The Institution of Engineers (India)

A Century of Service to the Nation



40th National Convention of Production Engineers and National Seminar on

SUSTAINABLE SMART MANUFACTURING FOR CIRCULAR ECONOMY



19 – 20 June 2026



Organized by

The Institution of Engineers (India)
Coimbatore Local Centre

under the aegis of

Production Engineering Division Board, IEI

in association with

Department of Production Engineering,
PSG College of Technology, Coimbatore

SMART MANUFACTURING | CIRCULAR ECONOMY | SUSTAINABLE FUTURE | INNOVATION & EFFICIENCY | COLLABORATION & GROWTH

SOUVENIR

The Institution of Engineers (India)

A Century of Service to the Nation

Fortieth National Convention of Production Engineers

and

National Seminar on

Sustainable Smart Manufacturing for Circular Economy

19-20 June 2026

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Coimbatore Local Centre

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in association with

Department of Production Engineering
PSG College of Technology, Coimbatore - 641 004

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The Institution of Engineers (India)

AN ISO 9001: 2015 CERTIFIED ORGANISATION
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Er Manish Mahendra Kothari, FIE
President

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A Century of Service to the Nation



MESSAGE

It gives me immense pleasure to know that The Institution of Engineers (India), Coimbatore Local Centre in association with Department of Production Engineering, PSG College of Technology, Coimbatore, is organizing the 40th National Convention of Production Engineers and National Seminar on **"Sustainable Smart Manufacturing for Circular Economy"** under the aegis of PRDB, IEI during 19-20 June 2026 at PSG College of Technology, Coimbatore.

The theme of the Convention is highly relevant in the present industrial scenario where sustainability, resource optimization and smart manufacturing practices are becoming essential for achieving long-term industrial growth and environmental responsibility. Smart manufacturing is not just about automating tasks but about creating a holistic ecosystem where data and technology optimize every aspect of production The integration of advanced manufacturing technologies with circular economy principles will play a significant role in building resilient and sustainable industries for the future.

I am confident that this Convention will provide an excellent platform for IEI members, engineers, researchers, academicians, industry professionals and students to exchange knowledge, share innovative ideas and discuss emerging trends and challenges in sustainable smart manufacturing.

I congratulate the Organizing Committee, Production Engineering Division Board IEI, IEI Coimbatore Local Centre and PSG College of Technology for their dedicated efforts in organizing this important national event. I also extend my best wishes to all the delegates and participants for the grand success of the Convention and Seminar.

Er. Manish M. Kothari, FIE
President
The Institution of Engineers (India)

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The Institution of Engineers (India)

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"A Century of Service to the Nation"



MESSAGE

It gives me immense pleasure to extend my warm greetings to all delegates, academicians, industry professionals, researchers, and students participating in the **Fortieth National Convention of Production Engineers and the Seminar on the theme "Sustainable Smart Manufacturing for Circular Economy"** organised by the Coimbatore Local Centre of Institution of Engineers (India).

The manufacturing sector today stands at a transformative juncture, where sustainability is emerging as a core objective through the reduction of waste generated by the traditional linear economy, thereby contributing to a healthier planet. It is a well-established fact that, over the past 50 years, humanity has consumed more resources than during all previous history combined. Between 1950 and 2025, global metals production increased almost ten-fold, oil consumption nearly nine-fold, and natural gas consumption about eighteen-fold. At present, humanity extracts over 100 billion tonnes of natural resources annually - nearly twice the quantity consumed around 2000 and more than three times the level of 1970 - reflecting the enormous pressure exerted on the planet's resources and ecosystems. This rate of resource consumption is clearly unsustainable. If we wish future generations to enjoy the same environment and natural resources that we inherited from our forefathers, it is imperative that we address this challenge at the earliest.

Industrial growth is no longer just about increasing production speed or reducing cost. True progress now requires us to decouple economic growth from resource consumption. Smart manufacturing technologies integrated with circular economy principles are redefining production systems by enhancing resource efficiency, minimizing waste, and promoting environmentally responsible practices. This convention provides an excellent platform for knowledge sharing, professional interaction, and collaborative discussions on emerging trends and challenges in the field of production engineering.

I congratulate the organizers for selecting a highly relevant and futuristic theme that aligns with global industrial priorities and national developmental goals. I am confident that the technical deliberations, expert lectures, and exchange of ideas during this event will inspire innovative solutions and strengthen industry- academia collaboration.

I also appreciate the efforts of the organizing committee in bringing out this souvenir, which reflects the collective commitment and contributions of professionals dedicated to advancing the discipline of production engineering.

I wish the National Convention and Seminar a grand success and hope that all participants benefit immensely from the technical sessions and networking opportunities.

With best wishes,

Dr Seeram Satyanarayana FIE
Chairman, PRDB

The Institution of Engineers (India)

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A Century of Service to the Nation

Prof (Dr) Girish Shrikisan Mundada, FIE

Chairman

Committee for Advancement of Technology and Engineering (CATE)



Message

It gives me immense pleasure to extend my warm greetings to all delegates, industry leaders, academicians, researchers, professionals, and students participating in the 40th National Convention of Production Engineers at Coimbatore.

The theme of National Convention, **Sustainable Smart Manufacturing and Circular Economy** is relevant, appropriate and significant. As industries across the globe navigate rapid technological advancements and increasing environmental responsibilities, the integration of smart manufacturing practices with sustainable production systems has become essential for long-term competitiveness and societal well-being.

The convergence of digital technologies, automation, artificial intelligence, data analytics, and Industry 4.0 solutions is transforming manufacturing ecosystems. At the same time, the principles of the circular economy encourage resource efficiency, waste minimization, product life extension, and responsible consumption. Together, these approaches offer a powerful pathway toward resilient, efficient, and environmentally conscious industrial development.

This Convention provides an excellent platform for knowledge sharing, collaborative learning, and meaningful discussions among experts from industry, academia, and research organizations. The exchange of innovative ideas, best practices, and emerging technologies will contribute significantly to shaping the future of production engineering and sustainable industrial growth.

I congratulate the Organizing Committee for their dedicated efforts in arranging this prestigious event and bringing together distinguished participants from diverse sectors. I am confident that the technical sessions, keynote addresses, panel discussions, and networking opportunities will inspire new perspectives and foster valuable partnerships.

I wish the Convention great success and hope that the deliberations and outcomes will contribute meaningfully in advancing sustainable smart manufacturing and circular economy practices for a better future.

With best wishes,

Dr Girish Shrikisan Mundada

Dr P R Thyla
Principal (FAC)

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MESSAGE

It is a matter of great pride for PSG College of Technology to host the **Fortieth National Convention of Production Engineers and National Seminar on "Sustainable Smart Manufacturing for Circular Economy",** organized jointly by The Institution of Engineers (India), Coimbatore Local Centre and the Department of Production Engineering, PSG College of Technology, under the aegis of the Production Engineering Division Board (PRDB), IEI, during 19-20 June 2026.

Engineering education today extends beyond classrooms and laboratories. It requires continuous interaction with industry, exposure to emerging technologies, and a deep understanding of societal and environmental responsibilities. In this context, the theme of the Convention assumes great significance as it addresses the need for innovative manufacturing systems that are intelligent, resource-efficient, and environmentally sustainable. The future of manufacturing will be shaped by engineers who can effectively integrate advanced technologies with sustainable practices. Forums such as this Convention play a vital role in creating opportunities for knowledge exchange, professional development, and collaborative research among academicians, industrial practitioners, researchers, and students.

The Department of Production Engineering at PSG College of Technology has consistently upheld excellence in manufacturing education, research, and industrial engagement. The presence of eminent experts from organizations such as Elgi Equipments, Larsen & Toubro, TVS Motor Company, Central Manufacturing Technology Institute (CMTI), Bosch and other reputed institutions will greatly benefit the student community by offering insights into current industrial trends, technological advancements, and career opportunities.

I commend the efforts of IEI Coimbatore Local Centre, the Department of Production Engineering, the organizing and technical committees, faculty members, students and volunteers, industry sponsors whose collective commitment has made this event possible.

I am confident that the deliberations and recommendations emerging from this Convention will contribute meaningfully to the advancement of sustainable manufacturing practices and inspire innovative solutions for the challenges of tomorrow.

I extend my best wishes for the successful conduct of the Convention and a rewarding experience for all participants.

With best wishes,

Dr P R Thyla
Principal (FAC)

The Institution of Engineers (India)

(Established 1920, Incorporated by Royal Charter 1935)

Coimbatore Local Centre

PSG Tech Campus, Peelamedu, Coimbatore - 641 004

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MESSAGE

It is my honour, as Chairman of The Institution of Engineers (India), Coimbatore Local Centre, to extend a warm welcome to all participants of the **Fortieth National Convention of Production Engineers and National Seminar on "Sustainable Smart Manufacturing for Circular Economy",** being held on 19-20 June 2026 at PSG College of Technology, Coimbatore.

The theme of this convention, **"Sustainable Smart Manufacturing for Circular Economy"** is both timely and critical. As engineers and educators, we stand at the intersection of innovation and responsibility. Advances in automation, data-driven manufacturing, and resource-efficient process design present powerful opportunities to decouple growth from environmental impact. Simultaneously, embracing circular economy principles in product life extension, materials recovery, and closed-loop design will be essential to ensure long-term industrial resilience and societal well-being.

This gathering brings together academicians, industry leaders, researchers, and young engineers to exchange ideas, present cutting-edge research, and explore collaborative pathways for sustainable industrial transformation. I encourage active participation, open dialogue, and the formation of cross-disciplinary partnerships that move promising concepts from the lab to scalable practice. Special appreciation is due to the Department of Production Engineering, PSG College of Technology, and to the PRDB, IEI, for their outstanding efforts in organizing this event and curating a program of high relevance and quality.

To participants and early-career professionals: your creativity and adaptability will drive the next generation of sustainable manufacturing solutions. I urge you to engage fully with proceedings of the Convention and to carry the insights from this convention into your research and professional practice.

I am confident that the deliberations and networks formed over these two days will contribute meaningfully to the advancement of production engineering in India, helping industry adopt smarter, greener, and more circular approaches.

Wishing the convention every success, and I look forward to the valuable outcomes that will emerge from our collective efforts.

With warm regards,

Dr M Senthilkumar FIE
Chairman, IEI CLC

The Institution of Engineers (India)

(Established 1920, Incorporated by Royal Charter 1935)

Coimbatore Local Centre

PSG Tech Campus, Peelamedu, Coimbatore - 641 004

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MESSAGE

It is a great pleasure to extend my warm greetings to all participants of **Fortieth National Convention of Production Engineers and National Seminar on "Sustainable Smart Manufacturing for Circular Economy",** organized by IEI Coimbatore Local Centre in association with Department of Production Engineering, PSG College of Technology, Coimbatore.

The theme of this year's national seminar, "Sustainable Smart Manufacturing for Circular Economy," is highly relevant in the present era of rapid technological transformation and environmental challenges.

Sustainable manufacturing, driven by digital technologies, resource efficiency, and circular economy principles, is essential for building resilient industries. The integration of automation, artificial intelligence, advanced manufacturing practices, and green technologies will redefine the future of production systems.

I appreciate the efforts of the organizers in bringing together experts from academia, industry, and research institutions. I am confident that the deliberations of this convention will generate valuable insights and innovative solutions for advancing sustainable manufacturing practices. I wish the convention great success and a meaningful impact on the engineering community.

With warm regards,

Dr J Krishnamoorthi
Immediate Past Chairman, IEI CLC
Member, MMDB, IEI

Professor & Head, Dept. of Metallurgical Engg.
PSG College of Technology, Coimbatore, Tamilnadu 641004

Fortieth National Convention of Production Engineers
and
National Seminar on
Sustainable Smart Manufacturing for Circular Economy

CHIEF GUEST MESSAGE



Er Rajkumar Ammaiappan
Senior Vice President
TVS Motor Company, Hosur, Tamil Nadu

I am delighted to be associated with the **Fortieth National Convention of Production Engineers and National Seminar on "Sustainable Smart Manufacturing for Circular Economy"** organized by The Institution of Engineers (India), Coimbatore Local Centre, in association with the Department of Production Engineering, PSG College of Technology, Coimbatore, under the aegis of the Production Engineering Division Board (PRDB), IEI on 19-20 June 2026.

The manufacturing sector is at a defining moment where competitiveness is increasingly determined by innovation, sustainability, and the ability to adapt to rapid technological advancements. Smart manufacturing technologies, coupled with circular economy principles, are transforming the way industries design, produce, utilize, and recover resources. Such approaches not only enhance operational efficiency but also contribute significantly to environmental stewardship and long-term economic resilience.

National-level conventions provide an invaluable platform for engineers, researchers, policymakers, industrial leaders, and students to engage in meaningful discussions on emerging technologies and best practices. The exchange of ideas and experiences during this event will undoubtedly contribute to strengthening the manufacturing ecosystem and fostering sustainable industrial development.

I appreciate the initiative taken by IEI Coimbatore Local Centre and PSG College of Technology in organizing this important Convention. Bringing together experts from academia and industry will help bridge the gap between research and industrial application, thereby accelerating technological progress and innovation.

I congratulate the organizers for their dedicated efforts and extend my best wishes to all delegates, speakers, authors, and participants. I am confident that the Convention will be a great success and will serve as a catalyst for new ideas, collaborations, and advancements in the field of production engineering.

I wish the Convention fruitful deliberations and lasting outcomes.

With warm regards,

Er Rajkumar Ammaiappan

Fortieth National Convention of Production Engineers
and
National Seminar on
Sustainable Smart Manufacturing for Circular Economy

GUEST OF HONOUR MESSAGE



Er N Gopalakrishnan
Vice President - Manufacturing
ELGI Equipments Limited
Coimbatore, Tamil Nadu

I am pleased to convey my greetings and best wishes to the organizers and participants of the **Fortieth National Convention of Production Engineers and National Seminar on "Sustainable Smart Manufacturing for Circular Economy",** being organized by The Institution of Engineers (India), Coimbatore Local Centre, in association with the Department of Production Engineering, PSG College of Technology, Coimbatore on 19-20 June 2026.

The manufacturing landscape is evolving rapidly with the convergence of digital technologies, intelligent systems, advanced materials, and sustainable production methodologies. As industries strive to remain globally competitive, the adoption of smart manufacturing practices and circular economy principles has become essential for creating value while conserving resources and protecting the environment.

Events of this nature play a pivotal role in bringing together thought leaders, industrial practitioners, researchers, academicians, and students on a common platform. Such interactions facilitate the exchange of knowledge, encourage interdisciplinary collaboration, and promote the development of practical solutions to contemporary industrial challenges.

I am particularly delighted to see the active participation of leading industries, academic institutions, and professional bodies in this Convention. The deliberations and technical sessions will undoubtedly provide valuable insights into emerging trends, best practices, and innovative approaches that can drive sustainable growth in the manufacturing sector.

I congratulate the IEI Coimbatore Local Centre, PSG College of Technology, the organizing committee, sponsors, speakers, authors, and volunteers for their collective efforts in making this event a reality.

I wish the Convention every success and hope that it inspires meaningful discussions, fruitful collaborations, and transformative ideas for the future of manufacturing.

With warm regards,

Er N Gopalakrishnan

The Institution of Engineers (India)

(Established 1920, Incorporated by Royal Charter 1935)

Coimbatore Local Centre

PSG Tech Campus, Peelamedu, Coimbatore - 641 004

Dr J Pradeep Kumar FIE
Honorary Secretary

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MESSAGE

On behalf of The Institution of Engineers (India), Coimbatore Local Centre, I extend sincere greetings to everyone attending the **Fortieth National Convention of Production Engineers and National Seminar on "Sustainable Smart Manufacturing for Circular Economy",** jointly organized with the Department Production Engineering, PSG College of Technology on 19-20 June 2026.

This convention arrives at a pivotal moment for production engineering. Rapid technological advances, artificial intelligence, digital twins, additive manufacturing and advanced sensors are reshaping how we design, produce and maintain products. Equally important is the shift toward circularity: designing out waste, optimizing resource use, and creating systems that regenerate value. The integration of these technological and sustainability paradigms will determine the competitiveness and environmental footprint of our industries.

Our objectives over these two days are practical and outcome-oriented to showcase innovations, share best practices, and identify implementable strategies that industries and academicians can adopt. I encourage delegates to focus on actionable insights process improvements, scalable technologies, collaboration models, and policy recommendations that can accelerate the transition to sustainable smart manufacturing in India.

I extend my sincere thanks to PRDB - IEI, the Department of Production Engineering, PSG College of Technology, the Organizing Committee, Technical Committee, faculty members, IEI Coimbatore Local Centre Committee Members, students and volunteers for their dedicated efforts and meticulous planning in organizing this Convention successfully. I also gratefully acknowledge the valuable support extended by industry sponsors Mahendra Pumps Private Limited, Janatics India Private Limited, and the eminent speakers from reputed industries including Elgi Equipments Limited, Larsen & Toubro, TVS Motor Company and Bosch, whose participation and contributions will greatly enrich the technical deliberations and ensure the successful outcomes of this event.

I wish the convention productive deliberations, robust collaborations, and clear action points that will advance the cause of sustainable manufacturing in our region and beyond.

With warm regards,

Dr J Pradeep Kumar FIE, C.Eng. (India)
Honorary Secretary

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MESSAGE

It is with immense pride and joy that I extend a heartfelt welcome to each one of you to the **Fortieth National Convention of Production Engineers and National Seminar on "Sustainable Smart Manufacturing for Circular Economy"**, organized by the Institution of Engineers (India), Coimbatore Local Centre, in association with the Department of Production Engineering, PSG College of Technology, Coimbatore.

This convention brings together researchers, academicians, industry leaders, policymakers and students under one roof to deliberate on one of the most pressing needs of our time: building a manufacturing ecosystem that is not only smart and efficient, but also sustainable and circular.

As we stand at the crossroads of technological innovation and environmental responsibility, the theme of this convention is both highly relevant and timely. The integration of Industry 4.0 technologies, additive manufacturing, green practices, digital twins, and AI-driven optimization into a circular economy framework holds the promise of transforming how we produce, consume, and renew.

I sincerely thank the National Advisory Committee, the Organizing Committee, the Technical Committee, our sponsors, and every member of the team whose tireless efforts made this event a reality. Special gratitude is due to the management of PSG College of Technology and the leadership of IEI for their unwavering support.

May the knowledge shared, collaborations forged, and ideas sparked at this convention pave the way for a greener and more resilient industrial future.

Warm regards and best wishes,

Dr M R Pratheesh Kumar
Organizing Secretary, 40th National Convention
Associate Professor, Department of Production Engineering
PSG College of Technology, Coimbatore

About The Institution of Engineers (India)

The Institution of Engineers (India) or IEI is the largest multidisciplinary professional body that encompasses 15 engineering disciplines and gives engineers a global platform for sharing professional interest. IEI has membership strength of above 2.6 lakhs. Established in 1920, with its headquarter at Kolkata, IEI has served the engineering fraternity close to a century. During this period of time, IEI has been inextricably linked with the history of modern-day engineering. In 1935, IEI was incorporated by Royal Charter and remains the only professional body in India which has been accorded this honour. Today, its quest for professional excellence has given it a place of pride in almost every prestigious and relevant organization across the globe. It provides a vast array of technical, professional and supporting services to the Government, Industries, Academia and the Engineering fraternity, operating through its 124 Centres located across the country and 6 overseas chapters. Besides, IEI has bilateral agreements with about 31 international bodies and membership of another 8 international bodies of the developed nations across the globe.

Being recognized as a Scientific and Research Organisation (SIRO) by the Department of Scientific and Industrial Research, Ministry of Science and Technology, Government of India, IEI promotes the cause of research and development by providing Grant-in-Aid support to undergraduate, post graduate students and Ph.D. research scholars of Engineering Institutions and Universities. IEI holds the International Professional Engineers (IntPE) Register for India under the global International Professional Engineers Alliance (IntPEA). The Institution also awards the Professional Engineers (PE) Certification and confers the Chartered Engineer (CEng) certification. IEI, in collaboration with Springer, regularly publishes peer-reviewed international journals in five series, namely Series A, Series B, Series C, Series D, and Series E, covering fifteen engineering disciplines.

About IEI Coimbatore Local Centre

IE(I) Coimbatore Local Centre, operating from the PSG College of Technology campus, has been actively serving the engineering fraternity for nearly 60 years. The IE(I), Coimbatore Local Centre has been one of the active centres of The Institution of Engineers (India) which is engaged in successfully translating the objectives and ethics of IE(I) into practice. The Centre was founded in the year of 1965, under the Chairmanship of Dr G R Damodaran, an educationist, the former Vice - Chancellor of Madras University, a philanthropist and also the architect of PSG College of Technology, Coimbatore, who lived for the technology development of the nation. Presently, IE(I), CLC has a strength of 3,136 corporate members, 6,198 student members and 22 institutional members. It regularly organizes technical and special lectures in the fields of engineering / management / present scenario in engineering industries / topics of special interest. Industrial visits are also arranged to promote good technical interaction among the members and industries. It also observes the international / national events like World Water Day, World Telecommunication and Information Society Day, World Environment Day and Engineers Day and other IE(I) statutory days in a fitting manner by organizing technical talks on the selected themes with experts in field. One Day Seminar / Workshop, All India Seminar / Workshop funded by the IE(I), Headquarters, Kolkata are also being organized under different engineering divisions in association with various institutions. A few National Conventions of IE(I) are also organized by the Centre.

The audited annual accounts, quarterly and annual reports of the Centre are being properly submitted to the IE(I), Headquarters on time. The monthly committee meetings and Annual General Meeting (AGM) are being held in an organized manner. The Centre served as an important examination centre in the region for many years conducting AMIE section A & B examinations during summer and winter sessions. The Centre has many students' chapters which are active under different engineering divisions in various institutions in and around Coimbatore. Every year, outstanding engineers and young achievers are honored by the Coimbatore Local Centre. Student scholarships are also distributed from various endowment contributions. The Centre houses a library with about 1900 text and reference books for the benefit of members. Guidance classes are also being conducted to support associate and student members.

Golden jubilee of the IE(I), Coimbatore Local Centre was celebrated in the year 2015 - 2016 with the inauguration of Centre's own building, "PSG - GRD Bhavan". Rotary eClub of Coimbatore Changemakers honored IE(I), Coimbatore Local Centre with **"Changemaker of Coimbatore Award for the year 2022-2023"**. Recently, the Institution of Engineers (India), Coimbatore Local Centre, has been adjudged the **"Best Local Centre" for its all-round performance during the year 2024-2025**. This recognition was also received earlier for the years 2019-2020, 2022- 2023 and 2023-2024.

About PSG College of Technology

PSG College of Technology (PSG CT), established in the year 1951 by PSG & Sons' Charities, is an ISO 9001-2015 certified autonomous college affiliated to Anna University, Chennai. Located in Coimbatore, Tamil Nadu, PSG CT has built a distinguished legacy of academic rigor, innovation, and strong industry engagement. Over seven decades, it has consistently adapted to emerging technological advancements while upholding its core values of integrity, discipline, and quality. PSG CT is consistently ranked among the Top 100 institutions in India under the National Institutional Ranking Framework (NIRF) in both Engineering and Management categories. The institution is accredited by the National Assessment and Accreditation Council (NAAC), affirming its adherence to high standards of academic governance and institutional performance. Several programmes are also accredited by the National Board of Accreditation (NBA), reflecting sustained quality and continuous improvement.

PSG CT offers 19 undergraduate and 24 postgraduate programmes covering diverse disciplines such as engineering & technology, computer applications, management sciences as well as the basic and applied sciences, besides offering doctoral research programmes in all departments. PSG College of Technology is equipped with several state-of-the-art Centres of Excellence, including the PSG-TI Centre for Medical Electronics, CARES Centre for Industrial Cyber Physical Systems Research, PSG-TRIDENT Centre for Alternative Cooling Technologies, PSG-Lap Centre for Excellence in Cable Technology, PSG-Danfoss Centre of Excellence in Climate and Energy, PSG- DHI Centre of Excellence in Welding Engineering and Technology, PSG-TI Centre of Excellence for Signal Processing (CESP), PSG-Intel Centre of Excellence in VLSI System Design, PSG- Keysight Centre of Excellence in Wireless Technology, CAD/CAM Centre, PSG-Janatics Centre for Pneumatics and Automation, PSG-Maxbyte Centre of Excellence in IoT, PSG-Fanuc Centre for Advanced CNC and Robotics, PSG-Heidenhain CNC Centre, PSG-Siemens Centre of Excellence in Automation, PSG-Festo Centre for Robotics, PSG-Pricol Centre of Excellence, PSG-EPLAN Centre for Efficient Engineering, and the Product Development Centre. The institute innovation cell, modern laboratories, advanced research centres and manufacturing facilities provide a dynamic ecosystem for academic and translational research.

Strong partnerships with leading industries and research organizations facilitate internships, sponsored research, skill development initiatives, and excellent placement opportunities. Alumni of the institution hold leadership positions across global industries, academia, and entrepreneurial ventures. Guided by its vision to provide world-class engineering education, promote research and innovation, and contribute meaningfully to societal development, PSG College of Technology remains steadfast in shaping future-ready engineers and leaders for national and global advancement.

About Department of Production Engineering, PSGCT

Established in 1975, the Department of Production Engineering at PSG College of Technology has played a pivotal role in advancing manufacturing education and research. With the M.E. Manufacturing Engineering programme being offered since 1964, the department has developed a strong academic foundation and research culture over the decades. Currently, the department offers B.E. Production Engineering, M.E. Manufacturing Engineering and Ph.D. programmes aligned with contemporary industrial requirements and emerging technological advancements. The programmes are accredited by the National Board of Accreditation (NBA), reflecting the department's commitment to quality, continuous improvement, and outcome-based education.

The department envisions becoming a leader in engineering education by imparting relevant skills and the right attitudes to students, enabling them to develop innovative products and efficient manufacturing processes that address societal needs. It seeks to advance knowledge through meaningful research while upholding professional ethics, social responsibility, and environmental consciousness. Its mission is to provide world-class learning facilities that foster innovation in manufacturing systems through a multidisciplinary approach, leveraging core engineering sciences and modern digital technologies to deliver sustainable and cost-effective industrial solutions.

Equipped with well-established laboratories in Metrology, Machine Vision, Precision Machining, Industrial IoT, Ergonomics, Product Styling and Design, CNC technology, Automation, Production Engineering, Simulation, CAD/CAM, Tool and Die, Virtual Reality and advanced research facilities, the department emphasizes experiential learning and research-driven education. Strong collaborations with industries, alumni and research organizations support internships, consultancy and sponsored projects. With its sustained commitment to excellence and innovation the Department of Production Engineering continues to shape competent, industry-ready manufacturing professionals capable of contributing significantly to national and global industrial development.

About the Convention

The National Convention on “Sustainable Smart Manufacturing for Circular Economy” aims to bring together industry leaders, researchers, academicians, practicing engineers, policymakers and students to explore innovative approaches for integrating sustainability into modern manufacturing. As industries worldwide strive to reduce their environmental footprint while enhancing efficiency, this convention will serve as a platform for knowledge exchange, collaboration, and the adoption of cutting-edge technologies. Sustainable smart manufacturing for a circular economy focus on utilizing innovative designs, advanced materials, emerging energy technologies, novel manufacturing concepts like additive manufacturing, green manufacturing, robotics, Industry 4.0, automation, data analytics, and digital twins to optimize production processes, minimize waste, and maximize resource reuse, thereby enabling a closed-loop system where materials are continuously recycled and reintroduced back into the manufacturing cycle, contributing to a more sustainable production model aligning with circular economy principles. By integrating smart and sustainable solutions, industries can achieve enhanced operational flexibility while fostering a resilient and environmentally responsible manufacturing ecosystem. This convention is a step toward transforming manufacturing into a sustainable, efficient, and intelligent system, creating long-term value for industries, society and the environment.

Sub-themes

- Advanced Materials
- Design for Circularity
- Modeling and Simulation
- Product Development, Design for X
- Additive Manufacturing
- Green Manufacturing
- Advanced Manufacturing Techniques
- Sustainable Manufacturing
- Modern Manufacturing Systems
- Next Generation Energy Systems
- Industry 4.0 / Quality 4.0
- IIoT, Data analytics
- Digital Twins, VR/AR
- Robotics and Automation
- AI in Process Optimization and Control
- Advanced Industrial Engineering
- Closed Loop Supply Chains
- Optimisation Techniques
- Circular Economy
- Sustainable Development Goals

F W TAYLOR MEMORIAL LECTURE

Inventor and engineer, Frederick Winslow Taylor was born on March 20, 1856 at Philadelphia, the USA. Educated at preparatory schools at Pennsylvania and New Hampshire, Taylor entered apprenticeship in the trades of pattern maker and machinist in Philadelphia in 1875. In 1878, he was employed by the Midvale Steel Company in their machine shop. In 1881, he introduced his method of increasing the efficiency of production by close observation of individual workers, identifying and eliminating wasted time and redundant motion. He earned a degree in 1883 from the Stevens Institute of Technology, and in 1884, he was elevated to the position of Chief Engineer at Midvale. In 1890, he became the General Manager of the Manufacturing Investment Company. He subsequently became consultant in management in a number of organizations. Having dedicated about forty years in the improvement of production techniques and productivity, Taylor earned the distinction of being the father of modern scientific management. He expired on March 21, 1915. **In memory of his dedicated service, The Institution of Engineers (India) instituted an Annual Memorial Lecture in his name during the National Convention of Production Engineers.**

Brief Citation - Dr Makkhan Lal Meena



Dr Makkhan Lal Meena
Professor
Department of Mechanical Engineering
Centre for Rural Development
Associate Dean (Consultancy)
Malaviya National Institute of Technology Jaipur

Dr Makkhan Lal Meena currently serves as Professor in the Department of Mechanical Engineering and Centre for Rural Development and Associate Dean (Research & Consultancy) at Malaviya National Institute of Technology (MNIT), Jaipur. He is a Fellow of IEI (F-129041-6) and also a Division Board Member - Production Engineering Division Board, The Institution of Engineers (India).

Dr Meena obtained his Ph.D. in Industrial Engineering (2014) and M.Tech. in Manufacturing Systems Engineering (2007) from MNIT Jaipur, MBA in Human Resource Management (2018) from Vardhman Mahaveer Open University (VMOU), Kota, and B.E. in Mechanical Engineering (2005) from the University of Rajasthan. He has more than 18 years of teaching, research, and professional experience in the fields of ergonomics, production systems, sustainable manufacturing, occupational health, and industrial engineering.

Dr Meena has published over 150 research papers in reputed international journals and conference proceedings. His research work has earned more than 3,000 citations on Google Scholar with an h-index of 28, reflecting his significant contributions to ergonomics, industrial engineering, and mechanical engineering. His research interests include Ergonomics, Work System Design, Occupational Health, Productivity Engineering, Sustainable Manufacturing, Lean Manufacturing, Industry 4.0, and workplace safety systems.

He has successfully supervised 13 Ph.D. scholars and 41 M.Tech. students and is presently guiding 5 Ph.D. research scholars. He has undertaken several research and consultancy projects funded by SERB-DST, KVIC, industries, and other funding agencies. He also holds two patents and has established an Ergonomics Laboratory to support advanced research and industry-oriented studies.

In recognition of his outstanding contributions to engineering education, research, and society, Dr Meena received the Outstanding Engineering Services to Society Award from The Institution of Engineers (India) in 2021 and the Fellow Award for Promotion of Industrial Engineering from the Indian Institution of Industrial Engineering, Mumbai, in 2023. Through his academic leadership, research excellence, and professional service, he continues to make significant contributions to the advancement of industrial and production engineering in India.

F W Taylor Memorial Lecture Note

Title: **"Human-Centric Ergonomics for Sustainable Smart Manufacturing Systems"**

The technologies of Industry 4.0, such as the Internet of Things, Artificial Intelligence, digital twins, cyber-physical systems, advanced automation, and collaborative robots, are transforming the manufacturing industries. Further, the emerging paradigm of Industry 5.0 focuses on the human-centric technological development and highlights the role of human-centric ergonomics in the operation, design, and manufacturing systems. These technological advancements in smart manufacturing systems will lead to improved productivity, enhanced flexibility, improved occupational health for employees, improved operational efficiency, better management of cognitive load, and improved workplace sustainability.

This lecture examines the advancement of ergonomics from its traditional focus on musculoskeletal disorder prevention, workplace design, and physical workload toward a broader, more integrated context encompassing digital, cognitive, and organisational ergonomics. This lecture traces the evaluation of manufacturing from the scientific management principle and the contributions of F. W. Taylor, where workers were performing the physically demanding and resistive tasks and focusing on efficiency and productivity improvement. It also highlights the transformation of the manufacturing systems through digitalisation, automation, and technological advancements. Further, this lecture highlights the human-centric manufacturing where workers interact with AI-enabled decision-support tools, collaborate with robots, supervise intelligent systems, interconnected with the manufacturing systems. These transformations shifted the responsibilities of the workers from manual to controlling and monitoring, and made the production systems more sophisticated.

This lecture focuses on the opportunities and challenges arising from digital human modelling, sensor-based worker monitoring, cognitive ergonomics, AI-driven decision environments, and human-robot collaboration. Further, this lecture highlights the role of ergonomics principles in sustainable production practices, designing safer workplaces, improving operational performance, and reducing human error. These changes in the manufacturing systems are enabling worker comfort and safety, real-time monitoring, reducing occupational risks and providing overall well-being along with proactive ergonomic interventions.

Further, the concept of sustainable smart manufacturing is explored with the incorporation of human sustainability, principles of circular economy, green manufacturing, energy efficiency, and workplace safety. The sustainable manufacturing factories is not only technologically advanced but also provide quality of work life, dignity, improve worker health, and are also environmentally sustainable. Further, this lecture highlights the future challenges, including AI ethics, cognitive workloads, trust in intelligent systems, workforce skill adoption, and digital stress.

Also, this lecture also identifies the opportunities of modern technologies and human-centric ergonomics in smart manufacturing for human augmentation, resilient manufacturing, and intelligent assistance. Finally, this lecture promotes a balanced vision in which technology and human work synergistically to create sustainable, intelligent, safe, and human-centred manufacturing systems.

Keywords: Smart Manufacturing, Cognitive Ergonomics, Circular Economy, Human-Centric Ergonomics, Industry 5.0, Sustainability.

G C SEN MEMORIAL LECTURE

Gopal Chandra Sen, graduated in mechanical engineering from College of Engineering and Technology, Jadavpur in 1933 and gathered first-hand experience for two years, first in a private firm and then in a distinguished workshop in Howrah. He joined the National Council of Education, Bengal as Instructor in 1935 and became Lecturer in 1940. In 1946, he went on a Government scholarship to the USA for higher studies in engineering. He got the degree of Master's of Science in Engineering from the University of Michigan. On return, he resumed teaching at Jadavpur University and became Professor of Mechanical Engineering in 1952. In June 1969, he was appointed Dean of the Faculty of Engineering and from August 1970 until his demise on the December 30, 1970, he was the Vice-Chancellor of Jadavpur University. Prof Sen was the pioneer in India of the teaching of production engineering and was the author of a number of very useful books including textbook on the Principles of Machine Tools and Metal Cutting, which are adored in many universities abroad. Prof Sen belonged to that vanishing 'tribe' of teachers who would take up teaching as dedication rather than profession. He was a disciplinarian with a difference. Apart from his academic brilliance, he was a poet and an artist - one who was an expert in drawing and an adept in drawing pen pictures. **In memory of his dedicated service, The Institution of Engineers (India) instituted an Annual Memorial Lecture in his name during the National Convention of Production Engineers.**

Brief Citation - Er Jagadeesh Rajagopalan



Er Jagadeesh Rajagopalan
Plant Head - ESDM
Larsen & Toubro Limited, Coimbatore
Mobile: 99448 75209
Email: jagsmt@gmail.com

Er Jagadeesh Rajagopalan is a distinguished manufacturing professional with over 30 years of experience in Electronics Manufacturing Services (EMS), specializing in Surface Mount Technology (SMT), Final Assembly, Testing and Packaging (FATP), greenfield project execution, automation, and Industry 4.0-driven manufacturing systems. He is currently serving as **Plant Head - ESDM (Electronics System Design and Manufacturing), Larsen & Toubro Limited, Coimbatore**.

Throughout his illustrious career, he has held key leadership positions in reputed multinational organizations such as Dixon Technologies (India) Limited, Wistron India, Flex, Syrma Technology, Salcomp, and Tandon Lanka. He has successfully led numerous greenfield projects, established advanced manufacturing facilities in India and abroad, implemented automation solutions, and driven significant improvements in productivity, quality, yield, and operational excellence.

During his tenure at Dixon Technologies, he successfully scaled Motorola smartphone production from 300,000 units to 1.5 million units per month within six months through strategic expansion of SMT and FATP lines and process optimization initiatives. He led a workforce of over 6,500 personnel and implemented advanced Manufacturing Execution Systems (MES), AI-based quality control, and smart factory practices to achieve world-class manufacturing performance.

A Mechanical Engineering graduate from Madras University with a Post Graduate Diploma in Information Technology, Er Jagadeesh has undergone specialized training in Surface Mount Technology, Advanced Packaging, Lean Manufacturing, Total Productive Maintenance, and Manufacturing Leadership. His expertise encompasses lean manufacturing, TPM, Six Sigma, automation integration, new product introduction, and digital transformation in electronics manufacturing.

Through his exceptional contributions to manufacturing technology, industrial automation, and operational excellence, Er Jagadeesh Rajagopalan continues to play a pivotal role in strengthening India's electronics manufacturing ecosystem and advancing the nation's vision of becoming a global manufacturing hub.

G C Sen Memorial Lecture Note

Title: **"Circular Economy in Product Design and Manufacturing"**

The manufacturing industry is transitioning from a traditional linear model of Take → Make → Use → Dispose to a more sustainable Circular Economy model. In a linear economy, valuable resources are extracted, converted into products, used, and ultimately discarded as waste. This approach has led to increasing resource depletion, environmental challenges, and rising waste generation.

Circular Economy offers an alternative approach by keeping products, materials, and resources in use for as long as possible. Instead of viewing products at the end of their life cycle as waste, Circular Economy views them as valuable assets that can be reused, repaired, refurbished, remanufactured, or recycled.

The foundation of Circular Economy begins at the product design stage. Nearly 80% of a product's environmental impact is determined during design. Therefore, products should be designed for durability, repairability, disassembly, upgradeability, and recyclability. A well-designed product can have multiple life cycles, reducing the need for new raw materials and minimizing environmental impact.

In manufacturing, Circular Economy focuses on maximizing resource efficiency while minimizing waste. Key strategies include material optimization, waste reduction, energy efficiency, remanufacturing, reverse logistics, and closed-loop production systems. These practices help manufacturers recover valuable materials and reintroduce them into the production process.

Modern technologies such as Artificial Intelligence (AI), Internet of Things (IoT), Digital Twins, Data Analytics, and Smart Manufacturing systems play a crucial role in enabling circular manufacturing. These technologies provide real-time visibility into resource consumption, product performance, and material flows, helping organizations make data-driven decisions and improve sustainability.

The benefits of Circular Economy in Product Design and Manufacturing are significant. Environmentally, it reduces waste generation, conserves natural resources, and lowers carbon emissions. Economically, it improves resource productivity, reduces material costs, creates new business opportunities, and enhances competitiveness. Socially, it supports sustainable development and strengthens corporate responsibility.

The future of manufacturing will not be defined solely by production volume but by how efficiently organizations use resources and preserve value throughout the product life cycle. Circular Economy is therefore not only an environmental necessity but also a strategic business opportunity.

Eminent Engineer Awardees



Dr P Hariharan
Professor and Dean
Department of Manufacturing Engineering
College of Engineering, Guindy
Anna University, Chennai



Dr Alluri Venkata Varaprasada Raju
Chairman
Indian Institution of Industrial Engg. &
Director
HES Infra Private Limited, Hyderabad

Young Engineer Awardees



Dr Tapas Debnath
Scientist 'C'
Centre for Additive and Special Manufacturing Process
Central Manufacturing Technology Institute
Bengaluru



Dr Challa Suresh
Professor & Head
Department of Mechanical Engineering
Avanthi Institute of Engineering and Technology
Andhra Pradesh



Dr Pradeep Kumar
Assistant Professor
Department of Mechanical Engineering
MBM University
Jodhpur, Rajasthan

Eminent Speakers

F.W. Taylor Memorial Lecture



Dr Makkhan Lal Meena
Professor
Department of Mechanical Engineering &
Centre for Rural Development, Associate Dean (R&C)
Malaviya National Institute of Technology Jaipur

G. C. Sen Memorial Lecture



Er Jagadeesh Rajagopalan
Plant Head - ESDM
Larsen & Toubro Limited
Coimbatore

Panel Discussion



Dr V Krishnaraj
Professor
Department of Production Engineering
PSG College of Technology
Coimbatore



Er S K Deepak
Managing Director
MediMals Healthcare Private Limited
Coimbatore



Dr K Suresh Kumar
Executive Director
PSG-STEP (Science & Technology
Entrepreneurial Park)
Coimbatore



Dr Tapas Debnath
Scientist 'C'
Centre for Additive and Special
Manufacturing Process
Central Manufacturing Technology
Institute
Bengaluru

Invited Lectures



Dr P Hariharan
Professor and Dean
Department of Manufacturing Engineering
College of Engineering, Guindy
Anna University, Chennai



Er V V Vaidyaraman
Technical Director
Bosch Global Software Technologies Pvt. Ltd.
Coimbatore



Er S Muthukrishnan
Head - Quality
Larsen & Toubro Limited
Coimbatore

19.06.2026	**Inaugural Session Agenda**	
09.00 AM	Registration	
10.00 AM	Prayer Song	**தமிழ்த்தாய் வாழ்த்து (Tamil Thai Vazhthu)**
10.03 AM	Welcome Address	**Dr M Senthilkumar** Chairman, IEI Coimbatore Local Centre & Professor and Head Department of Production Engineering PSG College of Technology, Coimbatore
	Honoring of the Dignitaries • Felicitation of Chief Guest by **Dr J Pradeep Kumar** • Felicitation of Guest of Honor by **Dr M R Pratheesh Kumar** • Felicitation of Chairman PRDB by **Dr M Senthilkumar** • Felicitation of Principal by **Dr M Senthilkumar**	
10.08 AM	Address on the Theme of the National Convention	**Dr M R Pratheesh Kumar** Organizing Secretary & Associate Professor Department of Production Engineering PSG College of Technology, Coimbatore
10.13 AM	Presidential Address	**Dr S Satyanarayana** Chairman Production Engineering Division Board, IEI
10.18 AM	Special Address	**Dr P R Thyla** Principal (FAC) PSG College of Technology
10.23 AM	Address by the Guest of Honour	**Er N Gopalakrishnan** Vice President - Manufacturing ELGI Equipments Limited Coimbatore, Tamil Nadu
10.33 AM	Inaugural Address by the Chief Guest	**Er Rajkumar Ammaiappan** Senior Vice President TVS Motor Company, Hosur, Tamil Nadu
10.48 AM	Felicitation of Eminent Engineer Awardees	**Awardees:** **Dr Alluri Venkata Varaprasada Raju** Head, Project Planning & Coordination / Quality Management Systems HES Infra Private Limited, Hyderabad **Dr P Hariharan** Professor and Dean Department of Manufacturing Engineering College of Engineering, Guindy, Anna University, Chennai

10.51 AM	Felicitation of IEI Young Engineer Awardees	**Awardees:** **Dr Challa Suresh** Professor & Head, Department of Mechanical Engineering Avanthi Institute of Engineering and Technology Andhra Pradesh **Dr Pradeep Kumar** Assistant Professor Department of Mechanical Engineering MBM University, Jodhpur, Rajasthan **Dr Tapas Debnath** Scientist 'C' Centre for Additive and Special Manufacturing Process Central Manufacturing Technology Institute, Bengaluru
10.56 AM	Release of Convention Souvenir	Chief Guest along with all dignitaries on the stage
10.58 AM	Vote of Thanks	**Dr J Pradeep Kumar** Honorary Secretary, IEI Coimbatore Local Centre & Associate Professor, Department of Production Engineering PSG College of Technology, Coimbatore
11.00 AM	**Tea Break**	

19.06.2026 (Day - 1) **Technical Sessions**

11.15 AM	**G. C. Sen Memorial Lecture**	**Er Jagadeesh Rajagopalan** Plant Head - ESDM Larsen & Toubro Limited Coimbatore
11.45 AM	**F.W. Taylor Memorial Lecture**	**Dr Makkhan Lal Meena** Professor, Department Mechanical Engineering & Centre for Rural Development, Associate Dean (R&C) Malaviya National Institute of Technology Jaipur
12.15 PM	**Briefing about IEI IEI Excellence Award and PE & Int PE Certification**	**Dr Kingshuk Sen, P Eng [India]** Assistant Director [Technical] The Institution of Engineers [India]
12.25 PM	**Lunch Break**	
01.45 PM	Panel Discussion on **"Future of Production Engineering"**	**Panelists:** **Dr V Krishnaraj** Professor, Department of Production Engineering PSG College of Technology, Coimbatore **Er S K Deepak** Managing Director MediMals Healthcare Private Limited, Coimbatore **Dr K Suresh Kumar** Executive Director PSG-STEP (Science & Technology Entrepreneurial Park) Coimbatore **Dr Tapas Debnath** Scientist 'C' Centre for Additive and Special Manufacturing Process Central Manufacturing Technology Institute, Bengaluru **Moderator: Dr M R Pratheesh Kumar** Organizing Secretary & Associate Professor Department of Production Engineering PSG College of Technology, Coimbatore
02.15 PM	**Invited Lecture 1**	**Dr P Hariharan** Professor and Dean Department Manufacturing Engineering College of Engineering, Guindy Anna University, Chennai
02.45 PM	**Tea Break**	
03.00 PM	**Technical Paper Presentation Session - I** Google meeting link: **https://meet.google.com/otb-ybgo-uzm**	**Technical Papers (Paper ID: 1001-1005 & 2001 - 2004)** **Chair: Dr S Elangovan & Dr R Rajamani** **Venue: Y Block 3rd Floor Smart Class Room**

1. **Paper ID 1001: Design Evaluation and Reverse Engineering of a Hand-Operated Air Pump Using CAD and 3D Printing** by Balamurugan R, Surya S, Barath S, Hariharan K

2. **Paper ID 1002: Experimental Study of a Biogas Production in Existing Biogas Plant for a Sustainable Solid Waste Management** by Dr R Premsudha, Hariskumar S, Maheswari, Moovanthika G, Regupathiraja J

3. **Paper ID 1003: Innovative Approaches to Sustainable Plastic Waste Bottle Management** by Dr. R. Premsudha, Paramasivam. M , Akila R, Arisiya Vajila M, Kavinkumar.M, Bhathreesan S M

4. **Paper ID 1004: Artificial Intelligence Driven Process Optimization for Sustainable Smart Manufacturing** by Sangavi J, Sabarish R, Eben Varghese Shaji

5. **Paper ID 1005: Digital Twin Technology for Smart Manufacturing** by Sai Swaroopa J, Ashwan A, Gowtham V

6. **Paper ID 2001: Performance optimization of Gas Tungsten Arc Welded dissimilar AA2024 & AA6061 Aluminium Alloys to alleviate Hot Cracking Phenomenon** by Suresh Rajkumar and **Jayakrishnan** Nampoothiri

7. **Paper ID 2002: Electrical Discharge Micro Drilling of WAAM Fabricated Functionally Graded Material of Alternate Layers of AISI 410 SS and Inconel 625 Using Grey Relational Analysis** by R Arun Prakash, J Pradeep Kumar, Lakshman Raghav V G, Soundarya Devi M, T M Gokul, Tharunbalaji V S

8. **Paper ID 2003: Piezoelectric Energy Harvesting By Tapping Pad In Bustling Street** by Narmada S B, Vigneshwaran

9. **Paper ID 2004: Parametric Optimization in Wire EDM of FGM Hybrid Sheet Using Taguchi Method** by Vinoth Kumar M and J Pradeep Kumar

20.06.2026 (Day - 2) **Technical Sessions**

10.00 AM	**Invited Lecture 2**	**Er S Muthukrishnan** Head - Quality Larsen & Toubro Limited, Coimbatore
10.30 AM	**Tea Break**	
10.45 AM	**Technical Paper Presentation Session - II** Google meeting link: **https://meet.google.com/otb-ybgo-uzm**	**Technical Papers (Paper ID: 1006 & 1007, 2005 - 2012)** **Chair:** **Dr M R Pratheesh Kumar & Dr Jayakishna Nampoothiri** **Venue: Y Block 3rd Floor Smart Class Room**

1. **Paper ID 1006: Integrating Smart Energy Management and Machine Health Monitoring for Next-Generation Sustainable Manufacturing** by Harivishnu M, C Sowmya Dhanalakshmi, Ashiq
2. **Paper ID 1007: Intelligent Sustainable Manufacturing** by I.Pamelia Jone, C.Sowmya Dhanalakshmi, K.Naveen
3. **Paper ID 2005: Effect of Wire Arc Additive Manufacturing and Nanocoating Assisted on Wear Properties of SS316L** by Ishwarya S V and Dr Somasundara Vinoth K
4. **Paper ID 2006: Smart Accident Alarming and Preventing for Industry Infrastructure** by Godwin Deepak J
5. **Paper ID 2007: Tribological Wear Analysis Of Al356/SiC Composites Using Pin-On-Disc Testing** by Nischal Kumar S, J Pradeep Kumar, K Somasundara Vinoth
6. **Paper ID 2008: Springback Reduction in V-Bending Through Process Parameter Optimization** by Nalvetha B, Pradeep Kumar J
7. **Paper ID 2009: Experimental Study on Micro Electric Discharge Machining of Wire Arc Additive Manufactured Inconel 625** by Ragul A, Pradeep Kumar J and Somasundara Vinoth K
8. **Paper ID 2010: Design and Development of a Bio-Inspired Robotic Cat Leg Using Subtractive Rapid Prototyping** by Idhayaraja S & Pradeep Kumar J
9. **Paper ID 2011: Taguchi Analysis on Mitigation of Shrinkage In Injection Moulding Defects** by Palpandi V, J Pradeep Kumar
10. **Paper ID 2012: A DMAIC Re-Analysis of Scrap Reduction in Refrigerator Door Edge-Bending by** Saravanakumar K, Ruthish S, Suruthi R

12.30 PM	**Lunch Break**	
01.45 PM	**Invited Lecture 3**	**Er V V Vaidyaraman** Technical Director Bosch Global Software Technologies Private Limited Coimbatore

02.15 PM	**Technical Paper Presentation Session - III** Google meeting link: **https://meet.google.com/otb-ybgo-uzm**	**Technical Papers (Paper ID: 3001 & 2007 - 2014 & 1008 - 1009)** **Chair:** **Dr J Krishnamoorthi & Dr G Madhan Mohan** **Venue: Y Block 3rd Floor Smart Class Room**

1. **Paper ID 3001: Circular Economy, Business Process Re-engineering and Mass Customization: Circular Customization in the Manufacturing Systems** by Dr Kingshuk Sen, P
2. **Paper ID 2013: Machinability of WE43 Magnesium Alloy Using Coated Carbide Inserts** by Manigandan S
3. **Paper ID 2014: Experimental Investigation on CNC Machining of Leaded Gunmetal** by Sukumaran J K
4. **Paper ID 2015: Experimental Investigation and Optimization of Machining Parameters in CNC Lathe** by S Sanjay Sree Varshan, Krishnaraj V
5. **Paper ID 2016: Application of Monte Carlo Simulation in Six Sigma-Based Process Optimization: A DMAIC Approach to Supply Chain Risk Management by** Kishornath A, Saravanakumar K
6. **Paper ID 2017: Process Parameter Optimization and Evaluation of Dimensional Accuracy and Geometrical Tolerances in LP-DED Fabricated AISI 316L Components by** Prabhakaran Sivalingam, Panner Selvam Periyasamy, Vignesh P, Vitto Adon R
7. **Paper ID 1008: Geo-Polymer Concrete Incorporating Recycled Micro-Plastic Aggregate: A Circular Economy Approach for Sustainable Infrastructure by** Kalaimathi D, Mohana R, Prajin V, Jothi S
8. **Paper ID 1009: Smart IOT-Based Irrigation System for Water-Efficient Agriculture by** Pratheba S, Deepa M, RajaKaviyarasan D,Premkumar A, ,Devika , Lingeshwaran N
9. **Paper ID 1010: AI-Integrated Green Building Audit Framework for Circular Economy: A Sustainable Approach toward Net-Zero Construction** by Alan Cijo, Amrutha Prathyankara, Rajadurai P, Akil K
10. **Paper ID 1011: Digital Twins in Manufacturing Industries: A Review of Applications, Challenges, and Future Trends** by Jayasurya J, Mohamed Thaiyub A, MohanRaj N
11. **Paper ID 2018: Process Capability Analysis of Metformin Hcl Tablets Using Six Sigma Methodology a Six Sigma Based Study on Pharmaceutical Tablet Quality Analysis** by Saravana Kumar K, Vinothini D, Lalitha Sree G
12. **Paper ID 2019: Improvement of Welding Quality in Structural Fabrication Using Lean Six Sigma DMAIC Methodology and Pareto Analysis** by Dheepika S P, Agatheeswaran N, Saravanakumar K

03.15 PM	**Tea Break**

Valedictory Session

Venue: Y Block 3rd Floor Smart Class Room

03.30 PM	Welcome & Presidential Address by	**Dr M Senthilkumar** Chairman, IEI Coimbatore Local Centre & Professor and Head Department of Production Engineering PSG College of Technology, Coimbatore
	Reporting on the Technical Sessions	**Dr J Krishnamoorthi** Immediate Past Chairman, IEI Coimbatore Local Centre & Professor and Head Department of Metallurgical Engineering PSG College of Technology, Coimbatore
	Finalization of Recommendations	**Dr M R Pratheesh Kumar** Organizing Secretary & Associate Professor Department of Production Engineering PSG College of Technology, Coimbatore
	Certificate Distribution	**Dr M Senthilkumar** Chairman, IEI Coimbatore Local Centre & Professor and Head Department of Production Engineering PSG College of Technology, Coimbatore
	Vote of thanks by	**Dr J Pradeep Kumar** Honorary Secretary, IEI Coimbatore Local Centre & Associate Professor Department of Production Engineering PSG College of Technology, Coimbatore
	National Anthem	

Eminent Speaker

Dr P Hariharan
Professor and Dean
Department Manufacturing Engineering
College of Engineering, Guindy
Anna University, Chennai



Dr P Hariharan is a distinguished academician, researcher, and manufacturing engineering expert with over three decades of teaching, research, and professional experience. He is serving as Professor in the Department of Manufacturing Engineering, College of Engineering Guindy, Anna University, Chennai, and has made significant contributions to the fields of manufacturing technology, smart manufacturing, precision engineering, CAD/CAM, metrology, micro-manufacturing, Industry 4.0, and advanced production systems.

Throughout his academic career, Dr Hariharan has successfully organized and coordinated numerous national and international conferences, workshops, seminars, and training programmes in emerging areas of manufacturing engineering, including Smart Manufacturing, Industry 4.0, Robotics, CNC Technology, Metrology, Additive Manufacturing, and Advanced Manufacturing Systems. He has actively promoted industry–academia collaboration and capacity building among engineering professionals, researchers, and students.

Dr Hariharan has participated and contributed to several prestigious international and national conferences, workshops, and research initiatives conducted by leading institutions such as IIT Madras, IIT Kanpur, IIT Bombay, Anna University, CMTI Bengaluru, and international organizations. His research contributions have been recognized through high-impact publications, patents, and professional awards.

A dedicated researcher and innovator, he holds multiple patents in areas related to manufacturing systems, renewable energy applications, transportation safety, and engineering product development. His outstanding contributions to engineering education and research have earned him several recognitions, including the High Impact Research Publication Award from Anna University and the Certificate of Commemoration for 25 Years of Unblemished Service.

Through his sustained commitment to excellence in teaching, research, innovation, and professional service, Dr P. Hariharan continues to contribute significantly to the advancement of production engineering and the development of competent engineering professionals.

Lecture Note

Title: **“Micromachining advances: Ten Years of PhD led Research”**

Micromachining is the process of manufacturing extremely small components, typically with feature sizes ranging from 1 to 999 micrometers (μm). The demand for micromachining is driven by the megatrend of miniaturization across high-value industries like aerospace, biomedical, energy, automotive and electronics for three critical reasons, functionality at scale, material integrity, and economic efficiency.

Over the years, the research group led by P. Hariharan have made significant contributions to micromachining domain through a series of masters and doctoral investigations focusing on micro domains of electrical discharge machining and micro domains of electrochemical machining and advanced hybrid micromachining techniques. These research efforts have addressed critical challenges associated with machining difficult-to-cut materials, improving dimensional accuracy, enhancing surface integrity, increasing material removal efficiency, and controlling process instabilities with statistical optimization techniques.

Progressive research consists of focusing on die-sinking Micro-EDM of hardened die steels, where the influence of electrode materials, discharge energy, tool wear, heat-affected zones, and surface characteristics were systematically studied and analyzed through number of experiments. These studies established optimal combinations of process parameters and electrode materials for achieving high-quality micro-features.

Subsequent research expanded into electrochemical micromachining of stainless steels and superalloys, including SS304, A286, Nitinol and Co–Ni–Cr–W based alloys. Particular emphasis was placed on understanding anodic dissolution mechanisms, electrolyte behavior, stray current effects, tool material selection, scale effects and micro-hole quality. Novel approaches on hybrid micromachining involves assistance of magnetic-field machining, dual-fluid systems, introduction of auxiliary electrodes, and non-aqueous electrolytes. Advancements led into the development of micro-tool fabrication through reverse ECMM, enabling the production of specialized hollow and tapered micro-tools for machining deep and complex micro-features. Further advancements included studies on deep inclined micro-hole machining using rotating helical tools, supported by computational fluid dynamics (CFD) analysis to understand electrolyte flow and debris evacuation mechanisms. Collectively, this research journey has established a strong foundation for precision micro manufacturing of advanced engineering materials while providing practical solutions for industrial applications requiring high-aspect-ratio micro-features and superior surface quality with valuable scientific knowledge, and innovative machining methodologies.

Micromachining is no longer a niche specialty; it is the backbone of Industry 4.0’s hardware. As we push towards, Industry 5.0, the frontier is not just smaller parts it is perfect parts at the micro-scale, enabling the next generation of materials towards sustainable processes.

Eminent Speaker



Er V V Vaidyaraman
Technical Director
Bosch Global Software Technologies Private Limited
Coimbatore

Er. V. V. Vaidyaraman currently serves as the Technical Director at Bosch Global Software Technologies Private Limited, Coimbatore. With over three decades of professional experience in engineering, product development, and technology leadership, he has made significant contributions to the development of advanced engineering and software solutions for global industries. His technical education began with a Diploma in Mechanical Engineering (Automotive Technology) from Thiagarajar Polytechnic College. He completed a Bachelor's degree in Business Administration from University of Madras between 2000 and 2003 and he obtained a Bachelor's degree in Mechanical Engineering from Dr. MGR Educational and Research Institute during the period 2004-2008. He completed his Master's degree in Business Administration from Indira Gandhi National Open University between 2005 and 2008, where he was actively engaged in academic activities related to Operations Research. Er. V. V. Vaidyaraman has a strong multidisciplinary educational background combining mechanical engineering and business administration. He began his professional career in the early 1990s as a CAD Engineer at Simpson & Co. Ltd. Over the years, he held several progressive roles including Assistant Engineer at Barry-Wehmiller International and Segment Manager for Product Development at Delphi, where he was actively involved in engineering design and development for automotive and industrial applications. In 2008, he joined Bosch Global Software Technologies, where he served for many years as Deputy General Manager in Product Engineering before taking on his current leadership role as Technical Director. He leads multidisciplinary engineering teams and contributes to the development of cutting-edge solutions in mobility engineering, embedded systems, and digital technologies.

Lecture Note

Title: **"Sustainable Smart Manufacturing - Smart Factories, Sustainable Future"**

- Manufacturing industries are moving from Take-Make-Dispose to Reduce-Reuse-Remanufacture-Recycle, enabling Circular Economy through Sustainable Smart Manufacturing.
- Sustainable Smart Manufacturing is the integration of data-driven Industry 4.0 technologies with eco-friendly production practices to minimize environmental impact while maximizing operational efficiency.
- Evolution of Industrial Revolutions from Industry 1.0 to Industry 5.0 with their key drivers and major technologies.
- Specific details on Industry 4.0, such as Industrial Internet of Things (IIoT), Artificial Intelligence, Digital Twin, Big Data Analysis, which represents the digital transformation of manufacturing through intelligent, connected systems (a.k.a. Smart Manufacturing) and its contribution to sustainability. Along with Industry 5.0, Sustainable Manufacturing Revolution, its 3 pillars & technologies.
- Brief overview on Industry 5.0 and Circular Economy, which supports 4R, Reduce, Reuse, Remanufacture & Recycle.
- Overview of Government of India Initiatives for Sustainable Smart Manufacturing and what is the future vision on Factory of 2035.

- Key messages are Industry 4.0 made factories intelligent. Industry 5.0 is making factories intelligent, sustainable, resilient, and human-centered.
- India's manufacturing journey is no longer only about producing more. It is increasingly about producing smarter, cleaner, greener and more sustainable through digital technologies, circular economy principles and Industry 5.0 practices.
- Sustainable Smart Manufacturing is the bridge that connects digital transformation with environmental responsibility and circular economy principles.
- Engineers of the future will not be judged only by productivity and cost reduction, but by their ability to create intelligent, sustainable, low-carbon, circular, and human-centric manufacturing systems.

Eminent Speaker



Er S Muthukrishnan
Head - Quality
Larsen & Toubro Limited
Coimbatore

S. Muthukrishnan is an accomplished Quality Assurance professional with over 15 years of experience in the Aerospace and Defense sector. Currently serving as Manager - Quality Assurance & Quality Control at Larsen & Toubro, he brings extensive expertise in quality systems, NDT, supplier quality, and AS9100 standards. He has played a key role in ensuring product excellence across complex manufacturing processes, including machining, welding, and assembly, while actively driving continuous improvement and risk management initiatives. He is a Certified Internal Auditor for AS9100 and ISMS, demonstrating strong competence in quality and information security management systems. Further strengthening his digital and technological capabilities, he has successfully completed a Capability Building Program in Artificial Intelligence, Internet of Things (IoT), and Machine Learning from IIT Roorkee.

With a strong academic background in Mechanical Engineering and hands-on experience across leading organizations such as L&T and Bharat Electronics Limited, he combines technical proficiency with a commitment to innovation, compliance, and operational excellence. His passion for learning and implementing new technologies contributes to enhancing quality standards and supporting organizational growth.

Lecture Note

Title: **“Integration of AI, Autonomy & Cyber Security in QA Processes”**

The integration of Artificial Intelligence (AI), Autonomy, Robotic Process Automation (RPA), and Cybersecurity is transforming Quality Assurance (QA) into a SMART, technology-driven system.

Traditional QA approaches are largely reactive, manual, and inefficient. The modern approach emphasizes automation, digital workflows, and data-driven decision-making, enabling faster and more proactive quality management.

AI enables predictive defect detection and intelligent analysis, while autonomous systems support self-correcting and highly precise inspection processes. RPA reduces manual effort by automating repetitive tasks and minimizing errors, and cybersecurity ensures data protection, system integrity, and regulatory compliance in digital environments.

The combined implementation of these technologies significantly improves accuracy, speed, and operational efficiency, while reducing manpower and process time. Although challenges such as resistance to change, system integration, and skill gaps exist, they can be effectively addressed through training, automation, and structured adoption strategies.

Overall, the future of QA lies in intelligent, automated, secure, and scalable systems that enable proactive quality excellence and enhanced performance.

Fortieth National Convention of Production Engineers

and

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Technical Paper Abstracts

Paper ID: 1001

Design Evaluation and Reverse Engineering of a Hand-Operated Air Pump Using CAD and 3D Printing

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Abstract

This paper focuses on the reverse engineering and design analysis of a hand-operated air pump to understand its internal features and working behaviour. Even though the pump looks simple externally, its performance mainly depends on its fit, alignment, and sealing of internal components. In this work, the pump was dismantled and important parts such as the piston, cylinder, piston ring, handle, and rubber bush were measured and studied carefully. Based on the measured dimensions, a 3D CAD model of the pump assembly was created to analyse the arrangement and motion of the components. Basic design calculations were also carried out for the piston ring to check the stress conditions and factor of safety using nitrile rubber properties. A prototype model was fabricated using 3D printing to verify the assembly and overall mechanism. The study helped in understanding the working principle of small pneumatic devices and showed how reverse engineering can be useful for analysing and improving existing mechanical products and components.

Keywords: Reverse Engineering; Hand-Operated Air Pump; CAD Modelling; Pneumatic Systems; 3D Printing; Design Analysis.

Paper ID: 1002

Experimental Study of a Biogas Production in Existing Biogas Plant for a Sustainable Solid Waste Management

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Abstract

The rapid increase in municipal solid waste (MSW) generation due to urbanization, industrialization, and population growth has become a serious environmental concern in developing countries. A significant fraction of this waste consists of biodegradable materials such as food waste, agricultural residues, and paper-based waste, which, if not properly managed, lead to environmental pollution, emission of greenhouse gases, and deterioration of soil and water quality. In this context, the present study focuses on the conversion of biodegradable waste into biogas through anaerobic digestion. The initial phase of the study was carried out at Akshaya College of Engineering and Technology, where preliminary data collection, literature survey, and identification of suitable waste substrates were performed. the practical experimentation was extended to Tamil Nadu Agricultural University, which has a dedicated renewable energy research unit. This combined approach ensured both theoretical understanding and experimental validation of the study. The study analyzes the physicochemical characteristics of the substrates, including pH, moisture content, electrical conductivity, total solids (TS), volatile solids (VS), volatile fatty acids (VFA), total dissolved solids (TDS), total organic carbon (TOC), nitrogen content, and carbon-to-nitrogen (C/N) ratio. These parameters play a crucial role in determining the efficiency of the anaerobic digestion process. The experimental investigation was conducted using a 10 L capacity Dheenabandhu digester at TNAU. A total of 5 kg of feedstock was prepared for each experimental cycle, consisting of 1.25 kg food waste, 1.25 kg cow dung or paper sludge, and 2.5 kg water, maintaining a mixing ratio of 1:1:2. The digestion process was carried out for a period of five weeks, with each cycle lasting six days. Different substrate combinations were tested, including food waste with cow dung (FW + CD) during the first, third, and fourth weeks, and food waste with paper sludge (FW + PS) during the second and fifth weeks. Biogas production was measured daily using standard gas collection methods, and cumulative gas production was calculated for each week to analyze the performance trend. The results of the study revealed that the FW + CD combination exhibited higher biogas production compared to FW + PS. This is attributed to the presence of active microbial population and better nutrient balance in cow dung, which enhances the digestion process. The biogas production followed a typical pattern, starting with a lag phase, followed by an active gas production phase, and finally reaching a stabilization phase. The cumulative biogas production increased progressively over the weeks, indicating improved microbial adaptation and digestion efficiency. The fourth week showed the highest gas production, demonstrating the stability of the digestion process under optimized conditions.

Keywords: Industrialization, Physicochemical, Dheenabandhu, digester, Urbanization.

Paper ID: 1003

Innovative Approaches to Sustainable Plastic Waste Bottle Management:

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Abstract

The rapid increase in plastic waste generation has become a major environmental concern due to its non-biodegradable nature and improper disposal practices. This study explores the production of sustainable construction bricks using recycled plastic waste and sand as an alternative to conventional building materials. The primary objective is to utilize discarded plastic effectively while reducing environmental pollution and minimizing the consumption of traditional clay bricks. The experimental methodology involved the collection, sorting, cleaning, shredding, and melting of plastic waste, followed by mixing with sand in different proportions and moulding into brick specimens. Various plastic-to-sand ratios were prepared to identify the optimal composition for enhanced performance. The manufactured bricks were subjected to compressive strength and water absorption tests to evaluate their mechanical and durability characteristics. The results indicated that plastic-sand bricks exhibit satisfactory compressive strength, low water absorption, lightweight properties, and enhanced resistance to moisture compared to conventional clay bricks. Among the different mix proportions tested, the specimen containing 40% recycled plastic and 60% sand achieved the highest compressive strength and overall performance. Furthermore, the manufacturing process eliminates the need for kiln firing, thereby reducing energy consumption and greenhouse gas emissions. The findings demonstrate that recycled plastic bricks are a sustainable, cost-effective, and environmentally friendly construction material suitable for non-load-bearing applications such as partition walls, paving blocks, walkways, and temporary structures. This approach contributes to effective plastic waste management, resource conservation, and the promotion of circular economy principles in the construction industry.

Keywords: Recycled Plastic Waste, Plastic-Sand Bricks, Sustainable Construction, Waste Management, Circular Economy, Eco-Friendly Building Materials, Environmental Sustainability.

Paper ID: 1004

Artificial Intelligence Driven Process Optimization for Sustainable Smart Manufacturing

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Abstract

The rapid growth of modern industries has increased the need for smart, efficient, and sustainable manufacturing systems. Traditional manufacturing methods often face problems such as production delays, machine failures, material wastage, high energy consumption, and reduced productivity. To overcome these challenges, Artificial Intelligence (AI) is playing an important role in transforming industries into intelligent manufacturing systems.

This paper focuses on the application of AI in process optimization and smart manufacturing. AI technologies such as Machine Learning, Predictive Maintenance, Computer Vision, and Industrial Automation help industries monitor production processes, analyze real-time data, detect faults, and improve decision-making. These technologies increase production efficiency, reduce human errors, improve product quality, and minimize operational costs.

The integration of AI with Industry 4.0 technologies such as IoT sensors, robotics, and data analytics creates a smart manufacturing environment capable of automatic monitoring and control. AI-based predictive maintenance systems can identify equipment problems before failure occurs, helping industries reduce downtime and maintenance expenses. In addition, AI contributes to sustainable manufacturing by reducing energy consumption, minimizing waste generation, and supporting environmentally friendly production practices.

This paper also highlights the role of AI in supporting circular economy concepts through efficient resource utilization, waste reduction, and sustainable production methods. Several industrial applications in sectors such as automotive, electronics, and textile manufacturing demonstrate the effectiveness of AI-driven systems in improving productivity and sustainability.

The study concludes that AI-driven process optimization is an essential part of future smart manufacturing systems. The adoption of AI technologies can help industries achieve higher efficiency, improved sustainability, and long-term industrial growth while supporting environmentally responsible manufacturing practices.

Keywords: Artificial Intelligence, Smart Manufacturing, Industry 4.0, Sustainable Manufacturing, Process Optimization, Industrial Automation, Circular Economy.

Paper ID: 1005

Digital Twin Technology for Smart Manufacturing

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Abstract

Digital Twin Technology is transforming the manufacturing industry by enabling real-time monitoring, simulation, and optimization of industrial processes. A digital twin is a virtual replica of a physical system that continuously collects and analyzes data using technologies such as Artificial Intelligence (AI), Internet of Things (IoT), cloud computing, and data analytics. In smart manufacturing, digital twins help industries improve operational efficiency, reduce machine downtime, enhance product quality, and support predictive maintenance. This technology also enables manufacturers to simulate production processes before actual implementation, thereby reducing errors, minimizing costs, and increasing productivity. Furthermore, digital twin systems contribute to sustainable manufacturing practices by optimizing energy consumption and reducing material waste. The integration of Digital Twin Technology with Industry 4.0 concepts creates intelligent manufacturing environments capable of making data-driven decisions in real time. This paper highlights the importance, applications, benefits, and challenges of digital twin technology in smart manufacturing and discusses its future scope in building efficient, flexible, and sustainable industrial systems.

Keywords: Digital Twin, Smart Manufacturing, Industry 4.0, Artificial Intelligence, IoT, Predictive Maintenance

Paper ID: 1006

Integrating Smart Energy Management and Machine Health for Next-Generation Sustainable Manufacturing

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Abstract

Sustainable manufacturing has emerged as a crucial paradigm in mechanical engineering, driven by the need to reduce energy consumption, minimize waste, and improve operational efficiency while maintaining economic viability of the process. Modern manufacturing facilities rely heavily on energy-intensive machinery, such as drilling machines and electric motors, which consume significant power and are prone to wear and failures. Therefore, the efficient management of both energy and machine health is essential for achieving sustainability in production systems. This study explores a combined approach that integrates energy-efficient machining processes with condition-based monitoring of mechanical systems to enhance sustainability in manufacturing. In the first part of this study, we focused on the drilling process, a common mechanical operation that requires substantial energy input. Traditional models for predicting drilling power and energy consumption are often complex and difficult to apply in practical settings. To address this challenge, a rapid and simplified energy prediction method is proposed that reduces computational complexity while maintaining high accuracy in power estimation. This approach allows manufacturing personnel to anticipate energy demands in real time and optimize drilling operations accordingly, thereby reducing unnecessary energy consumption and operational costs. The second part of this study examines the health and operational efficiency of motors driving manufacturing equipment. Motor failures or suboptimal performance can lead to unplanned downtimes, material waste, and increased maintenance costs. By employing vibration analysis and ensemble learning algorithms, the motor operational conditions can be accurately classified, enabling predictive maintenance. This proactive strategy ensures timely intervention, extends the lifespan of machinery, and reduces the environmental footprint of maintenance. By integrating these two approaches, energy-efficient drilling and predictive motor maintenance, a comprehensive framework was developed to promote sustainable manufacturing practices. The expected outcomes include significant reductions in energy consumption, fewer machine breakdowns, improved productivity, and minimization of material and resource waste. This study emphasizes that even simple monitoring and prediction methods, when applied thoughtfully, can lead to substantial environmental and economic benefits. This study contributes to the broader field of mechanical engineering by demonstrating practical strategies that combine energy optimization and machine health management. This underscores the importance of adopting holistic and proactive measures in manufacturing systems to achieve sustainability goals, ultimately supporting cleaner, cost-effective, and resilient production processes.

Keywords: Sustainable Manufacturing, Energy-Efficient Machining, Predictive Maintenance, Condition Monitoring, Ensemble Learning Algorithms

Paper ID: 1007

Intelligent Sustainable Manufacturing

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Abstract

The goal of sustainable manufacturing is to produce goods using methods that reduce adverse environmental effects, conserve energy and natural resources, are safe for workers, the public, and consumers, and are financially viable. Product solutions that are adaptable, versatile, and have the least environmental impact are becoming more and more popular. In this regard, the advantages of Industry 4.0 (I4.0) applications can be linked to social and environmental sustainability. Although the three primary elements (or pillars) of sustainability—social, economic, and environmental are essential when discussing production, they should also be viewed from a wider angle.

At this crucial point, the manufacturing industry is under growing pressure to lessen its environmental impact while preserving its competitiveness and productivity. An essential tool for addressing these issues is sustainable manufacturing, which aims to create and develop cost-effective methods of producing flawless goods using tried-and-true processes that utilise little energy and natural resources and have little impact on the environment. The rapid advancement of machine learning (ML) and artificial intelligence (AI) technology has also created new avenues for the growth of manufacturing industries across many sectors. One of the finest ways to promote sustainable development and increase economic success at the same time is to integrate AI and ML into sustainable manufacturing strategies.

Keywords: Sustainable Manufacturing, Energy-Efficient Machining, Predictive Maintenance, Condition Monitoring, Ensemble Learning Algorithms

Paper ID: 1008

Geo-Polymer Concrete Incorporating Recycled Micro-Plastic Aggregate: A Circular Economy Approach for Sustainable Infrastructure

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Abstract

This paper presents a first-of-its-kind integrated framework that simultaneously valorises post-consumer micro-plastic waste and decarbonises the construction supply chain. Fly ash-GGBS geo-polymer concrete (GPC) is formulated with recycled micro-plastic aggregate (R-MPA) derived from HDPE and PET waste at volumetric substitution levels of 0%, 10%, 20%, and 30% for natural fine aggregate. Experimental characterisation encompassed compressive and tensile strength (IS 516, IS 5816), durability (RCPT per ASTM C1202, acid resistance), and microstructural analysis (FESEM-EDX, TGA). The GPC-20 mix (20% R-MPA, NaOH-treated) achieved the optimal performance envelope: 38.4 MPa compressive strength at 28 days (satisfying IS 456 M35 grade) and 22.1% embodied carbon reduction over equivalent OPC concrete (M30). Per cubic metre of GPC-20 produced, 47.3 kg of micro-plastic is diverted from the environment and 69 kg of CO_2 is avoided. The framework directly advances UN Sustainable Development Goals 9, 11, and 12, and India's net-zero commitments under the Paris Agreement.

Keywords: Geo-polymer concrete; recycled micro-plastic aggregate; circular economy; Industry 4.0; GGBS; fly ash.

Paper ID: 1009

Smart IOT-Based Irrigation System for Water-Efficient Agriculture

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Abstract

Water scarcity and inefficient irrigation practices pose significant challenges to sustainable agricultural production, particularly in arid and semi-arid regions. This paper presents a smart irrigation system framework that integrates soil moisture sensing, environmental monitoring, microcontroller-based control, and IoT connectivity to optimise on-farm water use. The system continuously monitors real-time soil moisture, temperature, and relative humidity and automatically regulates irrigation based on crop-specific threshold values. When the soil moisture content falls below a predefined set point, the controller (Arduino/ESP32) activates solenoid valves or pumps; irrigation is terminated once the desired moisture level is restored, thereby minimizing water wastage and avoiding over-irrigation. A prototype system was modelled for a small-scale field, and a comparative analysis between conventional time-based irrigation and sensor-based smart irrigation was carried out. The proposed system demonstrated potential water savings in the range of 30–50% (conceptual estimate) while maintaining or improving crop health through more precise water delivery. Integration with a mobile/IoT dashboard enables remote monitoring, data logging, and control, supporting data-driven farm management decisions. The framework contributes to Sustainable Development Goals (SDGs) 2 (Zero Hunger), 6 (Clean Water and Sanitation), and 12 (Responsible Consumption and Production) by promoting efficient water management and sustainable agricultural practices.

Keywords: Smart irrigation; soil moisture sensor; IoT; Arduino; water efficiency; sustainable agriculture.

Paper ID: 1010

AI-Integrated Green Building Audit Framework for Circular Economy: A Sustainable Approach toward Net-Zero Construction

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Abstract

The construction sector contributes approximately 39% of global CO_2 emissions and generates over 1.3 billion tonnes of solid waste annually, making it one of the most resource-intensive industries in the world. This paper presents an AI-integrated Green Building Audit Framework (GBAF) designed to assess construction projects against Indian Green Building Standards, primarily GRIHA (Green Rating for Integrated Habitat Assessment) and IGBC (Indian Green Building Council) while incorporating circular economy (CE) principles such as material reuse, waste valorisation, and closed-loop resource flows. The proposed framework leverages OpenAI's language model APIs and a web-based interface to deliver real-time compliance scoring, actionable sustainability tips, and carbon footprint estimation for building projects in the Indian context. A pilot case study on a G+3 residential structure in Coimbatore, Tamil Nadu, using supplementary cementitious materials (GGBS-blended M40 concrete) demonstrates that compared to conventional OPC mixes, a 28% reduction in embodied carbon could be achieved. The framework bridges the gap between digital construction intelligence and on-ground sustainability practice, aligning with SDG 11 (Sustainable Cities), SDG 12 (Responsible Consumption), and SDG 13 (Climate Action).

Keywords: Green Building, Circular Economy, Net Zero, Sustainable Construction, AI Audit

Paper ID: 1011

Digital Twins in Manufacturing Industries: A Review of Applications, Challenges, and Future Trends

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Abstract

Digital twin is a part of the fourth industrial revolution (Industry 4.0). Digital twin is one of the concepts that is driving smart manufacturing: the ability to physically represent a product or a real-world process. Real-time monitoring, process optimization, quality assurance, predictive maintenance, and system reconfiguration are all areas where digital twin applications in manufacturing are consistently proving their importance. Big Data, the Internet of Things, product lifecycle management, artificial intelligence, and machine learning are just a few of the concepts that digital twins use to optimize manufacturing operations. The literature review reveals that digital twins are applied at different scales, from the machine and unit level to production lines, factories, and smart manufacturing systems, with benefits such as reduced downtime and improved quality. This review focuses with a complicated field in terms of definitions, scope, implementation and applications. Stronger and more applications in the fields of machining, assembly, smart workshop control, and reconfigurable systems, while newer directions consider learning-based optimization and human-machine knowledge integration. Overall, this review suggests that digital twins are evolving from descriptive virtual twins to actionable manufacturing infrastructures..

Keywords: Digital twin; Industry 4.0; smart manufacturing; Machine learning.

Paper ID: 3001

Circular Economy, Business Process Re-engineering and Mass Customization: Circular Customization in the Manufacturing Systems

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Abstract

By introducing a sustainable production and consumption system, opposite to the linear production and consumption system, circular economy introduces the concept of value generation by reusing resources. To reduce cumulative generation of waste, circular economy is proved to be a sustainable alternative for effective waste management and better control on socio-environmental issues. Business Process Re-engineering aims to redesign the core business workflows, eliminate redundant work components, optimize resources, and achieve dramatic improvements in speed, quality, and cost. Mass Customization is a competitive strategy that allows organizations to produce personalized, goods and services and thus balances mass production with the customer-centric strategy. Circular customization integrates these three concepts. when there is convergence of mass customization, streamlined work flow and regenerative production, that leads to a sustainable business model.

The objective of this study is to analyse and determine the points of coordination and improvement for a sustainable business model and explore further towards design and development of a Circular Customization Model.

Keywords: Circular Economy; Business Process Reengineering; Mass Customization; Circular Customization

Paper ID: 2001

Performance Optimization of Gas Tungsten Arc Welded dissimilar AA2024 & AA6061 Aluminium Alloys to alleviate Hot Cracking Phenomenon

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Abstract

Welding of dissimilar aluminium alloy materials are influencing a vital role in the modern industry requirement and applications in Aerospace, Automotive, Marine and Structural applications for Light weight and Higher Strength to Weight ratio. Several Aluminium alloys are used in Industrial applications to suit various needs, among that AA2024 and AA6061 are playing key role in structural applications of automobiles and aerospace sector. AA2024 is copper based aluminium alloy which can be heat treated and best suited for cyclic loading applications. AA6061 is magnesium, Silicon based aluminium alloy suited for corrosion resistance, structural toughness and weldability. Combination of this two aluminium alloy provides better structural performance with good strength in Automobile Sector. This research work focused on performance optimization of Gas Tungsten Arc Welded (GTAW) dissimilar Aluminium Alloys in place of Conventional Resistance Spot Welding (RSW) process used in Automobile applications. The research focusses on weldability of AA2024 and AA6061 using a conventional ER4043 aluminium silicon filler wire which possess better fluidity and good crack resistance. The hot cracking phenomenon of the weldment will be assessed by Liquid Penetrant Testing (LPT) method and the results will be optimized with the help of ANOVA analysis and the Design of Experiments was populated using Taguchi L9 orthogonal Array.

Keywords: AA2024, AA6061, Gas Tungsten Arc Welding (GTAW), Resistance Spot Welding (RSW), ANOVA, Taguchi, Welding Current, Gas Flow Rate

Paper ID: 2002

Electrical Discharge Micro Drilling of WAAM Fabricated Functionally Graded Material of Alternate Layers of AISI 410 SS and Inconel 625 Using Grey Relational Analysis

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Abstract

Machining of Functionally Graded Materials (FGMs) fabricated through Wire Arc Additive Manufacturing (WAAM) presents notable challenges due to their varied microstructure and differing material properties. In this study, Micro Electrical Discharge Drilling (micro-EDM) is induced to machine FGMs composed of alternate layers of AISI 410 stainless steel and Inconel 625. The influence of process parameters such as current, voltage, duty cycle, electrode diameter, and work piece thickness on machining performance is investigated. The performance characteristics considered include material removal rate (MRR), hole diameter error (HDE), overcut (OC), taper angle (TA), and aspect ratio (AR). Grey Relational Analysis (GRA) is employed to perform multi-objective optimization by converting multiple responses into a single grey relational grade (GRG). The optimal parameter combination was identified through GRA rank which provides an improvement in productivity and accuracy. The study demonstrates the effectiveness of GRA in optimizing micro-EDM drilling parameters for WAAM-fabricated FGMs.

Keywords: Micro-Electrical Discharge Machining (Micro-EDM), Wire Arc Additive Manufacturing (WAAM), Functionally Graded Material (FGM), Inconel 625, AISI 410, Grey Relational Analysis.

Paper ID: 2003

Piezoelectric Energy Harvesting by Tapping Pad in Bustling Street

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Abstract

This project focuses to produce an environmental friendly clean energy, in a sustainable way. Recently the demand for clean energy generation from renewable energy source is spiked up. Conventional form of energy is limited and cause intense environmental impact in nature. In order to overcome energy crisis issues, the project aims to build a fun game based tapping pad set-up in a bustling areas, will help generate a clean form of energy. That will generate the required amount of energy for the particular area, in addition to that it will sow seeds in the young minds to think and innovate. This project follows the fundamental of piezoelectric plate working and energy conversion principle. This concept is inspired from the Japanese Footstep Energy Harvester. Conversion of mechanical stress into an electricity. When a mechanical force is enforced on a plate these pressure in turn is converted to electricity. This can be used in a place where low power is required and low power utilizing component. This project targeted to make understand commoners the importance of energy generation in fun methods with entertainment. Focused areas are parks, shopping Centre, and malls. This project comprises of major 3 components includes technology, innovation, and sustainability.

Key words: Non-Conventional energy, fun stuffed energy generation, public participation and awareness, and innovation

Paper ID: 2004

Parametric Optimization in Wire EDM of FGM Hybrid Sheet Using Taguchi Method

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Abstract

This Wire Electrical Discharge Machining (Wire EDM) is a non-traditional machining process used to create complex shapes in (electric) conductive materials with high accuracy. It removes material through controlled electrical sparks between a thin wire electrode and the work piece in a dielectric fluid or medium. This process is useful for machining hard and advanced materials. The conventional methods have difficulties such as tool wear and very low precision. Functionally Graded Materials (FGMs) have gradually varying properties across in their thickness, that improves strength, corrosion resistance, and thermal stability. In this work, a hybrid FGM sheet made of AISI 410 stainless steel and Inconel 625 is selected. Machining such materials is problematic due to their non-uniform properties. The main aim of this work is to optimize Wire EDM parameters such as duty cycle, discharge current, and gap voltage. Experiments are conducted on a Wire EDM machine using a 0.18 mm wire to cut rectangular slots. Performance is assessed based on cutting velocity, dimensional error, and material removal rate. Taguchi's Signal-to-Noise ratio method is used to identify optimal parameter settings for high machining efficiency and good quality.

Keywords: Wire EDM; Functionally Graded Materials; AISI 410; Inconel 625; Taguchi Method; Material Removal Rate.

Paper ID: 2005

Effect of Wire Arc Additive Manufacturing and Nanocoating Assisted on Wear Properties of SS316L

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Abstract

Stainless steel 316L is extensively used in engineering applications; however, its wear behaviour is highly dependent on the processing route and resulting microstructure. In this study, a comparative dry sliding wear analysis is performed on three variants of SS316L, namely asrolled, wire arc additive manufactured (WAAM), and Si_3N_4 nano powder-modified SS316L. Prior to wear testing, all specimens were edge-ground to ensure uniform geometry, cleaned with acetone to remove surface contaminants, and weighed to record the initial mass. Dry sliding wear tests were conducted under constant load, sliding speed, and sliding distance using a pin-on-disc tribometer to enable direct comparison among the materials. The wear performance of the WAAM-fabricated SS316L differs significantly from that of the as-rolled material due to variations in microstructure induced by the additive manufacturing process. The introduction of Si_3N_4 nano powder is intended to enhance surface hardness and improve resistance to material removal during sliding contact. Wear rate was quantified based on mass loss measurements obtained before and after testing. The experimental results demonstrate that the as-rolled SS316L exhibits the lowest wear rate, indicating superior wear resistance under dry sliding conditions. The Si_3N_4 nano powder SS316L shows moderate wear behaviour, while the WAAM specimen records comparatively higher wear loss under identical test parameters. The improved wear resistance of the nano powder-modified material is attributed to the presence of hard ceramic particles, which restrict plastic deformation and enhance load-bearing capacity at the sliding interface. This study emphasizes the influence of processing route and nano-scale reinforcement on the tribological performance of SS316L.

Keywords: Stainless steel 316L, Dry sliding wear, Wire arc additive manufacturing (WAAM), Si_3N_4 nano powder reinforcement, Wear rate, Hardness, Tribological

Paper ID: 2006

Smart Accident Alarming and Preventing for Industry Infrastructure

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Abstract

This project purpose to improve the industry innovation and infrastructure to improving the production and the safety of the human being. Industry improves the R and D (Research and Development) to their product. Innovation should be eco-friendly to society and it also use the used product by the help of recycle .infrastructure of industry should have the safety for the for the human being and implement the smart alarming system, prevent system for the accident can take place in industry or a workplace .the accident can take place by human error ,malfunction or poor real-time monitoring .for this casus list above ,this work propose the developing of the IOT based accident preventing system and real time monitoring system for workplace safety ,machine control on automation based and immediate response to medical in emergency cases.

The system work by the integrated sensor, microcontrollers, IOT communication by the help of transmitter and receiver, machine and deep learning algorithms for fully automating the intelligent safety equipment's for sustainability for the Modern industry setting. A project system monitors the worker and the machine condition with the help of integrated sensor like proximity sensor, heart rate sensor and pulse detector. These sensors provide real time monitoring data that processed by the microcontroller.

Paper ID: 2007

Tribological Wear Analysis of Al356/SiC Composites Using Pin-On-Disc Testing

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Abstract

This work discusses the wear analysis of Al356- SiC composite alloy. This particular composite has received much attention due to the fact that the mechanical properties, including hardness and thermal stability, of SiC reinforced Aluminium alloys are promising and commendable. The aim of this research is to determine the effect of load and sliding speed variation on the wear behavior of Al356-SiC composites while keeping the sliding distance constant. Wear test for the composites were carried out using a pin-on-disc tribometer, where wear analysis of the sample was determined by measuring the weight losses before and after the test was conducted. A statistical method known as response surface methodology was used to determine the influence of the chosen parameters on specific wear rate. The response surface methodology was done using Minitab software.

Keywords: Pin-on-disc tribometry, Al356/SiC composite, specific wear rate, tribological behaviour, Response Surface Methodology

Paper ID: 2008

Spring back Reduction in V-Bending Through Process Parameter Optimization

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Abstract

The V-bending process is crucial in sheet metal forming, but the improper combination of process parameters can lead to issues such as spring-back and dimensional inaccuracies, affecting the quality and precision of formed components. Spring-back is a phenomenon where the material slightly returns to its original shape after bending, which compromises the desired geometry. Dimensional inaccuracies can result in assembly problems, reduced structural integrity, and increased manufacturing costs due to rework or scrap. In this study, the influence of key process parameters punch radius, die opening, and sheet thickness on spring-back in V-bending of SS304 stainless steel is investigated using a Design of Experiments (DoE) approach. Classical DoE methods are employed to analyze the effects of these factors and identify the optimal process parameters. The findings indicate that sheet thickness has the most significant impact on spring-back, followed by die opening and punch radius. The optimal combination of parameters for minimal spring-back is found to be a punch radius of R6 mm, a die opening of 20 mm, and a sheet thickness of 0.5 mm. These insights, derived from ANOVA calculations and main effect plot analysis, provide a pathway for improving dimensional accuracy and reducing spring-back in the V-bending process, ensuring consistent quality in sheet metal forming applications.

Keywords: V-bending, Spring back, SS304, Optimization

Paper ID: 2009

Experimental **Study on Micro Electric Discharge Machining of Wire Arc Additive Manufactured Inconel 625**

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Abstract:

This study investigates the optimization of machining parameters for fabricating micro-holes in Wire Arc Additive Manufactured (WAAM) Inconel 625 using Micro Electric Discharge Machining (Micro EDM). An experimental design based on the Taguchi L9 orthogonal array was employed, focusing on the effects of input current (Ip), pulse-on time (Ton), and pulse-off time (Toff). Using copper electrodes, 800 µm diameter micro-holes were machined, and responses such as Material Removal Rate (MRR), Tool Wear Rate (TWR), and dimensional accuracy (DA) were analyzed. Signal-to-Noise (S/N) ratio analysis was used to determine optimal machining conditions, achieving maximum MRR, minimum TWR, and enhanced DA. The results revealed that the optimal parameters for achieving these objectives were Ip = 2 A, Ton = 5 µs, and Toff = 9 µs. This research highlights the effectiveness of the Taguchi method and S/N analysis in enhancing machining performance for WAAM Inconel 625, contributing to improved precision and efficiency in manufacturing processes.

Keywords: Inconel 625, Micro EDM, Micro-holes, Optimization.

Paper ID: 2010

Design and Development of a Bio-Inspired Robotic Cat Leg Using Subtractive Rapid Prototyping

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Abstract

The development of a bio mimicry-inspired robotic cat leg using subtractive rapid prototyping techniques. The design replicates the proportions and functionality of a natural cat's hind limb, with the femur, tibia, and metatarsal scaled to maintain relative accuracy. Plywood was chosen as the primary material for its lightweight and cost-effective properties, making it ideal for iterative prototyping. The fabrication process involved precise 2D drawings translated into physical components through manual and laser cutting techniques. The assembled robotic leg demonstrated basic locomotion capabilities, mimicking the lifting, extending, and retracting movements of a cat's natural gait. While the prototype proved functional, challenges such as joint stiffness and material wear highlighted areas for improvement. This research underscores the potential of subtractive prototyping in creating biomimetic robotic systems and provides a foundation for future enhancements in joint flexibility, material selection, and movement precision.

Paper ID: 2011

Taguchi Analysis on Mitigation of Shrinkage in Injection Moulding Defects

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Abstract

Injection moulding is a high-quality process that is preferred in modern manufacturing. Due to the defects in Polyproylene (PP) polymer composites the parameter's had to be adjusted based on the necessity. Therefore, this study of parameters is to improve the quality characteristics of the injection moulding of PP samples. As the moulding of Polyproylene (PP) composites varies, the quality aspects that must be controlled are shrinkage and Flash defects. The parameters that are considered as factors are Melting Temperature (•C), Injection pressure (MPa), Injection speed (MPa) and cooling time (sec). Using the Taguchi Optimization method of L9 Orthogonal array, the injection moulding process was performed and found that the injection pressure of 40 MPa and temperature of 290-300 •C showed better results. The influence of parameters was studied through this research using Analysis of Variance (ANNOVA).

Keywords: Polyproylene (Pp), Injection Moulding Machine, Optimization, Annova.

Paper ID: 2012

A DMAIC Re-Analysis of Scrap Reduction in Refrigerator Door Edge-Bending

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Abstract

This paper provides an independent statistical re-analysis of published industrial data from a refrigerator door edge-bending process. The original case study reported baseline production data over 22 days: 17,179 parts with 509 defects, giving a scrap rate of 2.96% or 29,629 DPMO. A Gage Repeatability and Reproducibility study showed total measurement system variation of 28.38%, which fell below the 30% acceptability threshold. A P-chart confirmed that the process was stable during the baseline period. Normality testing using the Anderson-Darling method gave a p value of 0.161, so the normality assumption was not violated. Root cause analysis using an Ishikawa diagram and process mapping identified three independent failure mechanisms: off-axis force from a pneumatic cylinder, weak vacuum retention at the sheet centering station, and inconsistent manual positioning by operators. The team implemented four corrective actions together: removal of the pneumatic cylinder, installation of an extra vacuum cup, recalibration of the punching matrix, and deployment of visual work instructions with physical reference stops. Post-improvement data from another 22 days showed 18,715 parts with only 12 defects, a scrap rate of 0.06% or 641 DPMO. The process capability index Cpk went from negative 10.83 to 2.51. The standard deviation shrank from 0.12 mm to 0.013 mm, a reduction of 89%. The process mean moved from 4.75 mm to 4.002 mm, landing almost exactly on the target of 4.00 mm. A two proportion hypothesis test confirmed that the improvement was statistically significant with a p value below 0.001.

Keywords - Lean Six Sigma, DMAIC, process capability, scrap reduction, Gage R&R, edge bending, data reanalysis

Paper ID: 2013

Machinability of WE43 Magnesium Alloy Using Coated Carbide Inserts

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Abstract

Magnesium alloys, particularly WE43, are widely used in high-performance industries such as aerospace, automotive, and military applications due to their exceptional strength-to-weight ratios. However, their machining presents significant challenges, primarily due to their highly flammable nature. When exposed to heat, sparks, or friction during machining, these alloys are prone to ignition, posing severe safety risks and potential damage to both machinery and work pieces. To mitigate these risks and enhance productivity, it is crucial to carefully manage machining parameters such as tooling, cooling, cutting speeds, and feed rates. Implementing effective fire prevention systems and optimizing machining processes are essential to safely and efficiently machine WE43, minimizing tool wear, reducing costs, and ensuring the safety of both workers and equipment.

Keywords - WE43 Magnesium Alloy, Carbide Insert, Surface Roughness, Tool Wear.

Paper ID: 2014

Experimental Investigation on CNC Machining of Leaded Gunmetal

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Abstract

In manufacturing industries, the largest amount of money spent on drills. Therefore, from the viewpoint of cost and productivity, modeling and optimization of drilling processes parameter are extremely important for the manufacturing industry this paper presents a detailed model for drilling process parameter. This study explores the impact of machining parameters on material removal rate (MRR), cylindricity, and circularity during the drilling of leaded gunmetal using a Vertical Machining Center (VMC). By employing the Taguchi design of experiments (DOE) methodology, the research identifies the optimal parameter settings that enhance performance while maintaining dimensional accuracy. The investigation evaluates key parameters such as spindle speed, feed rate, and depth of cut, analyzing their effects through signal-to-noise (S/N) ratios and analysis of variance (ANOVA). A carbide drill tool with a diameter of 10 mm was utilized for its superior wear resistance and cutting efficiency. Results demonstrate the significant influence of these parameters, providing a comprehensive understanding of the conditions required for achieving high MRR alongside acceptable cylindricity and circularity.

Keywords: ANOVA, Drilling, Gunmetal, MMR

Paper ID: 2015

Experimental Investigation and Optimization of Machining Parameters in CNC Lathe

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Abstract

Tool wear is one of the most critical factors affecting machining accuracy, surface quality, productivity, and manufacturing cost in CNC turning operations. In modern industries, CNC lathes are extensively used to produce components with high dimensional accuracy and repeatability. However, continuous interaction between the cutting tool and workpiece generates heat, friction, and cutting forces, resulting in gradual deterioration of the cutting tool. This study investigates the influence of machining parameters such as cutting speed, feed rate, and depth of cut on tool wear behavior during CNC turning operations. Experiments were conducted using mild steel as the workpiece material and carbide cutting tools under varying machining conditions. Tool wear was measured using flank wear analysis through optical measurement techniques. Material Removal Rate (MRR) was also evaluated to understand the relationship between productivity and tool degradation. Experimental results indicate that cutting speed has the most significant effect on tool wear, followed by feed rate and depth of cut. The study identifies optimal machining conditions for improving tool life while maintaining machining efficiency and surface quality.

Keywords: CNC Turning, Tool Wear, Carbide Tool, Flank Wear, Material Removal Rate, Machining Parameters

Paper ID: 2016

Application of Monte Carlo Simulation in Six Sigma-Based Process Optimization: A DMAIC Approach to Supply Chain Risk Management

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Abstract

Supply chain risk management (SCRM) has emerged as a critical discipline in the era of globalized, interdependent production systems. This paper presents an integrated framework combining Monte Carlo Simulation (MCS) with Six Sigma's DMAIC (Define, Measure, Analyze, Improve, Control) methodology to systematically quantify, analyze, and mitigate supply chain risk. A computational experiment employing 10,000 stochastic iterations was conducted, modeling three principal risk drivers: lead time variability (mean = 5 days, σ = 1.5), demand fluctuation (mean = 1,000 units, σ = 250), and transport delay (mean = 2 days, σ = 0.8). The composite Risk Index converged to a mean of 8.00 (σ = 1.72), spanning a range from 1.27 to 14.26, consistent with a near-normal distribution as confirmed by the Central Limit Theorem. Simulation convergence was demonstrated beyond 2,000 iterations. Results illustrate that MCS provides high-resolution probabilistic risk profiles that enhance DMAIC-based decision making, enabling organizations to transition from reactive to predictive risk governance. The framework offers actionable metrics for process capability assessment (Cp/Cpk), tail-risk quantification (VaR/CVaR), and continuous improvement prioritization.

Keywords: Monte Carlo Simulation, Six Sigma, DMAIC, Supply Chain Risk Management, Stochastic Modeling, Process Optimization, Risk Quantification

Paper ID: 2017

Process Parameter Optimization and Evaluation of Dimensional Accuracy and Geometrical Tolerances in LP-DED Fabricated AISI 316L Components

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Abstract

Laser Powder Directed Energy Deposition (LP-DED) is a promising process for near-net-shape manufacturing and repair of components. However, problems with dimensional accuracy and process repeatability limit industrial application. In this work, the dimensional capabilities of LP-DED for AISI 316L stainless steel were extensively studied by analyzing benchmark artifacts. Single-track experiments were performed to optimize the process parameters and found that 700 W laser power, 4 g/min powder feed rate, and 20 L/min gas flow rate will be the best choice for printing the artifacts. The optimized parameters were then used to fabricate five benchmark artifact structures, such as cubes, cylinders, pyramids, cones, and hemispheres, that were scanned with an Advanced Topometric Optical Sensor (ATOS) structured light scanning system. Dimensional analysis was performed to find out the required dimensional accuracy, and certain aberrations were observed along the build direction, which was due to thermal accumulation and layer-wise deposition technique. The results provide quantitative benchmarks of the dimensional accuracy of the LP-DED process, which enable process optimization and effective fabrication of geometrically precise AISI 316L components.

Keywords - Additive Manufacturing; DED; AISI 316L; Single Track; Geometric Characteristics; Dimensional Tolerances

Paper ID: 2018

Process Capability Analysis of Metformin Hcl Tablets Using Six Sigma Methodology a Six Sigma Based Study on Pharmaceutical Tablet Quality Analysis

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Abstract

Process capability study using Six sigma method for Metformin Hydrochloride tablets manufacturing. The pharmaceutical preparations are generally a complex mixture of active, excipients, binders, lubricants, etc. Quality control of the prepared pharmaceuticals is one of the most important issues worldwide. In this study, six good manufacturing practice (GMP) parameters, such as the hardness, thickness, friability, disintegration time and dissolution rate of Metformin Hydrochloride tablets were evaluated by the statistical process control (SPC) approach, and the calculated capability indices were the main goals of this study. The Statistical Process Control (SPC) was performed on a monthly basis to maintain the quality of the prepared pharmaceuticals. Minitab software was used in the present work for the calculation of Distributions, as well as Capability Analysis. Therefore, 40 samples were developed during this analysis to enhance the process capability. The results of capability indices revealed that thickness and disintegration displayed excellent process capability and process stability. For hardness and friability, acceptable capability indices were obtained, indicating that there was a need for an improvement in the process centering and variation control were observed. However, dissolution exhibited poor capability indices in which this parameter needs a more comprehensive improvement in the manufacturing process. Combination of DMAIC with process capability analysis ensures that the manufacturing process, formulation, and manufacturing process studies are in the focus and that the process variations are identified and analyzed with an aim to enhance the process capability as an overall system.

Keywords - Six Sigma, DMAIC, Pharmaceutical Quality Control, Process Capability Analysis, MINITAB, Statistical Process Control.

Paper ID: 2019

Improvement of Welding Quality in Structural Fabrication Using Lean Six Sigma DMAIC Methodology and Pareto Analysis

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Abstract

This paper presents a structured Lean Six Sigma DMAIC case study aimed at reducing the incidence of welding defects in a structural metal fabrication process. Baseline data collected over twenty production shifts revealed a total of 250 welding defects distributed across five categories: porosity, lack of fusion, cracks, slag inclusion, and undercut, yielding an average proportion defective of 6.5% and a corresponding Defects Per Million Opportunities (DPMO) of 65,000. An NP-chart constructed for twenty equal-sized subgroups (n = 100 each) identified two out-of-control points at samples 4 and 16, confirming the presence of special-cause variation superimposed on a chronically elevated baseline. Pareto analysis revealed that porosity (34.8%) and lack of fusion (24.8%) collectively accounted for approximately 59.6% of all recorded defects, directing corrective resources toward these critical failure modes. Root cause analysis using an Ishikawa diagram traced the dominant failure mechanisms to inconsistent shielding gas supply, improper joint preparation, uncontrolled welding parameters, and operator positioning variability. Four targeted corrective actions were simultaneously implemented: installation of gas flow regulators with automated monitoring, mandatory pre-weld surface preparation protocols, digitally controlled power supply units with parameter lockout, and a structured welder qualification programme. Post-improvement monitoring over an equivalent observation window yielded only 18 total defects, reducing the proportion defective to 0.9% and DPMO to 9,000. The NP-chart for the post-improvement period showed all points within the revised three-sigma control limits, confirming process stability. The findings demonstrate the quantitative and operational benefits of combining Pareto-driven prioritization with the DMAIC problem-solving cycle in industrial welding environments.

Keywords - Lean Six Sigma, DMAIC, welding defects, Pareto analysis, NP-chart, process capability, defect reduction, statistical process control





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