solution to realizing critical engineering components to stringent design & performance specifications, due to its unique ability in producing complex configurations with functionally graded materials and location-specific microstructures. There is an increasing demand for such components to meet the mutually contradicting requirements such as complex hybrid structures for enhanced functional stiffness with optimized weight – agile designs. Additionally, AM has demonstrated its strength in the repair/reclamation of legacy components which have suffered partial damage in service. DRDO is tasked with the responsibility of developing cutting edge technology products for Indian Armed Forces, apart from supporting the sustainability of expensive legacy products of decades old vintage designs already in service. Taking cognizance of this significance of AM in defence manufacturing, DRDO has chosen *Additive Manufacturing for Defence Applications* as the right and relevant theme– being the host organization for Engineers Conclave-2024.

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PROCEEDINGS & RECOMMENDATIONS

Theme-1: Additive Manufacturing for Defence Applications

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Major Issues and Recommendations
Theme-1: Additive Manufacturing for Defence Applications

Technical Session IA: Alloy Development

The Key points of this technical session are as follows:

Metal additive manufacturing has tremendous potential to erase boundaries that conventional manufacturing processes impose on engineering design, particularly for geometrically complex parts. A wide range of variables must be thoroughly understood, including the relationships between process parameters, microstructure, mechanical properties, and performance. Optimizing machine setting and print parameters is crucial, as even minor changes to these or the feedstock can significantly impact the microstructure and, consequently, the functional performance of the final part.

a) The current status and future needs of additively manufactured metallic materials was discussed. The importance of understanding micro-texture, bulk crystallography, and their impact on mechanical performance was emphasized. The emerging facets of science behind Additive Manufacturing was brought out.

b) The trends in alloy development, stressing the need for a broader selection of build materials were discussed. The strategies for creating high-performance printable alloys and highlighted the benefits of micro-alloying were outlined. The importance of rationalizing alloys for additive manufacturing and its sustainability implications was emphasized.

c) The ICME approach promises to shorten the time required for the accelerated development of additive manufacturing alloy components. This involves multi-scale modeling and the transfer of critical information across different length scales. The state-of-the-art advancements in accelerated materials design and development, presenting case studies on nickel-base superalloys and aluminum alloys that are particularly relevant to the strategic sector was highlighted.

Technical Session IIA: Processing of Powders

The Key points of this technical session are as follows:

Powders play a crucial role in the AM of components. Techniques such as Inert Gas Atomization, Ultrasonic Atomization, Plasma Atomization, and the Plasma Rotating Electrode Processes are employed to produce powders suitable for AM. AM process requires highly clean, spherical powders with right size and distribution for optimal flowability. Currently most powders for AM processes are developed, manufactured, and supplied by AM machine manufacturers. Therefore, building powder manufacturing capabilities in India is essential.

a) ARCI's efforts in developing metallic powders for additive manufacturing through inert gas atomization were discussed. *It was iterated that while gas atomization is effective*, this method has limitations, including high energy consumption and defects like surface oxides, porosity, and satellite particles that can impact *the quality of AM parts*.

b) The Plasma Rotating Electrode Process (PREP) is promising for producing high-quality powders from various materials, such as titanium alloys, refractory materials, aluminium alloys, and nickel-base superalloys. The engineering aspects of PREP equipment and the benefits of PREP powders for additive manufacturing product was emphasized.

c) Designing alloys for additive manufacturing enhances powder flowability and packing density, resulting in fewer defects and higher-quality parts. The computational tools like CALPHAD *(Calculation of Phase Diagrams)* and machine learning can expedite alloy development were discussed.

Technical Session IIIA: Design of AM Machines

The Key points of this technical session are as follows:

India has experienced significant growth in the adoption of metal additive manufacturing in recent years, particularly in industries such as aerospace, defense, medical, and automotive. However, the country's utilization of this advanced technology remains lower than the global average due to various factors. There is a pressing need to indigenize this technology and raise awareness to promote widespread adoption, thereby future-proofing it against technological disruptions.

a) The challenges associated with indigenously built Electron Beam Hybrid Manufacturing, highlighting the advantages of using both powder and wire stock were discussed.

b) The key challenges that have been overcome in the process, as well as the current obstacles hindering the growth and adoption of this technology in the country were elaborated.

c) The basic principles and effectiveness of in-situ monitoring systems through real-time laser beam shaping and defect monitoring in the Laser Powder Bed Fusion additive manufacturing process, emphasizing their importance for immediate industrial adaptation was briefed.

Technical Session IVA: DfAM, Qualification, Certification and Applications

The Key points of this technical session are as follows:

Defence and Aerospace industry recognizes the significant advantages of AM over traditional manufacturing practices, particularly in reducing long lead times associated with conventional processes. However, qualification and certification are critical for the successful adoption of metal AM in strategic applications. The strategic sector is governed by stringent regulations, standards, and specifications. Further, the absence of established standards for AM poses a significant challenge in the implementation of AM products.

a) The importance of component testing under simulated conditions for product qualification to assess the "effect of defects" was highlighted. It was iterated that balancing qualification requirements involves understanding performance expectations alongside the capabilities of the process. The challenges faced by the space industry in the qualification and certification of AM products, supported by real-world examples were presented.

b) The process how predictive analytics, powered by artificial intelligence (AI) and machine learning, are being developed to anticipate potential defects based on data collected during the AM process was outlined. This proactive approach is expected to drastically reduce the time and costs associated with post-manufacture inspections and rework. The issues related to in-situ monitoring challenges and the importance of workforce development and training for reliable AM components were addressed.

c) Valuable insights into the applications of additive manufacturing in healthcare and medicine were provided. The key uses of AM, including customized implants, surgical models, tissue engineering, dental applications, and drug delivery systems were highlighted. The advantages of AM, such as personalization, design complexity, speed, and cost-effectiveness were emphasized.

d) Several challenges faced by the Indian AM ecosystem, including the availability of indigenous material powders, the lack of local machine manufacturers, and the absence of indigenous software for design, pre-processing, simulation, and process optimization were discussed. The opportunities for additive manufacturing in defence applications were covered.

e) The talk explained that while AM offers great design freedom, it also presents constraints. It was iterated that designers must consider factors such as layer thickness, support structures, and material properties when creating designs. It was briefed that different AM technologies and materials yield varying thermal and mechanical properties, which can affect the final product's performance.

It was elaborated that understanding these constraints is crucial for developing more efficient and effective designs.

f) The significance of laser powder bed fusion (LPBF) in metallic additive manufacturing for its versatility and ability to create complex geometries was discussed. The fact that LPBF outcomes are affected by process parameters, leading to issues like high residual stresses, porosity, and poor surface finish was notified. The influence of material properties, such as heat capacity and melting temperature, in mitigating these problems was highlighted. It was emphasized that the challenges persist in applying test data from coupons to thicker LPBF parts, emphasizing the complex interactions between materials and processes in optimizing engineering systems.

All the talks were intellectually inspiring, thought-provoking, and comprehensive in scope and content. During the two days of deliberations, it was recognized that there are numerous challenges and opportunities in this field and this conclave has thrown light on valuable insights into the dynamic world of additive manufacturing.

Recommendations

The Theme-I of Engineers Conclave-2024 namely *Additive Manufacturing for Defence Applications*, covered the entire gamut of issues relevant to AM techniques. The invited and plenary technical talks have dwelt with all the factors responsible for development of acceptable AM products for strategic applications. The subsequent panel discussion deliberated threadbare the crucial concerns for increasing the outreach of AM in the form of wider application of AM products. Based on the outcome of technical sessions and panel discussion, the following major recommendations have emerged:

- Thousands of alloy systems are presently in use as engineering materials for various applications. However, powders for additive manufacturing are available only for selected grades. To promote the wider application of AM for beneficial results, there is an immediate need for development of processing technologies for preparation of optimal powders in more of these alloys.
- There is need for exploitation of computational methods such as ICME/AI/ML for accelerated development of advanced alloy systems for AM, together with appropriate powders.
- Indigenous development of custom-built AM machines needs immediate thrust for catering to the specific requirements of Indian Industry, in particular the strategic sector.
- The evolution of real-time NDE/in-process monitoring for detection of defects generated during additive manufacturing calls for urgent attention to ensure the all-important structural integrity of AM products.

- To realize the unique advantages of AM products by Indian Engineering Industry, the need for clarification standards is non-existent. Therefore, there is an immediate need for development of holistic certification standards for AM products, with close collaborative efforts by all stakeholders.
- A knowledge graph needs to be created for capture of scientific capabilities and engineering tools in the country – dynamic, open, verifiable, and community driven.

Suggestions were made by several speakers and panellists, apart from the Fellows of INAE, about the need for proactive steps to increase the outreach of INAE in broadening the beneficial applications of AM – involving a professional body of academia, R&D organizations, and industry. The Engineers Conclave-2024 has added momentum to the national efforts to strengthen the defence manufacturing sector. This conclave also laid the groundwork for the expanded application of AM technology.

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PROCEEDINGS & RECOMMENDATIONS
Theme-II: Defence Manufacturing Technologies

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Major Issues and Recommendations
Theme-2: Defence Manufacturing Technologies

Technical Session IB: Ground Based Defence Systems.

The Key points of this technical session are as follows:

a) Higher content of imported components causing upper hand by supplier is affecting the deliveries of materials and for Indigenised material, consistency in quality is the issue.

b) Development of indigenous armoured steels should be promoted.

c) Industry partners with specific capabilities needs to be identified and deployed.

d) Dependency on foreign sources is causing supply chain resilience.

e) Having own standards for rationalization of material should be developed for international standards under ToT.

f) Software systems with predictive maintenance modules should be introduced.

g) Flexibility should be given in decision making for collaborative efforts to develop indigenous equipment.

h) Extensive use of digital manufacturing techniques has led to the prototype development of Light Tank within two years.

i) We need to harness the available resources for capability and infrastructure.

j) Development of futuristic platforms with public - private partnership should be encouraged.

k) Spiral development approach should be there to introduce indigenous systems as drop-in replacement.

Technical Session IIB: Aerospace Defence Systems

The Key points of this technical session are as follows:

a) Dependency on foreign OEMs for raw materials, engine, ejection seat and avionic sensors is the main reason for delays in deliveries.

b) We should increase our Capability for the development of cutting-edge technologies and equipment like (fuel cell, MUM-T, electric breaking system, cyber-attack and detection, etc.).

c) Cross-sectoral collaborations to be encouraged for the development of manufacturing ecosystem.

d) Collaborate/acquire the technologies from foreign OEMS to reduce the dependency on them. Simplification of certification process will be very helpful in timely delivery of products.

e) Government should fund for development of civil aircraft and industry investment in production.

f) Policies for exemptions/relaxation in taxes, import duties should be introduced by the Government to reduce developmental cost.

g) Focused skill development for Aeronautics technicians, supervisors, etc.

h) Building national test facilities – available to all private/public sectors. Certification challenges to be mitigated through DER/SME/Self-certification provision for less critical systems.

i) Imports of raw material, avionics systems are the main reason causing delays in deliveries. Indigenization efforts for self-reliance to be prioritized.

j) Current policy of third-party inspection approved by DGAQA for production shall be applicable for design and development process as well.

k) Technology driven approach with minimal procedures to meet the ultimate time frames and objectives. More R&D funds and skill development should be promoted with a focus on industry requirements including emerging Technologies like Industry 4.0.

Technical Session IIIB: Maritime Defence Systems

The Key points of this technical session are as follows:

a) There is a need for a robust private ship building centre capable of building aircraft carrier having necessary depth in waterfront and ship lift facility at Dry Dock.

b) Robust design capability should be developed for the carrier overall designs engine and propulsion design, deck design, HVAC, Storage, etc.

c) The Indian industry needs skilled teams with specialized knowledge levels. A multi-disciplinary course modules should be introduced in the premier institutions of the country to be taken up along with the existing course.

d) Manufacturing and quality infrastructure build with public and private partnership should be encouraged. A Robust private defence sector should be developed that can foster an ecosystem conducive towards indigenization efforts.

e) Take up unmanned domain awareness program in mission mode on war footing mode and involving the agencies/organization working in these areas in the country in an integrated manner.

f) Promote digitalization and green shipping. Develop special maritime clusters for shipbuilding, design, repair and manufacturing.

g) Build a network: large industry as Anchor industry supported by MSME's and startups in the supply chain.

h) Encourage private industry to invest in R&D by providing special incentives, tax rebates for R&D investments, matching grants towards R&D infrastructure building.

i) Support and encourage industry to export the innovative products developed through their R&D by Indian Industry.

j) Enhancing Indigenization/Innovation which will result in significant cost savings. Materials indigenization should happen and technologies should be built for next generation systems - missiles and underwater weapons and for specific international collaborative partnerships, if required.

k) Collectively adapting Next Generation technologies and establishing acoustic testing facilities.

l) Funding of big projects by Government should take place.

Technical Session IVB: Advanced Manufacturing Facility for Defence Applications

The Key points of this technical session are as follows:

a) Multiple redundancy in satellites to prevent spoofing.

b) There is shortage of R&D facilities for civil aviation. Dependency on government subsidies/incentives and on import material such as aviation fuel is higher.

c) Clarity in government approval processes/regulation should be improved. Certification process is long and clear regulation specification in DGCA is missing. Exclusive collaboration for OEM should take place.

d) Development of light weight blast proof composite armour, and special coatings for defence vehicle should be encouraged.

e) Indigenization for development of alloys should take place. Increased demand, inadequate supply of raw material and vintage machines is leading to delay in deliveries.

f) Investment in upgradation of manufacturing process lines should be done.

g) Equivalent design system for certification across multiple projects should be in place. Development of Indian standards for aerospace materials and components.

h) SAMAR software used for level grading to be acknowledged by regulatory authorities for self-certification. Integration of certification agencies like DGAQA, and CEMILAC to accelerate the development and production.

i) Setting up of National test facilities based on requirements. Automation of manufacturing, testing & inspection. Mission Systems for UAVs - with reduced Swap and faster-reliable data links.

j) Evaluation simulators for reducing cost on platform and training Simulators for manufacturing process.

k) Involvement of special/complex processes, process equipment and manpower skills for equipment manufacturing.

l) Development of strong and dependable manufacturing ecosystem including Supply Chain network with support from Government.

Recommendations

- New projects to be taken up for the development of Low-cost active protection system, electronic warfare to counter drone systems and hybrid electric drive system.
- Indian material standards for rationalization of materials developed for international standards under ToT.
- The certification process needs to be simplified in line with FAA/EASA.
- There is an urgent need of Cross-sectoral collaborations to develop a manufacturing ecosystem to improve indigenization.
- The Government of India should initiate national programs for development of RTA. The Government should provide funding for development of civil aircraft and industry should make investments in production.
- Defence finance corporation to be started to fund the mega projects with nominal interests by utilizing the market capitalization of PSU's.
- Current policy of third-party inspection approved by DGAQA for production shall be applicable for design and development process also.
- There is a need to Build national test facilities which are to be made available to all private/public sectors.
- The Government should Encourage private industry to invest in R&D by providing special incentives, tax rebates for R&D investments, matching grants towards R&D infrastructure building.
- National repository of technologies should be developed in the country.

Policy Interventions

- Policies for exemptions/relaxation in taxes, import duties should be introduced to reduce developmental cost.
- Tax Exemptions for Indigenous civil Aircraft development.
- Initiation of national programs by ministry level to meet aerospace demands in the country instead of individual organization initiation including Indigenous technologies
- Technology driven approach with minimal procedures to meet the ultimate time frames and objectives.
- Skill development with a focus on industry requirements including emerging Technologies like Industry 4.0.
- Review of government procurement processes/regulation and GFR's to ease the technologists /scientist/engineers to accelerate the innovations & product realisations.
- Policies to be made to promote Raw Materials indigenization.
- Development of strong and dependable manufacturing ecosystem including Supply Chain network with support from Government should be promoted.