



ATIRA Research & Innovation Quarterly

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ATIRA RESEARCH & INNOVATION QUARTERLY



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02

Chairman's Welcome

ATIRA welcomes Mr. Punit Lalbhai as Chairman of the Council of Administration

03

Director's Message

Materials that Matter - Pragnesh Shah

06

63rd Joint Technological Conference (JTC)

Advancing collaboration in India's technical textile ecosystem

07

High-Performance Composites in India: Addressing the Critical Raw Material Challenge

- Dr. Ankush Sharma, ATIRA

12

ATIRA Clean Room & Cold Room Facility

14

Harnessing AI To Achieve Global Competitive Edge In Textile Manufacturing

-Radhakrishnaiah Parachuru, PhD

19

World Natural Fibre Production, Value and Employment: Technology is Key to Growth

- Dr. Terry Townsend, Cotton Analytics

24

Robotics, Automation And Digital Composite Manufacturing – From Cells To Intelligent Production Ecosystems

-Dr. Shantanu Bhat & Prof. Dr. Thomas Gries

26

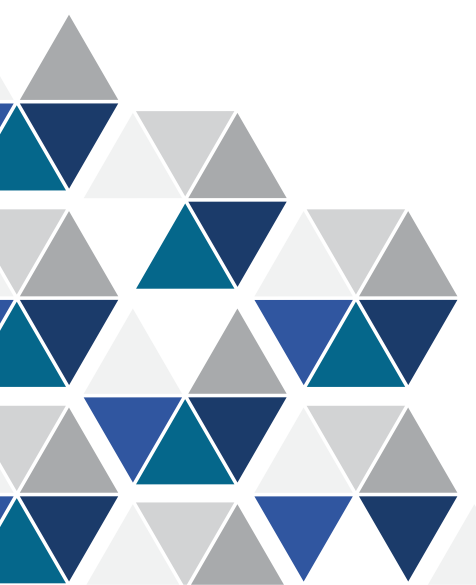
Skill Development in Advanced Composites

Building industry-ready capabilities under NTTM

28

International Symposium on Advancements in Composites, Speciality Fibres & Chemicals

-Jyoti Taskar



WELCOME MESSAGE

ATIRA welcomes Mr. Punit Lalbhai as Chairman of the Council of Administration



ATIRA is pleased to welcome Mr. Punit Lalbhai as the Chairman of its Council of Administration. Having previously served on the Council, Mr. Lalbhai brings with him a strong familiarity with ATIRA's work and a deep engagement with its evolving focus on technical textiles and advanced materials.

As Vice Chairman of Arvind Ltd., he brings extensive industry experience spanning textiles and advanced materials, including composites. His perspective on the growing importance of high-performance materials across sectors such as aerospace, defence, infrastructure, energy, and mobility aligns closely with ATIRA's strategic direction.

Mr. Lalbhai holds a Bachelor's degree in Conservation Biology from the University of California, Davis, a Master's degree in Environmental Science from Yale University, and an MBA from INSEAD, France. His global academic background, combined with his leadership in Indian industry, sustainability, and education, positions him well to guide an institution that operates at the intersection of research and industrial application.

ATIRA looks forward to his guidance as it continues to strengthen its work in technical textiles, composites, advanced materials, and sustainability-driven innovation.

DIRECTOR'S MESSAGE

Materials That Matter - India's Composites Moment

In 1984, when Rakesh Sharma described India from space, the moment was poetic. But behind that moment was engineering precision, where every gram mattered and every material had to perform without failure under extreme conditions.

That discipline is no longer limited to space. Today, it defines industries such as aerospace, defence, mobility, and infrastructure. At the centre of this shift are fibre-based materials and composites, an evolution deeply rooted in textile science.

Carbon fibre, glass fibre, and aramid are not separate from textiles. They are extensions of it. The same fibre science that once powered fabrics now underpins aircraft structures, protective systems, and next-generation industrial materials.

India has long been a global supplier of fibre and fabric. The question before us now is more fundamental. Can we lead in the advanced materials that define critical industries?

Composites are increasingly becoming standard engineering solutions where weight, strength, and durability are non-negotiable. Their impact is measurable in terms of lighter aircraft, extended vehicle range, and improved performance across defence and infrastructure systems.

At ATIRA, we see this as both a responsibility and an opportunity.

Our recent expansion of the Centre of Excellence for Composites reflects this direction. With the addition of controlled clean room environments and in-house design capability, ATIRA is now positioned



to support the full development cycle from concept and material selection to fabrication and validation.

This integrated capability addresses a long-standing gap where advanced composite development often required external dependence. We now offer industry a domestic platform for design-led, application-ready composite solutions.

Technical textiles and advanced materials are not peripheral to India's industrial future, they are embedded within it. From aerospace to infrastructure, from mobility to emerging technologies, materials will define performance, efficiency, and competitiveness.

ATIRA's role is to strengthen the link between research capability and industrial application.

We invite industry partners to engage with us, to bring challenges, explore solutions, and build together.



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Materials That Matter: India's Composites Moment Has Arrived

On technical textiles, advanced composites, and ATIRA's expanding role in India's most demanding industries

In 1984, when Rakesh Sharma became the first Indian to travel to space, his answer from orbit was poetic: "Saare Jahan Se Achha." The engineers who built his mission suit had a more technical answer — every gram matters. Every material must perform without failure, in conditions no human can survive unprotected.

That discipline — the obsession with material performance under extreme conditions — is no longer confined to space programmes. It now defines sectors such as aerospace, defence, automotive, and infrastructure. At the centre of this shift is a family of materials the textile industry helped create: fibre-reinforced composites.

Carbon fibre is a textile product. Glass fibre is a textile product. Aramid, used in ballistic protection, is a textile product. The braided pressure vessels in hydrogen systems, woven aircraft structures, and highway reinforcements all trace their origins to fibre science. India's textile industry has long supplied the world with fibre and fabric. The question before us now is sharper: are we ready to supply the advanced materials that define its most critical industries?

“
*We shape our tools, and
thereafter our tools shape us.*
- Marshall McLuhan

Advanced composites are no longer niche materials. They are becoming engineering defaults where weight, strength, and durability are non-negotiable. A carbon fibre component can be 40–60 percent lighter than its steel equivalent, at comparable or superior strength. In aircraft, every kilogram saved translates into decades of fuel efficiency. In electric vehicles, lightweighting extends range. In defence systems, it expands operational capability. Lightweighting is not an engineering detail — it is an economic strategy.

India's ambitions in these sectors are clear: defence indigenisation under Atmanirbhar Bharat, rapid civil aviation expansion, the transition to electric mobility, and large-scale infrastructure development. All of these require composites. Most still depend heavily on imported materials and external design capability. That is a vulnerability — and an opportunity.

In this context, ATIRA has expanded its Centre of Excellence for Composites to address a long-standing gap in the ecosystem. We have commissioned Class 10,000 and Class 100,000 clean room facilities for controlled fabrication, along with in-house design capability enabling development from concept and simulation through to prototype. Our capabilities now extend across process development, fabrication, and material characterisation.

Until now, composite development in India has often followed a fragmented path — testing domestically, but design and process development dependent on external partners. ATIRA's expanded CoE changes that equation. We are now positioned to support the full development cycle: design, material selection, process development, fabrication, and validation. For aerospace, defence, automotive, and advanced engineering applications, this integrated capability has been notably absent.

This capability is immediately relevant across sectors — aerospace and space, where structural integrity is critical; defence, where performance is strategic; automotive, where lightweighting drives efficiency; and infrastructure, where lifecycle performance matters.

“

*The Stone Age did not end
for lack of stone.*

- Sheikh Ahmed Zaki Yamani

”

In an earlier issue, I wrote that ATIRA must evolve from a research institution into a knowledge and capability engine. The

expansion of the composites CoE is one step in that direction. But infrastructure alone does not create impact. It becomes meaningful when industry brings its problems, product ideas, and development challenges.

We invite industry to engage with us — to develop new composite solutions, validate materials, and build capabilities for next-generation applications. The conversations that begin in a laboratory must ultimately end in a production line. We are ready for that journey.

Technical textiles and advanced composites are not a niche corner of India's future. They are embedded within it — in the aircraft overhead, the highways under construction, the vehicles on our roads, and the systems that will define emerging industries. India has the ingredients: deep fibre knowledge, a strong manufacturing base, capable engineering talent, and growing infrastructure. What has been missing is the bridge between research capability and industrial application.

That is the gap ATIRA exists to close — issue by issue, project by project, and partner by partner.



63rd Joint Technological Conference (JTC)

Advancing collaboration in India's technical textile ecosystem



The 63rd Joint Technological Conference, hosted by ATIRA on 16–17 February 2026 in Ahmedabad, brought together research institutions, industry, academia, and policymakers to strengthen India's technical textile ecosystem.

Jointly organized with BTRA, NITRA, and SITRA, and supported by the National Technical Textile Mission (NTTM), the conference focused on advancing research, technology development, and industry collaboration aligned with national priorities.



The event witnessed participation from over 250 delegates, including researchers, industry leaders, students, and government representatives. The presence of the Textile Commissioner further reinforced the importance of policy–industry–research alignment in driving sectoral growth.

A total of 24 research papers were presented across themes such as:

- Functional and advanced textiles
- Fibre and process innovation
- Sustainable materials
- Emerging textile technologies

Three focused panel discussions addressed:

- Sustainability in textiles
- Industry transition toward technical textiles
- Global competitiveness of cotton

The conference also featured an innovation expo, showcasing research and developments from participating institutions and start-ups under NTTM. A key highlight was ATIRA's exhibit on an indigenous nanofibre-based HEPA filtration system, demonstrating progress toward commercialization.

An important addition this year was the introduction of Best Paper Awards, recognising excellence in research and encouraging higher-quality scientific contributions within the ecosystem.

Overall, the conference served as a platform for knowledge exchange, collaboration, and technology translation, supporting the continued development of India's technical textile and advanced materials landscape.



High-Performance Composites in India: Addressing the Critical Raw Material Challenge

- Dr. Ankush Sharma, ATIRA

Global trends, supply chain constraints, and strategic pathways for strengthening India's composite industry.

1. INTRODUCTION

Over the past two decades, composite materials have transitioned from niche engineering materials to critical enablers of advanced manufacturing across sectors such as aerospace, renewable energy, transportation, and defence.

Fiber-reinforced polymer (FRP) composites offer a superior strength-to-weight ratio, corrosion resistance, fatigue durability, and design flexibility, making them indispensable for high-performance structural applications.

Globally, demand for advanced composites continues to grow, particularly in applications where lightweighting and structural efficiency are essential. Carbon fiber reinforced polymer (CFRP) systems are increasingly used in aircraft structures, hydrogen storage systems, satellite components, and wind turbine blades.

The global carbon fiber market now exceeds 120,000 tonnes annually, with projected growth of 8–10% per year, driven by aerospace, automotive, renewable energy, and hydrogen applications.

India is gradually positioning itself within this evolving ecosystem. While the domestic composites industry has expanded across wind energy, infrastructure, transportation, and defence, a key constraint remains — limited availability of critical raw materials, particularly for high-performance composites.

2. MATERIAL ECOSYSTEM OF HIGH-PERFORMANCE COMPOSITES

High-performance composites depend on a specialized material system comprising:

- **Reinforcement fibers** – carrying structural load
- **Matrix materials (resins)** – binding fibers and transferring stresses

The performance and reliability of composites are fundamentally determined by these constituents.



2.1 REINFORCEMENT FIBERS

Key reinforcement systems include:

| Fiber Type | Key Characteristics | Applications |
|--------------|---------------------------------------|---------------------------------------|
| Carbon Fiber | High strength, stiffness, low density | Aerospace, hydrogen tanks, satellites |
| Aramid Fiber | High impact resistance | Ballistic protection |
| Glass Fiber | Cost-effective | Wind energy, automotive |
| Basalt Fiber | Thermal resistance | Construction |
| UHMWPE | High toughness | Defence, marine |

Among these, carbon fiber is the most critical material for high-performance structural composites.

It offers:

- **Tensile strength: 3–5 GPa**
- **Modulus: 230–600 GPa**
- **Density: ~1.8 g/cm³**

These properties enable unmatched structural efficiency.

However, carbon fiber production is technologically complex and capital intensive, involving:

- **Precursor (PAN) production**
- **Stabilization and carbonization**
- **Surface treatment and sizing**

The PAN precursor stage is particularly critical, influencing both cost and final material performance.



3. GLOBAL CARBON FIBER SUPPLY LANDSCAPE

The global carbon fiber supply chain is highly concentrated, dominated by a limited number of manufacturers:

- **Toray Industries (Japan)**
- **Teijin Limited (Japan)**
- **Mitsubishi Chemical (Japan)**
- **Hexcel Corporation (USA)**
- **SGL Carbon (Germany)**
- **Hyosung Advanced Materials (South Korea)**

Production is concentrated in Japan, the United States, and Europe, creating high entry barriers for new players.

This concentration has important implications:

- **Limited supplier access**
- **Long qualification cycles**
- **Strategic dependence for emerging markets**

CRITICAL RAW MATERIALS SNAPSHOT

| Material | Role | Availability in India | Strategic Importance |
|------------------|-----------------------|-----------------------|-----------------------|
| Carbon Fiber | Primary reinforcement | Mostly imported | Aerospace, hydrogen |
| PAN Fiber | Precursor material | Limited | Cost driver |
| Epoxy Resins | Matrix system | Partial domestic | Structural composites |
| High-Temp Resins | Advanced matrix | Limited | Aerospace |
| Aramid Fibers | Impact resistance | Imported | Defence |
| Glass Fibers | Industrial composites | Domestic | Infrastructure |
| Additives | Performance tuning | Mostly imported | Optimization |

4. CURRENT STATUS OF COMPOSITE RAW MATERIALS IN INDIA

The Indian composite industry has traditionally been dominated by glass fiber reinforced polymer (GFRP) systems, largely due to their cost effectiveness and relatively easier availability. Applications such as wind turbine blades, industrial tanks, pipes, building and construction and automotive components rely heavily on glass fiber composites.

However, as industries move towards higher performance requirements, the demand for carbon fiber composites is steadily increasing.

Sectors such as aerospace manufacturing, defense programs, satellite structures, and high-pressure vessels are increasingly dependent on CFRP materials. Despite this growing demand, domestic availability of carbon fiber reinforcement materials remains extremely limited.

At present, the majority of carbon fiber used in India is imported from international manufacturers. This dependence introduces several constraints, including:

- **longer procurement cycles**
- **price fluctuations due to global demand variations**
- **supply chain vulnerabilities during geopolitical or logistical disruptions**

Furthermore, the availability of advanced prepreg systems and specialty resin formulations suitable for aerospace or high-performance applications is also largely dependent on imports.

Strategic Importance for India

The availability of high-performance composite raw materials has important implications for several national initiatives, including aerospace manufacturing, defense modernization, renewable energy expansion, and the development of hydrogen energy infrastructure.

Without a robust domestic supply chain for advanced reinforcement materials, the long-term growth of these sectors may remain constrained by external dependencies.

Emerging Demand Drivers for Advanced Composites

Demand for high-performance composites in India is expected to rise rapidly due to growth in several key sectors:

- **Aerospace & Space:** Modern aircraft use ~50% composites by weight (e.g., Boeing 787, Airbus A350). Expansion of India's aerospace manufacturing and space programs will increase demand for aerospace-grade carbon fiber composites.
- **Hydrogen Energy:** Type-IV hydrogen cylinders (up to 700 bar) require carbon fiber filament winding, making carbon fiber availability critical for hydrogen infrastructure.
- **Renewable Energy:** Larger wind turbine blades increasingly use carbon fiber in spar caps and structural regions to improve stiffness and reduce weight.
- **Electric Mobility:** EVs require lightweight composite structures for battery enclosures, body panels, and structural components.

These sectors will act as major demand drivers for advanced composite materials in the coming decade.

5. ROLE OF RESEARCH INSTITUTIONS AND CENTRES OF EXCELLENCE

Research institutions and specialized centres of excellence play a crucial role in supporting the development of advanced composite technologies. Facilities equipped with advanced testing infrastructure, pilot manufacturing capabilities, and material characterization laboratories can significantly contribute to bridging the gap between laboratory research and industrial deployment.

Institutions such as ATIRA and other national research organizations can contribute by supporting industry in areas such as material development, process validation, testing and certification, and skill development.



6. SUMMARY

Composite materials will continue to play a critical role in enabling next-generation engineering systems across multiple sectors. As India expands its capabilities in aerospace manufacturing, renewable energy, and advanced mobility systems, the demand for high-performance composite materials will inevitably increase.

However, the long-term sustainability and competitiveness of the Indian composite industry will depend not only on manufacturing capability but also on secure access to critical raw materials. Developing a resilient domestic supply chain for reinforcement fibers and advanced matrix systems should therefore be viewed as a strategic priority for the country.

By investing in material innovation, precursor production, and collaborative R&D initiatives, India has the potential to strengthen its position within the global composite materials ecosystem and reduce dependence on imported raw materials.



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ATIRA Clean Room & Cold Room Facility

A benchmark for precision infrastructure for aerospace-grade composite manufacturing composite manufacturing in India

A benchmark for precision infrastructure for aerospace-grade composite manufacturing composite manufacturing in India

ATIRA has commissioned a new aerospace-grade clean room facility to support high-precision composite manufacturing and advanced material development. Built to international standards, the facility provides controlled, contamination-free environments for applications across defence, mobility, and aerospace.

This facility provides industry access to a controlled, aerospace-grade composite manufacturing environment, strengthening ATIRA's role in advanced materials development.

Facility Snapshot

| Parameter | Specification |
|-----------------|---|
| Clean Room Type | Dual-Class (ISO 14644-1) |
| Classes | ISO Class 7 & ISO Class 8 |
| Layout | Dual-zone controlled environment |
| Applications | Aerospace, defence, mobility, advanced composites |

Clean Room Configuration

ISO Class 7 (Class 10,000)

| | |
|------|---|
| Size | 16 m × 13 m |
| Use | Prepreg handling, aerospace lay-up, critical assembly |

ISO Class 8 (Class 100,000)

| | |
|------|---|
| Size | 16 m × 13 m |
| Use | Pilot production, material prep, inspection |

Core Operating Conditions

| Parameter | Range / Detail |
|-------------------|------------------------------------|
| Height | 3.5 m |
| Lighting | 800–1000 Lux |
| Temperature | –18°C to 27°C |
| Relative Humidity | 40%–70% |
| Flooring | Epoxy (dust-free, easy sanitation) |

Air Handling & Contamination Control

| System | Specification |
|-----------------|---|
| Pre-Filtration | 10 micron |
| HEPA Filtration | 0.3 micron |
| Entry System | Two-person air shower |
| Protocol | Gowning + anti-room + controlled transfer |
| Wall Panels | 100 mm PCGI/PPGI insulated |

Cold Room – Composite Raw Materials

| Parameter | Specification |
|---------------|---|
| Temperature | -18°C |
| Size | 5 m × 5 m |
| Anti-Room | 0°C to 4°C |
| Load Capacity | 3 tonnes |
| Suitable For | Prepregs, resins, thermosets, sensitive materials |

Capabilities

- Aerospace-grade prepreg handling
- Composite lay-up & structural fabrication
- Defence and space applications
- High-precision material processing
- Pilot-scale composite manufacturing

Industry Access

Available for:

- R&D and prototyping
- Testing and validation
- Demonstrations and training
- Collaborative projects with OEMs, defence organisations, and startups



HARNESSING AI TO ACHIEVE GLOBAL COMPETITIVE EDGE IN TEXTILE MANUFACTURING

-Radhakrishnaiah Parachuru, PhD

*(Principal Research Scientist & Senior Academic Professional - Emeritus Status),
Georgia Institute of Technology, School of Materials Science & Engineering.*

Introduction

Some of the key action verbs that characterize the role of AI in textile manufacturing are optimize, analyse, minimize, maximize, customize, recognize, utilize, personalize, organize and revolutionize.

For a large textile-producing nation such as India, sustained global competitiveness does not come from low labour cost alone. Countries that dominate global textile trade combine technology, supply-chain integration, sustainability leadership, and strong branding. India already possesses several structural advantages—large cotton production, an experienced workforce, a diverse fiber base, and a vast domestic market. The challenge is converting these advantages into high productivity, innovation-driven manufacturing, and globally trusted supply chains.

A critical step is modernization of manufacturing infrastructure. Many textile facilities still operate with aging/conventional machinery that account for lower productivity and reduced consistency. Strategic investment in carefully selected spinning automation, digital weaving systems, AI-enabled quality inspection, and smart dyeing technologies can significantly raise output per worker and cut down defects. Integration of new technology tools such as IoT sensors, predictive maintenance systems, and real-time production monitoring can help factories maintain high uptime and consistent quality. This shift is essential because global buyers increasingly demand traceability, speed, and reliability rather than simply low price.

Another major contributing factor is vertical



integration across the textile value chain. Fragmentation remains a structural weakness in many textile-producing regions. When fiber production, spinning, weaving, knitting, wet processing, garment manufacturing, and logistics operate independently, lead times increase and costs accumulate. Establishing integrated textile clusters where these processes operate within the same ecosystem can dramatically shorten production cycles and improve coordination. Efficient logistics infrastructure—modern ports, rail corridors, and digital customs clearance—further strengthens global competitiveness by enabling faster export turnaround.

Sustainability leadership is becoming one of the most powerful differentiators in the global textile trade. International brands increasingly demand environmentally responsible manufacturing practices. Countries that adopt water-efficient dyeing technologies, chemical

management systems, renewable energy use, and textile recycling initiatives will gain preference from global buyers. Implementation of strict compliance with global frameworks such as REACH, ZDHC, and circular textile standards can transform sustainability from a regulatory burden into a marketing advantage. Investments in wastewater treatment, zero-liquid-discharge systems, and fiber recycling technologies will also future-proof the industry against tightening environmental regulations.

Equally important is product diversification into high-value technical and functional textiles. Traditional apparel manufacturing is highly competitive and price sensitive. By expanding into sectors such as medical textiles, geotextiles, protective fabrics, automotive textiles, and smart textiles, Indian manufacturers can capture higher margins and reduce dependence on volatile fashion markets. This transition requires strong collaboration between industry, established research institutions and universities, focusing on developing innovative materials, performance fibers, and specialized manufacturing processes.

Another strategic priority is skilled workforce development. Modern textile manufacturing increasingly requires technicians capable of operating automated equipment, managing digital production systems, and maintaining advanced machinery. Establishing specialized training centres, upgrading textile engineering curricula, and building industry-led apprenticeship programs can rapidly elevate workforce capabilities. Continuous training also improves productivity and reduces costly operational errors.

Brand building and global market positioning are often overlooked but highly impactful. Instead of remaining primarily a contract manufacturing base, countries can encourage the development of globally recognized textile and apparel brands. Strategic promotion of heritage textiles, sustainable production practices, and advanced technical fabrics can strengthen international reputation. Trade agreements, export promotion programs, and participation in global textile exhibitions also help to build strong commercial networks.

Finally, digital supply chain platforms can transform textile distribution. Integrated digital marketplaces connecting mills, garment manufacturers, and global buyers enable real-time inventory visibility, rapid order placement, and transparent pricing. Such platforms reduce dependence on intermediaries and shorten the distance between producer and customer. Combined with modern warehousing and logistics systems, this digital infrastructure can significantly enhance responsiveness to global demand shifts.

If implemented in a coordinated way, these strategies can transform any large textile-producing nation into a technology-driven, sustainable, and globally trusted textile powerhouse capable of competing with the most advanced manufacturing economies.

Key Action Points

- Modernize textile manufacturing with automation, AI-based inspection, and advanced digital technologies
- Develop integrated textile clusters linking fiber, spinning, weaving, processing, and garment production
- Upgrade ports, logistics corridors, and export infrastructure to shorten delivery times
- Lead globally in sustainable textile production (water efficiency, chemical compliance, renewable energy)
- Invest heavily in textile recycling and circular economy technologies
- Diversify into technical textiles and high-value functional materials
- Strengthen industry–university collaboration for textile innovation and R&D
- Build advanced workforce training programs for automated textile manufacturing
- Promote global branding and market positioning of national textile products
- Implement digital supply-chain platforms and textile e-marketplaces for efficient distribution

These actions collectively can shift the industry from volume-based competition to technology-

sustainability-, and innovation-driven leadership in the global textile economy.

Importance of AI in Modern Textile Production

The integration of artificial intelligence (AI) into textile production has revolutionized the industry, bringing forth significant improvements in efficiency and quality. AI-driven quality control systems have emerged as essential tools for manufacturers aiming to enhance product consistency and cut down defects. These systems employ advanced algorithms to analyze fabric properties and detect anomalies in real-time, ensuring that only the highest quality products reach the market. As a result, businesses can maintain their reputation while minimizing waste and operational costs.

Predictive analytics plays a crucial role in demand forecasting within the textile sector. By leveraging historical data and market trends, AI can provide insights into future demand for specific products. This enables textile manufacturers to optimize their production schedules and inventory levels, thus reducing the risk of overproduction or stockouts. Entrepreneurs and engineers alike can harness these insights to make informed decisions, ensuring that resources are allocated efficiently and that customer needs are met promptly.

Automation of fabric inspection through machine learning is another significant advancement in modern textile production. Traditional inspection methods can be time-consuming and often rely on manual labor, which is prone to human error. However, AI-powered machine vision systems can rapidly scan and evaluate fabrics for defects, significantly increasing the speed and accuracy of the inspection process. This not only enhances product quality but also frees up human resources for more complex tasks, driving overall productivity.

AI applications extend beyond quality control and inspection; they also encompass supply chain optimization. Intelligent systems can analyze data across various stages of the supply chain, identifying bottlenecks and inefficiencies. By streamlining processes and improving communication between suppliers

and manufacturers, AI helps businesses enhance their operational efficiency. Furthermore, AI-enhanced inventory management systems allow for better tracking of materials, ensuring that production runs smoothly without unnecessary delays. AI-powered solutions are reshaping the design and finishing processes in textiles. Intelligent dyeing processes can adapt in real-time to ensure consistency and reduce resource wastage. Additionally, virtual sampling and design tools enable designers to create and modify textile patterns rapidly, enhancing creativity while maintaining production efficiency.

In addition to these operational benefits, AI technologies facilitate customization and personalization of textile products. Consumers increasingly demand unique and tailored products, and AI analytics can provide insights into preferences and trends. By leveraging virtual sampling and design tools powered by AI, manufacturers can create personalized offerings that resonate with customers, driving sales and customer loyalty. Overall, the importance of AI in modern textile production cannot be overstated; it is transforming the industry and paving the way for a more efficient and responsive future.

AI-driven Quality Control Systems in Textile Production

With the integration of artificial intelligence (AI), the traditional methods of quality assurance are undergoing significant transformation. AI-driven quality control systems enable real-time monitoring and analysis of fabric properties, allowing manufacturers to identify defects early in the production process. Machine learning algorithms can now analyse vast amounts of data to detect defects with a level of precision that surpasses human capabilities. Automated fabric inspection systems not only speed up the quality control process but also reduce labour costs and human error. This level of automation is essential for maintaining high standards in mass production, and it is transforming how quality assurance is approached in the textile sector.

AI's role in customization and personalization of textile products is reshaping consumer expectations. With advanced analytics, manufacturers can offer tailored products that

meet individual customer preferences, thus enhancing brand loyalty and customer satisfaction. Coupled with intelligent dyeing and finishing processes, these innovations are setting new benchmarks for quality in the textile industry. As AI continues to evolve, its impact on quality control will undoubtedly deepen, offering exciting opportunities for entrepreneurs and engineers alike.

AI innovations are transforming dyeing and finishing processes in textiles. Intelligent systems are optimizing the dyeing process by accurately predicting the required dye quantities and application methods, resulting in significant savings in both resources and time. Virtual sampling tools powered by AI allow designers to experiment with colors and patterns digitally, reducing waste and expediting the design phase. As the industry continues to evolve, the adoption of these AI technologies will be essential for companies striving for excellence in quality control and production.

Case Studies of Successful Implementation of Quality Control

In recent years, the textile industry has witnessed a remarkable transformation through the successful implementation of AI-driven quality control systems. One notable case study involved a leading textile manufacturer that integrated machine learning algorithms to monitor fabric quality in real-time. This system not only detected defects more efficiently than traditional methods but also significantly reduced waste and production costs, leading to enhanced operational efficiency and customer satisfaction.

Another compelling example can be observed in the use of predictive analytics for demand forecasting within textile production. A mid-sized firm adopted AI-based forecasting tools that analysed historical sales data and market trends. As a result, they improved their inventory management, reducing overstock by 30% and ensuring that production levels aligned closely with actual consumer demand, thereby optimizing resources and increasing profitability.

The automation of fabric inspection through machine vision systems has also proven beneficial. One case study highlighted a company that deployed AI-powered cameras and image recognition technology to inspect

fabrics during production. This approach not only accelerated the inspection process but also enhanced accuracy, identifying defects that human inspectors often overlooked, thus ensuring a higher quality product for end-users.

AI applications have significantly streamlined supply chain optimization for textiles. A prominent textile brand implemented AI tools to analyse supply chain data and identify bottlenecks. By doing so, they were able to optimize their logistics and inventory flow, resulting in a 20% reduction in lead times and improved responsiveness to market changes, which ultimately enhanced their competitive edge.

The incorporation of intelligent dyeing and finishing processes using AI has also set a new standard in the industry. A forward-thinking company utilized AI algorithms to optimize dye formulations and processes, dramatically reducing water and energy consumption while achieving consistent dye quality. This not only met environmental standards but also appealed to a growing base of eco-conscious consumers, demonstrating the potential for AI to drive sustainability in textile manufacturing.

Intelligent Dyeing and Finishing Processes Using AI

Dyeing and finishing are pivotal processes in the textile industry, significantly influencing the quality and appeal of fabric products. These processes not only enhance the aesthetic qualities of textiles through vibrant colours and textures, but also improve functional properties such as durability and resistance to environmental factors. Understanding the intricacies of dyeing and finishing is essential for entrepreneurs and engineers looking to innovate within the textile sector, particularly as they explore the integration of advanced technologies such as artificial intelligence (AI).

The traditional methods of dyeing and finishing often involve manual interventions and time-consuming practices, which can lead to inconsistencies in quality. However, with the advent of AI-driven quality control systems, the industry is witnessing a transformation in how these processes are managed. By utilizing predictive analytics, manufacturers can

forecast demand more accurately, allowing them to adjust dyeing and finishing operations in real-time to meet market needs while minimizing waste and optimizing resources. Machine vision systems can detect colour mismatches and fabric flaws during the dyeing process, ensuring that only the highest quality products reach consumers. This level of scrutiny is vital for maintaining brand reputation and customer satisfaction in a competitive market.

AI-driven systems facilitate the precise control of dyeing parameters, ensuring consistent colour quality and minimizing the risk of human error. This not only streamlines production but also contributes to sustainable practices by optimizing resource use in dyeing processes. One prominent innovation is the application of machine learning algorithms that analyse historical dyeing data to predict optimal dye formulations. This predictive capability allows manufacturers to respond swiftly to changing market demands while maintaining high-quality standards. By leveraging predictive analytics, textile entrepreneurs can forecast trends and adjust production schedules accordingly, ensuring that inventory levels align with consumer preferences. This agility is crucial in a fast-paced market where time-to-market can significantly impact profitability.

Finally, the integration of AI in dyeing techniques supports customization and personalization of textile products. With AI analytics, manufacturers can offer bespoke dyeing options tailored to individual customer preferences, thereby elevating the consumer experience. This capability not only meets the demand for unique products but also fosters a deeper connection between brands and their customers. As the textile industry continues to evolve, the role of AI in innovating dyeing techniques will undoubtedly remain pivotal in shaping its future.

The textile industry faces increasing scrutiny regarding its environmental impacts, particularly in terms of resource consumption and waste generation. As the demand for sustainable practices rises, integrating intelligent textiles with AI-driven quality control systems can significantly reduce the

ecological footprint of production processes. By monitoring energy usage and optimizing resource allocation, companies can mitigate their environmental impact while maintaining high standards of quality and efficiency.

Future Directions for AI in Textiles

The future of artificial intelligence in the textile industry is poised to revolutionize various aspects of production and quality control. As AI-driven quality control systems become more sophisticated, they will enable manufacturers to detect defects with unprecedented accuracy, reducing waste and improving overall product quality. This evolution will not only enhance the efficiency of production lines but also ensure that consumers receive textiles that meet high standards of excellence.

The future of the textile industry is undoubtedly intertwined with AI innovations. From enhanced inventory management systems to energy management solutions, the potential applications are vast and varied. For entrepreneurs, engineers, and consultants navigating this landscape, staying informed about these technologies will be crucial in harnessing their full potential and achieving excellence in textile production. The commitment to integrating AI into textile manufacturing processes will not only drive profitability but also contribute to a more sustainable future for the industry.



World Natural Fibre Production, Value and Employment: Technology is Key to Growth

- Dr. Terry Townsend, Cotton Analytics

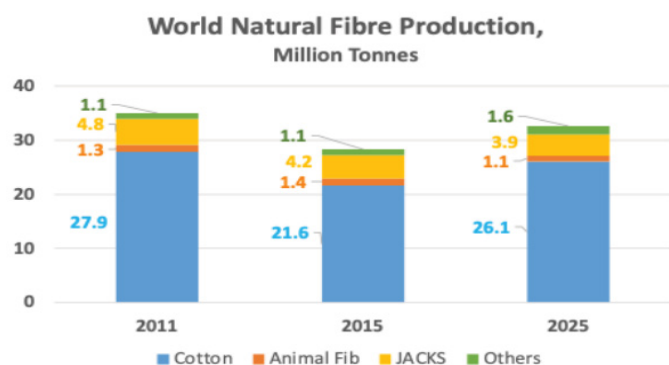
World Production Stable

World natural fibre production totalled 32.8 million tonnes in 2025, about 200,000 tonnes less than production in 2024. The estimate of world cotton production issued by USDA in February 2026 was 26.1 million tonnes. The estimate by DNFI of world production of ^{Even} jute is 2.4 million tonnes. Wool and coir production are estimated at around one million tonnes each, and all other natural fibres combined are estimated at two million tonnes.

| March 2026 | 2021 | 2022 | 2023 | Pct of total fibres in 2023 | Pct of natural fibres in 2023 | 2024, est. | 2025, pre. |
|---|--------------------|--------------------|--------------------|-----------------------------|-------------------------------|-------------------|-------------------|
| | Metric Tonnes | | | | | | |
| Abaca | 83,700 | 76,900 | 58,800 | 0.05% | 0.2% | 56,000 | 52,000 |
| Coir, without pith | 1,099,000 | 1,084,000 | 1,112,500 | 0.98% | 3.5% | 1,113,000 | 1,113,000 |
| Cotton Lint | 24,893,316 | 25,238,189 | 24,435,010 | 21.61% | 77.3% | 25,808,840 | 26,096,233 |
| Fibral Fibres (banana, pineapple, palm) | - | 1,697 | 2,455 | 0.00% | 0.0% | 3,802 | 2,149 |
| Other Fibre Crops, raw, n.e.c. | 870,330 | 639,173 | 655,036 | 0.56% | 2.1% | 659,967 | 689,967 |
| Flax Fibre, long fibres only until 2010 | 328,000 | 346,000 | 302,000 | 0.27% | 1.0% | 448,000 | 537,600 |
| True Hemp, raw or retted | 357,256 | 332,689 | 329,061 | 0.29% | 1.0% | 368,502 | 398,502 |
| Jute, Kenaf & Allied Fibres | 3,265,200 | 3,278,200 | 3,104,600 | 2.75% | 9.8% | 3,000,000 | 2,400,000 |
| Kapok fibre | 76,693 | 79,023 | 78,844 | 0.07% | 0.2% | 78,000 | 78,000 |
| Ramie, raw or retted | 58,012 | 58,495 | 57,790 | 0.05% | 0.2% | 58,099 | 58,099 |
| Sisal, Henequen and similar hard fibers | 297,300 | 277,600 | 294,800 | 0.26% | 0.9% | 275,000 | 290,000 |
| Silk, raw | 86,311 | 91,319 | 93,986 | 0.08% | 0.3% | 97,351 | 101,000 |
| Wool, clean | 1,036,000 | 1,050,816 | 1,046,426 | 0.93% | 3.3% | 1,020,768 | 968,110 |
| Other animal fibres, dehaired | 23,000 | 24,000 | 23,000 | 0.02% | 0.1% | 23,000 | 23,000 |
| Total Natural Fibres | 32,274,118 | 32,600,000 | 31,600,000 | 27.95% | 100.0% | 33,000,000 | 32,800,000 |
| Cellulosic | 7,155,000 | 7,195,000 | 7,576,000 | 6.7% | | | |
| Synthetics: | 73,078,000 | 72,444,000 | 73,888,000 | 66.4% | | | |
| Polyester | 60,369,000 | 59,769,000 | 60,845,000 | 53.8% | | | |
| Polyamide (includes Nylon) | 6,035,000 | 6,065,000 | 6,368,000 | 5.6% | | | |
| Acrylic | 1,345,000 | 1,325,000 | 1,259,000 | 1.1% | | | |
| Polypropylene | 3,885,000 | 3,850,000 | 3,966,000 | 3.5% | | | |
| Other Synthetic | 1,445,000 | 1,435,000 | 1,450,000 | 1.3% | | | |
| Synthetic Filament | 53,029,000 | 52,684,000 | 53,787,000 | 47.8% | | | |
| Synthetic Staple | 20,050,000 | 19,760,000 | 20,101,000 | 17.8% | | | |
| Total Manmade Fibres | 80,234,000 | 79,639,000 | 81,464,000 | 72.1% | | | |
| Total Fiber Production | 112,508,118 | 112,239,000 | 113,064,000 | 100.0% | | | |

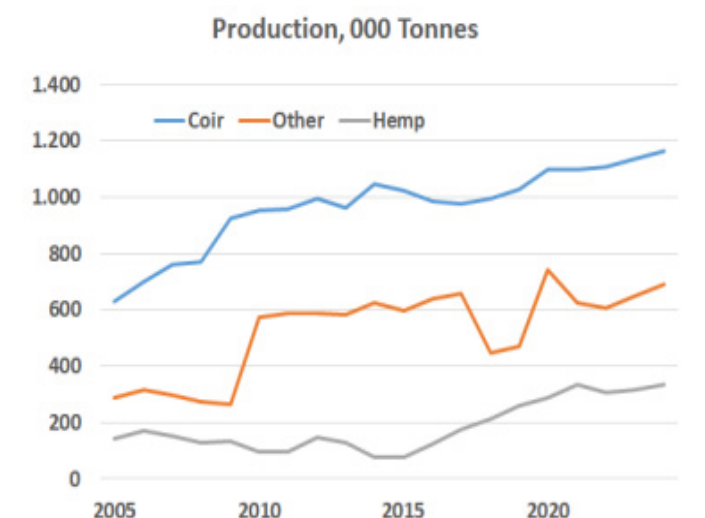
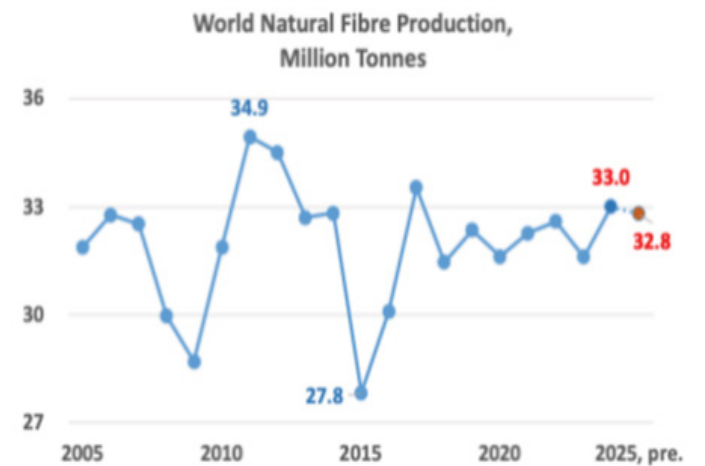
Initial projections for 2026 are that lower prices for cotton, jute and wool will lead to lower production of natural fibre total.

Over the last two decades there has been no growth in total natural fibre production. The highest level of production occurred in 2011 at 35 million tonnes, and the lowest in the last two decades was during 2015 at 28 million tonnes. The average over the two decades has been 32 million tonnes, and production in 2025 was above average.



Even though the total is not growing, three natural fibre categories have experienced growth since 2005, Coir, Other Fibres not elsewhere counted, and Industrial Hemp (hemp varieties containing less than 0.3% THC by weight).

World coir production reached 1.1 million tonnes in 2023 (most recent year of data provided by the Trade and Markets Division of FAO). Coir production is trending upward from about 600,000 tonnes two decades ago. The average annual increase over the past decade has been about 30,000 tonnes. India is the largest producer of coir and accounts for about two-thirds of world production.



The FAO category "Other Fibre Crops, raw, not elsewhere counted," includes "alfa, esparto (*Lygeum spartum*; *Stipa tenacissima*); bowstring hemp (*Sansevieria spp.*); caroa (*Neoglaziovia variegata*); fuque fibre (*Furcraea macrophylla*); Mauritius hemp (*F. gigantea*); New Zealand flax (*Phormium tenax*); palma ixtle (*Samuela carnerosana*), and other fibres that are not identified separately because of their minor relevance at the international level. These other fibres are often associated with artisanal production." (FAOSTAT)

Production in 2024 reached 660,000 tonnes. A linear extrapolation of the trend over the past decade results in an estimate of nearly 700,000 tonnes in 2025.

(<https://www.fao.org/faostat/en/#data>)

World industrial hemp fibre production is estimated at 370,000 tonnes in 2025. Hemp production dropped to just 126,000 tonnes in 2016 but has been climbing almost every year since.

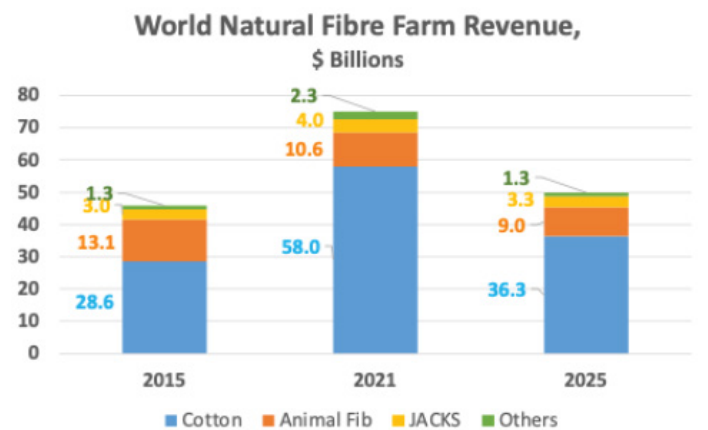
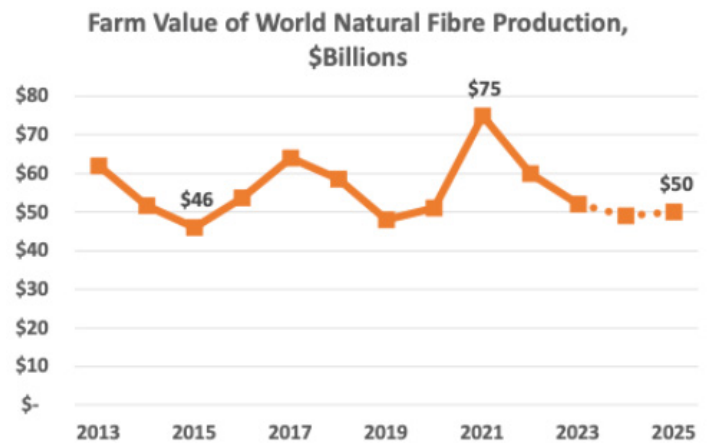
(<https://www.fao.org/faostat/en/#data>)

France and China are the two largest hemp fibre producers, accounting for about three-fourths of the world total. Production in France jumped from only about 1,000 tonnes of fibre a decade ago, to 123,000 tonnes in 2023. Production in China climbed from about 20,000 tonnes a decade ago to more than 100,000 tonnes in 2023.

Value Totals \$50 Billion

The value of world natural fibre production at the farm level was about US\$50 billion in 2024, down from a record (in nominal terms) of \$75 billion in 2021 during Covid-era disruptions to world trade. The value of production averaged \$54 billion over the last decade. In 2025, cotton production at the farm level was valued at \$36 billion, wool, silk and luxury animal fibres totaled \$9 billion, jute, kenaf and allied fibres about \$3 billion, and all other fibres together were valued at \$1 billion.

In 2021, when the value of world natural fibre production was record high at \$75 billion, cotton was \$58 billion, wool and other animal fibres were \$11 billion, jute and allied fibres were \$3 billion, and all other fibres were also \$3 billion.



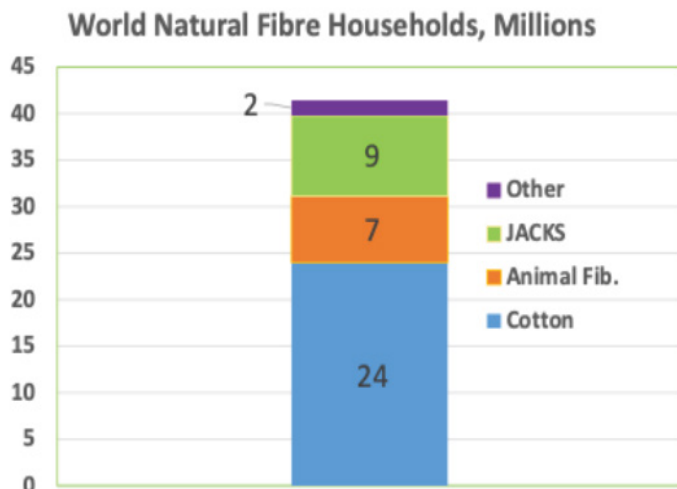
40 million Households Produce Natural Fibres

As of 2025, more than 40 million households were involved in producing natural fibres, including 24 million involved in cotton production, 7 million raising sheep, silkworms and luxury animals for fibre, about 9 million producing jute and allied fibres and another 2 million producing hemp, flax, sisal, and other vegetable fibres.

Employment in agricultural industries is more difficult to estimate than numbers of households because family size varies, in some cultures crops are grown communally, and seasonal employment means that many workers move from crop-to-crop during the year. Nevertheless, based on average labor requirements per tonne of production, total employment in natural fibre industries, including family labor, hired seasonal labor and communal farming systems, probably reaches between 150 million and 200 million people.

In 2021, when the value of world natural fibre production was record high at \$75 billion, there were about 50 million households involved in production, including 30 million

growing cotton, more than 10 million raising sheep, silkworms and other animals for fibre, 6 million growing jute and allied fibres and 2 million growing abaca, coir, flax, hemp, kapok, ramie, sisal, and other fibres.



Assurance Programs Increasingly Define Natural Fibre Industries

Natural fibres have been produced and traded as commodities for centuries, with value determined by supply and demand, and premiums and discounts set according to quality, location and temporal differences. The basic structure of natural fibre industries is changing with the rise of sustainability programs designed to assure adherence to environmental and social standards.

In the cotton and wool sectors, there are already a plethora of various standards and schemes which increasingly disrupt trade and determine eligibility to participate in certain markets.

A partial list of cotton sector sustainability schemes includes:

- ABRAPA (ABR)
- BASF e3
- Better Cotton (BCI)
- Cleaner Cotton
- Cotton made in Africa (CmiA)
- Fairtrade
- Fairtrade Organic
- ISCC
- Kasturi
- myBMP

- Organic Cotton
- Recycled Cotton
- REEL Cotton
- Regenerative Cotton
- Sustainable Cotton Project
- Transitional Cotton
- United States Cotton Trust Protocol

Wool third party assurance programs include:

- Responsible Wool Standard
- SustainaWOOL
- Authentico
- ZQ Merino
- NativaTM
- Abelusi Wool
- National Wool Declaration
- Kering Standards
- Sustainable Cape Wool Standard
- Direct Network Advantage
- American Wool Assurance Standards
- Quality Falkland Wool Accreditation Scheme
- Better Choices
- Taprock Quality Mgmt
- Farm Assurance Prgm
- PGG Wrightson
- New Merino
- Origen

About 7 million tonnes of cotton, a bit more than one-fourth of total world production, are produced under the various cotton assurance programs as of 2025. Roughly 6% of world wool production was certified under one or more of the wool standards as of 2022, and that proportion was growing by about 2% per year.

Technology Drives Growth in Production

World natural fibre production has not grown in two decades. If more natural fibres are not produced, they cannot be used, and the world will turn increasingly to synthetic fibres. Without increased fibre production, farmer's incomes will not rise.

It is self-evident that the only viable path to increased production is not through expanded land area, but through higher yields per hectare, and higher yields can only be achieved with the use of production-enhancing technologies.

Therefore, proposed EU regulations that would limit the use of inputs in agricultural production threaten the continued viability of natural fibre industries. Proposed EU Green Deal regulations will have impacts on consumer level demand for fibres. In addition, EU regulations are also affecting natural fibre supply by discouraging, even preventing, the use of modern technologies in agricultural production.

As one example, the EU Ecodesign for Sustainable Products Regulation (ESPR) contains recommendations for performance requirements on maximum limits of the use of fertilizer, pesticides or water per hectare or per kilogram of cotton.

The role of agricultural technology in the world economy is demonstrated by a chart of population growth. When the world was just leaving the stone age 3,000 years ago, the population of the entire world is estimated by the UN Population office at just 70 million. By the time of Julius Cesar and as the world entered what we now call the Christian Era, the world population had grown to 300 million, and by the time of the Black Death in Europe, the population of the entire world had reached just 500 million. Over a period of 3,500 years, the world population grew by just 430 million people. With the start of the Renaissance, the world population began growing a bit faster, and by 1900, the world population reached 1.7 billion. By 2000, the population reached 6.1 billion. Today, the world total is 8.3 billion and is expected to top out around 11 billion later this century.

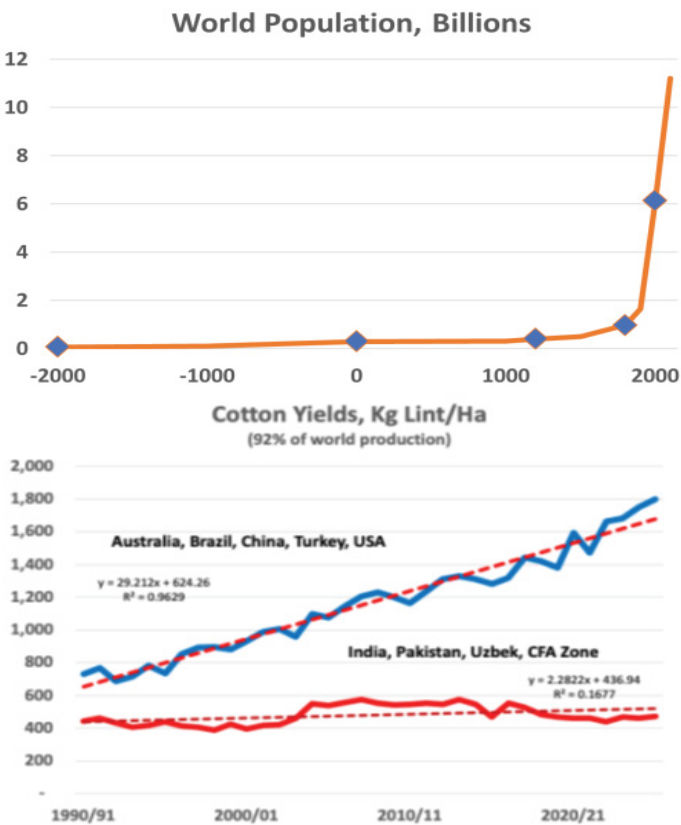
Why was the world population so small for so long, and why did it suddenly start growing? Population was held in check for centuries by war, disease, exposure to elements, stress and other factors, but the main constraint to population growth in any natural environment, whether it is the number of deer in a forest or birds in trees or humans on earth, is food

availability. What biologists call the carrying capacity of an environment is determined primarily by food availability, and for centuries, all agriculture was organic, and people routinely starved to death because of famine caused by agricultural failure.

Agricultural technologies, including mechanization, directed breeding, synthetic nitrogen, chemistry-based pesticides, modern water-conserving irrigation systems, and more recently the development of GMOs and the life sciences, are the keys to overcoming the natural constraints on agricultural production. Modern technologies like sanitation, medicine and everything from air conditioning to elevators that reduce stress contribute to life expectancy and population growth. However, none of those technologies would do much good if millions routinely starved during famine. The conquering of starvation is one of mankind's greatest achievements, and agricultural technologies have created a world of abundance not dreamed of two centuries ago. Yet, the EU would limit the use of synthetic nitrogen, the use of pesticides, the use of irrigation, and it has already banned the use of GMOs. If natural fibre industries cannot adopt technologies, they cannot grow, and they will wither.

The importance of technology in natural fibre production is shown by a chart of yields in cotton in countries that do and do not adopt agricultural technologies. (We have excellent statistics on cotton production, but the lessons are applicable to all fibres, including the protein fibres.) Since 1990/91, cotton yields in China have climbed from around 800 kgs of lint per hectare to 2.5 tonnes per hectare in 2025/26. Yields in the USA have climbed from 700 kgs of lint per hectare to about 1,000 kgs. Yields in Brazil have climbed from 300 kgs per hectare to two tonnes per hectare. The cotton industry in Australia was established in the 1960s, and yields have since climbed from around 600 kgs per hectare to two tonnes. Yields in Turkey have climbed in a similar fashion, rising from 950 kgs per hectare in the early 1990s to 1,650 currently. In all five countries, technology adoption has driven yield and production increases, resulting in

rising incomes for farmers and increased supply for consumers.



In contrast, countries using or who have used the Currency of Francophone Africa (Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Cote d'Ivoire, Mali, Niger, Senegal and Togo) have seen little growth in cotton yields in seven decades. Cotton is important to the economies of West Africa, and the CFA region is the third largest source of cotton exports in the world. If any region of the world needs to adopt modern agricultural technologies to raise yields and improve incomes, it is the CFA region. As recently as the mid-1980s, the average yield in the CFA zone was above yields in Brazil and nearly equal to yields in the United States, but since the 1980s, Australia, Brazil, China, Turkey and the USA have raced ahead in technology adoption, and Africa remains mired in a low-yield environment of labour-intensive, low-input use production practices that perpetuate poverty.

As of 2023, 72% of cotton production in the CFA zone was produced under European-based certification systems known as Cotton made in Africa, based in Hamburg, and Better Cotton, based in Geneva. Both certification systems reflect the biases against the use of agricultural technologies embedded in European culture and Green Deal proposals.

Like the CFA Zone, yields in India, Pakistan, and Uzbekistan, have stagnated or even declined over the past decade for various reasons. A common factor is the failure to adopt modern agricultural technologies effectively.

Decades ago, famine was still a common occurrence in the world, including famines in China during the Mao era, and famine in Bengal India. In the 1970s, the world was worried about population growth and the specter of mass starvation ("The Population Bomb," by Paul Ehrlich), and the work of Norman Borlaug to create the Green Revolution was heralded with a Noble Prize.

Today, most of the world's population lives in relative urban abundance, and most are generations removed from the realities of agricultural production. Tropes about agriculture are embedded in the common understanding.

Typical tropes are that:

- GMOs are dangerous (Every person on earth has eaten food containing GMO traits by now, and there is not a single reported incidence of injury);
- Fertilizers are toxic (If fertilizer was toxic, we would all be dead. 72% of our atmosphere is Nitrogen);
- Pesticides are harmful (Pesticides are supposed to be harmful. The purpose of pesticides is to kill things! Of course, pesticides represent a hazard, but with safe handling and application, exposure to hazards can be managed and risk reduced to an acceptable level.)
- Conventional agriculture is BAD, and Organic agriculture is GOOD. If all agriculture in the world returned to organic methods, as was the case prior to World War II, billions of people would starve within a decade. How can that be considered SUSTAINABLE?)

In all these tropes, natural fibres have been targeted, and the impact has been to undermine consumer demand, depress prices, prevent technology adoption, and undermine livelihoods. Everyone associated with the long run viability of natural fibre industries needs to work to change anti-science biases and the regulations that stem from the perpetuation of such tropes.

ROBOTICS, AUTOMATION AND DIGITAL COMPOSITE MANUFACTURING – FROM CELLS TO INTELLIGENT PRODUCTION ECOSYSTEMS

-Dr. Shantanu Bhat

Head of Division Composite Production (ITA)
RWTH Aachen University, Germany

-Prof. Dr. Thomas Gries

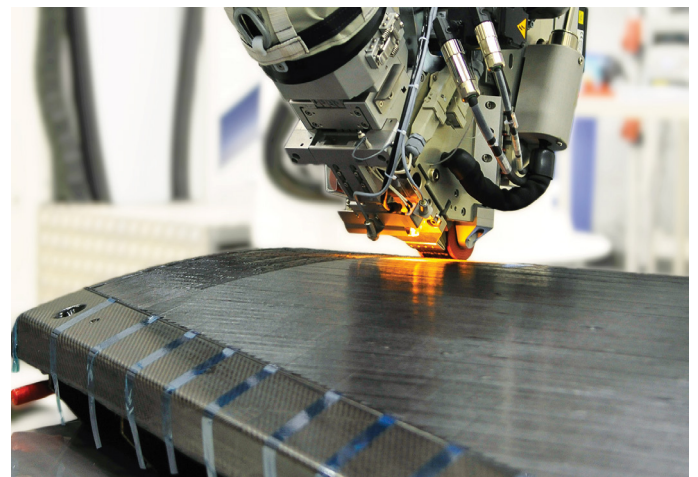
Director, Institute for Textile Technology (ITA)
RWTH Aachen University, Germany

The composites industry is entering a decisive phase of industrial transformation. While global demand for fiber-reinforced materials continues to grow, manufacturers are simultaneously facing increasing pressure on costs, productivity, and sustainability. In parallel, geopolitical uncertainties, supply chain disruptions, and regulatory requirements are reshaping the way advanced materials are designed, produced, and certified.

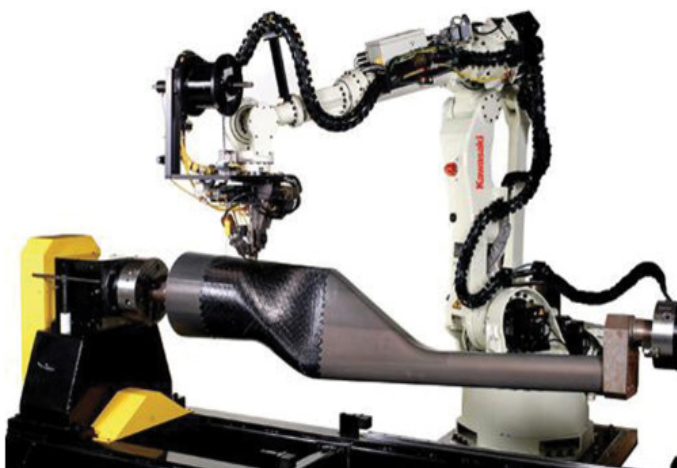
Against this backdrop, automation is no longer a long-term ambition, it is a necessity. The global surge in industrial robot installations reflects a clear trend: companies are investing in efficiency, resilience, and process stability. However, in fiber-reinforced composite (FRC) manufacturing, automation is fundamentally more complex than in traditional industries. The handling of flexible, anisotropic materials, combined with multi-step processes such as draping, preforming, and consolidation, requires a new generation of intelligent, adaptive production systems.

A key challenge lies in the integration of these individual process steps into a coherent and scalable manufacturing chain. Today, many bottlenecks remain in manual or semi-automated operations, particularly in preforming and material handling. Addressing these challenges requires a shift from isolated automation solutions toward holistic system thinking.

At ITA, our vision is to enable this transformation through three strategic pillars.



First, we focus on multi-robot and multi-agent systems as a core enabler for flexible composite manufacturing. Instead of relying on single robotic cells, distributed robotic collaboration allows tasks to be dynamically allocated, enabling higher throughput, adaptability to complex geometries, and improved robustness against process variability. This approach is particularly relevant for large-scale and high-mix production scenarios, such as aerospace structures or next-generation lightweight components.



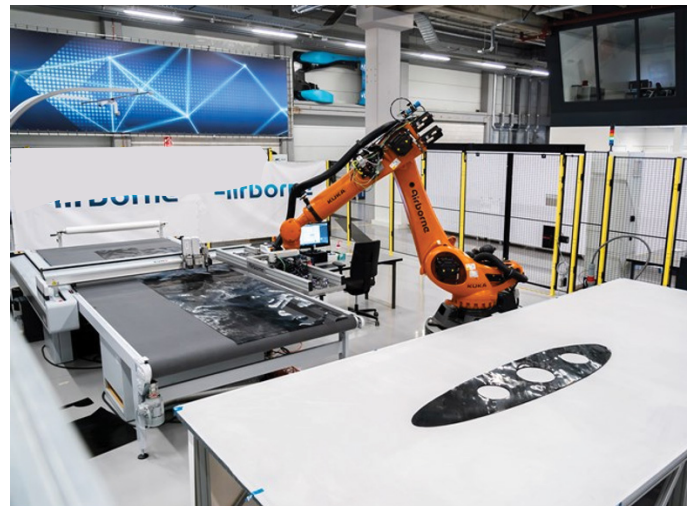
Second, we are driving the development of a digital production and planning platform across the entire FRC manufacturing chain. Concepts such as the Digital Twin and Digital Thread are no longer theoretical constructs, they are becoming essential tools for linking design, process planning, production, and quality assurance. By creating a continuous data flow across all stages, we enable predictive process control, early detection of deviations, and full traceability, capabilities that will become critical in light of upcoming regulatory frameworks such as digital product passports.



Third, we are advancing semi-finished product and preform technologies toward higher technological readiness levels (TRL) while simultaneously targeting cost reduction. Industrial adoption depends not only on performance but also on scalability and economic viability. By combining material development with automated processing strategies, we aim to create robust, application-ready solutions that can be seamlessly integrated into industrial value chains.

Technology alone, however, is not sufficient. The successful implementation of these innovations requires a strong organizational foundation. This includes a clear thematic

focus, targeted recruitment strategies aligned with long-term goals, and, most importantly, interdisciplinary collaboration. In particular, the integration of software and data expertise into traditionally engineering-driven environments is essential. Rather than building all competencies internally, strategic partnerships, both within academia and with industry, offer a faster and more effective path to innovation.



Equally important is visibility. Demonstrators, pilot lines, and real-world applications are not just communication tools; they are critical instruments for technology transfer, stakeholder alignment, and industrial adoption. Showcasing what is technically possible builds confidence and accelerates implementation.

Looking ahead, the convergence of robotics, digitalization, and advanced materials will redefine composite manufacturing. The future lies in intelligent, connected production ecosystems, where machines collaborate, data flows seamlessly, and processes continuously learn and improve.

By aligning technological innovation with strategic focus and strong partnerships, we can position robotics and automation as key drivers of competitiveness in composite manufacturing, ensuring that advanced materials not only meet the demands of tomorrow but also enable sustainable and scalable industrial solutions.

Skill Development in Advanced Composites

Building industry-ready capabilities under NTTM

ATIRA's Centre of Excellence (CoE) for Composites continues to play a key role in strengthening technical capabilities under the National Technical Textiles Mission (NTTM) through structured skill development programs aligned with industry needs.



Shri. Neeraj Mathur, Group Director, SAC, ISRO



Shri. Girish Haganoor, Sr. General Manager, Tata Auto Components



Shri. Pragnesh Shah, Director, ATIRA

Pultrusion Operator Training (TG-2)

ATIRA successfully conducted a 300-hour Pultrusion Operator training program from 8 December 2025 to 10 February 2026 under the TG-2 component of NTTM.

Designed for 10th-pass and non-technical candidates, the program focused on building practical, job-ready skills in composite manufacturing.

The curriculum combined fundamentals with hands-on training, covering:

- Composite materials and applications
- Pultrusion process fundamentals
- Machine operation and handling
- Raw material handling (fibres and resins)
- Quality control and inspection
- Workplace safety practices

A key highlight was live machine training, enabling participants to gain real-time operational experience.

The program addressed the growing demand

for skilled manpower in sectors such as infrastructure, electrical systems, and renewable energy, while enhancing employability among entry-level candidates.

Composite Material Testing (TG-3)

Upskilling for quality and compliance

A 90-hour training program on Composite Material Testing was conducted from 5–16 January 2026 under TG-3 (Upskilling & Reskilling).

The program covered:

- Physical, mechanical, thermal, and chemical testing
- Non-destructive evaluation (NDT)
- ASTM and ISO standards
- Sample preparation, testing procedures, and data analysis

With over 57 hours of hands-on lab exposure, participants gained practical experience in defect identification, reporting, and testing methodologies.

The program saw participation from professionals across industry and startups,

preparing them for roles in aerospace, automotive, construction, marine, and energy sectors.

Heat & Flame Testing of Composites (TG-3a)

Specialized training for safety-critical applications

ATIRA conducted a 90-hour advanced training program from 2–12 February 2026 under TG-3a, focused on fire performance evaluation of composite materials.

The program addressed critical safety and compliance requirements, particularly for applications such as railway systems, where adherence to EN 45545-2 standards is mandatory.

Key areas included:

- Heat release rate, smoke density, and toxicity
- Flammability and ignition behaviour
- Testing standards and regulatory requirements
- EN 45545-2 protocols
- Data interpretation and reporting

Participants gained hands-on exposure at ATIRA's testing facilities, preparing them for roles in testing labs, QA/QC, certification bodies, and R&D organizations.



TG-1 Program Approval: Building Foundational Capability

ATIRA's course on "Fundamentals of Technical Textiles and Composites" has been approved under the TG-1 category of NTTM.

Designed for undergraduate students, the program focuses on:

- Technical textile fundamentals
- Composite materials and applications
- Manufacturing processes
- Testing methodologies

With strong emphasis on practical learning and lab exposure, the program aims to bridge the gap between academia and industry and improve employability in emerging sectors.

The program will be launched shortly in collaboration with academic institutions.

Impact

Across programs, ATIRA's skill development initiatives are contributing to:

- Creation of job-ready workforce
- Strengthening of testing and manufacturing capability
- Alignment with industry standards and compliance requirements
- Capacity building under NTTM and Skill India Mission



International Symposium on Advancements in Composites, Speciality Fibres & Chemicals

ATIRA is pleased to announce the International Symposium on Advancements in Composites, Speciality Fibres and Chemicals, to be held on 5–6 June 2026 at the J.B. Auditorium, ATIRA–AMA, Ahmedabad.

The symposium will be inaugurated by the Hon'ble Minister of Textiles, Shri Giriraj Singh, underscoring its importance in strengthening India's advanced materials ecosystem.

As India advances towards Atmanirbhar Bharat and Viksit Bharat 2047, materials such as composites, speciality fibres, and chemicals are becoming critical across sectors including aerospace, defence, electric mobility, renewable energy, infrastructure, and railways. The symposium aims to serve as a platform for policy–industry–academia convergence, driving dialogue on indigenization, sustainability, commercialization, and global competitiveness.

Building on the success of its first edition, the symposium is expected to bring together 250+ participants, including policymakers, industry leaders, global experts, researchers, startups, and MSMEs—enabling meaningful collaboration and knowledge exchange.

Key Focus Areas

- **Indigenization and supply chain strengthening**
- **Advanced manufacturing and emerging technologies**
- **Sustainable materials and circular approaches**
- **Testing, certification, and quality frameworks**
- **Skill development and industry readiness**

The symposium is jointly organized by ATIRA and Composites Association – India (CAI), in partnership with the National Technical Textiles Mission (NTTM), Ministry of Textiles, Government of India, with the objective of contributing to India's evolving Composites Strategy 2030.

We invite industry members, startups, entrepreneurs, and students to participate.

Contact: Ms. Jyoti Taskar
jyoti.taskar@atira.in





वस्त्र मंत्रालय
MINISTRY OF
TEXTILES



ISAC

INTERNATIONAL SYMPOSIUM

ADVANCEMENTS IN COMPOSITES, SPECIALITY FIBRES AND CHEMICALS

5 - 6 JUNE, 2026 | J.B. AUDITORIUM, ATIRA-AMA, AHMEDABAD



250+ Delegates



Global Participation



Policy & Industry Leaders



Technology Showcase



High-Value Networking

Theme:

Building a Resilient and Sustainable Ecosystem for Composites Growth: Vision 2030

WHO SHOULD ATTEND?

- INDUSTRY LEADERS & MANUFACTURERS
- R&D ORGANIZATIONS & ACADEMIA
- STARTUPS & INNOVATORS
- MATERIAL, TECHNOLOGY & SOLUTION PROVIDERS

KEY FOCUS AREAS

- AEROSPACE & DEFENCE
- ELECTRIC MOBILITY & EVS
- RENEWABLE ENERGY & SUSTAINABILITY
- INFRASTRUCTURE & SMART CITIES
- URBAN AIR MOBILITY & DRONES



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SUPPORTING ORGANISATIONS



PARTNER WITH ATIRA WHERE RESEARCH BECOMES INDUSTRY IMPACT

India's next leap in advanced materials, technical textiles, and composites will come from strong collaboration between industry, academia, startups, and national missions.

ATIRA stands at the intersection of science, innovation, and real-world application — offering deep technical expertise, advanced testing infrastructure, and decades of domain leadership.



Developing
next-generation materials



Scaling technical textile
production



Building aerospace,
defence, mobility, or
infrastructure solutions



Seeking testing,
certification, or conformity
assessment



Launching a tech-textile
startup



Or exploring R&D
partnerships under NTTM or
Tex-RAMPS

ATIRA is your research, validation, and innovation partner.

ATIRA remains committed to advancing India's leadership in textiles through research, innovation, testing, and human capital development. Let's co-create the future of materials and technical textiles, from idea to impact, from prototype to scale, from India to the world.



Ahmedabad Textile Industry's Research Association (ATIRA)

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