

SOUVENIR

**Diamond Jubilee National Convention of IIIE
&
International Conference
on
Role of Industrial Engineering
in Industry 4.0 Paradigm (ICIEIND 2018)**



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IIIE ODISHA CHAPTER

Organised By : **IIIE**

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Diamond Jubilee National Convention of IIIE & International Conference on Role of Industrial Engineering in Industry 4.0 Paradigm (ICIEIND 2018)



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SOUVENIR

**Diamond Jubilee National Convention of IIIE
&
International Conference
on
Role of Industrial Engineering
in Industry 4.0 Paradigm (ICIEIND 2018)**

27th - 30th September 2018, Bhubaneswar



In collaboration with :

Hosted By :

IIIE ODISHA CHAPTER

Organised By : **IIIE**



SIKSHA 'O' ANUSANDHAN
(Deemed to be University)

FOREWORD

Industrial engineering is the science of innovation. All scientific innovations have aimed at improving productivity and quality of work systems. The first industrial revolution brought in the mechanization of labor and noticed a huge leverage against the humanized labor. However, it lacked sustainability and quality of products and processes. With the advent of electricity the second industrial revolution significantly lessened human labor and facilitated mass production improving productivity and quality. The computers, electronics and the sensors played the central role in the third industrial revolution, where product sizes and costs became small, products worked more efficiently with improved quality and sustainability and work systems moved towards competitiveness. The present fourth industrial revolution, also known as Industry 4.0, is squeezing the physical space through seamless network of men, machines and materials with a promise of high productivity, quality, agility and digital transformation in every human endeavors and work systems. The industry 4.0 inherently refers to four essential characteristics such as; (1) vertical networking of smart factories and smart products propelled with smart logistics and smart services, (2) horizontal integration of business partners and customers across the physical space and temporal space, (3) sustainability and ecology of the smart product from its inception to end of life cycle and (4) the exponential technologies that greatly accelerates the end user centric market application and brings down the cost and size of products resulting in improved quality, reliability, safety and minimizing risks. Real time and accurate data analysis open up innovative ways to improve quality and avoid or self-correct faults in the products as well as the processes. Robotics are connected remotely to the computer systems and controlled through internet of things thus needing little or no human intervention. Fortified with the data sciences and technologies along with the internet of things, the smart products and services will create successful business models and customer-centric product/process architecture. In order for the machine systems to be industry 4.0 adaptable, it is highly desirable to have interoperability between machines, attached sensors, computers and the human workers. There are many challenges and issues to the industry 4.0. The smart factories and systems need to have greater reliability and flexibility/agility for any successful cyber physical communication. A byproduct of industry 4.0 is the loss of some of the currently high paying human jobs and this may be a concern to the social security. At the same time the lack of experienced manpower to create and implement this coordinated automation and control task, initial reluctance of many heavy investors may be a barrier in the transition period to industry 4.0. However, the benefits accruing from a fully compliant industry 4.0 have the potential to outweigh these concerns. The coordinated automated and controlled system will be a boon to the human civilization with increased revenues, better outputs, higher market share and profits. In today's customer centric digital space, what matters most are the direct personalized models of production, distribution, maintenance, reliability and deliverability of both essential and value added services? The interface between the real world and the virtual world is cyber physical production system, which works in similar ways as the social networks. Thus the machines become social machines; communicate with each other through internet enabling them to take note of the current stock levels, fault in product line, and change of demand level or change of deadline. Coordinated working boosts efficiency, optimizes time and resource allocation and enhances quality across the value chain.

This international conference is organized with the above background in context. We have seen the vigor and enthusiasm in both academia and industry professionals to participate, deliberate and above all to enhance their knowledge horizon. We express our deep sense of gratitude to all of the participants representing many countries across the globe. We are greatly obliged to one and all for their support and encouragement to this international conference. We have the hope that the outcomes will enable all of us to strengthen our perpetual endeavor towards enriching the science of innovation that is the essentials of Industrial Engineering by adopting and adapting the principles and practices of Industry 4.0 for the maximum welfare to humankind.

Professor R. P. Mohanty
Patron, ICIEIND 2018

ACKNOWLEDGEMENTS

We express our gratitude to our chief guests and guests of honor in the inaugural and valedictory functions.

We sincerely thank the principal keynote speaker, as well as all other key note speakers, panel members of the top management forum, chair persons of different technical sessions, jury members, authors of technical papers, and participants in national productivity case study competition and technical poster presentation.

We are indebted to the President, SOA Trust for agreeing to collaborate in organizing the Diamond Jubilee Convention of IIIE and International Conference 'Role of Industrial Engineering in Industry 4.0 Paradigm' (ICIEIND 2018). We take this opportunity to record our obligation to all the sponsors for their magnanimous support and encouragement in providing much needed resources.

We have received a number of messages of goodwill from many dignitaries across the world. We acknowledge our gratitude to all of them and cherish them ever.

Finally, we thank all the advertisers and exhibitors, artists in the cultural programmes, all the delegates, organizing committee members and volunteers for their involvement in making the programme a great success.

PRINCIPAL COORDINATORS

Cdr. (Dr.) B.M. Bhandarkar, Director General, IIIE

Dr. A.K. Behera, Chairman, IIIE Odisha Chapter



NAVEEN PATNAIK
Chief Minister, Odisha



**STATE SECRETARIAT
BHUBANESWAR**

MESSAGE

I am glad to know that the Indian Institution of Industrial Engineering (IIIE) Odisha Chapter is organizing an International Conference on "The Role of Industrial Engineering in Industry 4.0 Paradigm" on the occasion of its Diamond Jubilee Convention from 27th to 30th September, 2018 at SOA Deemed to be University, Bhubaneswar. A souvenir is also being brought out in commemoration.

I understand that a significant number of internationally recognized experts and researchers from many countries are participating in this Conference. My best wishes to all the participants and organizers on this joyous occasion. I wish the event all success.

A handwritten signature in blue ink, consisting of stylized loops and strokes.

(NAVEEN PATNAIK)



Dr K. SIVAN
Chairman



Indian Space Research Organisation

Department of Space

Government of India

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Bangalore - 560 231, India

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Fax : +91-80-2341 5328

e-mail : chairmangisro.gov.in

MESSAGE

Dear Dr. Mohanty,

Thank you for your letter inviting me to be the Chief Guest at the Diamond Jubilee convention of Indian Institution of Industrial Engineering (IIIE) & International Conference on "Role of Industrial Engineering in Industry 4.0 Paradigm" scheduled for September 27th, 2018 at Bhubaneswar. Owing to a prior commitment on September 27th, I am not in a position to accept your invitation. However, I wish the Convention and Conference every success.

With best wishes,

Sincerely yours

(K. Sivan)



SIKSHA 'O' ANUSANDHAN
Deemed to be University

Prof. K. Pradhan
Chancellor

MESSAGE

I am glad to know that the Indian Institution of Industrial Engineering (IIIE) in collaboration with Siksha 'O' Anusandhan Deemed to be University, Bhubaneswar is celebrating the Diamond Jubilee National Convention of IIIE and organizing an International Conference on "Role of Industrial Engineering in Industry 4.0 Paradigm" during September 27-30, 2018 at Institute of Technical Education and Research (ITER). Since a large number of eminent Academicians as well as Industry Professionals from all over the world are participating and deliberating on 4th Industrial Revolution, I am sure our faculty members, research scholars and the student community at large will take the benefit of the deliberations.

I wish the National Convention and International Conference a great success.

(K. Pradhan)



SIKSHA 'O' ANUSANDHAN
Deemed to be University

Prof. (Dr.) Manojranjan Nayak
Founder President

MESSAGE

First of all, I am extremely happy that IIIE Odisha Chapter is organizing the Diamond Jubilee Convention and International Conference in collaboration with our university. IIIE is a very distinguished professional Institution and our collaboration with IIIE is very strong since 2011. In 2012, we have jointly conducted also an international conference on "Best Practices in Supply Chain Management (BPSCM)" very successfully.

I know that many distinguished academicians as well as top management professionals from many countries and many sectors in the Globe are participating in the diamond Jubilee convention-2018 and will be deliberating on the most significant theme of "Industry 4.0".

I have great pleasure in welcoming all the guests to our University. I very sincerely look forward to their contributions to the realization of our cherished mission to emerge as a leading inclusive University in the globe.

Finally, I congratulate the organisers, sponsors, participants and other stakeholders through Professor R.P. Mohanty and wish all success in their future professional endeavors. I will be delighted to extend support.

(Prof. (Dr.) Manojranjan Nayak)



Anil K. Shastri
Chairman: BOG

Lal Bahadur Shastri Institute of Management,
Delhi
Former Cabinet Minister, Govt. of India

MESSAGE

I am delighted to learn that the Diamond Jubilee convention of Indian Institution of Industrial Engineering (IIIE) and the International Conference on “Role of Industrial Engineering in Industry 4.0 paradigm” are being organized by Odisha chapter from 27th to 30th Sept. 2018 wherein many professionals both from India and abroad would participate and deliberate on various important themes of the event. I am sure that this platform will provide an excellent opportunity for exchange of knowledge and practices by professionals from both industry and academia.

I extend my warm greetings and felicitations to all those associated with IIIE and the International conference.

(Anil K.Shastri)



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MESSAGE

Dear Prof. Mohanty,

I have noted the magnificent progress of IIIE for the last 60 years and with stalwarts like you leading it ahead, I am sure it will achieve greater success in future!

With best wishes,

Yours sincerely,
(Sharu S. Rangnekar)



Kailas C. Sahu
Ex-President and Life Fellow, IIIE

300 N.Story Place
ALHAMBRA, CA 91801, USA
kailassahu@gmail.com

MESSAGE

Hearty congratulations to the President and Members of the Odisha Chapter of the IIIE, and all Organizers of the Diamond Jubilee Convention of the IIIE being held between September 27-30, at SOA Deemed to be University, its esteemed President and Faculty Members.

Focused on the challenges and opportunities for the Industrial Engineering profession in the Industry 4.0 era and beyond it no doubt will stimulate thinking and action by the IE professionals to help create a better World for all.

A very warm welcome to all participants from India and abroad.

I wish it a grand success

(K.C. Sahu)



Institute of Industrial and Systems Engineers

Don H. Greene, P.E., CAE
Chief Executive Officer

MESSAGE

Dear Dr. Bhandarkar:

The Institute of Industrial and Systems Engineers (IISE) is pleased to know that the Indian Institution of Industrial Engineering is celebrating its Diamond Jubilee. We applaud you and all those who join with IISE worldwide to advance Industrial Engineering. As you celebrate your 60th year, your dedication to the productivity and quality movements is to be praised. Best wishes as you continue to promote and support the industrial engineering profession and all those who practice it in the years to come.

I send my congratulations and best wishes to you and IIIE on such a special occasion.

Sincerely,
(Don H. Greene)



Kazuyoshi Ishii
President

**Japan Industrial Management Association
(JIMA)**

MESSAGE

I am delighted and honored by the invitation to write the message to the Diamond Jubilee Convention of Indian Institution of Industrial Engineering (IIIE) and the International Conference on “Role of industrial engineering in industry 4.0 paradigm.”

At the beginning of the 20th century, Frederick Winslow Taylor published The Principles of Scientific Management (1911), which proposed a highly efficient management system. This system was premised on Smith's concept of a division of labor to enable specialization and simplification, which is elaborated in The Wealth of Nations (Adam Smith 1789). However, Taylor extended this concept through the formulation of the standardization paradigm and proposed the division of planning and control functions. The scientific management became the origin of industrial engineering. Peter Ferdinand Drucker (1993) observed that during the twentieth century, the application of knowledge related to scientific management in industrial workplaces has resulted in dramatic increases in productivity. Subsequently, such knowledge has been of greater importance in relation to the management of resources compared with its application in relation to capital and labor. Drucker further clarified that, in the future, the problem of management will center on improving the efficient application of knowledge to create the necessary expertise for developing new products, services, and innovations.

In recent years, in the prevailing context of the World Wide Web and diverse social networking services (SNSs), information communication techniques have rapidly advanced, and many useful management and engineering information systems have been developed. “Industry 4.0” is one of useful concepts and systems for industrial engineering field on the basis of digital technologies such as digitization, digitalization and digital transformation mentioned above.

We, JIMA hope that you will have successful and fruitful conference. Also, if IIIE and JIMA could share the problem of future scientific management raised by Drucker, future collaboration with the two institutions will create a great value from Asia to development of the world in the 21st century.

(Kazuyoshi Ishii)



Prof. Ahad Ali
Executive Director
IEOM Society International



Southfield, Michigan, USA

MESSAGE

It is my great pleasure to know that the Indian Institution of Industrial Engineering (IIIE) is organizing ICIEIND, an international conference 2018 on the theme 'ROLE OF INDUSTRIAL ENGINEERING IN INDUSTRY 4.0 PARADIGM' from 27th to 30th September 2018.

The fast-changing horizon of the industry with new technologies, new processes and new business being churned out with rapid succession has posed hitherto unheard of challenges to businesses all around the world. Staying competitive has become complex like never before and achieving growth is possible only with carefully formulated strategies to address the various areas of concern. Endeavors such as this conference are the need for the day as it would amalgamate the expertise of the industry with the strong fundamental concepts of the academia to provide the basic inputs for devising appropriate strategies for the future. Due to smart integration with Industry 4.0, industries and workforce should be prepared for fast changing industries.

Industrial Engineering and Operations Management Society USA has a collaboration with IIIE for the worldwide promotion of Industrial Engineering. I congratulate organizers, especially Dr. RP Mohanty and Prof. Bhaskar Bhandarkar for their untiring efforts and indefatigable will to make this conference a huge success. I wish the delegates a great value added experience at this conference.

(Ahad Ali)



Ilkyeong Moon

Department of Industrial Engineering,
Seoul National University, Seoul, KOREA
President Elect, Korean Institute of Industrial Engineers

MESSAGE

On behalf of the Korean Institute of Industrial Engineers, I would like to extend its warmest congratulations to the Diamond Jubilee Convention of Indian Institution of Industrial Engineering (IIIE) and the International Conference on “Role of industrial engineering in industry 4.0 paradigm” in Bhubaneswar.

Since its inception, IIIE has been recognized for its exceptional dedication and commitment to the advancement of the discipline of Industrial Engineering and professional development for every industry in India. The long history of this conference not only paved the way for the legacy of its Industrial Engineering society, but also lay the foundation of the future industry by delivering rich contributions on Industry 4.0.

This conference recognizes the outstanding achievements driven by novel experts from academia, industry, and research institutes across the country. Their contributions are testament to the development of new theory and its application in practices that become a critical key for the success of Industrial Engineering in India.

I wish IIIE another success for this conference and look forward to expecting the future development of new industry standards, as always.

(Ilkyeong Moon)



Chi-Hyuck Jun, Ph.D



President, Asia-Pacific Industrial Engineering
& Management Society
Professor, Industrial & Management Engineering,
POSTECH, Korea
chjun@postech.ac.kr/ +82 54 279 2197

MESSAGE

I am immensely happy and profoundly pleased to know that Indian Institution of Industrial Engineering (IIIE) Odisha Chapter is organising the Diamond Jubilee National Convention and International Conference on “The role of Industrial Engineering in Industry 4.0 Paradigm”, from 27th to 30th September, 2018 at SOA Deemed to be University, Bhubaneswar; Odisha. Industry 4.0 is emancipating across the globe to bring transformation in all sectors of the economy as well as society. Industrial Engineering as a matured and perpetually advancing discipline has contributed greatly to the welfare of human kind. I understand that a significant number of internationally recognised experts and researchers from many countries in the World are actively participating to expand the frontiers of Industry 4.0 and deliberating on the changing role of IE. My best wishes to all of them.

Professor R.P.Mohanty, who is an internationally known and reputed academician and is providing the leadership deserves our congratulations.

(Chi-Hyuck Jun)



Asbjørn Rolstadås
Professor Emeritus



Norwegian University of Science and Technology
Faculty of Engineering
Department of Mechanical and Industrial Engineering

MESSAGE

I take this opportunity to congratulate the Indian Institute of Engineering (IIIE) with its Diamond Jubilee. The institute has an important mission to fill in advancing Industrial Engineering and facilitating professional development. Manufacturing today is a global business requiring a continuous focus on productivity, quality and industrial innovation. The requirement for change is rapidly increasing as new technology (such as Industry 4.0) is being developed. The field of digitalization opens new opportunities and affect the way we work and live. No one can risk to fall behind in this race.

The Diamond Jubilee National Convention of the IIIE and its international conference is a platform for exchange and dissemination of knowledge in this field. It is a fora where top academic and industrial actors at both national and international level meet.

The success of the manufacturing industry is the key to our future welfare.

I wish all delegates a successful conference.

(Asbjørn Rolstadås)



Dr. Xiao-Guang Yue
Associate Professor



International Engineering and Technology Institute
Co-Founder of International Engineering and
Technology Institute

MESSAGE

Congratulations for DIAMOND JUBILEE National Convention of IIIE and International Conference.
And I wish the event a complete success.

(Dr. Xiao-Guang Yue)

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INTEGRATE KNOWLEDGE PERTAINING TO PRODUCTION AND OPERATIONS MANAGEMENT*

Sushil Gupta

POMS Executive Director
Professor, Florida International University
Miami, Florida

MESSAGE

I am pleased to know that Indian Institution of Industrial Engineering (IIIE) is celebrating its diamond jubilee this year. IIIE has been the motivational force for the productivity and quality movement in India. IIIE is at the forefront for embracing new and emerging technologies like Industry 4.0. IIIE has expanded Industrial Engineering applications to new fields like Agriculture and Healthcare. IIIE's teaching programs, journal publications and annual conferences have contributed significantly to the development of Industrial Engineering profession in India.

I wish Dr. Bhandarkar and his team good luck in organizing the conference.

Best wishes

(Sushil Gupta)



Md. Sabur Khan
Founder and Chairman,
Board of Trustees

Daffodil International University
Bangladesh

MESSAGE

I am overwhelmed with delight to know that the Indian Institution of Industrial Engineering (IIIE) is observing its Diamond Jubilee Year in 2018. On this auspicious occasion, I am also utterly pleased to remember the long, glorious history of this esteemed institution in propagating the profession of Industrial Engineering. Since Daffodil International University (DIU) has built a strategic tie with this institution, I feel more privileged that DIU is also in the same direction.

Its upcoming international conference on 'Industry 4.0', with the theme that focuses on harmonization of futuristic approaches like cyber-physical system, big data analytics and cloud computing is a very good move. Reportedly, Fourth Industrial Revolution is expected to create up to \$3.7 trillion in value by 2025. Technologies such as the internet of things, advanced robotics, artificial intelligence (AI) are facilitating in generation of net productivity which demonstrates that the technology is shaping the future of production. McKinsey Global Institute states, more than 60% of all manufacturing activities can be automated with current automation technology.

According to an analysis of World Economic Forum (WEF), 'Five years from now, over one-third of skills (35%) that are considered important in today's workforce will have changed. The future workforce will be required to line up required skills to keep rotating with changing job sectors and patterns.

I, once again, would like to congratulate the team of IIIE who are putting their best efforts in transforming this illustrious celebration a grand success.

(Md. Sabur Khan)



Ir Dr Ritz MH LAU

Chairman, Manufacturing and Industrial Division

The Hong Kong Institution of Engineers

MESSAGE

On behalf of the Manufacturing and Industrial Division, The Hong Kong Institution of Engineers, I am delighted to congratulate The Indian Institution of Industrial Engineering for reaching its Diamond Jubilee. We are looking forward to broadening and strengthening our institutional interaction in the future, and wish you a very successful National Convention and International Conference in September 2018.

(Ir Dr Ritz MH LAU)



Vicente L. Co
PIIE President

MESSAGE

Our warmest greetings to the Indian Institution of Industrial Engineering (IIIE) as it celebrates its Diamond Jubilee that coincides with the National Convention of IIIE and International Conference to be held on 27th to 30th September 2018 with the theme "Role of Industrial Engineering in Industry 4.0 Paradigm".

It is interesting to note that our very own Philippine Institute of Industrial Engineers (PIIE) is celebrating its 20th Anniversary which will coincide with 16th National Congress and 8th Research Conference dubbed as PIIE@20 that will be held on September 28-29, 2018 in Marriott Hotel Manila with a theme "IE for Industry 4.0: Embracing Digital Transformation".

Our twin events with almost similar themes only show the growing impact of Industry 4.0 in our industrial engineering organizations and to our profession to ensure seamless execution of transformative change.

We indeed look forward to intensify our efforts and further strengthen our professional recognition as well as collaboration to continue instilling among industrial engineers the summation of our core beliefs to attain competitiveness and value supremacy.

As IEs, we believe that our constant purpose is "Continuous Improvement" in all our endeavours and we should be able to carry our mission forward as we embrace our crucial role during this period of digital transformation.

Mabuhay!

(Vicente L. Co)



Jay Lee

Fellow of ASME, SME, ISEAM

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Dept. of Mechanical and Materials Systems
& Founding Director of NSF Industry/University Cooperative Research Center on
Intelligent Maintenance Systems (IMS)
& Founding Director of Industrial AI
Univ. of Cincinnati

MESSAGE

Dear Prof. Mohanty,

I am pleased to accept your invitation to give a keynote presentation at THE DIAMOND JUBILEE AND INTERNATIONAL CONFERENCE. The Theme of the Event on Role of Industrial Engineering in Industry 4.0 Paradigm is a timely topic for India. I am pleased to give a presentation about the Industrial Big Data Analytics and Platform for Industry 4.0 Transformation with Case Studies.

I will introduce the fundamentals of Industrial Big Data as well as its value to product and manufacturing transformation. In addition, I will further present the 5C architecture of Industry 4.0 and Cyber Physical Systems to support the integration of data system, edge analytics, cloud, and industrial AI for smart manufacturing and service applications. Finally, I will give some real-world examples about how these technologies have been applied and deployed in diversified industries, including the automotive industry, the semiconductor industry, the transportation industry, and the energy/power industry, etc.

I am the founding director of National Science Foundation (NSF) Industry/University Cooperative Research Center (I/UCRC) on Intelligent Maintenance Systems (www.imscenter.net) which consists of the Univ. of Cincinnati (lead institution), the Univ. of Michigan, Missouri Univ. of S&T, and the Univ. of Texas-Austin. Since its inception in 2001, the Center has been supported by over 100 global companies. IMS was selected as the most economically impactful I/UCRC in the NSF Economic Impact Study Report in 2012 which reported that the Center has delivered to its members a combined benefit of \$847.6 million in cost savings, and that the Center returned \$238.30 of benefits for every \$1 invested by the National Science Foundation. Currently, I am also leading a newly established Industrial AI Center. I also serve as a senior advisor to McKinsey & Company, S&T advisor to Plastic Omnium of France, a Member of Scientific Advisory Board of A*STAR SIMTech of Singapore, a member of Board of Governors of the Manufacturing Executive Leadership Board of Frost Sullivan, and a Board member of PHM Society, a member of the Leadership Council of MFOresight-a NSF/NIST funded Manufacturing Think Tank, as well as a member of Technical Advisory Committee (TAC) of Digital Manufacturing and Design Innovation (DMDI).

I look forward to meeting you and other members/speakers of the Event.

Sincerely yours,

(Jay Lee)



J. Mahender Reddy
Vice Chancellor

The ICFAI Foundation for Higher Education, Hyderabad
(Deemed to be University)
Former Fulbright Fellow,
Boston University Former Chair in Indian Ocean Studies,
University of Mauritius
Former Member, Governing Council,
Association of Indian Universities

MESSAGE

I am happy to know that the Diamond Jubilee National Convention of IIIE and International Conference on "The Role of Industrial Engineering in Industry 4.0 Paradigm" are being organized by IIIE Odisha Chapter in collaboration with Siksha 'O' Anusandhan (Deemed to be University), at the Institute of Technical Education and Research.

I am glad to hear that the top management professionals from industry and academia are participating in this conference. This kind of interaction between academia and industry will immensely help both by enabling technology and knowledge transfer.

I am impressed with the mission of the conference which is to create a platform for exchange and dissemination of knowledge in the emerging field of Industry 4.0, which is area of high importance. It emphasizes the latest happenings in automation and data exchange in manufacturing technologies. It fosters what has been called a "smart factory". This can be termed as the new industrial revolution due to its potential to create new wealth and further improve living standards.

I am particularly happy to note about a poster competition for students, which will encourage them to participate in the event. The participation will generate interest among students and make them an active part in taking the mission of the institution forward.

I am sure that the conference will enrich the participants and help them improve the quality of their study through devoted discussions that follow the paper presentation. Publishing the proceedings of the conference in world reputed journals will definitely provide the conference an international mileage and audience.

The need of the hour in the country is to carry on quality research so as to enhance the competitiveness of the industry nationally and globally.

My best wishes for the conference.

Thanks and regards

(J. Mahender Reddy)



D. Rajkumar
Chairman & Managing Director

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MESSAGE

Heartiest Congratulations to the Indian Institution of Industrial Engineering on the occasion of their Diamond Jubilee Convention & International Conference at Bhubaneswar. It is indeed a matter of pride for every Indian that an Indian Professional Society is offering services to the professional community world over. The theme of this conference 'Role of Industrial Engineering in Industry 4.0 Paradigm' is important and relevant in the present business scenario.

Traditional methods of managing industrial units yield only limited results, especially in the prevailing disruptive business environment. I understand that the objective of industry 4.0 paradigm is to explore the applicability and relevance of disruptive technologies in offering superior products and services, thus delivering enhanced value. I am sure the professionals present at the convention would contribute immensely with their rich experience, in-depth knowledge and innovative approach.

I am confident that the participants would greatly benefit from this event. Events such as these are not only enriching but also encourage in creating paradigm shifts across domains.

My best wishes for the grand success of this conference!

(D Rajkumar)



D V Bhagat
Chairman, NC
IIIE

MESSAGE

It's really a proud moment for all of us in Industrial engineering fraternity, that IIIE is celebrating Diamond Jubilee of its inception by organising National convention and International conference during 27th to 30th September 2018 at Bhubaneshwar, Odisha.

Many distinguished Dignitaries and eminent Speakers from all over the world would be gracing this function and be a part of these glorious moments sharing their thoughts on Role of Industrial Engineering in Industry 4.0 paradigm.

Beside this many teams from various national industries would be participating in productivity competitions and sharing their innovative skill, knowledge and experience on productivity improvement in their respective fields, which would be immensely beneficial to the participants.

I wish this Diamond Jubilee national convention and international conference'2018 a great success.

(D V Bhagat)



Dr. Bhaskar Bhandarkar
Director General IIIE

MESSAGE

It is destiny, that we have the honour to organize the Diamond Jubilee Convention of IIIE and International Conference in a grand manner.

The Indian Institution of Industrial Engineering has always been at the forefront of the productivity crusade of our country. The theme of the conference “ROLE OF INDUSTRIAL ENGINEERING IN INDUSTRY 4.0 PARADIGM” is appropriate against the canvas of the contemporary challenges and the quest for the competitiveness of the business.

This is a time to remember our late visionary leaders like Shri H N Thadani, Brig. K Pennathur, Prof. NS Ramaswamy, Dr SC Bhattacharjee, Shri Duleep Singh, Cdr. KN Nair, Shri HK Firodia, Shri KK Nohria, Prof. TS Venkoba Rao Ranapratap, Dr JM Mahajan for their untiring efforts to shape IIIE as the knowledge repository of Industrial Engineering. IIIE is indebted to the contributions of Dr SM Patil, Shri PB Nayar, Prof. SK Warriar, Shri SS Rangnekar, Prof. HC Patel, Shri VKS Menon, Shri R Gopalakrishnan, Dr. KC Sahu, Dr. RP Mohanty, Dr. S Ramani, Shri MA Pathan, Shri SN Jha, Shri Subir Raha, Shri Sarthak Behuria, Shri Arun Balakrishnan, Shri RK Singh, Shri RG Rajan and Shri D Rajkumar. We are also proud of the role of Dr Premvrat, Dr KGK Nair, Shri R Sampat, Shri PK Sasmal, Shri NM Shah, Shri SA Khan, Shri MK Wagh, Shri PCK Sarma in developing the Institution. Yes, we could do it! This is because of the cohesive, synergetic and exemplary teamwork of IIIE members, associates and the large numbers of supporters. No words can articulate the Servant Leadership being practiced by Dr RP Mohanty, without which this Kumbh Mela of the 'Angels of the Productivity Movement' could just have been another routine event.

This convention has opened a new leaf in the glorious history of IIIE. I am sure that we together would add many more. No woods could be dark, deep and deterrent in front of our collective resolve to take this wonderful Institution to enviable global position of excellence.

Thank you, dear friends. This is our gratitude for your comradeship, crusade and conventions.

I am confident, that each one of you would experience this Diamond Jubilee Celebration to be a memorable one.

Jai Hind!

Jai IIIE!!

(Dr. Bhaskar Bhandarkar)



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MESSAGE

I am happy to learn that the Indian Institution of Industrial Engineering (IIIE) is celebrating its 60th Diamond Jubilee National Convention from 27th September to 30th September 2018. It is praiseworthy that on this occasion, an International Conference on the "Role of Industrial Engineering in Industry 4.0 Paradigm (ICIEIND)" is also being organized by the Odisha chapter of IIIE in collaboration with Siksha 'O' Anusandhan (Deemed to be University), at Institute of Technical Education and Research (ITER), Bhubaneswar, Odisha,

From horse-power to steam engine, electricity to automation, the gradually increasing involvement of technological advancement has ushered in the new era of Fourth Industrial Revolution i.e. Industry 4.0. Availability of vast data techniques like Machine Learning and Internet of Things, leverage Machine Intelligence and, thereby, enabling Industries towards an efficient work-flow. The amalgamation of such cyber-physical systems with Industrial Engineering makes Industry 4.0 a true revolution. I am pleased to know that through this conference, IIIE is creating a platform for exchange and dissemination of knowledge in such an emerging field of Industry 4.0, by engaging both, the professionals from the industries and researchers from academia. I am confident that adoption of the best practices discussed in the conference, by the Industry, would lead the nation on a path of robust industrial growth.

I wish the organizers, a grand success for the Diamond Jubilee Convention and the Conference.

(Dr Chandra Bhanu Satpathy)

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Origin and Development of Industrial Engineering: A Historical Survey

Kailas C. Sahu

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1. PREAMBLE

WORK:

Work and life are inseparable. Hands, head and heart are involved in any work -irrespective of its nature and purpose. Any work offers scope for creativity and innovation, if done with passion. Those who are engaged in work they love and love what they do are happy.

TIME:

Each moment of time, being perishable, un-storable, hence irreplaceable, is the most valuable resource for anywork, unlike other inputs like material, energy or money.

WORK SYSTEMS:

Any work situations can be conceived as a system of inputs, worked on by human-technology interaction, to create outputs.

Designing work systems is the basic professional domain of the industrial engineers. It requires creativity and innovation involving 3-H (Hand, Head, and Heart) and offers scope for perpetual pursuit of perfection (3-P). Work and knowledge reinforce each other. As industrial engineering is concerned with work, time, and work system design, its origin is co-terminus with human existence, since Homo sapiens used their hands and legs to gather food.

All living beings, from birth to death, as individuals or as members of teams, willingly or otherwise, have worked and keep working to create everything in the world, in fields or factories. Intellectuals , inventors, and discoverers in all fields: Euclid (323 BC), Gutenberg (1400), Galileo (1616), Isaac Newton (1642), James Watt (1782), Alesandro Volta (1800), Charles Darwin(1859), J. J. Thomson (1897), Max Plank (1900), Albert Einstein (1905), to name randomly, just a few, have created all knowledge: Physical, Biological, Psychological Sciences, Mathematics, and Technological foundation of modern world using which human work made the wonderful artifacts we enjoy on land, water and sky.

Work has also created weapons for violence and destructive wars- conventional and nuclear wars, using most modern and sophisticated sciences and technologies. Imagine the quantum and vast diversity of the work in work systems involved from Industry 1.0 era to the threshold of Industry 4.0 in present century. Search for designing and operating work systems with more efficiency and effectiveness led to creation of the new profession of work study/industrial engineering (IE).

2. IE RELATED THEORIES, PRINCIPLES AND TECHNIQUES: A NARRATIVE

1750-1849:

Richard Arkright: Training and factory discipline

J.R.Perronet: Systematic overall time study, in secrecy, to establish 'standard' production rate, mechanical inventions, cooperative movement and trade union movement.

James Watt, Jr: Established integrated 'modern' engineering plants.

Adam Smith: Causes of national wealth and economic gain from "Division of Labor" laying the foundation of prevailing free capitalistic economic systems in all democratic countries.

Robert Owen: Liberal and participative management at the New Lanark Mill, work measurement making allowances for fatigue. Few quotes from his books The New Lanark establishment and the New view of society should be inspiring, even today.

“If care of inanimate machines can produce such beneficial results, what may not be expected if you (the owners) devote equal attention to your vital machines far more wonderfully constructed? XXXX Time and capital (must be) more advantageously applied to improve living machines”. Hope, we all are listening and trying to follow!

S Frederick created the first recorded manual both for the owners and the workers he hired for their factories.

Charles Babbage's book Economy of Machinery and Manufacturers laid the foundation of factory accounting and costing. These keep evolving with company laws getting more complicated over the years to strike balance between free economy and more expensive bureaucracies in democratic governance. He was also interested in calculating machines- the fore-runners of computers.

1851-1899:

Henry Ford (1863-1947) through his Ford Motor Company producing the Model 'T' pioneered revolutions in road transportation industry and in Industrial Management.

M. Henry discussed for finding cost of manufactured products and for administration of workshops, concept of Engineering Economy and profit sharing.

H R Towne in background of these developments, reviewed the need for engineer to be an economist as well, another foundation for the modern Industrial Engineering theory and practice.

FW Taylor, the would be father figure of work study and the scientific management movement in early forthcoming century fired his first thought: A Piece – Rate system, paying employees by their output.

1900-1949:

In 1900 Henry Fayol in his presentation formally discussed role and nature of administration in government and in industries.

FW Taylor's path breaking paper and after few years, his Book on shop management were published based on his practice as an Engineer-Manager on the shop floor- classics till date. A couple of years later came his theoretical exposition of concept of 'SCIENTIFIC MANAGEMENT' in a book form.

Charles Bedaux contributed concept of 'RATING' based on 'tempo' to the STOP WATCH TIME STUDY.

In 1912 in a hearing before special committee of US House of Representatives to investigate Taylor and other systems of Shop Management under authority of HR 90, Taylor explained the core concept as 'Science, not Rule of Thumb' which is not just a bundle of techniques like stop watch time study or incentive systems but involves 'complete MENTAL REVOLUTION' on both sides-Workers and Management.'

H. L. Gantt's Graphical Daily Balance in Manufacturing, continues as Gantt Charts and his work, wages, and profits and Harrington Emerson's Rational Basis For Wages and Modern Theory of Cost Accounting continue to be the basis for present day accounting systems.

F.W. Harris formulated often used 'Economic Order Quantity' formula.

Haley, Rowan and many others designed wage-incentive plans to reward faster, better operators.

F. B. Gilbreth through Motion Study, Micro –Motion study, 'THERBLIG's was the pioneer in Method Study. The Industrial Engineering is still often viewed by many as WORK STUDY (TIME STUDY plus METHOD STUDY) practitioners.

L.D. Brandeis extended use of Scientific Management to railroads, a new effort beyond conventional, goods, producing factories.

A.H.Church and many others furthered the Principle of Rational Management.

LillianM. Gilbreth's (wife of Motion Study pioneer F.B. Gilbreth) seminal book on The Psychology of Management focused on the Human operators in the Factories. **Our IIIE celebrates her contribution by The Lillian Gilbreth Award.**

HUMAN ENGINEERING/ERGONOMICS

During the First World War (1914-1918), besides many being killed, large number of young veterans returned home without one or more 'working' limbs. To keep them socio-economically contributing and happy, efforts were made to design/redesign machines to suit their limited abilities, starting the HUMAN ENGINEERING era in USA. On the other side of Atlantic it was called ERGONOMICS for sustaining MOTIVATION for Work.

A.B. Sagur initiated Motion Time analysis in 1925.

A.G. Anderson, in 1928, named Work study related work as INDUSTRIAL ENGINEERING.

G. Elton Mayo the primary researchers elaborated on 'Human Problems' and Social Problems of an industrial civilization- two famous contributions.

M.P. Follett the prolific writer on Management, discussed changing environment facing factory in 'The Dynamic Administration'.

Walter Shewhart's Statistical Control charts, since its introduction in 1931, are still extensively used since 1931. The same year LHC Tippet Work Sampling, still in use.

Joseph Quick suggested the Work Factor system in 1934.

In 1935, Jack Welch, the Business leader, advised to 'INVEST in PEOPLE,' wise and always relevant as also his counsel: **'strangle bureaucracy or it will strangle you' may all the leaders not only in Business but everywhere, specially in governments, act on this?**

A. H. MASLOW's NEED HIERARCHY theory for sustaining MOTIVATION for work continues to offer be the much in practice guidance for this vital purpose.

Very modest ENIAC Computer by Eckert et.al appeared in 1940 beginning a mighty revolution which continues unabated.

N. Wiener's CYBERNETICS- the Science of control continues to be a much respected classic.

Mathematical and statistical study for more effective operation of World War II, spurred the use of these in managing highly competitive Industry/Business Management under the generic title of 'Operations Research' or 'Management Sciences' after the War.

In 1947, Michael Porter propagated the idea of 'Competitive Advantage' for planning.

1950-1999:

Churchman(et. al) Book Introduction To Operations Research continues to be a popular Text book of the subject in most academic programs.

Herzberg et. al in 'Work and Nature of Man' explain the - TWO-FACTOR theory for motivation at work place. It still awaits widespread experiment.

H.A. Simon formally presented Management Science as a new Science.

J.W. Forrester: INDUSTRIAL DYNAMICS keeps inspiring many researchers to model and analyze many industrial/business in SYSTEM DYNAMICS format.

Value analysis started at RCA is much in use with cost vs value comparisons.

For Project Management, considering numerous Socio-Economic, Science-technology based 'Projects, Project Evaluation and Review Technique (PERT) of US NAVY and the Critical Path Method (CPM) of Remington Rand are in wide spread application as a very significant part of IE & OR.

A historic moment for the profession of industrial Engineering was its formal definition – too well known: “Industrial Engineering is concerned with Design, improvement, XX of integrated systems of Men, Material and Equipment. XXXXXXXX “ adopted by AIIE after 5 symposia with 43 participants drawn from Academia and practicing Professional, from 1955-1959 in five different universities, in the third one in Georgia Institute of Technology at Atlanta on November 7-8, 1957. IIIE and many others have adopted the same.

R.N. Lehrer: Use of Science and Engineering as aids to Management, explicitly naming it as the MODERN Industrial Engineering Approach.

S.C. Bhattacharya: Made the earliest survey of origin and application of Industrial Engineering in India way back in 1962.

KC Sahu in 1972 made a brief survey of status of Operations Research in INDIA.

Late Professor R Mishra, my revered Guru and affectionate mentor wrote about Industrial Engineering Education in 1976 of which he was the pioneer, dating back to start of IIT Kharagpur way back in 1951. More on the preceding two references, in the next Section on Industrial Engineering in India.

KC Sahu in 1984 wrote about philosophical ethical Issues in Re-designing Work systems and challenges facing Industrial Engineering as a profession. He explicitly elaborated the basic task of Industrial Engineers as Work system Designers

G. Saran discussed about Building Productivity culture in the same year.

R.P. Mohanty made the 'state of the art' survey of IE practices in India in 1988.

In 1989, author made a survey of Industrial Engineering- from Taylor Era to Twenty-First Century at an invited Lecture in February 19, 1989, which was later published as a paper in, Jr. of Inst. Of Engrs (India), vol.70, July, 1989. In 1993, his paper on Creativity and Networking for Excellence was presented at the top Management Seminar sponsored by IIIE.

It is an honor to close this half century with the following wise inspiring quotes of KONOSUKE, (1894-1989) considered as God of Management in Japan:

'Peace with Prosperity', 'Low priced mass-produced goods'. 'Mutual respect and support between Corporation and Employees'.

3. INDUSTRIAL ENGINEERING IN INDIA

Soon after its introduction, Industrial Engineering (USA) /Work Study (UK) have spread all over the World. This last section will be confined to highlight its origin and growth in India only. In 1936, John Moor and Horder Allen from USA started Eastern Bedaux Co. Ushering in IE, the first Indian to join them was Sri M.K. Rao. The group expanded at the beginning of World War II with few from British Bedaux and three more Indians, Shri D.P. Basu, Sri V.S. Vernekar and Sri S.P. Patel joining the pioneering group.

IBCON started in 1945 laying the foundation of IE in India. IE became a department in Ever-ready Company of India, Calcutta in 1940 where Time study, Job Evaluation and Incentive schemes were started. ICI (India) established IE department and trained personnel at ICI, UK by M. Russel Curie. Labour studies were started in 1938 in Ordnance Factory. O&M studies in Government was started in 1942. **Hope it is still there!** Predictably, Shri JRD Tata encouraged IE from beginning. Planning Commission of Government of India got interested for speedy project implementation.

4. EVOLUTION OF IIIE:

Started in 1957 with just 32 Members, with founder Chairman Mr. Farman, Sri H.N. Thadani was at the helm as Chairman from 1958 to 1969. In 1959, Graduate Membership was introduced. Membership grew to a still modest 140 by 1963. Gradually Chapters were formed.

In 1963, Prime Minister Jawaharlal Nehru inaugurated the institution of Work Study. Spear headed by Defence Institute of Work Study with Productivity Scientists like Brig. Krish Pennathur, Capt. H D. Selby, Capt. S S Rao. It was affiliated to Institute of Work study Practitioners (London). Members were from Government Organizations like Defence, Railways, and the Secretariat training school. It conducted examination for Work Study for the practitioners.

A land mark event was merger of IIIE and the Institute of Work Study in 1968 and named IIIE. It conducted first Graduateship exam in 1971. Our Journal started in 1957. IIIE has remained very active in international organizations like PAFIE, WCPS.

5. EDUCATION IN INDUSTRIAL ENGINEERING IN INDIA

Education in Industrial Engineering started at IIT Kharagpur since its inception in 1951 as a Department, along with TWO others – at VJTI and IIT Sc. Bangalore offering Post Graduate Courses in IE since 1952-53. During the decade of 50s IIT has conducted very popular Short term courses / EDPs in Management- General and functional- attended by galaxies of senior level Executives and addressed by luminaries like Late V.V.Giri and shri R. mudaliar at IIT, Kharagpur. It continues with unabated qualitative growth with vigorous research in the newest areas.

We all, IE professionals and academicians, owe gratitude to Late much lamented Professor R. Mishra , my GURU and affectionate mentor from whom I learnt the little on IE, I know.

By ILO inspiration and help, in 1958 National Productivity council came into being and NITIE, devoted exclusively to IE was established in 1961 and started activities since 1964. NITIE has vastly expanded its activities in depth and spread with post graduate programs and research.

6. CONCLUDING REMARKS

This narrative will be closed with two inspiring thoughts rather than the conventional summary of foregoing narrative:

'The IE techniques should be adopted to Indian reality by concentrating on increasing productivity of Capital, Material, and the Equipment rather than of Labor'.

An universally useful advice from Dr.Frank E. Cotton Jr (Ex President IISE):

'Our critical need is for more effective Management of Technology and prudent design of our SOCIAL Systems. An Industrial Engineer is educated to DESIGN such SOCIAL SYSTEMS.'

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Evolution of Industrial Engineering

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Definition of Industrial Engineering as adopted by IIIE

Industrial Engineering (IE) is concerned with the design, improvement, and installation of integrated systems of people, materials, information, equipment and energy. It draws upon specialized knowledge and skill in the mathematical, physical, and social sciences together with the principles and methods of engineering analysis and design to specify, predict, and evaluate the results to be obtained from such system.

1. Science and Engineering – Early Developments

To understand the role of industrial engineering in today's complex world, it is helpful to learn the historical developments involved in the progress of IE. Science is concerned with the search for basic knowledge. Engineering is concerned with the application of scientific knowledge. Engineering and science have been developed in a parallel, complementary fashion, although not always at the same pace. Engineering provides feedback to science in areas where new knowledge is needed. In earlier times, although science and engineering each have different characteristics but are different disciplines sometimes. They are the same persons. For example, Leonardo da Vinci (April 15, 1452 – May 2, 1519) was an Italian scientist, mathematician, engineer, inventor, anatomist, painter, sculptor, architect, botanist, musician and writer. The person who discovered the knowledge also put into use for building the Pyramids, the Great Wall of China, the Roman construction Projects with the efforts to provide a better life. Almost all engineering developments prior to 1800 had to do with physical phenomena.

Later developments were concerned with chemical and molecular phenomena:

- Electricity
- Combustion
- Properties of materials
- Thermal processes
- Other chemical processes

Fundamental to almost all engineering developments was the advances made in mathematics. Another very important contribution of mathematics was ability to represent reality in abstract terms. The use of abstract models representing complex physical systems is a fundamental tool of engineers.

2. Science and Engineering – Modern Era

Beginning in 1750s:

- Engineering schools appeared in France in the eighteenth century.
- The term civil engineering was first used in 1750.
- Principles of early engineering were first taught in military academics with road and bridge construction.

Military Engineering

- Same principles were applied to nonmilitary endeavors: Civil engineering.
- Interrelated advancements in the fields of physics and mathematics laid the groundwork for practical applications of mechanical principles.

An important advancement was the development of a practical steam engine.

- These efforts resulted in the emergence of mechanical engineering.
- Latter part of the eighteenth century, fundamental work is conducted on electricity and magnetism and static electricity:
- Samuel Morse, development of telegraph (1840s)
- Thomas Edison, invention of carbon-filament lamp
- Generation, transmission and utilization of electrical energy: Electrical engineering

Developments in mechanical and electrical engineering initiated the progress in the understanding of substances and their properties.

- Fuels, lubricants, protective coatings, dyes, synthetic materials
- Chemical engineering

As industrial organizations profit from technological developments, the size and the complexity of manufacturing units increased giving rise to:

- Mass production
- Interchangeability of parts
- Specialization of labor

Science and Engineering – Modern Era

- Within half a century the developing countries changed from largely rural, agricultural economies and societies to urban, industrialized economies and societies (from 1850 to 1900).
- The management practices that had worked well for small shops and farms simply were inadequate for large, complex manufacturing organizations.
- The need for better management systems led to the development of what is now called industrial engineering.
- Five major engineering disciplines (civil, mechanical, electrical, chemical, and industrial) were the branches of engineering that came out prior to the World War I.

3. The Industrial Revolution

Developments following World War II led to other engineering disciplines, such as nuclear engineering, electronic engineering, aeronautical engineering, computer engineering. Engineers solve problems, but so do mathematicians. Engineers analyze, but so do statisticians and economists. Engineers design systems. Architects design buildings, but they rely on engineers for much of their work. The distinguishing characteristic of engineering is that concerned with the design of systems. Design involves considerable amount of creativity. Creativity is a kind of an art that one learns through experience.

System

- A system may be defined as a set of components which are related by some form of interaction, and which act together to achieve some objective or purpose.
- Components are simply the individual parts, or elements, that collectively make up a system.
- Relationships are the cause-effect dependencies between components.
- Objective or purpose of a system is the desired state or outcome system is attempting to achieve.
- Air-conditioning system: Components of this system include the heat pump, the thermostat, the air within the system and the electricity that drives the system (even the house (walls, ceiling, floors, furniture, etc.) itself is a component).

The Engineering Process

- Analysis is concerned with resolving something into its basic elements.
- Concerned with existing systems.
- Synthesis is concerned with combining elements into a whole.
- Concerned with a new or improved system.
- Synthesis is a term whose meaning is almost the same as design (in engineering).
- The engineering process, which is used by all engineers, involves both synthesis and analysis

Engineering as a Profession

Professions

- Medicine, teaching, architecture, law and engineering
 - Associated with a profession is a significant body of special knowledge.
 - Preparation for a profession includes an internship-like training period following the formal education.
- Code of ethics:
- Each member of a profession recognizes his responsibilities to society over his clients or other members of the profession.
 - The need for continuous learning and public service are the other features of engineering.

4. Chronological Development of Industrial Engineering

Although there is considerable commonality among the different branches of engineering, each branch has distinguishing characteristics that are important to recognize.

- Industrial engineering emerged as a profession as a result of the industrial revolution and the accompanying need for technically trained people who could plan, organize, and direct the operations of large complex work systems
- The need to increase efficiency and effectiveness of operations was also an original stimulus for the emergence of IE.
- Charles Babbage (1791–1871) visited factories in England and the United States in the early 1800's and began a systematic recording of the details involved in many factory operations. He carefully measured the cost of performing each operation as well as the time per operation required to manufacture a pound of pins. Money could be saved by using women and children to perform the lower-skilled operations. The higher-skilled, higher-paid men need only perform those operations requiring the higher skill levels.
- Division of labor: right person for the right job.
- Interchangeable parts manufacture is to produce parts so accurately that a specific part of a particular unit of a product could be interchanged with the same part from another unit of the product.
- Eli Whitney(1765–1825)received a government contract to manufacture muskets using this method.
- Laborers were having only a minimal amount of training.
- Whitney created the first mass production system.
- Frederick W. Taylor (1856-1915) recognized potential improvements to be gained through analyzing the work content (minimum amount of work required to accomplish the task) of a job and designing the job for maximum efficiency. Improving efficiency is a three phase method that involves:

- Analyze and improve the method of performing work,
- Reduce the times required,
- Set standards for what the times should be.
- Frank B. Gilbreth (1868-1924) extended Taylor's work considerably. His primary contribution was the:
 - identification
 - analysis
 - measurement

Measurement of fundamental motions involved in performing work. Gilbreth was able to measure the average time to perform each basic motion. This permitted, for the first time, jobs to be designed and the time required to perform the jobs known before the fact (art to science)

- Lillian Gilbreth (1878–1972) – the first industrial psychologist.
- Henry L. Gantt (1861 –1919) developed the Gantt chart. The Gantt is a systematic graphical procedure for pre-planning and scheduling work activities, reviewing progress, and updating the schedule.

During the 1920s and 1930s much of fundamental work was done on:

- economic aspects of managerial decisions,
- inventory problems,
- incentive plans,
- factory layout problems,
- material handling problems,
- principles of organization.

Idea of scientific management (systematic work study) became very successful. It has increased the productivity, while reducing physical efforts and hours of work of labours, and increased the productivity by a factor of one hundred. The period from 1900 through the mid-1930s is generally referred as scientific management. Industrial engineering begins in the late 1920s and extends to the present time. Operations researches had a great influence on IE practice starting in the mid-1940s and extend past mid-1970s. The fourth period known as industrial engineering and system engineering is shown beginning around 1970 and extend indefinitely into the future.

5. Definition of Industrial Engineering

- Formal definition of Industrial Engineering adopted by the Institute of Industrial Engineers (IIE) USA.
- The definition implies industrial and systems engineering.
- The term industrial is often associated with manufacturing organizations; here it is intended to apply to any organization.
- The basic principles of IE are being applied widely in agriculture, hospitals, banks, government organizations, and so forth.

6. Industrial Engineering Education

- Industrial Engineering subjects were initially taught as special courses in mechanical engineering departments (elective in ME).
- The first separate department of Industrial Engineering was established in 1908 (Pennsylvania State University, USA).
- But it was only after the World War II, separate IE departments became wide spread in USA Universities.

7. Impact of Related Developments – Impact of Operations Research

- The development of industrial engineering has been greatly influenced by the impact of an analysis approach called operations research.
- This approach originated in England and the United States during World War II and was aimed at solving difficult war-related problems through the use of science, mathematics, behavioral science, probability theory, and statistics.
- Following World War II, OR were extended to problems in industry and commerce.
- This resulted in considerable number of mathematicians and scientists who contributed to OR (and also IE).

Some IE departments have changed their names to IEOR:

- University of California, Berkeley
- Colombia University
- Cornell University

A specific problem was identified. Specialists from appropriate fields formed an interdisciplinary task force to develop a solution. One person cannot have expertise in all the scientific areas. Currently, OR represents a set of quantitative methods that are applicable to a wide range of managerial and operational problems. Many industrial engineers do consider operations research as being their primary interest.

8. Impact of Related Developments – Impact of Digital Computers

Another development that had a significant impact on the IE profession is the digital computer. Digital computers permit the rapid and accurate handling of huge quantities of data, so permitting the IE to design systems for effectively managing and controlling large, complex operations. The digital computer also permits the IE to construct computer SIMULATION models of manufacturing facilities in order to evaluate the effectiveness of alternative facility configurations.

9. Computer-Aided Design (CAD) and Computer-Aided Manufacturing (CAM).

Generate process plans, bills of material, tool release orders, work schedules, operator instructions (ERP). IEs are good at computers, since they use PCs extensively to:

- perform various analyses,
- execute mathematical models,
- plan and manage complex projects,
- create data bases,
- implement a wide range of decision support tools.

10. Impact of Related Developments – Service Industries

- In the early days of the industrial engineering profession, IE practice was applied almost fully in manufacturing organizations.
- After World War II there was a growing awareness that the principles and techniques of IE were also applicable in non-manufacturing environments.
- Health-care industries applied IE to improve their operations, eliminate waste, control inventories, schedule activities.

11. Government Agencies

Thousands of Industrial Engineers are employed by government organizations to increase efficiency, reduce paperwork, design computerized management control systems, implement project management techniques, monitor the quality and reliability of vendor-supplied purchases, and for many other functions.

12. Challenges of the Future

Major challenges are:

- Learn to accomplish the engineer's mission in recognition of constraints on natural resources.
- Design systems and processes that are compatible with our natural environment.
- Design and production of safe and reliable products.

13. Diversity of IE

- Industrial engineering is a diverse (various) discipline concerned with the design, improvement, installation, and management of integrated systems of people, materials, and equipment for all kinds of manufacturing and service operations.
- Industrial engineering is concerned with performance measures and standards, development of new products and processes and product applications, ways to improve use of scarce (limited) resources and many other problem solving endeavors.
- An Industrial Engineer may be employed in almost any type of industry, business or institution, from retail establishments to manufacturing plants to government offices to hospitals.
- Because their skills can be used in almost any type of organization, and also industrial engineers are usually distributed among industries than other engineers.
- Industrial engineers work in insurance companies, banks, hospitals, retail organizations, airlines, government agencies, consulting firms, transportation, construction, public utilities, social service, electronics, personnel, sales, facilities design, manufacturing, processing, and warehousing.

14. Duties of IE

- Industrial engineers determine the most effective ways for an organization to use the basic factors of production - people, machines, materials, and energy. They are more concerned with people and methods of business organization than engineers in other specialties.
- To solve organizational, production, and related problems most efficiently, industrial engineers design data processing systems and apply mathematical analysis such as operations research.
- They also develop management control systems to help in financial planning and cost analysis, design production planning and control systems to coordinate activities and control product quality, and design or improve systems for the physical distribution of goods and services.
- Industrial engineers conduct surveys to find plant locations with the best combination of raw materials, and transportation.
- They also develop wage and salary administration systems and job evaluation programs.
- Install data processing, management information, wage incentive systems,
- Develop performance standards, job evaluation, and wage and salary programs,
- Research new products and product applications, improve productivity through application of technology and human factors,
- Select operating processes and methods to do a task with proper tools and equipment, design facilities, management systems, operating procedures, improve planning and allocation of limited resources, enhance plant environment and quality of people's working life, evaluate reliability and quality performance,
- Implement office systems, procedures, and policies,
- Analyze complex business problems by operations research,
- Conduct organization studies, plant location surveys, and system effectiveness studies,
- Study potential markets for goods and services, raw material sources, labor supply, energy resources, financing, and taxes.

16. New role of IE

- The diffusion of digital technologies in Industry 4.0 – e.g., internet of things, cloud computing, block chain, big data, artificial intelligence etc. – has facilitated a remarkable transformation in work system's boundaries, processes, structures, roles, and interactions. To be sure, this is not just a traditional process since it affects the work systems in totality, thereby mandating to redefine strategies, management processes, and innovation mechanisms. This permeation will in turn lead to the emergence of new ways of organizing value chains and inter relationships, which now will increasingly occur not in isolation but in digital ecosystems. Firms and organizations will use digital transformation in different ways. Some will be compelled to use it to improve the internal organizing process of innovation and run it more efficiently and effectively. Others will use it to sharpen the way they connect to and collaborate with stakeholders. Others instead will leverage digital transformation to build two-sided platforms and remodel their role and impact within entire industries by changing the rules of competition. Industrial engineers will be engaged in studies that clarify how digital transformation affects:
 - the boundaries, processes, structures and roles of extended enterprise's value chain in the industries where they operate, and/or collateral ones,
 - the way organizations create and capture value,
 - the way organizations cooperate and compete simultaneously,
 - the way organizations form and operate partnerships in the digital ecosystems,
 - the way organizations manage the risks arising from interconnected products and increasing interdependence.

Although Industry 4.0 is driven by new production and information technologies, people centered organizational concepts will continue to be important. Even with highly automated production techniques, smart factory, blue ocean techniques, lean practices, team building and the emotional engagement of employees in particular will remain important critical success factors. Education and the willingness of employees to engage in lifelong learning are major success factors. The aim of Industry 4.0 is not a factory devoid of people; rather more it is the synthesis of the use of information technology and classical people centered forms of work systems.

Ultimately, the professional ethics will remain the same (**MAXIMUM WELFARE FOR THE MAXIMUM PEOPLE**).

Introduction of an Integrated Industry 4.0 and Cyber Physical Systems in the Context of Indian Industry

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Abstract: Industry 4.0 is transforming factories and production floors across the world. It involves a wide set of technologies that provides a good platform for innovation and creative solutions. From the viewpoint of the Indian manufacturing industry, the “Make in India” initiative is spearheading the wider adoption of ‘Industry 4.0’. It is important for manufacturing industry in India to adopt the Industry 4.0 technology and to get adapted to the same. Cyber-Physical System is one of the key enabler for the realization of Industry 4.0 for building smart factories and the Government of India plans to set up 25 Cyber Physical Systems across the country over the next seven years. This study describes a unified 5- level CPS architecture necessary to implement a modern enterprise design according to Industry 4.0 standards.

Keywords: Industry 4.0, Cyber Physical Systems, Preventive Maintenance, Industrial big data

1. Introduction

Until the year 1991, India was a closed market, where industry was given a ‘quota’ for production targets, penalties were imposed on surplus production, heavy taxes were charged on importing goods/raw materials from foreign countries [1]. This made the Indian market/manufacturing system economically irrelevant. However, post this period until 2014, the introduction of new government reforms led to the opening up of the Indian market which changed the Indian manufacturing industry significantly. To further deconstruct and replace the obsolete and impending systems of the past, Indian government launched the “Make in India initiative” on September 25, 2014 to make India a global manufacturing hub. The highlights of the campaign are [2]:

- To increase in the share of manufacturing in the country’s Gross Domestic Product from 16% to 25% by 2022.
- To increase manufacturing sector growth to 12-14% per annum over the medium term
- To enhance the global competitiveness of the Indian manufacturing sector
- To increase domestic value addition and technological depth in manufacturing
- Ensuring sustainability of growth, particularly with regard to environment.
- To create 100 million additional jobs by 2022 in manufacturing sector.

The aim is to pull out investors from different countries and make them manufacture in India. Therefore, to maintain a competitive edge the Indian manufacturing industry will need to compete with global standards. The Indian manufacturing industry needs to equip itself with new technological capabilities, service models etc. to leapfrog into manufacturing attractiveness. Industry 4.0 has the potential to change the face of Indian manufacturing and become a quintessential part of the manufacturing revolution in India. Cyber Physical Systems [3-5], Cloud Computing [6-8], Industrial Internet of things[9] and Big Data Analytics [10-12] are the key pillars of innovation in the Industry 4.0 paradigm. Processing of big data (based on the domain knowhow) into useful information via predictive analytics coupled with secure and adaptive connectivity offered by cloud computing technology can provide better estimate of machine health. Based on the information of current status of machine condition, industrial Internet of things can provide valuable information about interdependencies such as: job scheduling, flow of materials, cycle time etc. thereby increasing operational efficiencies and lowering inventory costs as well.

Cyber physical systems are the core technological concept that constitutes the Industry 4.0 enabler. Cyber-physical system integrate computational and physical capabilities such as sensing, communication and actuation to physical world [13]. With the help of sensors (physical element), data from the physical world is processed and made available for network-based services (computing/cyber elements) to have a direct effect on the physical processes via actuators. The resultant loop can learn, control, and execute allied operations with minimum (almost negligible) human supervision and support real-time performance in safety-critical applications. The objective of the paper is to provide a vision for the Indian manufacturing industries to evolve for the upcoming industrial revolution. The paper aims to present the IMS 5C CPS based architecture for sustainable innovative service. The rest of the paper is organized as follows: Section 2 illustrates the proposed IMS-5C architecture; Section 3 introduces the IMS analytics toolbox .Section 4 introduces a case study at a manufacturing company to demonstrate the feasibility of the proposed 5C architecture in operation. The conclusions are outlined in Section 5 along with some perspectives.

2. 5C CPS Architecture: A necessity

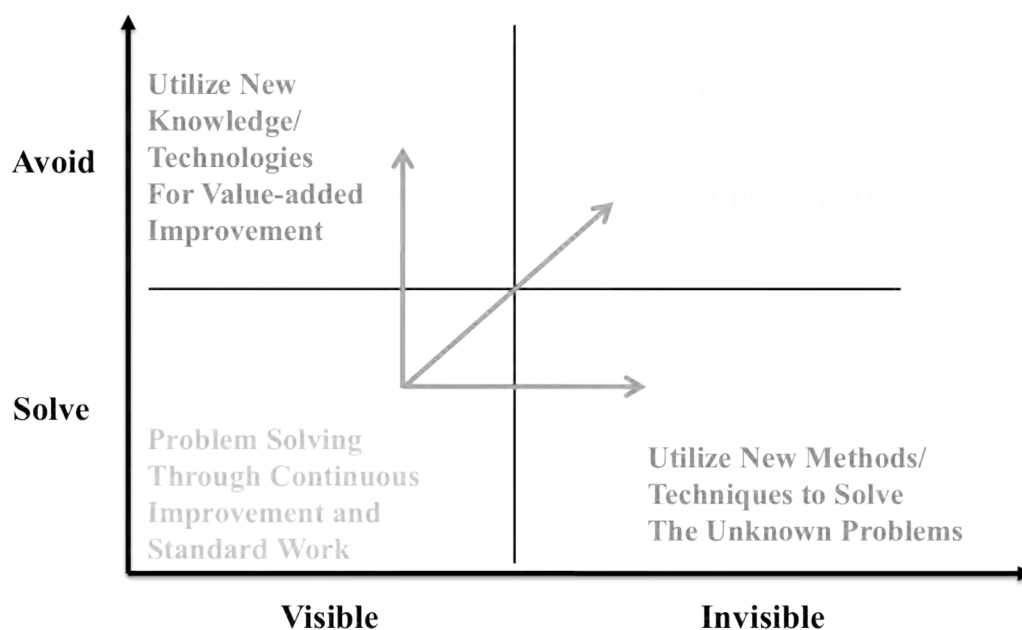


Figure 1 The impact of Industrial AI: from solving visible problems to avoiding invisible.

As described in [10], manufacturing issues in general can be mapped into two spaces (Figure 1): visible and invisible. Machine breakdown, reduced yield, loss of product quality etc. are some examples of visible defects. Invisible issues correspond to machine degradation, component wear, lack of lubrication, etc. Generally, well defined problems such as breakdowns, quality, and productivity etc. are usually solved through continuous improvement and standard work i.e. the traditional manufacturing approach (lower left space). Competitive manufacturers design, produce, and deliver high-quality customer-desired products faster than competition for problem avoidance (upper left space). Current efforts by many companies have led to the development of new methods/techniques for the invisible issues (lower right space). Cyber physical systems can aid in producing new value-creation opportunities for smart manufacturing in a dynamic and uncertain environment (upper right space). They may not only aid in solving visible problems but avoid invisible ones as well. Cyber physical systems would involve interactions between physical space, cyber space and system space. As shown in Fig. 2a, Physical space would comprise of real time information and data acquisition from sensors, machines, materials and humans to determine the condition of an asset. Cyber space would involve softwares, analytics, intelligent data management and computational capabilities. The system space would comprise of interaction and control (feedback) via integration and optimization of analyzed information to maintain the stability of the system. From the viewpoint of the above architecture, system space builds a bridge between the cyber and the physical dimensions.

CPS aims to take advantage of transformative technologies (such as Big data Analytics, Computational power, Human machine interaction etc.) to build and manage interconnected systems. The 5C architecture introduced in [3] consists of 5 levels in a sequential workflow manner and illustrates how to construct a CPS from the initial data acquisition through analytics to the final value creation. The proposed 5C architecture consists of five levels including 1) Smart Connection, 2) Data-to information Conversion, 3) Cyber, 4) Cognition and 5) Configuration. This 5C Structure, as shown in Fig. 2b, provides a sequential workflow for constructing a CPS system from initial data collection to final value creation. The details for each level are given below:

A. Connection

Connecting machines and their components for acquiring reliable and accurate data is the first step in developing a CPS for smart factories. A variety of data can be acquired via different devices and sensors. Data can also be acquired via PLC, manufacturing systems such as SCM, MES, ERP or programmable automation controllers.

B. Conversion

Various models and mechanisms are deployed to extract meaningful information/features from the acquired data. Detailed insight can be gained about the current condition of the monitored machine systems by deploying intelligent algorithms for data mining, data processing and calculating health value. This level provides self-awareness property to machines.

C. Cyber

This level plays the role of a central information hub, to which information is being passed on from machines in the machine network. Specific analytics are used to gain useful insights over the status of individual machines among the fleet. Additionally, the individual current machine performance is compared with stored historical data for future behavior prediction of the machine.

D. Cognition

Cognition level aids in a proper visualization of the analyzed information in the cyber level to the operators and factory managers for making informed decisions. Any potential failures can be diagnosed in advance based on the predicted health status. Based on the availability of the comparative information and individual machine status (self-compare functionality), the priority of the maintenance process and job scheduling can be planned effectively.

E. Configuration

This configuration level gives feedback from the cyber part to the physical part and acts supervisory control to make machines self-configure and self-adaptive. It acts as the Resilience Control System to apply the controls corresponding to the decisions made in the cognition level to machines.

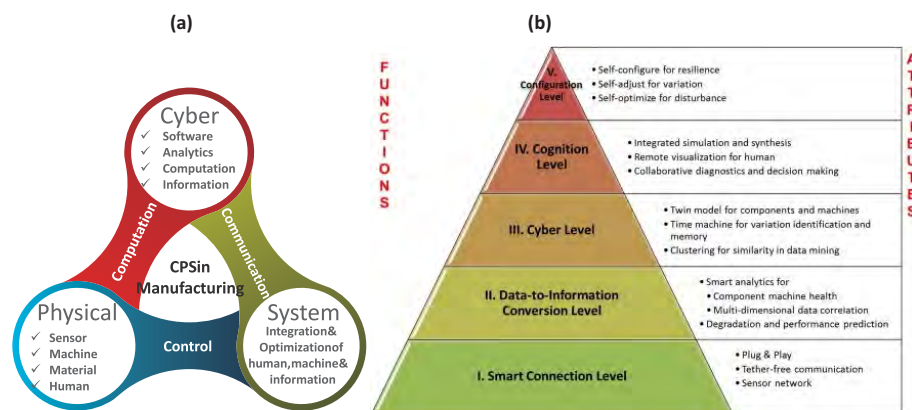


Figure 2 (a) Cyber Physical component of Railway transportation system **(b)** 5C architecture for implementation of Cyber-Physical System

3. IMS analytics toolbox approach

Center for Intelligent Maintenance Systems (IMS) at the University of Cincinnati has developed a PHM-ready Smart Box prototype which is a reconfigurable local hardware agent for cloud-based PHM system. The core functions of the device are data acquisition, data preprocessing, knowledge based feature extraction and data communication with cloud server. The PHM-ready box is designed to be able to acquire multiple channels of data from different sources. Sensor data is collected from built-in sensors such as vibration, cutting force, flow rate, pressure, temperature, current etc. to monitor and report the real-time performance of machine. Many of these signals can be acquired directly via the machine controller as well, given the controller is capable of extracting it.

Currently, the most feasible way of collecting, analyzing, and transferring such big data with high quality is edge (or fog) computing. Edge computing provides the capacity to preprocess the data locally and only send the features containing the asset health information to the cloud. While the sensors/actuators remain with the equipment, the computational processing is done in edge and storage takes place remotely in the cloud. This significantly reduces the amount of data processing burden at cloud server and effectively ensures the quality of data sent to the cloud to perform data-driven modeling. This data-driven modeling consists of establishing a library of events or conditions, where the signature of assets in different locations – machine signature before failure in particular – is stored. Data-driven models are trained based on these events, and in the case of a similar scenario, will be able to detect and predict failures before they happen. Extracted information regarding machine health and remaining useful life in real time can be integrated into the machine control which brings self-awareness to machines. Web and iOS-based user interfaces were developed to aid in decision making process. The plant managers and operators can access the health status of every connected machine in real time via the web interfaces.

4. Case Study

This section describes the implementation of the IMS 5C CPS architecture framework to cutting tools (critical components) of a CNC sawing machine. Band Saw Machines (BSM) are normally used to cut solid components and metal frames with high accuracy for large process lines. The blade on the BSM is considered as one of the critical components in BSMs, its failures can result in low cutting accuracy, energy waste and even severe damage to the entire system. The speed of the sawing process has a considerable role to play on the final quality of the product. High cutting speed may result in precision errors which get propagated to the subsequent steps resulting in poor quality products. Lower cutting speeds may perform accurate cuts, but slows down the production rate. Therefore, it is very challenging to maintain an optimal balance between surface quality and speed. Further, the health status of band sawing machine and its components would have a considerable effect on both the speed and quality of cuts. Therefore availability of exact health information from the band sawing machine would significantly aid in maintaining the cutting speed and accuracy.

4.1. Connection

Figure 3 provides an overview of how the application of 5C CPS architecture for a CNC band sawing machine. As a first step for deploying 5C architecture, the data acquisition system is set to collect high quality from machines through both add-on sensors (vibration, current sensors, temperature and acoustic emission) and controller signals (blade speed, blade height, cutting time).

4.2. Conversion

The signals are processed to extract conventional time-domain and frequency domain features such as Kurtosis, RMS, frequency band energy percentage, etc. from acoustic and vibration signals. The features are then pushed to a database in the cloud server for storage and further processing.

4.3. Cyber

On the server, an AI program is run to extract machine health information and save that in the database along with machine information and time stamp to segment the blade performance history (from when a new blade was installed to now) into discrete working regimes based on the relative change of the features comparing to the normal baseline and the local noise distribution. In the server, machine-learning algorithms are utilized to

establish a model that represents what a healthy machine signature looks like. Once a deviation is observed, the AI tool identifies the similarity of the observed deviation with previous observations and makes inference about the type of fault (if any) and the time left before failure or deviation in part quality occurs.

4.4. Cognition

A web interface is designed to pull data from the database and show the machine health status and diagnosis information in real time. The cognition level enables the machine with capability of having self-configure functionality. For example, in case of any degradation in the sawing machine components, the system will send an alarm to operators to perform the maintenance.

4.5. Configuration

Each machine can access the database in cognition level and the jobs can be prioritized based on the criticality of the machines and overall availability of machines in the factory.

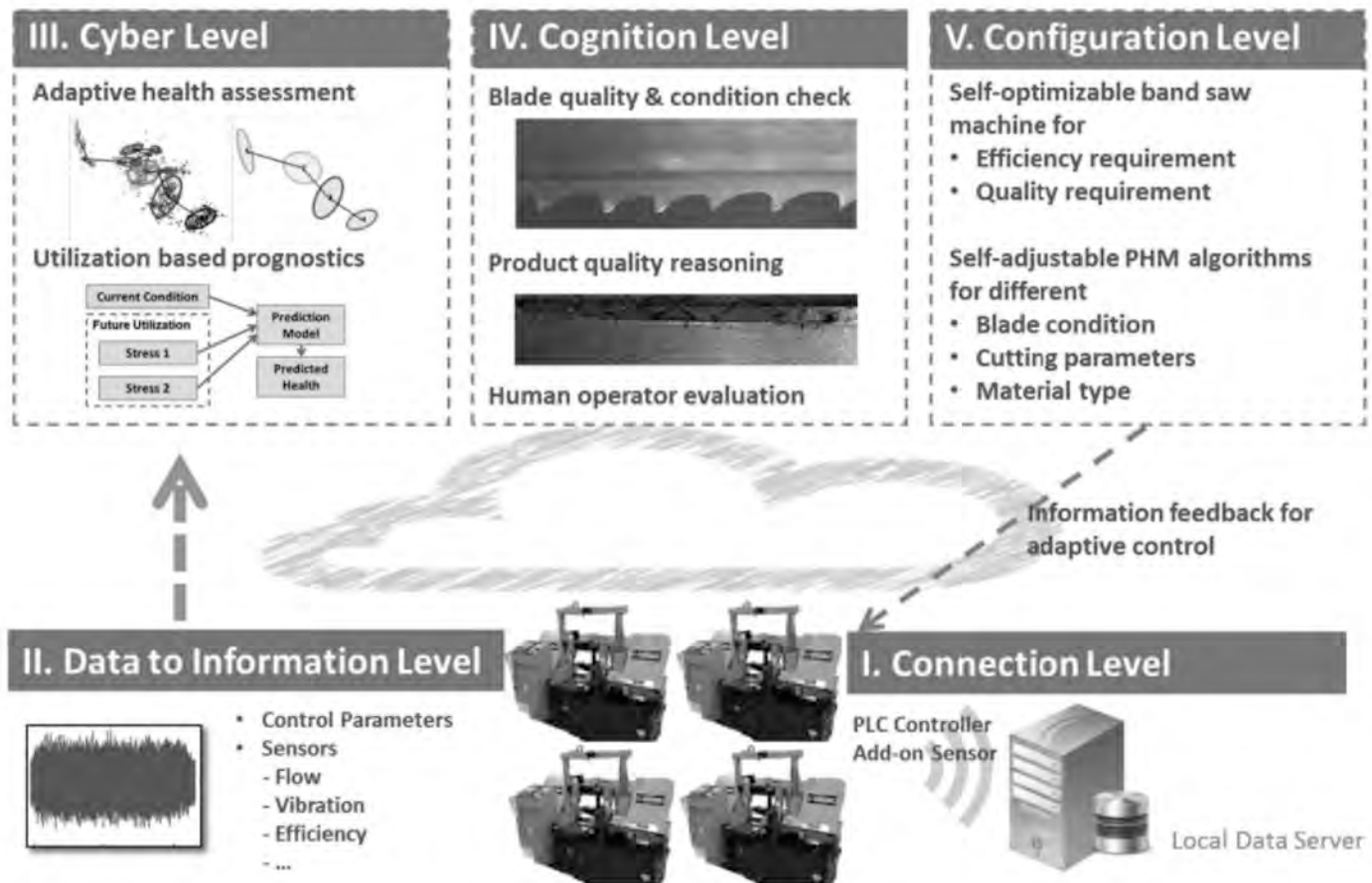


Figure 3 Overall Cyber Physical System setup for band saw Machines

5. Conclusions

The concept of Industry 4.0 is in its infancy stage with regards to the Indian manufacturing industry and thus needs a clear definition for systematic development and implementation in business. This paper aims to provide a guideline for strategizing the efforts toward realization of Industrial 4.0 with regards to Indian Industry. Industry 4.0 envisages Cyber physical systems, which seamlessly stitch together hardware and software via analytics. Cyber physical systems are one of the key enabling technologies of Industry 4.0 and are critical to the design and development of future engineering systems. In this sense, the proposed study may provide opportunities to Indian Industry that enable the creation of a long term ecosystem to manufacture everything at global quality standards.

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AAM01062

Advancements in Thermoplastic Injection Molding System with Conformally Cooled Channels

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Abstract – Designing of cooling channel for Thermoplastic Injection System has always been a struggling task for mold designer. In injection molding process quality and productivity mainly depends on cooling system of injection mould. In this process cycle time plays a significant role. Thus reducing cycle time along with maintaining quality is a major concern. There are several methods of cooling that are adopted by the mold industry. This paper gives a review about the recent advancements in cooling channel and adoption of conformally cooled channels in the injection molding process. Researchers have used various heat transfer models to design a conformal cooling channel and hence designing and simulating it using software like Autodesk Moldflow Insight, Ansys, Solidworks and Creo parametric to analyse the cooling process. The analysis conducted is a transient thermal analysis. The study indicates that the conformal cooling channels have benefits over conventional cooling channels as it dissipates more heat accordingly thus reducing the cycle time. With the use of conformal cooling channels, there is reduction in defects like warpage, shrinkage, sink marks, thermal stresses and weld lines, hence it results in reduction of number of part rejections. Also as cycle time reduces, more number of parts can be produced thus increasing productivity of the plant. With the advancement in rapid prototyping techniques, fabrication of these channels is easier. This paper discusses various types of Rapid Prototype techniques to make conformal cooling channels along with the benefits of conformally cooled channels over conventional one and gives an overview of types of the channels in terms of shapes of channels or the method of manufacturing the cooling channels like straight drilled or milled grooved or by metal deposition techniques.

AAM02067

Impact of Additive Manufacturing in Different Applications of Industry 4.0

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Abstract - The purpose of this study is to understand how Additive Manufacturing (AM) can impact various applications of Industry 4.0. A large number of research papers on additive manufacturing in Industry 4.0 and other related articles in manufacturing field have been studied to identify its impact and the subsequent research direction. Additive manufacturing technologies will be an essential part of tomorrow's smart factories, where software, technologies, and processes will be integrated to deliver the world-class results. It provides extensive inputs to smart manufacturing systems through the use of digital design and specialised machining technology. AM also helps create product innovation and impact various other applications of Industry 4.0. AM supported the design and manufactured products in a fraction of the time. It helps to reduce a considerable amount of unused inventory and also to minimise the product delivery time. Based on the demand of consumer and market, AM easily fulfils customised products requirements. AM creates a prototype for specific users in lesser time and can be used to test product concepts, production scalability, assessing market demand and fulfil supply chain requirements.

AAM03074

Phase Field Modeling of Coalescence of AlSi10Mg Particles in Direct Metal Laser Sintering

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Abstract: Direct metal laser sintering (DMLS) is one of the most proficient additive manufacturing processes which produces high quality products. The physical properties of the final products are immensely affected by the process parameters of the process. Being a fast process, the solidification rate is very fast as powdered materials sinter into crystalline structures with the application of laser power. Since the past few decades, computational modeling has helped researchers to predict and optimize the quality of output products. In this study, phase field modeling has been used to study the sintering mechanism and importance of neck growth of AlSi10Mg in DMLS process. Using temperature as an input parameter to study neck growth in equal and unequal sized particles, it is found that the rise in temperature leads to higher neck growth. Also it has been found that unequal sized particles experience faster sintering due to high diffusion rate.

AAM04083

Power Performance of BFO-Graphene Composite Electrodes Based Supercapacitor

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Abstract - In the present work, the performance of BiFeO₃-graphene composite as electrodes material for supercapacitor has been investigated for high power application. The composite material was coated on the stainless steel substrate by drop casting method. The supercapacitor device was made in two electrodes configurations and an aqueous electrolyte of Na₂SO₄ was filled between the electrodes. The electrochemical performance was determined using constant current charging/discharging and cyclic voltammetry curves. It was observed that the supercapacitor can deliver a power of 3.75 mW/cm². The surface morphology of the electrode was characterized by high scanning electron microscopy. XRD was also used for the structural analysis of the electrode.

AAM06097

Graded Distribution of Solute Particles in Centrifugal Casting

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Abstract - The paper analysed the processing factors responsible for gradation of second phase, rejected solute particles in centrifugal casting that would lead to the production of functionally graded materials (FGMs). The experiment conducted under laboratory simulated conditions involved the solidification of molten wax as the matrix and wood and sand particles as reinforced materials, in a rotating mould. The use of the prototype to establish the influence of the processing factors could be accomplished at a considerably low cost and was decisive in fixing the effect of these factors like the rotational speed of the mould and mould dimension in the real life metal casting paving a way for tailoring the FGMs keeping an eye to its specific end use.

AAM05095

Benefits of Using Nano-fluids in Minimum Quantity Lubrication (MQL) Turning of Steel

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Abstract - To understand compatible nano-materials used in machining of steels and to discover newer nano-fluids preparations and applications in the field of machining science that will benefit the society at large. Design of Experiment (DOE) and Taguchi approach is employed to most of experiments. Maximization of tool life and surface finish, Minimization of temperatures at tool tip, cutting forces on the tool are dealt. Other approaches such as Response surface method (RSM), regression analysis are also studied. Various combinations of weight percentage of nano-particle in base fluids are established. This research work will enable management in improvising better machining through sustainable green manufacturing technologies with the aid of minimum quantity lubrication and nano-fluids synthesis in coolants. The readers will understand the basic setup of MQL with nano-particle mixture and the properties of nano-fluids which has influence on the responses. Nano-fluids will help optimize the process parameters in machining.

AAM07101

A Review of Micro Lubrication for Metal Working Process

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Abstract - The purpose of this paper is to understand the effectiveness of micro lubrication over the dry and conventional flood lubrication in different machining processes. Different methodology like flow simulation, computational fluid dynamics techniques and through experimentation nozzle design, and process parameter were studied. Conventional flooded lubrication machining can be replaced by micro lubrication machining, which maintains the environmental laws of reducing pollution below unsafe level and improving health and safety of the operator. Micro lubrication is green machining techniques which minimize the use of cutting fluid during the machining process, reduce the surface integrities of a workpiece, and increases the tool life. This paper promotes new findings in micro lubrication for various manufacturing process.

AAM08139

Compaction Die Design and Preparation of Aluminium Matrix Composite Products by Powder Metallurgy Technique

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Abstract – An intensive investigation for high strength light weight aluminium composites with the aim of achieving improvement in properties and performances is required. The main objective in developing aluminium composites is to provide enhanced performance characteristics and properties beyond the established properties of currently available materials. Al-Composite can be explored and utilized in many industrial use like manufacturing, aerospace, defense and automobile sectors. Therefore, in this research work a powder compaction die is designed according to the working load with the selection of die material. The metal powders are synthesized with Copper- 2.5 wt%, Magnesium- 0.5 wt%, Silicon- 0.5 wt% and Silicon Carbide- 5 wt% matrix composite were reinforced with aluminium (91.5 wt %) through blending, followed by compaction and sintering.

AAM09144

Experimental Study on Influence of Process Parameters of Abrasive Water Jet Machining on Surface Roughness of Kevlar Epoxy Composite

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Abstract - The present paper describes an experimental study on influence of process parameters of abrasive water jet machining (AWJM) on surface roughness of Kevlar epoxy composite. A set of process parameters is optimized to achieve minimum surface roughness. The process parameters namely water pressure and abrasive grit size are considered in the present study. Root Mean Square (RMS) is used to plan design of experiments and analysis of variance (ANOVA) is used to statistically interpret experiment data to find out the significant process parameters influencing surface roughness of the material. It is found that abrasive grit size is the most significant parameter followed by water pressure influencing surface roughness. Further on the basis of experimental analysis, optimization of process parameters is performed in order to minimize surface roughness.

AAM10150

Influence of Modeling Assumptions on the Simulated EDM of Beryllium Copper Alloy

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Abstract - Electrical discharge machining (EDM) involves complex mechanism during discharge. Due to these mechanisms material removes from both the electrodes. During the discharge of spark from the tool electrode, the work piece material melts, evaporates and also ejected. To understand this phenomena thermal modeling is necessary to model the material erosion process. Several modeling approaches have been proposed by many researchers to understand the physical phenomena of material removal during EDM. These analytical models help to predict the process performance parameters effectively. In this study three most known analytical model which are based on three different types of heat flux (e.g Disk, Point and Gaussian heat source) has been considered for modeling the machining of Beryllium –Copper (Be-Cu) alloy (C17200) by EDM. The material removal rate has been predicted numerically by simulating the machining process for single discharge.

AAM11153

Study on Effect of FDM Process Parameters on Tensile Strength and Surface Roughness of FDM Built ABS Parts

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Abstract - Additive manufacturing (AM) processes are relatively new technologies developed in the late twentieth century. AM is now rapidly overtaking conventional manufacturing processes. However, AM technologies like fused deposition modelling (FDM) is still widely unexplored and organizations are looking for a more standardized system for AM processes. This study aims to identify the effect of basic process parameters like layer thickness and build orientation on key characteristics of FDM parts such as tensile strength and surface roughness. This study utilizes a multi-objective decision making techniques like grey relational analysis to find a suitable parametric setting to obtain the best possible parts from the FDM process.

AAM12158

Material Characterization of Cu-Graphite-Flyash and Cu-Lead-Flyash Metal Matrix Composites

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Abstract - In this present work copper matrix composites were fabricated and characterized with the aid of powder metallurgy technique. Lead and graphite powdered particles are reinforced in copper matrix with 5 wt% along with 5, 10 and 15 weight percent fly ash were fabricated under various compacting pressures. Compacting properties of these composites were characterized. The results were analyzed and found that composites reinforced with 5 wt% of graphite or 5% lead and 10 wt% of flyash exhibits compacting properties in comparison with pure copper.

AAM13165

Machinability Studies of Inconel 625 Using Uncoated and CVD Coated Tool Inserts in Flood Cooling Condition

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Abstract - The present work emphasizes effects of machining on Inconel 625 with uncoated and CVD coated tools under flood cooling. With the wide range of applications of nickel-based super alloys in different fields, it has become increasingly necessary to study the machinability of such alloys with advanced cutting tools in different cutting environments. The main focus of the work is characterization of this metal pertaining to its machinability in flood cooling. Tool wear and its mechanism, cutting forces have been studied using uncoated and chemical vapour deposition (CVD) multilayer coated tools with different cutting speeds i.e. 55, 75, 95, and 125 m/min. Feed (0.14 mm/rev) and depth of cut (0.5 mm) were kept constant throughout the experimentation. The present experimentation emphasizes that the cutting forces is lower in case of CVD coated tool except at higher cutting speed. CVD coated tool shows significant decrement in tool wear as compared to uncoated tool.

AAM14168

Friction Stir Welding of Similar and Dissimilar Light Weight Metals

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Abstract - Friction stir welding is a prominent solid state welding process widely used in different industry to join similar and dissimilar light weight metal that are difficult to weld by conventional fusion welding process. This paper provides an overview of effect of tool geometry and various parameters such as tool rotation speed, welding speed, vertical pressure on tool shoulder on the mechanical properties, microstructure of joint. Various welding defects in friction stir welding are also studied and analyzed.

AAM15181

Recent Trends in Surface Roughness Prediction Monitoring and Control: - A ReviewA. Deshpande¹, Minhaj. Ahemed², R. L. Srivastav³^{1,2} Department of Mechanical Engineering, St. Vincent Pallotti College of Engineering³ Department of Mechanical Engineering, YCCE Nagpur, Maharashtra India

Abstract – One aspect of Industry 4.0 is getting first time right products. It implies that there is no scope for rework. Any machining operation has certain process output variables. Over the years several authors have made an effort to predict or estimate few of those variables prior to the beginning of machining. This paper presents a systematic review of all such work carried out so far. Such a review will assist in finding a new approach to the work carried out so far. A lot has been spoken about the impact of machining output parameter estimation but none of the authors have investigated about its impact on overall shop productivity. The future implications of this study will assist in designing a module for CAM software to aid in computer-aided process planning thereby faster time-to-market and identify a method to ascertain the impact of this study on shop productivity.

AAM16184

**Impact of Tempering Factors on Mechanical Properties of Ck55 Steel
(0.55wt%C -0.75wt%Mn)**

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Abstract - In the composite era, steel have been still gaining emphasis for automobile machine parts. In this regard Ck55 steel is taken due to its optimum balance between ductility and strength in tempered conditions. In present study, Ck55 grade steel is tempered at three temperature conditions i.e. at 600°C, 400°C and 200°C for different time length. The properties of all the specimens are evaluated and we found the maximum hardness and tensile strength for tempering at 200°C for 1 hour with minimum ductility because of the presence of less no. of softer carbide and ferrite. We get the maximum ductility at tempering at 600°C for 2 hours with minimum tensile strength because softer carbide and ferrite dominants whole of the microstructure. It is found that tempering time and temperature greatly influences the strength as well as hardness value without much compromise in the ductility.

AAM17185

**Relation Between Fatigue Limit and Tensile Strength at Different Tempering
Temperature and Time of Ck55 Steel**

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Abstract - Fatigue properties of tempered Ck55 (.55%C) has been investigated by using Moore rotating beam testing machine at a load ratio of $R = -1$ and cycling frequency of 100 Hz with specific consideration regarding microstructural points of interest. Ck55 steels demonstrate a distinct variation of fatigue limit and life at different tempering temperature and time length. No specimen failed below fatigue limit for high number of cycles. The actual fatigue test results for given materials, relates the tempering temperature and time which is because of the formation and changes in the microstructure. An attempt has been made to imperative connections between tensile strength and endurance life by varying tempering temperature and time.

AAM18195

Solid Particle Erosion Properties of Areca Sheath Fiber Reinforced Polyvinyl Chloride Composites

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Abstract - The present paper describes the solid particle erosion property of chemically modified short areca sheath (AS) fiber reinforced with polyvinylchloride (PVC) composites. For this purpose the test specimens were prepared with varying fiber loading (0-40 wt%) by using a twin screw micro-compounder and an injection molding machine. The solid particle wear test was conducted on each fiber loading (0, 10, 20, 30 and 40 wt%) at impact angles (15, 30, 45, 60 and 90°) and impact velocities (48, 70, 82 and 109 m/s) using silica sand particle ($200 \pm 50 \mu\text{m}$) as erodent and effect of impact velocity, impact angle on erosion rate was investigated. It was observed that the fiber content has no influence on erosion rate and it increases with fiber content. Moreover, the erosion rate shows its peak value at 60° impact angle for all the composites revealing its ductile property. The wear mechanism was studied and surface quality after erosion was studied by using a scanning electron microscope (SEM).

AAM19017

Tool Condition Monitoring System in Radial Drilling Machine by Vibration Analyzer

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Abstract - This paper presents a tool condition monitoring technique for radial drilling machine by using vibration analyzer is vital for in the field of on-line monitoring of machining processes in manufacturing industries. Purpose of this paper is to present a research on tool condition monitoring system in radial drilling machine by vibration analyzer for cutting tool wear sensing are crucial in view of the optimum use of cutting tools, signal and acquisition processing, vibration signals. The paper work includes the methodology of literature survey, problem definition, hypothesis statements, plan for various test analysis, hypothesis tests, experiments planned, research plan, use of FFT analyzer. This paper work presents a complete research for undertaken on investigation of collection of data in terms of signals from sensors such as cutting force, vibration, acoustic emission and signal processing and extraction of features from the signals and classification or estimation of tool wear using pattern recognition. This paper work provide vital information on investigation of tool condition monitoring system in radial drilling machine by vibration analyzer, with an effective monitoring system, worn tool can be changed in time to avoid unexpected downtime and scrapped components, feature selection and feature classification and affected process parameters and tool work piece material combination. This paper work is applicable to especially in drilling process and manufacturing operation in mechanical and automotive industry, but there are some limitation about accuracy and surface finish in component design and development. Manufacturing industries will receive the vital information and guidelines with an effective tool condition monitoring systems to the machine tool, unexpected downtime and scrapped components can be reduced. This paper work will put forward the new direction to use of radial drilling machine for manufacturing of the mechanical component with improved process quality.

AAM20205

Compaction and Sintering of High and Low Carbon Content Ferrous Powders for Composite Making

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Abstract - In the present investigation high carbon content rapidly solidified alloyed ferrous powders were used as reinforcing materials to prepare composites. The powders were mixed with low carbon content ferrous powders in 50:50 weight percent and metal matrix composites were prepared following cold compaction and sintering processes. Improved micro-hardness values were obtained for the processed composites with grain refinement and this enhanced the acceptability of these for industrial use. Again shrinkage and growth data of the composites were calculated after sintering for extending necessary assistance to the design engineers to prepare die for product manufacturing.

AAM21213

Investigate an Effect of MIG Welding Process Parameters for SS304 & Ni200 Materials on Strength & Corrosion Resistance

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Abstract –As we know that the use of nickel and stainless metals in different industrial sector such as oil and gas, aerospace, automobile, power plant, manufacturing etc. is high due to their higher tensile strength and toughness etc. Therefore need has arrived to think out in the merger of dissimilar metal which are compatible and stronger such as stainless steel. By MIG welding at the interface between dissimilar metals has been investigated with the use of Taguchi method of optimization. Metal inert gas welding, a high power density but low energy input process, provides solutions to a number of problems encountered with conventional joining techniques. To achieve optimization, the process parameters must be adjusted in such a way that the deviations from target are minimized while the robustness to noise and to process fluctuations are maximized which in turn to get better corrosion resistance and tensile strength which is an important parameters while designing the ice moulding machines.

AAM23237

Review of Roll Pass Model for Tandem Cold Rolling Mill

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Abstract - Cold rolled products need strict product quality with respect to uniform gauge, good shape, and dimension. Factors affecting quality are inhomogeneous composition of steel due to non uniform distribution of alloying elements, interstand tension, and variation in pressure and co-efficient of friction. In addition to it, variation in input gauge, bending of work during roll affect quality such as flatness of the strip, uniform gauge, along the length as well as across the width. Efforts have been made in optimisation of various parameters, like power consumption, mill balance control, estimation of deformation parameter and roll bending measurement and intermediate roll shifting, and finally validation through measurement. Even though there has been improvement with respect to process automation, still there exists the need for 3D mathematical modelling of cold rolling process, with fast computational facility with huge data storage system. This paper presents the progress in this field.

AAM22216

Minimization of Surface Roughness for Milling of Ti-6Al-4V Using Response Surface Methodology

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Abstract - Achieving good surface finish is a challenging task in industries while machining titanium alloys. In the present work an attempt has been made to minimize surface roughness in milling operation of Ti-6Al-4V. Design of experiment was performed using response surface methodology (RSM) for developing model for surface roughness with cutting parameters as variables. Developed model was validated with additional milling trials other than the ones used in main design of experiments. It was observed that surface roughness is continuous uniformly influenced by cutting speed and feed rate whereas depth of cut has non uniform effect over surface roughness. Correlation coefficient (R^2) of 98 % shows goodness of the model which means 98% of data can be explained by the developed model. Later on, minimization of surface roughness was done with response surface based desirability approach. Response optimiser give minimum surface roughness as $0.82\mu\text{m}$ and corresponding cutting parameters as 820.15 RPM , feed rate 0.13mm/tooth and depth of cut 2.06 mm.

CPS01011

Smart Maintenance Model Using Cyber Physical System

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Abstract - Modern manufacturing are exposed to rapid and dynamic changes in operating conditions, market demands, national and international competition. Therefore, new generations and concepts of maintenance techniques are necessary to overcome the deficiencies in the current techniques. The purpose of this paper is to propose a maintenance model that is automatic, digitalised and intelligent using Cyber Physical System (CPS-Maint). In this paper, we presented comparable maintenance approaches and described their shortages. Thereafter, we developed a new maintenance model. Then, A simulation using LabVIEW is conducted to examine the model and its behavior. The results showed that the required tasks are performed with no conflict among its components. The major result is the development of CPS-Maint and the major conclusion is applying CPS-Maint fulfills industry needs. This paper provides a framework that could help developers and researchers in designing and developing an automatic and smart maintenance system.

CPS02050

India's Readiness for Industry 4.0

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Abstract - Industry 4.0 is a strategic initiative recently introduced by the German government. The goal of the initiative is transformation of industrial manufacturing through digitalization and exploitation of potentials of new technologies. Industry 4.0 has highly intelligent connected systems that create a fully digital value chain. It particularly is based on cyber physical production systems that integrate communications, IT, data and physical elements and wherein these systems transform the traditional plants into smart factories. Here the objective is that the machines talk to other machines and products and information is processed and distributed in real time resulting in profound changes to the entire industrial ecosystem. This paper explains statistics about how Indian economy are growing and India's readiness for adopting Industry 4.0.

CPS03056

Expectations from a Car in Industry 4.0 Era: Identifying and Prioritizing the Futuristic Attributes of a Car

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Abstract - Industry 4.0 era is going to witness smart cars with embedded systems, which will use cyber physical systems, big data and Internet of Things. In this research the important desires of the future generation were identified from discussions, literature surveys and review of ongoing research in the field of automobile engineering. Ten (10) major attributes contributing towards driving safety, automation, optimized use of renewable energy, driver assistance, process control systems, etc. were selected. The opinions about these attributes were captured from a survey. Fuzzy AHP was then used to prioritize these attributes. Communication between vehicles, long term evolution and sheet thin batteries evolved as the most preferred attributes. Innovation always leads to competitive advantage in the long term. Connected cars and cloud powered automotive industry are the major automotive industry trend and for automakers, embracing these smart technologies will offer both challenges and opportunities, thereby keeping them ahead in competition.

CPS04186

Wide Band Circularly Polarized Patch Antenna Using the Symmetric U-Slot for GPS Applications

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Abstract - A symmetric U-Slot microstrip patch antenna with circular polarization (CP) is presented in this work. The CP is achieved by the truncation of the corners of the rectangular patch. The designed antenna resonates near to 1.575 GHz. For the designing of above antenna, a substrate with comparatively higher dielectric constant is utilized. The resonance frequency of the proposed design makes this antenna useful for the global positioning system operations. Different antenna parameters have been considered with their simulated as well as measured values. The measured and simulated results are nearly similar which prove the authenticity of proposed design.

CPS05188

An Implementation of Single Node on Distributed File System Using Apache's Hadoop on Ubuntu

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Abstract- Apache Hadoop is an open source Java framework managed by Apache Software Foundation. It provide storage of large amount of data efficiently with low costing. Hadoop has two main core components one is HDFS (Hadoop Distributed File System) and another is Map Reduce. It is basically a file system and has capability of high fault-tolerant and while deploying supports low cost hardware. It also provide the high speed access to the application data .The Hadoop architecture is based on cluster, which consist of two nodes named as Data Node and Name Node which perform the internal activity known as heart beat to process data storage on distributed file system and Map reducing is performed internally to show the clustering of distributed data on localhost of ssh server

CPS06190

Smartphone Driven Fourth Industrial Revolution

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Abstract – The purpose is to make qualitative education and medicine inexpensive. The approach will be smartphone-based technology. In this paper we have zeroed in on smartphone driven affordable and portable health care with special emphasis on ophthalmic applications. Coupling a smartphone with sensors and output channels one can build up handheld tunable focus confocal microscope to see-through ophthalmoscope for retinal imaging. We have also given passing remarks on cell phone microscope and cell phone spectrometer which will revolutionize optics education in schools of developing nations. This will produce smart managers who will deliver quality products and services on time in fewer prices. As smartphone has penetrated into life of almost everybody and the technology is fast picking, this paper highlighting the educational and medical applications of smartphone based intelligent manufacturing will add immensely to 4.0.

CPS07191

Low Cost Smart Devices Using Smart Factory

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Abstract - The whole world is on the verge of forming the Internet of Things (IoT). Subsequently IoT will animate the factories and government to begin an evolutionary passage toward the fourth industrial revolution called Industry 4.0. This paper aims to illustrate the concept of industry 4.0 by presenting the architecture for IoT-based smart factory which can produce smart devices with affordable price. Along with this it also explains how the smart devices can be implemented in diagnosis of different eye related diseases also. Apart from this, the paper provides some devices based on smart factories which can be used for different purpose for the service of mankind. Here also we have explained the smart phone based technology in understanding the light spectra from different sources. At last, with the advanced progression in the development of smart device, the society will be benefitted to much extent.

CPS08194

Evolutionary Elements and Technologies for the Transition to Industry 4.0

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Abstract - Captivating towards elements and technologies leads the transition to industry 4.0, which is the tag relates to the term Automation in manufacturing technologies that include, the Internet of things, cyber-physical systems, cognitive computing and cloud computing will help early detection of defects and production failures, thus enabling their prevention and increasing productivity, quality, and agility that have significant competitive value. In the current industry environment, providing high-end quality service or product with the least cost is the key to success and industrial factories are trying to achieve as much performance as possible to increase their profit as well as their reputation, also exploring further in key areas of design principles and challenges in implementation and impacts followed by relevant factors framework of Industry 4.0.

CPS09199

Location Prediction Using Legendre Method in Wireless Network

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Abstract - Artificial neural network structure such as Multilayer Perceptron with back propagation (MLP-BP), Legendre neural network (LeNN) applied to this Location Management Problem in the cellular system is proposed in this paper. The nonlinear neural network that is computationally efficient solves the issues associated with the location management. A large amount of computation time for learning in case of feed forward neural network such as back propagation (BP) that is a major issue. The proposed LeNN basically a single layer structure in which nonlinearity is introduced where the input pattern is enhanced with nonlinear functional expansion is simpler than MLP-BP. The novelty of the proposed work is the less computational time is required in LeNN than that of MLP-BP. The simulation result shows that LeNN outperforms the other proposed two techniques regarding performance error. From simulation, the effectiveness of subscriber prediction is evaluated. It is also shown that proposed network is computationally cheap and gives better classification accuracy than that of MLP classifier.

DFE01013

Design and Development of 2-Jaw Parallel Pneumatic Gripper

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Abstract - This paper presents an alternative solution for the 2-jaw parallel pneumatic standard gripper. In this gripper pneumatic cylinder is used to actuate the vertical motion for the gripping action and the pair of prismatic pair is used to transfer the vertical motion to horizontal motion to create a gripping motion to pick the object. The standard RCCB manufactured by L & T is used to as a object for pick and place purpose. The paper gives the detail design and manufacturing of Designed Gripper with proper calculations and graphical results. The paper also helps to give the cheaper solution to small scale industry and the applications where the use is less.

DFE02044

Design and Analysis of Rocker Bogie Mechanism Based Robot

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Abstract: Rovers play a very important role when it comes to analyse the Martian soil. For this purpose a reliable mechanism was needed which do not need much maintenance and could pass over the uneven surfaces of mars without flipping over. Therefore, NASA developed a mechanism, which could fulfil all the conditions known as rocker bogie mechanism. The proposed mechanism is currently the most favoured design for every space exploration company indulged in the business of space research. The motive of this paper is to design, analyse the rocker bogie mechanism and control it using Arduino via Bluetooth module. Through ANSYS analysis it is shown how we can optimize the robot by changing the material used. This paper also shows how this mechanism can be used for other applications like defence, disaster relief and space exploration. It also reveals how we can make this mechanism cost efficient and reliable with uniform weight distribution over the entire structure.

DFE03063

Weight Optimization of Formwork and Staging of an Underpass

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Abstract - The advancements in technology have enabled various facilities for human beings in the past couple of decades. While enjoying these facilities, a greater portion of the resources gets depleted, it may be material, capital or time. Therefore it is the responsibility of a design engineer to analyze the components in such a way to use these resources in optimum way. The conventional formwork used in construction of underpasses is very heavy and consumes a lot of material in its fabrication. This research paper focuses on optimization of formwork weight used in construction of an underpass. This is done by analyzing the each components of the formwork assembly to find the minimum dimensions based on the value of induced stress. This analysis results further used to validate the result obtained from analytical approach. Finally result shows that the 14% overall weight has been reduced compared to conventional formwork.

DFE04110

Design of Fuzzy Logic Based PID Controller for Heat Exchanger Used in Chemical Industries

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Abstract - In industries, the use of heat exchanger are badly necessary to transfer heat through fluid. For such purpose, control of temperature has a great role, so that PID controller are used vastly. This paper basically focuses upon the feed forward-feedback control strategy involved along with the PID control. This control strategy cancels the effect of the measured disturbances and load changes in the system. The use of Fuzzy controller tuning of PID controller makes the system intelligent and robust. The simulation results endorse the effectiveness of fuzzy controller based tuning along with the feed forward-feedback control strategy.

DFE05124

Fabrication and Properties of Orgonic-Inorganic Composite Polymers

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Abstract - Cost-effective conducting polymer composite films were prepared from the nonconducting polymer using black Tea. Those are good at conduction and showed optimum magnetic properties. The coercive field, saturation magnetization and remnant magnetization values are found to be 80 Oe, 0.14 emu/g (at field 8kOe), and 9×10^{-3} emu/g, respectively. Nowadays, materials are using high-frequency applications such as high-speed wireless communications. In order to understand the behavior of materials at such applications, dielectric properties at high frequencies have to be measured and low-frequency properties are also still interesting. For this reason, complex permittivity spectra in a wide range of frequency were obtained for the composite polymer films. The measured ϵ' and $\tan\delta$ values of material are 260 and 0.37 at 1 kHz. The estimated σ_{dc} value is 1.6×10^{-8} S/cm.

DFE06132

Structural Evaluation of Fused Deposition Modeling Parts

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Abstract - Mechanical properties of fused deposition modeling parts depend on many process parameters, like, build orientation, air gap, layer thickness, temperature. This work attempts to check the relation of build orientation and anisotropy. Parts are printed with different orientations using FDM and subsequently, are tested on the digital testing machine to study the behavior in all the three directions. The FEA analysis has to be carried out in order to establish the relationship between orientation and strengths in three principal directions. The result provides the evidence of anisotropy of fused deposition modeling process. It also gives the future scope of the work.

DFE08012

Optimization of Design of Jaw Contact Mechanism of an Air Circuit Breaker using Finite Element Analysis Model and Design of Experiments

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Abstract – Optimize the design of Jaw Contact Mechanism of an Air Circuit Breaker (ACB) of rating 1600A for reducing Temperature Rise (TR). To reduce TR; Various parameters contributing to heat generation in current path are investigated and optimized using three-dimensional steady-state FEA analysis and Full Factorial Design of Experiments (DOE) approach. Design of jaw contact mechanism is optimized by selecting best parameters which give less temperature rise. To validate the results, experimental TR test has been carried out in the laboratory. There is a good agreement between experimental results and software results. This model can be used to analyze, predict and optimize the thermal behavior of current path of all types of circuit breakers of all ratings. This optimization will improve performance of the ACB and help the organization to improve product growth in market.

DFE07042

Digital Manufacturing: A Step Towards Engineering Collaboration Between Design & Manufacturing in Auto Industry

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Abstract - In automobile industry, digital manufacturing is a complete digital representation of vehicle product data, manufacturing process and manufacturing facility. Digital manufacturing is highly used to shorten the product development time by providing quick feedback to product designer on design for assembly, design for manufacturing and design for serviceability. Considering the existing facility of factory in design environment, product designer collaboratively worked with manufacturing process planner by using computer-aided design, computer-aided manufacturing in product life cycle management. Due to digital manufacturing, it is expected to achieve drastic time reduction and cost savings of many manufacturing industries and improves quality of products and reduces time to market of new product launch by anticipating upcoming changes in manufacturing facility and product modification. In the present work, an attempt has been made to analyze the wheel rim and carry out topological optimization on it. The topological optimization analysis is carried out through reverse engineering approach and it shows that the weight reduction contributes largely to the overall functioning of the equipment without affecting the functional use and the manufacturing process.

DFE09156

Smart Materials for Industry 4.0: A Multilayered Approach to Analysis of Functionally Graded Material Panels

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Abstract - The purpose of the present study is to bring about a well designed and well analyzed smart material by using the concept of functionally graded material where the product attributes such as light weight, high strength, high stiffness and easy tailorability can be successfully met. In order to create a suitable material laminate, an analytical formulation using an efficient shear deformation theory is developed where different layers functionally graded materials can be stacked up by ensuring perfect bonding between the layers or can be created in a single continuous operation by using the more versatile 3D printing. It is found that the resulting analytical model correctly identifies the critical locations and parameters that are responsible for material failure as well as the appropriate variation of material properties across laminate thickness that enhances productivity and quality of the designed laminate. The technique will significantly reduce the time and computational cost involved with analysis of smart materials and will provide a basis for finite element implementation.

DFE10161

Design for Manufacturing and Assembly (DFMA) Technique Applicable for Cost Reduction –A Review

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Abstract - In manufacturing process, design is the first step where most of the important decisions are made which affect the final cost of the product. The main emphasis is given to obtain an optimum design solution for an existing product. It has been already proven fact that large percentage of the product cost is due to the complex manufacturing and assembly process. DFMA can be used as an early cost estimation technique. And there are no boundaries to the application of the DFMA principles. One can use DFMA throughout any type of organization/enterprise/industry .It can also be used in case of multidisciplinary tasks, supply chain management ,activities based on manufacturing and assembly or the architectural design choices of any product development and manufacturing. This paper reviews on Design for Manufacturing and Assembly (DFMA) principles and its applications for early cost estimation and reduction techniques.

DFE12171

Performance Enhancement of Self-Aspirated Porous Surface Domestic Cooking Burner Using Secondary Aeration

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Abstract - This paper presents the effect of secondary aeration on the performance of a novel self-aspirated porous surface burner used for domestic cooking. The burner is designed and developed in contrast to the principle adapted so far in bi-layer porous burners. Liquefied Petroleum Gas (LPG) is used as the test fuel for the experiment. The experimental results revealed that the thermal efficiency of the burner is 71.78% which is about 7% more efficient compared to the conventional burners operating within the range of 0.55 to 2kW. Emissions of CO and NOx are significantly lower than the conventional free flame LPG burners. Provision for mixing secondary air with preheated primary air-fuel mixture is made through the tubes attached to the body of the burner. Further reduction in CO values to 32ppm with an improvement in maximum thermal efficiency to 73.22% is also observed with secondary aeration by natural drafting.

DFE11026

Design and Finite Element Analysis of Power Transformer Tank for Deformation Study

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Abstract - In the early design phase of Power transformer tank, there are no standardized and recognized methods for deformation study for optimizing the steel weight of tank. The existing method is based on previous tank models, experience, and only a few combinations are considered before decisions are made. In the initial design stage analytical calculation is carried out, which are semi-empirical in nature and do not give an accurate calculation for deflections and stresses. The tank designed on the basis of these formulae may not be strong enough and its strength can be assessed more reliably by Finite Element Analysis which is widely used in the industry. The designs that fail the FEA test are redesigned on basis of FEA alone is added advantage of this proposed method in this paper.

DFE14182

Study of Rheological Characteristics of Coal Water Alcohol Slurry

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Abstract - A comparative analysis of coal water slurry alcohol has been done taking glycerol, glycol and ethanol as an additive. 10 ml of alcohol additive was added to the slurry and a range of 50-64% of concentration by mass was obtained. Various parameters like shear rate, shear stress, pH, temperature, apparent viscosity, stability etc. was examined and compared the result of coal water glycerol slurry(CWGIS), coal water glycol slurry(CWGS) and coal water ethanol slurry(CWES) for a particular mono-modal sample. From each parameter study it is concluded that coal-water slurry in presence of glycerol has less viscosity as well as more stability than coal-water slurry in presence of glycol and ethanol. This is due to the presence of more number of OH⁻ radicals in the alcohol group. More OH⁻ radicals creates more carbon atoms which will increase the tendency to adsorb on the coal surface.

DFE13179

Effect of Different Catalysts on the Production Rate of Biogas from Banana Leaves

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Abstract - In this study, the effect of metal oxide nanoparticles (NPs) such as titanium oxide (TiO₂) and aluminum oxide (Al₂O₃) mixed with urea (2% of biomass w/v) on production of biogas from semi dried banana leaves added to 500 ml of sewage sludge samples was compared with pure sewage water inoculums on anaerobic digestion process. The results revealed that sludge solution with urea alone (S+U) showed better performance in the production of biogas and methane content than pure sewage water and NPs mixed inoculums. Maximum methane yield content in case of sludge solution with urea was found to be 65.28% in 38 days for 50 gm of semi dried banana leaves with 2 mm size. While methane content of pure sewage was found to be 54.46 % in 46 days and in case of TiO₂ methane yield was found to be 59.18 % in 38 days and in case of Al₂O₃ it is 54.88% in 42 days.

DFE15220

A Review of Solid State Processes in Manufacture of Functionally Graded Materials

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Abstract- The demand for materials exhibiting multiple functionalities & having greater relevance to aerospace & other similar applications have led researchers to develop such materials named Functionally Graded Materials, having properties that may be tailored for a definite application. Better stiffness-to-weight ratio characteristic of such material is the main reason of their popularity today. Efforts are also directed to produce such materials in bulks and in a cost effective manner. An overview of fabrication methods such as Powder metallurgy, Solid Freeform Fabrication, Laser cladding, Selective Laser Sintering, 3-D Printing and Selective Laser Melting etc are deliberated here. The quality of FGM produced with better awareness, research and patronization at the state level is a continuous process, hence a review of solid state processes in manufacture of Functionally Graded Materials is the need of the hour.

DFE16223

Design and Fabrication of Compressible Car

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Abstract – Normally the city are getting congested due to increase in population and also paying capacity due to which four wheel vehicles are getting more in number in the same size roads and city. This is creating the shortage in the parking area, restriction for movement in congested area. A vehicle which is folding within itself when required, retaining the seating for the drive. Here is a proposed model of four wheel vehicle with a drive for front wheels and steering mechanism powered by DC batteries. The frame is made in two parts which is hinged together by four bar linkage or parallelogram mechanism, through links which folds together by leadscrew mechanism being powered by DC motor when actuated by button control. The outside cover is made accordingly, the front seat being hinged on the pivots with gravity method. This helps in less occupancy during the parking and also to move in congested area.

DFE18234

Performance of 310 Steel Used for PAT Runner Against Silt Erosion

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Abstract - Pump can be operated as turbine to generate electricity in remote areas where a small stream of water is available which is called Pump As Turbine(PAT). It can provide off-grid electrification to the rural areas, which prevents transportation losses. In order to find out the possible characteristics of a pump to be operated as turbine, various researches are being carried out. Cavitation erosion and silt erosion are main problems associated with the running of PAT. Ultimately which leads to induced vibration, fatigue damage, decrease in efficiency, mechanical failure and frequent shut down. To overcome these problems researches are carrying out on different hard material for PAT runner. This investigation is carried out to study the erosion behavior and mechanism of erosion of 310 SS steel. Results obtained are compared with one of the existing erosion models and the erosion behavior obtain from these experiments are well agreed with the theoretical model.

DFE17229

A Topsis QFD Approach for Ranking of Design Attributes

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Abstract - In product development process, researchers are always trying to find a best suitable method, which will save a product from its failure. Quality Function Deployment (QFD) was also born in the same manner and doing number of product development process. Initial use of QFD was not so effective, almost 45 percent newly launched product becomes fail. To save the product from its failure, number of tools have been integrated with QFD. These integrations are mainly done in the customer importance ranking part of QFD. None of them have put their mind to improve the score calculation method of QFD. As the nature of score calculation comes under multicriteria decision making method (MCDM). Therefore, in this study a suitable MCDM technique (TOPSIS) have been used to calculate the score of QFD methodology. Further, this concept has been applied in a previously published literature. Results of the study indicate that integration of QFD with TOPSIS gives better ranking for score of QFD.

DFE20239

Experimental Investigation of Performance of a Triple Concentric Helical Tube Heat Exchanger Using Al_2O_3 Nanofluid

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Abstract - This article reports an experimental study of flow characteristics of a triple concentric heat exchanger, using a helical coil at the middle flow system. A comparison of the performance for the designed heat exchanger is computed under turbulent flow conditions for N-H-C (nanofluid at normal temperature flows in inner pipe- hot fluid flows through the helical coil over inner pipe - cold fluid in the annulus region) and C-H-N (cold fluid flows in inner pipe - hot fluid flows through the helical coil over inner pipe - nanofluid at normal temperature in the annulus region) flow arrangement with parallel and counter flow of hot fluid. Al_2O_3 nano-particles of about 50 nm diameter are used in the present study to enhance the heat exchanger effectiveness with different flow arrangements.

DES01023

Conceptual Modeling of Production Scheduling in Virtual Enterprise

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Abstract - Now-a-days organizations are facing the rapidly changing business environment which results in unpredictability of long term investment in technologies and working conditions. Though small and medium enterprises are the largest employers of industrial workers, they lack capacity and capability to compete in turbulent market. In this paper a collaborative network called virtual enterprise has been proposed with relevant system architecture and protocols to share resources, responsibilities, risks and rewards. In the conceptual modeling only spare capacities of resources are considered to develop the appropriate market model. Since production scheduling plays important role in the operation of virtual enterprise, an agent based decentralized approach has been taken to develop mathematical model for faster implementation

DFE19238

Comparative Analysis of Thermal and Hydraulic Performance of PHE and S&T Heat Exchanger During Pasteurization of Mango Juice Using Nanofluid

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Abstract - Food industries including dairy units, fruits and beverages industries are frequently subjected to thermal processing inside heat exchangers. Today, the vital demands for any food and beverages industries are fluids having high heat transfer characteristics, low pumping power, easy cleaning surfaces and hygienic operations. In food process industry these requirements are often met by different heat exchanger typically, plate heat exchanger and the shell and tube heat exchanger are widely used. A comparative study of performance of Plate heat exchanger (PHE) and shell and tube heat exchanger (S&T HE) using Al_2O_3 /distilled water nanofluid during the thermal processing of mango juice is done. The heat exchanging fluids employed here are nanofluid acting as hot fluid and mango juice as cold fluid. The experiment is carried out at constant cold fluid inlet temperature i.e. 20°C with varying inlet temperature of hot fluids ($50, 55, 60$ and 65°C) and varying volume flow rates ($4, 5, 6$ and 7LPM) for three nanoparticle concentrations ($0.1, 0.2$ and 0.3% by weight). Experimental results confirms that the Plate heat exchanger (PHE) have high heat flux increment which is twice that of shell and tube heat exchanger (S&T HE) with lower pressure drop. The S&T HE have higher pressure drop compared to the PHE i.e. 36 times at lower flow rate and 40 times at higher volume flow rate The enhancement of Nu number in PHE is 39% than that of S&T HE.

DES02032

Critical Success Factors for Performance Improvement of Furniture Cluster: Study of Indian Furniture Clusters

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Abstract - Industry can improve its performance by focusing its efforts and spending its resources on some vital factors called critical success factors (CSFs). Identification of these factors is essential for performance improvements of furniture cluster. This paper reviewed the literature on CSFs and various supporting philosophies. The paper studied the impact of these factors through interaction with various stakeholders. Focused efforts on these CSFs may help in channelizing the resources and efforts of cluster in maximizing the gains through quality and productivity improvements. The researchers can access the impact of these factors by undertaking quantitative analysis. The cluster can improve its performance and gain competitive advantage by concentrating on these factors. It helps clusters in developing the use of effectiveness data in their decision making. This paper contributes to providing a better understanding of CSFs for improving the performance of furniture cluster.

DES03047

Favourable Factors for Promoting Digital Entrepreneurship: A Conceptual Model

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Abstract - Due to glass ceiling effect and the problem of work flexibility, women entrepreneurs want to enter in entrepreneurship field. More research has taken place in this field and makes the women entrepreneur perceptible as the new women's liberation movement of the 21st century. Through the establishment of the digital enterprises, they spawn employment, contribute in economic condition, and also responsible for improving the status of other women. For this, certain factors are there which affect the growth of these digital entrepreneurs. The intention of this paper is to recognize, analyze and explain the factors associated with the development of women owned enterprises in the context of digital entrepreneurship. Extensive and rigorous literature review has been done for the certain period. For searching the papers, some keywords such as factors associated with digital entrepreneurship, impact of cultural factors, social factors, motivational factor etc., on women entrepreneurship, has been searched from the different data bases such as Elsevier, Emerald, Google scholar, Proquest, etc. A woman becomes self-confident and accumulates, synchronizes, arranges and manages the land, labour, and capital for the establishment of the venture. Due to liberalization and globalization, women entrepreneurs have gained recognition at international level. The women are involved in entrepreneurial activities because of push/pull factor to earn the profit from business which provides the financial independency as well as recognition in society. The other factors apart from digital knowledge like father's occupation, financial support from banks, government and non government organization, responsibility of children and husband in home, legal rules and regulations emphasized on the development of women owned digital enterprises. It is globally accepted that women are emerges as strong economic force in business world but still they are lagging behind in the race of digital entrepreneurship with men. It means some thresholds are present which not studies by the researchers and it needs further examination as qualitatively and quantitatively both.

DES04092

Towards Bridging Industry 4.0 Skills Gap: A Case

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Abstract – Industries and organizations leveraging Industry 4.0 paradigm use data in myriad ways to drastically improve quality, productivity, and customer satisfaction of their offerings. In this new era, we are witnessing methods and techniques that use diverse disciplines including quantitative methods, supervised and unsupervised machine learning, neural networks, artificial intelligence, cloud computing, internet of things (IOT), natural language processing and many others. Dizzilyngly large number of software and tools are employed to implement these systems. Both from skills and expenses perspective, educational institutes find it difficult to create infrastructure that can address critically relevant skill sets. In this paper, we describe experience gained at an institute for building such an infrastructure. This paper recommends the use of few software tools that offer an opportunity to create low cost but effective way to impart necessary skills. It was found that open source tools are of special relevance in that context.

DES05019

Lean Digital Thinking™ Framework for Addressing Problems of Construction 4.0Subhash Rastogi¹, Gautam Tewari²¹Adjunct Faculty, IIM Kashipur, India²Founder, SmartVizX, NCR, India

Abstract - In the 4th revolution of global economy, newer challenges in construction sector include designing and executing more complex structural & buildings, providing greater experience to new age customers, during complete process of owning or leasing the asset, focusing more on personalization and mass-customization of designs and good experience to even end-users of facilities. All this is to be provided at lower cost and world-class quality. Lean Digital Thinking™ is a new framework developed by VSR of BT & BT, India (refer acknowledgement), leveraging Lean concept of Manufacturing and various Digital & Operational technologies emerged and emerging. The framework defines 12 principles, contextualized here for Construction Industry. The paper describes this framework in brief and explains how this was applied to a world-class company's new office workplace design and construction in India. The use of Lean concept and digital technologies specially Virtual Reality, resulted to fast-track agreement on the workplace designs and provided excellent customer's experience in approving the design and reduced time of project completion with very high quality at low cost.

DES06180

Digitalization- Growth in a Power Industry - A Case Study

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Abstract - In the current scenario of global competitive milieu, only if a country adopts digitalization in all sectors at all steps, new heights could be reached to achieve goals. Past several years, industrial and information technology field have undergone profound changes, entering "Industry 4.0" era. As a representative of the future of the Fourth Industrial Revolution, evolved from embedded system to the Cyber Physical System (CPS), manufacturing will be via the Internet, to achieve Internal and external network integration, toward the intelligent direction. Now, it is the time to cope up with the technology changes to make the dreams come true. Enterprises have been realizing the benefits of transforming their businesses towards innovative tools and solutions that maximize efficiency, increasing profits and give a competitive edge. Objective of the study is to identify the fields in which industry 4.0 is implemented and reviewed the impact of the industry 4.0 -digitalization in NLC India Ltd. in which, a case study has been made. Research methodology in the study of this paper is based on secondary data collected from the areas in which the particular application has been implemented and data has been collected by discussing with the Executives concerned. Scope of the study is restricted to various supporting service departments and among various applications, Centralized Project Management Module application in NLC India Ltd. has been analysed in detail. Here technology adopted is based on big data bank and data analytics for taking decisions on real time basis based on the collaboration with the field Executives through internet and Mobile applications such as SMS and online updating the events then and there. Because of this industry 4.0 application, information to the Top Management is instantaneous based on the input from the site on day to day basis for an appropriate decision for the multiple number of tasks simultaneously, which is the need of the day. This paper helps in identifying the advantages of the implemented software for further application in needy areas.

HFE01036

Overall Ergonomic Assessment to Improve the Working Comfort of Corporate Employees

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Abstract - The aim of this study is to evaluate the degree of discomfort among the clerks and to list out various possible factors which are causing discomfort. A comfortable worker will deliver better performance and thus ultimately will improve the productivity of the company. In this study of 275 subjects, from banks and school/colleges, the questionnaire is designed to evaluate the discomfort under the heads of physical, psychological and environmental conditions. The overall ergonomic assessment is performed which involves the assessment of man, workplace and environment. The quantification of discomfort and its causes is carried out. The results obtained from the study projected huge amount of overall discomfort exist in clerks. Result shows that the huge amount of clerical workers are feeling and suffering from discomfort during work. The health related problems like back pain, neck pain, headache, eye irritation and carpal tunnel syndrome are very frequent and prevalent. The result reveals the most affecting parameters causing discomfort. The effect of each and every factor responsible for generation of discomfort among clerks is evaluated and according to effect, the ranking of factors are done. This hierarchical ranking will be helpful for designing the code of conduct for such workers. Prevention of occupational ergonomic hazards may require attention to psychological and environmental factors in addition to physical factors. This paper will help to reduce the overall discomfort of an employee by controlling the most significant factors.

HFE02037

The Concept of Ergonomic Evaluation for Industrial Building Spaces

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Abstract – This paper provides a conceptual framework to evaluate and design the industrial building spaces with an ergonomic approach. The concept describes an evaluation methodology which considers various environmental factors affecting human comfort and productivity. The factors have been considered based on the literature survey and the acceptable range of them from various standards organizations. Significant ergonomic factors like illumination, acoustics, thermal, vibration and utility were found to be key contributors to the evaluation methodology. The environmental factors were found to be significant in altering the productivity and comfort through an ergonomic point of view. It was found that an evaluation methodology can surely help towards improvising the design of industrial building spaces as well as improve the productivity and comfort of the employees. The methodology concept may contribute towards evaluations of existing industrial spaces and also help in designing upcoming projects.

HFE03049

A New Approach for Ergonomic Analysis in Industry 4.0

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Abstract – Purpose – Integration of automation and digitization and networking in industrial production domain is leading the industries towards the fourth industrial revolution, Industry 4.0. This paper discusses a new way of ergonomic analysis in Industry 4.0 context. **Approach -** The new technological paradigm that adds a new level to the human-machine interaction and ergonomic approach, covered in this research. **Findings and conclusion -** Simulation and virtual reality are the main technological areas of Industry 4.0 where the contribution of ergonomics fits. With technical devices and dedicated software it is possible to capture the movements of an operator in real-time and synchronize with a dummy in a virtual scene, create virtual ergonomics. **Research implications –** Virtual ergonomics approach will bring a substantial innovation in existing industrial production system. **Utility -** This new approach for ergonomic analysis may reduce the need for physical prototypes and save time and cost associated with development.

HFE04059

Study of Impact of Carpal Tunnel Syndrome on Manual Workers: A Case Study

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Abstract - The study aimed to examine the impact of CTS on manual workers engaged in different operations of cotton textile unit. The study includes 114 workers. Health questionnaire (followed by OSHA guidelines), Goniometer and Camry hand dynamometer are used for data collection. Correlation analysis shows that there is strong correlation ($r = +0.99757$) exists between hand grip strength and CTS symptoms. Fisher's exact test results show that there is a significant difference ($p=0.048025996 < p=0.05$) in CTS sufferers & prevalence of CTS in workers at non-neutral elbow position is 1.796875 times as compared to neutral position. The study will be helpful in identifying the potential CTS symptoms and risk factors which adversely affect the productivity. Workers working at different elbow position are developing CTS and unaware of disabilities. This paper gives a direction to study the impact of CTS.

HFE05060

Study of Work Related Musculoskeletal Disorders (WMSDs) in Workers Working in Typical Indian Saw Mills

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Abstract - The purpose of the study is identifying the occupational health and safety risk of workers in Indian sawmills. The present study sample consists of 108 manual workers. Videography, Pinch strength dynamometer and statistical tools were used for data analysis. In correlation analysis, t -calculated value $22.34 > t$ -tabulated $= 6.314$ so, the hypothesis is accepted. Thus, healthy workers have more pinch strength than that of non-healthy workers. ANOVA shows that F -calculated value $= 0.1924997 < F$ -critical $= 3.8056$. Thus, the hypothesis is accepted thus, the potential symptoms significantly contribute to the occurrence of the CTS. The study is helpful for analyzing the CTS factors and in increasing the productivity of Indian saw mills. This paper will be useful for identifying the risk factors of CTS and health issues of workers working in prone areas of Indian saw mills.

HFE06115

Challenges and Opportunities in Occupational Health and Safety in Small and Medium Scale Industries in India with Emphasis on Green Ergonomics: A Review Based Productivity Enhancement Approach

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Abstract – The paper illustrate the scenario ,major challenges and opportunities in occupational health and safety (OHS) and green ergonomic practices in small and medium scale enterprises(SME) in India. The objective is to trace out OHS issues in small and medium scale industries and propose action plan in order to improve health and safety of workers to improve overall productivity. The term “green ergonomics” is used here to describe ergonomics interventions in small scale enterprise with a pro environmental emphasis. The occupational diseases and injuries along with occupational accidents in India are compared with global estimates with an objective of emphasizing the need of take reactive efforts by SME towards OHS rather proactive .The opportunities and initiatives need to be taken in small and medium scale industries are discussed with proposed action plan to effect the health and safety. The green ergonomic practice and OHS culture is proposed to improve workers health, well-being and productivity in SME sector in India

HFE07123

Ergonomic Analysis of Posture in Brick Stacking Operation

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Abstract - Ergonomically posture prediction of human, working in manual assembly is based on the human movements in different joints to reduce energy and fatigue of the working subject. In this article a simple human performance measure is introduced that enable the mathematical model for evaluation of cost functions. Here human is modeled as a structure of 20 DOF. The necessary scheme is to evaluate the performance in the form of cost factors. Here two main cost factors are considered as discomfort factor and energy expenditure rate in different limbs movement. The basic aim is to optimize the movement of the limbs w.r.t. the cost factors. The above procedure is tested with a case study of fly ash bricks manufacturing unit. Here two subjects are stacking bricks in stacking pan. A multi objective optimization (MOO) method is used for posture prediction, in which cost factors are minimized with less joint discomfort and less energy expenditure.

HFE08134

Why are Human Factors Relevant Even in Industry 4.0 Paradigm?

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Abstract - To explore the relevance of human factors in Industry 4.0 paradigm. Exploratory study combining the state of the art and view points, developing insights on the importance of human factors in industry 4.0. Paper states the importance of human factor specialist in developing complex systems and the challenges upfront in the assimilation of human machine interface. Critical success factors for a human centered manufacturing are stated along with the complementary skills of humans and machines to envisage adoptive automation and an inclusive system. The paper reinstates the fact about the coexistence of technology and human work together for the benefit of the organizations and society at large. Organisations need to take a proactive stance in appointing the human factor specialist in system design. The relevance of human factors can not be undermined even in a changed scenario of Industry 4.0. The way forward is creating an inclusive system ensuring participation of all the stakeholders and developing a sense of ownership in them.

IAR01051

An Online Digital Application to Aid Maintenance Planning and it's Activities – An Approach to Automation and System Digitalization at an Indian Steel Plant

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The Hot Strip Mill comes under Mills department at a leading private sector steel plant in India. The end products of HSM i.e. coils are supplied to various customers within & outside the Steel plant. Mill Mechanical Maintenance plays a very important role in carrying out preventive as well as corrective maintenance of various equipment in the HSM line. It is also involved in preparing the crucial shutdown maintenance planning activities and scheduling different critical jobs. This paper identifies an online digital platform to digitize some of the crucial maintenance operations of the HSM to obtain significant improvement in current working method in some identified pain areas such as Troubleshooting during preventive and corrective maintenance of jobs by workers, Monitoring of Critical Shutdown Job Status by top management, Positive Isolation of jobs during shutdown and Shutdown planning document

IAR02102

Automated University Course Timetable Generator

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Abstract - Scheduling and planning are considered difficult combinatorial optimization problems and belong to the NP-complete class. The university course timetabling problem (UCTP) is one such type of problem which is to be solved under various constraints. The purpose of this paper is to create a university course timetable generator to automate the university course scheduling process, which is one of the most challenging and cumbersome tasks for the administration. All modules of the proposed timetable generator are inter-linked in SQL database and implemented in C# programming on the .NET platform. The generator consists of ~4200 lines of codes; Major part of the code is dedicated for graphical interface. The proposed university course timetable generator is tested on several randomly generated problem instances of various complexities to verify the efficiency. The outcomes of them signify the importance of the solver, as it is producing a conflict-free timetable by taking very less amount of time and primary memory. By incorporating timetable generator into the academic institutions, we need not have to spend hours figuring out the timetable for each class. We just need to enter our constraints along with the course data, and within no time, we will be able to obtain a solution generated without any hassle. Creating timetables for university courses are one of the toughest challenges for the administration. Its manual creation is confusing and time-consuming. Also, the outcome may not be of any worth. Hence, the incorporation of proposed timetable solver in the academic institutions will solve such situations.

IAR03130

Optimisation of Serial Manipulator for Less Energy Utilization

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Abstract-Recently, the importance of sustainable manufacturing has been widely discussed. The optimization of energy consumption in product manufacture has been deeply analysed, mainly focusing on the energy directly absorbed by the manufacturing process. On the contrary, this paper focuses on the analysis and optimization of the energy consumption related the robot arm, probably the most mathematically complex robot anyone could ever build, we will present optimized solution for the movement of a three-arm manipulator using Analytical Hierarchy Process (AHP). A scheme is given for optimizing the movement of robotic arm with the help of AHP so that the minimum energy consumption criteria can be achieved. As compared to Direct Kinematics, Inverse Kinematics will evolve two solutions out of which the best-fit solution will be selected with the help of AHP and is kept in search space for future use.

IAR04131

Performance Analysis of Gough Stewart Platform With 6 Limbs

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Abstract - This paper concentrates on widespread study of parallel manipulator. It focuses on optimal designing of manipulator which has a large number of application fields. Optimal design is an important criterion to improve the accuracy of a robot. Through optimal design a robot can achieve isotropic configurations where the condition number of its jacobian matrix equals one. In this we are also concentrating on transmission index and stiffness index along with their plots, which can affect the kinetostatic performance of the robot. In this the singularity of Gough Stewart platform is also studied.

IAR05147

Process Optimization of a Robot Manipulator Using ANN

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Abstract - Recently, the importance of sustainable manufacturing has been widely discussed. The optimization of process operation in product manufacturing has been deeply analysed, mainly focusing on the energy directly absorbed by the manufacturing process. On the contrary, this paper focuses on the analysis and optimization of the process related the robot arm, probably the most mathematically complex robot anyone could ever build, we will present optimized solution for the movement of a three-arm manipulator using Artificial Neural Network (ANN). A scheme is given for optimizing the movement of robotic arm with the help of AHP so that the minimum energy consumption criteria can be achieved. As compared to Direct Kinematics, Inverse Kinematics will evolve two solutions out of which the best-fit solution will be selected with the help of AHP and is kept in search space for future use. The Inverse Kinematics, Fitness Value evaluation task will simulate and testing will be done using Genetic Algorithm (GA). Although, four factors viz. Movement, Friction, Least Settling Time (or Min. Vibration) and Forces acting on the links are used for finding the Fitness Function / Fitness Values, however some more factors can also be considered. Finally, in conclusion the optimized operating values are presented in which the process for the task is minimized.

IAR06209

A Review of Literature on Industry 4.0

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Abstract - The Purpose of this paper is to review the most recent work on industry 4.0 to find out the current status of research on Industry 4.0 through the articles published in the period of January 2017 to June 2018. A structured review methodology with 5-steps approach for selection of articles have been used consists of 1) Database Selection 2) Keyword Selection 3) Article Collection 4) Inclusion/Exclusion Criteria 5) Reviewing Selected articles. Most of the work is found to be conceptual or case based in nature. However, there is a need of empirical research to be done in this field. Future research direction provided in this paper can be helpful to researchers who are willing to do research in Industry 4.0 domain. A lot of interest has been developed related to industry 4.0 which led to large amount of publication over the different topics associated with the Industry 4.0. This paper surely helpful for getting future research directions.

IMG01054

Distributed Ledger Technology: A Case of Hyperledger Platform and its Application to Smart Manufacturing

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Abstract - Industrial revolution has taken a significant leap from Industry 3.0 to Industry 4.0. The fourth revolution has taken a big leap within itself and extended from digitization to decentralization, Distributed Ledger Technology (DLT) etc. One such important part of this phase of Industry 4.0 is discussed in this paper called Hyperledger (a Blockchain based technology). Further, having an overview of a few DLTs a proposal of Hyperledger as one of the suitable platform to sharing resource as part of Smart Manufacturing. The paper presents a detailed of this concept.

IMG02064

Review Paper on Hydrogen Fuel Cell System

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Abstract - Fuel cell is a promising candidate as a renewable energy source. This cell uses hydrogen as a fuel and generates electricity which can be used during non sunshine hours. Conventional method of production of hydrogen is very energy intensive. If fuel cell and associated components are not designed properly, it may lead to negative net energy. It is a thrust area to develop a fuel cell system which has positive net energy. Worldwide researchers endeavor to develop such system so that dependency on fossil fuel and ghg generation can be mitigated substantially. Many of the researchers reported their work on this topic have covered various methods of electrolysis for hydrogen fuel production and conversion of the same into electricity. They have discussed the individual approach in detail. The work reported by worldwide researchers have been referred and appreciated. Still there are some research gaps which need to be studied and it is the very objective of the present work.

IMG04075

Perceived Importance of Smart HRM in the Era of Fourth Industrial Revolution (ID 4.0)

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Abstract - The purpose of this paper is to identify the importance of Smart HRM and its approaches essentially needed during ID 4.0 by the companies to sustain in business. The paper reviews various publications/reports by industries and authors to gain insight about Smart HRM. Findings of the study concluded that, transition from Digital HRM to Smart HRM during ID 4.0 would be challenging for companies and employees, view potential demand for higher skills, competencies and knowledge to fit into the complex digital workplace. Continuous automation of simple manufacturing processes will lead to increase in number of workspaces with a high level of complexity and this will demand developing high level of skills set in employees. This study attempts to contribute to the Industrial Engineering body of knowledge by bringing out the perceived importance of Smart HRM in ID 4.0.

IMG05080

Role of Blockchain in Smart Manufacturing

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Abstract - Economic growth of a nation depends upon the effectiveness of its manufacturing sector. To improve the operational excellence, manufacturing industries are moving towards smart technologies and appliances, which help in complete transformation of traditional systems into a fully digitized one, referred to as “Smart Manufacturing.” Despite advances in technologies used in smart manufacturing, there exist some concerns regarding security and privacy of the data used throughout the design, manufacturing and supply chain processes. Blockchain technology is the most upcoming development that has the capability to deal with these issues. This is due to its ability to maintain data privacy, integrity, immutability, and security. More importantly, it helps in improving transparency, trust, and security among processes and partners. Integrating blockchain with smart manufacturing makes the system more reliable and effective. Despite the applicability of blockchain concept, its deployment in smart manufacturing is not mature. This study has attempted to develop a conceptual framework to understand the role of blockchain technology in smart manufacturing.

IMG06100

Literature Review on 'Industry 4.0/Smart Manufacturing' Using Bibliometric Analysis: Recent Trends and Future Directions

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Abstract – In the last few years, Industry 4.0 has gained much interest from academics and practitioners. This paper analyzes the available scientific literature related to 'Industry 4.0/ Smart manufacturing'. This study examines 1295 journal articles published in this area (i.e., 'Industry 4.0/ Smart manufacturing') by utilizing bibliometric analysis and network analysis. This study highlights the contribution of the key researchers, institutions, and countries working in this area. We also report the top journals and most cited papers in this area. This study facilitates researchers working in this domain to understand the current research trends and focus on the potential research directions. This study systematically analyzes the body of research on 'Smart manufacturing/ Industry 4.0' published during the year 1984 to 2018, and therefore, the researchers may follow the reported outcomes and analysis.

IMG07117

Adoption of Lean Principles in New Product Development Projects: A Case Study of Bearing Organization

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Abstract - The purpose of this paper is to gain insights about the adoption of lean principles in NPD (New Product Development) projects. It also explores the lean implementation issues which arise when applying Lean in NPD projects. An exploratory case study is carried out for identifying lean practices in NPD projects for bearing organization. This research reveals that value, flow, and pull are relevant in NPD project, while value stream and perfection are not conspicuous. It implies that lean is applied partially in the NPD projects and full in the manufacturing industries. This paper investigates the status of lean practices along with emerging and re-emerging methods adopted in NPD projects. This paper would prove invaluable for practitioners to gain knowledge by adopting lean in NPD projects. It also put forward the key issues while implementing lean practices in NPD projects.

IMG08154

Parametric Appraisal of Dimensional Accuracy of FDM Built Parts

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Abstract – Rapid prototyping is a broad term used for all number of technologies which enable fabrication of part directly from CAD data source. As compare to traditional method like forging and milling which are based on formative and subtractive principles respectively, these techniques are based on additive principle. Among all available rapid prototyping processes, fused deposition modeling (FDM) uses thermoplastic filament in semi molten state which extruded from tip of nozzle for building a part in layer by layer deposition method. It is necessary to understand the factors which are affecting the quality of FDM part. This study focuses on the improvement of dimensional accuracy of FDM build part by controlling the processes parameters. The process parameter viz. layer thickness, orientation, raster angle and number of contours along with their interaction affects the dimensional accuracy of FDM processed ABSM30 (Acrylonitrile-butadiene-styrene) part. For improving the dimensional accuracy, response surface methodology is adopted; it is found that different factors and their interaction control the part dimensions along different direction. Due to shrinkage of semi molten thermoplastic material extruded from nozzle is the major cause of dimensional inaccuracy. In the present study volumetric deviation has been considered as dimensional inaccuracy for the analysis.

IMG09200

Adoption of Lean Manufacturing for Improving Productivity: A Review of Case studies

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Abstract - Lean manufacturing uses various tools and techniques for elimination of waste and non-value-added activities. This paper provides insights into some barriers to implementation for adopting lean in different sectors. Tools and techniques in the context of lean practices and realization of benefits have been growing in various industries especially the SME, healthcare, and automobile sectors. A literature review of published case studies has been conducted to identify the problems and barriers for implementing lean in the production system and management. This paper describes the similarities in problems and barriers in the implementation of lean manufacturing at three case studies, and also suggests techniques for achieving maximum productivity.

IMG10208

Rotating Machines Fault Detection and Performance Estimation with Adaptive Canonical Variate Analysis

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Abstract - Canonical variable analysis (CVA) is one of the most commonly applied fault diagnostic methods for industrial systems. However, conventional CVA is unable to handle the characteristics of time-varying processes. To address the challenge of implementing diagnostics in real-world applications with time-varying properties, the time-invariant CVA model is extended using first order perturbation theory, resulting in the improved adaptive CVA (ACVA) diagnostic model. Moreover, a multivariate process modelling approach is developed to improve the accuracy of traditional canonical variate analysis (CVA) in predicting the performance of industrial rotating machines under faulty operating conditions. The proposed technique is validated through condition monitoring data acquired from an operational centrifugal compressor. The results indicate that the proposed method can effectively detect faults and predict fault degradation in real industrial systems under time-varying operating conditions.

IMG11215

A Novel Information System for Three Stage Hierarchy Industry Operating in MTS Environment

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Abstract - Product quality & production variability with optimal usage of available tools and equipment's is key feature of any production system. A new era of automation is evolving. Automation hierarchy of production planning & control is still a focus of attention. The upcoming technology and automation will be totally information based control system. In recent decades, information has emerged as biggest competitive asset of the manufacturing system and hence any organization. Machines with latest technology with high cost need to be operated in errorless scenario to get required results. This is only possible by optimally customised information systems. This paper presents a framework to develop a novel Information System for an Industry operating in MTS Environment. It is found that, for a flexible-agile integrated manufacturing system such an information system is very much necessary. The simulation results prove the utility of the proposed research work.

ITC01030

Internet of Things: Applications

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Abstract - The purpose of the paper is state-of-the-art of IoT and presents the key technological drivers, potential applications, challenges and future research areas in the domain of IoT. Internet of Things (IoT) applications and understand the scope. According to the various researcher study and literature survey on Internet on thing and its applications. It presents an overview on internet of thing & applications. Internet of things is a new technology which provides many applications to connect the things to things and human to things through the internet. Major issues of future research in IoT are identified.

IMG12221

Smart Laser Machine Integrated Image Recognition Towards Industry 4.0

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Abstract – CNC machines provides versatility combined with the technical competence of unconventional machining. This paper looks to utilize the versatility of the CNC laser cutting machine operation with image recognition and interface with Internet of Things (IoT). Traditional CNC machines are large, prodigious and stationary tools with physical limitations that hinder the creative capacity of users whose ideas are larger than the small workspace they are confined to. The laser cutting requires skilled labours and needs more time for processing. In replacement of this method, the Image recognition cameras can be used through mobile phone compatibility. The worker need to give the input in the form of sketch and the image recognition camera recognises the sketch given by the worker and the dimensions can be edited. This method doesn't require the skills of labour in coding and computer handling. This paper addresses the compatible CNC machining through IoT technology focusing Industry 4.0.

ITC02038

An Investigation of Industry 4.0 From Perspective of the Product Data Management Systems

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Abstract - The paper attempts to investigate into the impact of various Industry 4.0 components on Product data management (PDM) systems. The paper is focused on theory building approach by investigating into available research articles. PDM being a central system dealing with product data, it is important to understand the effects of industry 4.0 on these systems. The analysis of basic architectural framework of these systems has been performed and available literature has been analyzed for understanding the impact at different level on PDM systems. The important components of industry 4.0 and their impact on architecture and functional aspects is presented by the this paper. The article provides direction for PDM based research in order to yield application focused studies. This approach would be helpful in order to support development in industry 4.0. The paper provides a practical approach and basic architectural framework in order to facilitate for potential research domain.

ITC04061

Cloud Computing Adoption in Multifarious Applications

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Abstract - Cloud Computing (CC) is capable of on-demand use and sharing of resources. Various sectors like education, manufacturing, service, healthcare have successfully adopted CC. Cloud Computing Adoption (CCA) in these sectors is practically being implemented for real life applications. Scholarly articles discuss these popular applications. However there are other applications like governance, insurance, forensic, biomedical etc. which are also using CC services. The purpose of this study is to understand CCA in these miscellaneous applications. The benefits, issues and concerns of CCA for e-Governance, e-Commerce, e-Science, digital forensic, geoscience, non-profit organization, biomedicines, and health insurance are discussed herewith. Conclusion and future scope of study are presented at end.

ITC05071

The Internet of Things for Smart Tele Monitoring Healthcare: An Overview Survey

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Abstract - The Internet of Thing (IoT) provides a number of application domains in which telemedicine healthcare is one of them. The IoT uprising is renovating new telemedicine healthcare with capable technological, economical and social prospect. IoT devices connected to hospitals, homes to alert them of medical emergencies and take preventive measures. In this paper overview surveys of advances in IoT based telemedicine healthcare technologies and review the modern network architecture and commercial trends in IoT based telemedicine healthcare solutions. Further this paper propose an intelligent cost effective IoT module which will be affordable for every user; and discusses on policies across the world to decide how they can make societies and economies in terms of sustainable growth; and gives the opportunities to research on IoT-based telemedicine healthcare based on open issues and challenges.

ITC06098

Cleaning and Cooling of PV Modules in Solar Energy Plant With PLC-SCADA System

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Abstract – PV module technology is most promising among all. Because of dust and high temperature Photovoltaic modules goes under various losses like loss in power generation, loss in efficiency, reduction in the life etc. Module efficiency drops at the rate of 0.4 - 0.5% once the temperature excided STC (25°C). The dust accumulation of 4g/m², reduce the power conversion by 40%. For maximum efficiency panels should clean and cool regularly. For this mist spray technique integrated with PLC-SCADA system is used which operates on set commands. As panels crosses set temperature SCADA system automatically on mist spray system and off the system as temperature goes below set value. In this paper cleaning and cooling with maximum utility of water by mist spray is done automated with precise PLC-SCADA system help to increase the power output of solar energy plant.

ITC07105

Industry 4.0: Some Glimpse on Security in Internet of Things (IoT)

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Abstract - Industry 4.0 is the fourth industrial revolution initiated in Germany. In Industry 4.0, the Internet of Things (IoT) is used in the industry to focus the manufacturing process of industries and making the automated decision based on the data. Because of the wide use of the IoT, the issues related to the security of the IoT must be considered as the vital challenge to the IoT users. The present paper highlights some of the glimpse on the security in the IoT that how the different layers are connected in the IoT and the requirement of the security in the IoT. The different technologies for the security in the IoT is explained in this paper.

ITC08114

Compressed Datagram Transport Layer Security (DTLS) Mechanism for IoT

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Abstract - DTLS is a communications protocol. The size of message and overhead header in DTLS is large. So, the header needs to be compressed. The aim of compressed DTLS is reducing the size of header and maintaining overall security in IOT. The world is surrounded with IOT devices. IOT devices are the devices which are connected via Internet for exchange of data. These all devices need to be secured and protected from malicious attacks. DTLS protects these IOT devices to transfer messages safely and provides end to end security. It also provides the security i.e. tampering, message forgery and prevent eavesdropping for datagram-based applications. DTLS or Datagram Transport Layer Security is a technique used for securing the IOT devices and protecting them from different attacks. It is an application layer protocol. This paper highlights the transmission of messages between one process to another using compressed DTLS security protocol. This DTLS protocol also preserves datagram and deals with loss of datagram, reordering of packets, and complex and larger data than the size of a datagram network packets.

ITC09126

A Layered Approach to Security for Big Data

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Abstract - Every few years a new technology emerges which tends to make a paradigm shift in the manner in which things worked conventionally. We call it a disruptive technology. Over the last few years there has been immense breakthrough in scaling, performance and data processing capabilities. Big Data has now transformed and enhanced data analytics which was unimaginable a few years ago. The scale and diversity of data, its sources and format combined with the unison in which Hadoop with its numerous open-source components work, create unique risks. The “point solutions” will not work in ensuring effective and efficient security. We mean point solutions, as attempting to make one or other components of the system secure without having a holistic approach. The suggested model of layered security to the Big Data Ecosystem discusses the risks and controls in each stage of Big Data starting from design and deployment all the way up to the consumption of the analysed data. Each layer adds a certain level of security in order to secure the entire system.

ITC10127

Ranking of Challenges for Internet of Things (IoT) Adoption in Agriculture Supply Chain Management (ASCM)

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Abstract - Internet of things (IoT) has gained noticed throughout the world. It has changed the agricultural supply chain and permits farmers and food processing organization to compete with massive issues they face. Currently, IoT is at developing stage for its implementation in Agriculture Supply Chain (ASC). Therefore purpose of this paper is the identification of critical challenges in IoT adoption for ASC. In this paper Technique of Order Preference Similar to Ideal Solution (TOPSIS) methodology adopted to prioritize the identified challenges. Findings introduce some recent technology in IoT field and also ten critical challenges in IoT adoption. This paper concluded that IoT based infrastructure for ASC is the most important challenge and IoT based cloud system f is the worst challenge. This paper also has managerial implications for organization's managers to adopt IoT in the ASC to improve their competitiveness. This paper may be utilized in Industry 4.0 applications.

ITC11137

IOT Adaption in Tracking Inventories of Manufacturing Industry: An ISM Approach

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Abstract - Internet of Things (IoT) is considered as a key strategy, which influences a strong positive impact on efficiency and effectiveness of manufacturing industries in this century. But there are number of barriers which roadblock its success. This paper identifies and analyses the nine factors which are performing as key barriers for adoption of IoT in manufacturing industries particularly for effective management of inventory. This research paper uses ISM (Interpretive Structural Modelling) technique as a tool to establish the interdependency and to prioritize the barriers with short term and long term focus. The results show that the factors like- - Data Management Challenge, Seamless Technology Integration, Accuracy & Reliability, Scale of Industry and Lack of Compatibility are the key drivers to achieve the objective of perceived benefit of IOT at effective cost. This research paper provides a guideline to the decision makers for effective implementation of IoT in manufacturing industries.

ITC12142

Automated Greenhouse Cultivation of Crops Using Internet of Things (IoT)

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Abstract - Cultivation is the fundamental wellspring of pay of the general population in a nation like India adding up to 15-16% of the Gross domestic product of the nation. As per the financial overview of India 2018, around 55% of the number of inhabitants in India relies upon cultivating as their wellspring of occupation pay and time has come to acquaint a few changes with supplant those conventional cultivating rehearses with the development of money trims under computerized nursery utilizing IoT through remote sensors, actuators, microcontroller, raspberry pi, GSM module and associating links. In this paper we have proposed a low cost greenhouse prototype model which can be affordable by the Indian farmers for the cultivation of cash crops such as saffron, vanilla, sugarcane, etc and they can carry out the cultivation under this automated greenhouse thus improving their social, economic and financial condition by a great extent.

ITC14159

Study of Digital Transformations Contributing to Healthcare 4.0

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Abstract - The merging of digital technology and internet with conventional healthcare industry has the potential to affect every aspect of the said industry. This article focuses on importance of concept of Industry 4.0 and subsequently the digital transformations cardinal to improvement of the healthcare sector. This article discusses the impact, challenges and opportunities of digital transformation in Healthcare sector. It has been found that the Internet of Things, Data and Services have been the next wave of Innovation in HEALTHCARE 4.0.

ITC13157

Pulse Shaped Visible Light Communication System Analysis for Out Band Interference

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Abstract - Wireless data traffic is increasing exponentially despite the continuous improvements in wireless communication technology, it is expected that the future demand cannot be met because the radio frequency spectrum has been almost completely utilised. A potential solution to the emerging problem is the development of Visible light communication. With the advancement in communication technology the higher data rate is always desirable. Visible Light Communication (VLC) based on Optical signal to send the information is a new area of research where the light waves are used to carry the information. Pulse shaping can be used with the VLC system to suppress the out band interference and improve the spectral efficiency. Out band interference (OBI) is one of the key concern in VLC, this OBI will leads the interfering power to the adjacent channel. This paper deals with OBI analysis for VLC system.

ITC15178

Cross-Layer Optimization Review for Secured and Clustered Network

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Abstract - This paper reviews the cross-layer optimization that contributes to the enhancement of performance of secured and clustered ad hoc network. This paper provides an idea on Cross-Layering and Clustering, and then with a view to sustain the ad hoc network life, it discusses the various aspects of cross-layer optimization and clustering heuristics. The lack of desired performance parameters in MANET has led to several efforts to re-invent the ad hoc networking problem. Route optimization, dynamic network configuration, maximum network utilization, heterogeneity of devices, scalability, load balancing, energy conservation, real time scenario and integration has increased the importance of cross layer design in adhoc network. Intelligent heuristics provide adaptive mechanisms which exhibit intelligent behavior in complex and dynamic environment. Clustering Methodology based on analytical modeling and categorization of various Clustering heuristics are represented based on the various optimization techniques by the different authors.

ITC16183

Mobile Number Portability & Other Policy Initiatives for Growth of Telecom Services in India

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Abstract - Liberalization in the telecom sector and the reforms initiated by the Department of Telecom (DoT) has drastically changed the telecom scenario in India. Presently India has the second largest telecom network in the world after China. Mobile Number Portability (MNP) has facilitated the subscriber to retain his mobile number while changing the telecom operator, thus initiating competition among the telecom operators and facilitating the customer with better service quality. Universal Service Obligation Fund (USOF) of DoT has contributed significantly in providing access of telecom services to the people residing in rural & remote areas of the country at reasonable and affordable price. National Digital Communication Policy (NDCP) 2018 has been drafted by DoT to ensure that the benefits of the latest technologies are accessible to all equitably and affordably. An attempt has been made to discuss the structure of Licensed Service Areas (LSA) in India, telecom & broadband network and major initiatives taken by DoT like MNP, USOF, NDCP to further enhance the telecom connectivity and also to provide the latest technology across the country.

ITC17214

A Virtual Survey of Industry 4.0 Status of Indian Firms

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Abstract - Industry 4.0 is reality. Indian firms must be at different stages of embracing Industry 4.0. This research paper tries to explore the status of Indian firms with regards to moving towards Industry 4.0. This paper also tries to capture the challenges companies are facing to call themselves Industry 4.0 ready. A virtual survey of Indian companies is carried out. Methodology is to survey companies by visiting their websites and other newspaper articles to collect data on various aspects of Industry 4.0 activities of top companies in two sectors. The research result shows that the two industries studied were much ahead in adopting Industry 4.0 relevant technologies. But there were other industries which were not even near to technologies to be Industry 4.0 ready. The findings reveal there is huge scope in spreading awareness and thereby action required in several industries. Research paper definitely provides a basic understanding of status of companies in two industries with regards to Industry 4.0 readiness.

ITC18219

Challenges of a Delivery Manager in IT Services in Industry 4.0 Paradigm

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Abstract - Purpose of this paper is to highlight the challenges of a delivery manager and how these challenges can be met by technological interventions of Industry 4.0. This paper is based on the literature review and the empirical experiences. The IoT based technological interventions enable to counter the typical challenges like resource sharing, multi-vendor base, miscommunication etc. These technologies allow 24 x 7 integration of cyber-physical systems. Empirical research and case studies need to be developed validating and highlighting the use of Industry 4.0 based technologies. The findings will be of immense use to delivery managers, project managers and the liaising executives interfacing with clients.

MDD02111

Big Data Analysis and Classification of Bio-medical Signal Using Random Forest Algorithm

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Abstract - The health care industries generate a huge amount of data due to computer aided diagnosis system. The purpose of this paper is to analyze these huge amount data and classification of the ECG signals using Random forest algorithm. A four step classification model is designed in this work. First the raw ecg signals are filtered using the median filter and a 12 order low pass filter. Then the features from the clean ecg signals are extracted using wavelet transform. These wavelet features are then taken for the classification using random forest algorithm. The proposed random forest classification model is giving around 87% classification accuracy which is quite good. In future different methods can be applied for obtaining a good classification result. This method can be applied in the medical sector for early detection and better diagnosis of any disease.

ITC19222

Framework for Understanding Internet of Things in Human Resource Management

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Abstract - Internet of things is the next technology innovation in the area of HR. This paper investigates on the role of IoT in HR and attempts at developing a framework for understanding the same. The innovations in internet of things have enabled to track employees and made their work easier. However is this enough or is there a need for regulating this development in a streamlines way? The paper is an insight into the use of IoT in developing HR analytics.

ITC20224

Re-designing the Business Organization Using Disruptive Innovations Based on Blockchain-IoT Integrated Architecture for Improving Agility in Future Industry 4.0

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Abstract - Blockchain and IoT technologies have recently gained much attention for industry 4.0. With the emergence of disruptive technologies, it has become essential to redesign the business for innovations based on blockchain-IoT integrated architecture that helps organizations to improve agility in their operations. An industrial pump was sensorized and IoTized to monitor its operations on real-time and take predictive measures for managing these assets with more agility. The developed architecture was further extended for proposing the use of blockchain and how it can benefit the organisation. The known features of blockchain such as increasing the capacity of decentralization, trust-less transactions, security, and allowing autonomous coordination of the devices along with the boons of IoT will help achieve the motto of improving agility in industry 4.0. This article gives a new dimension to utilization of blockchain technology. Blockchain along with IoT that gives a way forward for industries like manufacturing, oil & gas, engineering & construction, utilities, etc. to Re-Designing the business organization in a more agile way.

MDD04145

Operational Excellence in Indian Healthcare: Integration of Digital Framework

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Abstract: This Paper aims at evaluation of excellence and its attributes in Indian healthcare. Various problems of health care industry through analysis of factors and its attributes using factor analysis, correlation and other framework parameters has been done. An integrated approach for Big Data and Internet of things (IoT) framework is presented. It was found that Human Resource Capability, Infrastructural Resources were the most significant CSFs apart from Operational process, Team management and culture. Surprisingly findings revealed that factors namely Top Management and Leadership were least significant. As there is no clear framework for excellence in healthcare, where stakeholders are an integral part of complete service, developed CSF and its connectivity to Big Data and IoT may help to resolve the service level issues of Indian Hospital.

MDD01073

Role of Industry 4.0 in Medical Field: An Overview

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Abstract - The purpose of this study is to understand the role of Industry 4.0 in the medical field and identify its research status along-with future applications. Industry 4.0 is an established reality which fulfils various requirements of the medical field, and extensive research is going in this area. Thus, there is a need to understand how Industry 4.0 can be a useful paradigm for innovative design and manufacturing of medical implants and devices which can fulfil various requirements of medical using the smart manufacturing system. To undertake this study, research papers on Industry 4.0 in medical and other related articles studied to identify its applications and following research direction. Through this study, we have identified eleven significant requirements which can be fulfilled by Industry 4.0, and this further provides a significant contribution to the research & development of new medical models and devices. Industry 4.0 seems to be an essential part of tomorrow's medical field and smart factories, where software, technologies and processes provide efficient and world-class results with lesser time and cost. Industry 4.0 shows extensive capability for manufacturing customised and new innovative tools and instruments used in the medical area as per the individual requirements of the patient/industry with optimisation of time and cost. Industry 4.0 is an innovative approach to generate new concept and undertake development in the medical field through the integration of technologies, smart machines and different software.

MDD03129

Comparison of Medical Models Construction by Additive Manufacturing (3D Printing) Techniques

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Abstract - Additive Manufacturing (AM) known as 3D Printing is one of the advanced manufacturing methods to produce physical models from virtual model. Selective Laser Sintering (SLS) and Fused Deposition Modeling (FDM) are well known techniques in powder and solid based processes respectively. One of the medical application of AM technique is preplanning of surgery. For this, the surgeons are using prototype models of mandible for measurement, evaluation of the diseases and surgical procedures. However manufacturing of the accurate prototype model is one of the unsolved problems. This paper presents dimensional error between the 3D CAD mandible model to AM mandible models of cyst in mandible patient, also comparison of dimensional error between fabricated models of SLS and FDM techniques. It has been observed that the dimensional error between SLS and FDM mandible models from 3D CAD mandible model at 6.17% and 8.5% respectively, and the difference of dimensional error between FDM to SLS mandible was 1.15 mm.

MDD05160

3D Printed Dry Electrodes for Wearable EEG Systems

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Abstract - Electroencephalography (EEG) is a technique for recording brain activity typically in a non-invasive manner. There are two types of sensors used to pick up signals, i.e., wet electrode and dry electrode. Predominantly wet electrode (using conductive gel) is used because it provides a low impedance path but it causes patient discomfort, requires skin preparation time, causes skin irritation and its impedance significantly increases as the gel dries. Due to this, wet electrodes can't be conveniently used for continuous monitoring of brain in applications like epilepsy/seizure diagnosis, brain computer interfaces, sleep studies. Dry electrode overcomes all the difficulties faced by the use of wet electrodes at the expense of high impedance. In recent years there have been developments in design, manufacturing of these dry electrodes through 3D printing. In this article, these novel 3D printed approaches for making dry electrodes for wearable EEG systems are reported and further work needed is highlighted.

MDD06192

Factors Influencing Industry 4.0 Adoption in Healthcare: An ISM Approach

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Abstract - The purpose of this article is to provide structural hierarchy for industry 4.0 adoption in healthcare sector using interpretive structural model approach. Industry 4.0 is the current trend which mainly focus on automation through data utilization. The concept of Industry 4.0 is also adopted in the service sector also. In healthcare industry 4.0 adoption can be helpful to cater future healthcare need through data exchange, however a step by step guide to adopt this philosophy is not available. In this paper we have identified six key factors influencing industry 4.0 adoption in the healthcare sector. We have developed structural frame work which will help professional to understand, identify, and deploy the concept of industry4.0 in the healthcare sector.

MMS02016

Hermite Hadamard and Fejer Type Integral Inequalities for Harmonic Convex (Concave) Fuzzy Mappings

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Abstract - The purpose of this paper is to study Hermite Hadamard and Fejer type integral inequalities for harmonic convex (H-convex) and harmonic concave (H-concave) fuzzy mappings. The above type of integral inequalities have been studied by using the ranking value function. In this paper, the Hermite Hadamard inequality via Sugeno fuzzy integral has been given for H-concave fuzzy mapping. Furthermore, the upper bound of the Sugeno fuzzy integral has been obtained for the H-concave fuzzy mapping by using ranking value function. The above results have been justified with suitable examples. This work will be helpful to study different integral inequalities which are important mathematical tools both in theory and applications of non-linear analysis.

MMS01008

Statistical Analysis to Predict the Surface Roughness in Single Point Incremental Forming

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Abstract - Single point Incremental forming (SPIF) is an innovative manufacturing process in which shaping the metal sheet without using dedicated dies. In SPIF, the desired surface roughness of hard to form metals is difficult. Cu67Zn33 alloy is considered for the experiment as it is demanded in many sectors due to its toughness and corrosion resistance properties. In the study, a statistical experimental investigation is carried out to determine the factors which profoundly affect the surface roughness. The input process variables are taken as step down size, feed rate of tool, RPM, wall angle, thickness of metal and lubricant. The output response indicated that the Step down size, feed rate of tool, wall angle and thickness of sheet are the significant factors whereas RPM and lubricant are not significant for surface roughness in SPIF. The results show that the thin sheet of Cu67Zn33 alloy can be shaped through SPIF and surface roughness can be achieved by controlling the input variables.

MMS05084

Process Capability Analysis by Using Statistical Process Control in a Small Scale Industry

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Abstract - The purpose of this study is to improve the performance of current process by reducing the variability in the dimension of parts produced, thereby reducing rejections and process improvement. Statistical Process Control (SPC) is a collection of tools, when used together can result in better process stability and variance reduction, thereby leading to a more streamlined production process. In this study, post SPC application, the capability indices which were 0.69 & 0.7, respectively for the existing process, increased to 1.61 & 1.60, respectively for the improved process, thereby representing good process performance with higher stability. Several methods are adopted in an organization to enhance productivity, one such approach is SPC. The proposed methodology can be applied in many process capability analysis. In this study the application of SPC tools has been done to improve the process capability of a process, thereby showing the importance of SPC technique when used in manufacturing industry.

MMS06113

A Non-conventional Approach of Analysis of Strategic Market Management in the Light of Stochastic Processes

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Abstract - This paper entails a novel approach of analysis of strategic market management based on renewal reward stochastic process. The paper has also pointed out a discovered fact that clearly infers realization of cost analysis of product revalidation in the light of Brownian motion with drift. The paper indicates a rare and new concept of how can compound stochastic process be applied to sense business cost analysis. In demand-supply analysis, there lies the essence of realization of alternating renewal theory based customer satisfaction. Furthermore the paper also shows a novel analysis of product upgradation in the light of conditional expectation and simple random walk.

MMS03046

Some Aspect of Total Time Minimization Transportation Problem

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Abstract - We consider a new type of total time minimization transportation problem along with the total cost minimization transportation problem. We have designed an active transportation route and minimize the total transportation time. It leads to zero one integer programming problem. Different objective functions are formulated subject to original constraints in transportation problem. The time transportation problem has been defined from the original transportation problem, paying importance to time. We analyze different variety of transportation problems and exhibit mathematically the importance of time transportation problem. The paper may be extended for other variety of transportation problems such as cargo handling in airport, transportation of perishable marine product etc. Application of this type of transportation problem is best fitted to combat zones for supplying ammunition to soldiers in advance fighting zones. This problem can be applied to marooned people and disaster management system for cyclone, flood earthquake affected people etc. We have quoted a numerical example and solved it with the algorithm we have developed.

MMS04055

Trading of Derivative in Stock Market: A Predictive Approach Towards Effective Decision Making

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Abstract - Predicting behavior of stock market is a real challenge for any investors and corporate stockholders; aligned to decision making in investment incorporating market risks. Trading of derivative in stock market, every day we try to forecast tomorrow's price. Most of the cases, forecast based on predictive analysis is not 'accurate'; but considering complexity of behavior in this area, sometimes output will become 'significant'. Here, an attempt has been made to predict coming day stock price on the basis of previous day stock prices. Method to develop trading in stocks and corresponding derivatives, we propose multiple regression analysis. To show efficacy of relationship, we propose and develop 'error analyses'. Result show the 'error is nearly same as the change per day'. Coefficients in regression indicate 'how and when this method can be used for trading' and large value of magnitude shows accuracy in prediction. Real life application with a time framed span shows both types of contradictory results. Using method to trading for some selected stocks, efficacy of fulfilling the basic criteria considered to be pertinent. In this study, proposed method is validated by taking different stocks by incorporating three leading Indian companies in two indices; namely NIFTY and NASDAQ Composite. Results indicate that the 'outcome of prediction' is not zero; there is a significant amount of scope exists for some selected stocks and indices in the market.

MMS07151

Commute Cost Predictability – A Study of Indian Sub-urban Rail Commuter's Productivity

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Abstract - This paper examines the predictability of Psychosocial Crowd commuter's behavior. The research has been done in and around the northern region of India. Data for research has been collected through a structured questionnaire. The researchers followed the random sampling technique and the study is quantitative in nature. Secondary data have been obtained from a review of available literature. Four variables were used in this study - For data analysis, the researchers used the SPSS statistical tool. Structural equation modeling was applied by using Amos and the model was confirmed by using confirmatory analysis. Analyses depict that time taken for travel to office and back home has significant impact on employee behavior. The cost of commute may understand in the form of travel stress experience and distance of daily commute. The final outcome of this research work derived as job dissatisfaction of employee. Future prospects and commute related factors have a significant effect on commuter job satisfaction. All the analyses, findings and suggestions have been enumerated in the conclusion.

MMS08187

The Cost Observance of Crops in Rajasthan - An Orientation Analysis in Pre & Post Reform Periods

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Abstract - The purpose of this paper is to empirically test the relationship among the factors affecting the pre and post reforms period of Rajasthan. The study is based on secondary data of farm harvest price index (Base year 1987-88 to 1989-90) of major crops in Rajasthan. The purposive selection of crops and crop groups is done for which data of farm harvest price indices is collected from various issues of 'Statistical Abstract of Rajasthan' and '50 Years Agricultural Statistics of Rajasthan' published by the Directorate of Economics and Statistics of Rajasthan. We assumed that post-reform period started from 1998-99 which can be divided into two parts (i) pre reform period (ii) Post Reform period. A comparison of prices among various crops and crop-groups as well as in pre and post reform periods is done. The results of linear trend show that the absolute change in farm harvest price index of major crops in Rajasthan is higher in post reform period than pre reform period. The results of linear trend show that the absolute change in farm harvest price index of major crops in Rajasthan is higher in post reform period than pre reform period. The traditional crops of bajra and maize have shown the least increase whereas pulses and gram have shown the highest increase in prices during both sub periods. The rate of absolute increase in price was slightly higher for the non-food crops than the food grain crops in pre reform period but in post reform period the food grain crops have marked comparatively higher rate of increase.

MMS09210

Analysis of Mixed Convection in a Lid Driven Trapezoidal Cavity Heated at the Bottom for Various Aspect of Angles

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Abstract - The study is carried out for natural convection of air in trapezoidal cavities. The inclined walls are insulated and the bottom wall is maintained at a higher temperature whereas the top moving wall is maintained at a lower temperature. In the present study ANSYS 14.0 software is used. It is found that the air circulation, heat transfer rate and drag force on top walls are more at higher lid-velocity. The cold air changes its inclination angle from 0° to 45° to make the shape as a trapezoidal cavity. The heat transfer rate increases from the bottom wall to top wall as angle of inclination increases. The drag force is almost same for different inclination angles when lid velocity is kept constant. Lid-driven flow in a cooled/heated cavity, which has applications in flow and heat transfer in solar ponds dynamics of lakes, crystal growth and float glass work.

MMS10225

Replenishment Model with Entropic Order Quantity for Deteriorating Items Under Inflation

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Abstract - The present paper proposed a replenishment model for decaying goods in which a constant fraction of on hand inventory is perished per unit time. The model is developed for stock and selling price dependent demand under inflation without permitting shortage. Optimal solution is achieved by cost minimization strategy considering replenishment cost, purchase cost, holding cost, deterioration cost with a special approach to entropy cost for bulk size purchasing units. The effectiveness of the proposed model has been avowed through numerical illustrations. Finally sensitivity analysis has been accomplished to deduce managerial insights.

MMS12227

Success Factors for Knowledge Management in Educational Institute in Developing Countries

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Abstract - Identification of key success factors that govern knowledge management in the educational institutions is the need of the day. With aim of this, the study identifies the key knowledge management success factors in education institute. Firstly the factors have been identified from the previous literature and then quantitative empirical research via survey questionnaires was conducted to fulfill the purpose of this research. The data were analyzed using SPSS software. The paper recapitulates the finding of the study and offers inferences to increase the organizational performance of educational institutions through effective enactment of KM practices. The data for this study is collected from some private technical institutions of Chhattisgarh. The numbers of private technical institutions in Chhattisgarh are mainly situated in Raipur and Bhilai and now and the numbers of the colleges are falling down day by day. Therefore in this research, the Raipur and Bhilai zone have been focused.

MMS11226

Evaluation of Differences Between Public and Private Sector Plants on the Basis of Key Success Factors: Case of Indian Steel Plants

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Abstract - Enterprise resource planning (ERP) systems have become essential strategic tool in recent business environment. ERP system implementation is a big exercise in an organisation whether they maybe public sector or private sector, although there are some differences between these two factors (Koch, 2005 and Mitchell, 2002). This articles attempt to identify key success factors for the success of implementation of ERP system and evaluate differences between public and private sector plants on the basis of key success factors. Indian integrated steel plants more than one million tons per annum capacity are considered as case for this research work. Key success factors extracted from brainstorming were used for questionnaire survey; they are management support, organisational clarity, user training and support, ERP system vendor quality and Technical integration of ERP system with business functions. Questionnaire was distributed to the executives of ERP system department of public and private Steel plants for quantitative data collection. 263 get responses have been collected for this study. Statistical technique T test was used to analyse the data. Result of t-test illustrates both public sector and private sector differs significantly on ERP system implementation in context of success factors. Identification of key success factors and understanding of differences in success factors will help organisations to emphasize on certain factors to ensure the success of implementation of ERP system.

MMS13088

Utilize Soft Information in Finance to Analyze Financial Risk by using Analytical Techniques

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Abstract - In this study, on the basis of the text information in financial reports, which is so called soft information, we apply analytical techniques (regression and ranking) to study relations between texts and financial risks. Financial risk is the chance that a chosen investment ministration will lead to a loss. The aim is to minimize the financial risks among the companies. A company analyzes a potential project on its forecasting potential not actual cash flows for a project, where forecasting are based on assumption which may be incorrect. Therefore, we conduct a study on financial sentiment analysis by using a finance-specific sentiment lexicon to examine the relation between financial sentiment words and sentiment analysis.

MMS16138

Fuzzy Stochastic Programming Problem with Log-Normal Distribution

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Abstract - Fuzzy stochastic programming is an optimization problem in which parameters are fuzzy random variables, where both randomness and fuzziness are present. The main objective of this paper is to discuss the methodology for solving fuzzy stochastic problem where the uncertain parameter is fuzzy log-normal random variable.

MMS14093

A Fuzzy EOQ Model for Defective Rate Using Allowable Proportionate Discount With Different Holding Costs

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Abstract - In this paper, we developed both crisp and fuzzy EOQ models with proportionate discount for items with imperfect quality using different holding costs. First, we construct an optimal order quantity of crisp case. Next, proposed three different fuzzy inventory models where in the first case the defective rate is fuzzified, in the next case, both defective rate and annual demand rate are fuzzified. The objective is to find the optimal lot size for models to maximize the total profit (both for crisp and fuzzy models). We considered the triangular fuzzy numbers to represent the fuzziness of defective items and annual demand. Finally, the optimum order quantity is obtained using the signed distance method. A numerical example is provided to illustrate the results of the proposed models and the sensitivity analysis is conducted to know the effect of changes made for the values of different parameters on the actual lot size and the profit respectively.

MMS15094

Solving a Single-Period Inventory Model With Fuzzy Inequality

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Abstract - This paper presents a fuzzy chance constrained single period inventory model (FCCSPIM) in which the objective function is crisp and one constraint has fuzzy inequality "" inside the probability function. This model deals with crisp random variables i.e. no fuzzy random variable is used. Here the fuzzy partial order relation is present in between a random variable and a crisp number. The objective of this paper for maximizing the expected profit of FCCSPIM with over-stock situation under storage space and budget constraints. We consider zimmermann fuzzy technique of fuzzy programming approach in the presence of fuzzy partial order relation to convert the FCCSPIM to a proper deterministic equivalent. Then the resulting deterministic model which is a nonlinear integer programming problem is solved by using LINGO software. To investigate the proposed model, numerical illustration is performed.

MMS18233

Statistical Analysis on the Effect of the Silt Attack on Composite Coating and Bare Steel Using Latin Square Methodology

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Abstract - Samples of bare Grade 420 steel are coated with three different coatings like NiCrBSi-5%Al₂O₃, NiCrBSi-10%Al₂O₃ and NiCrBSi-15%Al₂O₃ by using High Velocity Oxy Fuel (HVOF) process. The coated samples are characterized by its thickness, hardness, roughness and porosity. The as sprayed coatings and the bare steel are exposed to silt attack in an air jet erosion tester. The eroded coated and uncoated samples were analyzed under the Scanning Electron Microscope. The effect of parameters like impingement angle, erodent size and velocity, on the coatings and uncoated samples were statistically analyzed using Latin square method. It was found that the parameters did not have any significant effect on all the coated samples where as on bare Grade 420 steel, the parameters like erodent size and velocity had a significant effect

MMS17162

Analytical Application of Operation Management Tool for Paani Foundation

Shyam K Fardale

DMIETR Wardha

Abstract - Since beginning of the human progress, people have evolved tools and energy sources to power these tools to meet the requirements for making the life easier and enjoyable. But due to undo advantage of environment Water scarcity is basic problem face by Human being. So Stapes has been taken by Paani Foundation which is a not-for-profit company set up in 2016 by the team of the TV series Satyamev Jayate to fight drought in rural Maharashtra. Water scarcity is largely a man-made condition, Paani Foundation aims to harness the power of communication to mobilise, motivate and train people in this mission to eradicate drought. Offering training in scientific watershed management, leadership and community-building. For doing such activities analytical Operation management tool were use and give the scientific turn to PAANI FOUNDATION work. For each planning phase (strategic, tactical and operational), we describe the planning problems arising there and discuss some Operation management models and tool in the form of Schedule Chart, Gant Chart, Critical path Method, Programme Evolution Review Technique had been use and the result had been in favour of People.

OPT01002

Study Effect of AWJM Process Parameters for AMC Material Using MODM Method

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Abstract - The In this paper, Abrasive water jet machining is a non-conventional machining Process that offers a productive alternative to traditional technique. Process parameters of machining are optimized for maximum material removal rate and minimum surface roughness, kerf width using Genetic Algorithm (GA) Technique. GA is a relatively new and powerful method for optimization and which is used to obtain optimum solution in given circumferences. This research work attempts to achieve maximum metal removal rate (MRR) and minimum surface roughness (SR), kerf width (KW) in abrasive water jet machining under all constraints which are for different process parameters such that stand off distance, jet pressure, abrasive material grain size and abrasive material. Obtained results are better than ANOVA which is other optimization technique.

OPT02052

Study of Customer Relationship Management in Automobile Industry

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Abstract - Customer relationship management is a concept which is widely used for managing an organization's interaction with its customers and its sales prospectus. Customer Relationship Management is gaining a lot of importance in the present business world, especially in the field of automobile industry. Here we evaluate how Customer Relationship management helps in improving the business of the automobile industry especially focusing in the areas of product quality, brand building, customer loyalty, and after sales service. The methodology adopted here is to gather information and data through online research and a ground survey of the automobile dealers in and around and analysing those data thereby reaching a suitable conclusion.

OPT03057

A Novel Multi-Criteria Decision Framework for Evaluating Sustainable Supplier for a Battery Manufacturing Industry

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Abstract - The purpose of this paper is to integrate the “MOORA and WASPAS” approach in the supplier's selection decision. It also aims to consider the feedback effect of the decision on strategic factors that determine the future viability of the firm in the market. Multi-criteria decision model is used that considers simultaneously the impact of criteria and sub-criteria on the reverse logistics service provider's selection decision. The proposed model is evaluated and criteria weight is determined using the step-wise weight assessment ratio (SWARA) approach. The MOORA & WASPAS considers the impact of criteria, sub-criteria and their interdependencies simultaneously. The outcome of the model is the relative priorities for suppliers. This research was conducted in one of the largest developing economies. The impact of integrating sustainability would be widespread due to the huge market in which the company operates. The results of this research can provide support to the decision makers in arriving at an optimal decision considering all sustainability dimensions. The novelty of the approach lies in the application of multi-criteria model integrating sustainability dimensions with a feedback effect for supplier selection. The case company would benefit by showing its commitment toward environment, economic and social responsibility leading to improved brand image and sustainable business.

OPT04085

Inventory Models for Perishable Items with Weibull Distributed Deterioration Rate

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Abstract: Majority of Retail industry deals with perishable items. Although, there is an increasing demand for the good quality items, there is no demand for deteriorated items and therefore it is very important to optimize order quantities and reduce loss. In this paper, inventory models are developed for deteriorating items with instantaneous replenishment, time varying linear, quadratic or exponential demand without shortages. The rate of deterioration follows two parameter Weibull distribution. The formulae for optimal total cost and the economic order quantity are derived without carrying out any approximations over the deterioration rate. Time dependent demand rate makes this model more realistic. Models for increasing linear demand, increasing quadratic demand and decreasing exponential demand are studied to minimize total variable cost.

OPT05089

Optimization of Process Parameters During TIG Welding of 304L Stainless Steel With and Without Flux

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Abstract – This research aims at investigating the weldability of 304L stainless steel by tungsten inert gas (TIG) welding technique with and without the use of activated fluxes. In the activated flux TIG (A-TIG) welding process, two different fluxes SiO₂ and CdCl₂ have been used to study and compare the influence of process parameters on the welding performance of 304L stainless steel. The experimental design was carried out using Taguchi's technique where L₂₇ orthogonal array was used for welding. Multi-objective optimization was done using PCA based TOPSIS method to find the optimal sample among the entire samples. The optimal sample was found to be SiO₂ flux at welding current=160 A, gas flow rate=16l/min and weight of the flux=0.147g.

OPT06090

Outsourcing in e-Governance: A Fuzzy AHP Approach

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Abstract- Application of IT has been seen over a decade in Government services with an objective to make better citizen services leading to many E-governance implementations. But over a period of time many application has resulted partial or total failure, out of several reasons for failure, outsourcing is one. Often these services are being outsourced, without sufficiently analyzing the decision making of whether or not to outsource. In this context may be selective outsourcing be one solution to improve the system effectiveness. In this paper an attempt has been made through a case analysis, with the help of the Fuzzy AHP to find out an optimum level of outsourcing. The paper suggested a balance mix strategy between in house and external agency with a suggested selective outsourcing. Research/managerial implications- The selective mix strategy reduces risk of failure. Decision making with respect to various strategy needs to performed component wise.

OPT08096

Prioritization of Reverse Logistics Enablers

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Abstract - To rank and prioritize the selected enablers of reverse logistics for institution to focus upon the betterment of their institution. List of enablers is being generated by the rigorous efforts in going through 449 selected articles on RL. Top 10 enablers having higher frequency of occurrence is being selected and ranked with help of Fuzzy Analytic Hierarchy Process (FAHP). Government regulations towards end of life components and latest information technology are the top three enablers of RL. These are followed by Government support towards RL and competitive advantage. This research will help managers to understand different enablers for implementing RL practices. This research will prepare industries (managers) for more effective and efficient implementation of RL and will bring sustainability to their organization.

OPT10107

Numerical Approach to Optimize the Process Parameters of Direct Metal Laser Sintering Process

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Abstract - Direct Metal Laser Sintering is a metal additive manufacturing process, which fabricates complex prototypes directly from the metal powders. The quality of the build parts depends on processing condition. For quality parts, it is necessary to investigate the effect of processing condition and to optimize the process parameters. In the present study, the effect of process parameters i.e., laser power, scan speed and percentage of porosity present in powder bed on sintering depth were analyzed using statistical design technique. Based on the simulation results, the process parameters were optimized by using surface response method. From this analysis, it is found that at a scan speed of 164mm/s, laser power of 115watt and at 35 % of porosity, the sintering depth is 2.757mm/s, which gives optimized set of parameters to fabricate quality components. This model will be an important tool for the development of optimized process controls to build quality components.

OPT07091

Environmental Constrained Economic Dispatch of Fixed Head Hydrothermal with Wind Farm Power System using Whale Optimization Algorithm

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Abstract - To solve emission constrained economic dispatch (EED) problem of hydrothermal units with wind energy Power systems. This paper has proposed to handle the economic environmental dispatch of fixed head hydrothermal units with wind power scheduling as a multi-objective task with competing noncommensurable objectives. Both the objectives (Fuel Cost and emission level) are optimized simultaneously satisfying all operational constraints. Whale optimization approach (WOA) is implemented to solve this problem. The numerical results for a test system have been presented to validate the result obtained using WOA. The results obtained implementing WOA also compared with the results obtained implementing Real coded genetic algorithm (RCGA), Strength Pareto Evolutionary algorithm (SPEA-2) and Non-dominated sorting genetic Algorithm (NSGA-II). The result obtained from the proposed approach is found to be lower for fuel cost, emission level and computational time is also lower than NSGA-II and SPEA-2. Whale optimization algorithm gives better result for fuel cost and emission level than other methods discussed in the paper. This can be implemented practically. The proposed system uses wind energy systems so emission gets reduced.

OPT09103

Experimental Investigation and Parametric Optimization During WEDM of Inconel 625 Using Grey Relation Analysis and MOORA

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Abstract –The present investigation highlights an experimental study and optimization of machining outcomes characteristics (such as MRR and Ra) during WEDM process of Inconel 625. Taguchi's L_{27} orthogonal array has been utilized for selecting the appropriate outline of experiment by varying Pulse-on Time, Pulse-off Time, Wire speed, Wire Tension and Servo Voltage and a comparative study has been applied between the Grey Relation Analysis (GRA) and Multi-objective optimization on the basis of ratio analysis (MOORA) to find out the best satisfactory machining performances. The most favorable machining parameter obtained through aforementioned optimization technique as [Pulse-on Time=110 μ s, Pulse-off Time=40 μ s, Wire Speed=5m/min, Wire Tension=12N, Servo Voltage=28V]. In this study, adopted optimization methods can capable enough to solving the multi process optimization problems of WEDM the process. Moreover, it is apparent that will be very helpful to the manufacturing sectors, especially fabricators in the area of fittings and good dimension accuracy with Inconel 625.

OPT11108

Application of Overall Evaluation Criteria to Optimize the Process Parameters in EDM of Al–20 wt. % SiC_p Metal Matrix Composite

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Abstract - The present paper is described one of the effective optimization technique i.e. Over all Evaluation Criteria (OEC) to controlling the process parameter during Electrical discharge machining (EDM) of Al – 20 wt.% SiC_p metal matrix composite (MMC). To exploit the industrial application of this material with EDM it needs to optimize the process parameter for reliable and economical production of this process. The experiment is followed by Central composite design method by considering the three input process parameters like peak current, pulse on time and flushing pressure and the output are material removal rate, tool wear rate, radial over cut and surface roughness (R_a). In order to optimize the process parameter a combine effect of Entropy weight measurement method and OEC is used to get a single numerical index. Finally confirmation test is conducted to perform the desirable approach of present work.

OPT12166

Prioritizing the Performance Measures of Design for Disassembly of a Product Using AHP

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Abstract - The purpose of this study is to identify and analyze the performance measures of design for disassembly of a product to improve the sustainable performance of the organization. The crucial performance measurement factors that significantly influence the organizational performance was identified through past/existing literature analysis and subsequent discussion with expert decision panel. Further, the finalized selected performance measures were ranked using Analytical Hierarchy Process. The results indicate that management support and total disassembly time are the most important performance measure for design for disassembly. Further study is required to validate the findings by conducting a case study. This study would enable academicians and policy makers to understand different performance measures with their relative importance.

OPT13169

Optimization of Job Shop Scheduling in Flexible Manufacturing Systems Using AGVS

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Abstract – Automated guided vehicles (AGVS) play an important role in flexible manufacturing systems. These AGVS are one of the advanced material handling systems, whose importance and application is increasing day by day. They are integrated with production equipment and controlled through computers. The overall efficiency of the flexible manufacturing system depends both on the scheduling of jobs on the machine centers and scheduling of material handling systems. The present work concentrates on achieving an integrated schedule of both machines and automated guided vehicle (agvs) in flexible manufacturing system. A C++ code is generated to find the optimal solution that is optimum makespan and the corresponding optimum schedule.

OPT14170

Self Convolution Windows: A Critical Analysis

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Abstract - Windows function plays very important roles in Signal Processing. Sidelobes power in Windows affects the performance in communication systems. Self Convolution windows obtain by convolution of the window function with itself leads to better sidelobe attenuation and higher Sidelobe fall off ratio (SLFOR). Various self convolution windows like (Triangular Self convolution window) TSCW, (Hanning Self convolution window) HSCW, Blackmanharris self convolution window) B-HSCW, Cosine Self convolution window) CSCW and (Nuttall Self convolution window) NSCW are analysed using MATLAB software and the relative comparison is studied.

OPT15172

Multi Criteria Decision Making Techniques for Supplier Selection in the Context of Gear Manufacturing in India

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Abstract - Supplier selection has always been a key concern in manufacturing industries and this study is an attempt to explore different supplier selection criteria in the context of Indian gear manufacturing micro-small and medium enterprises (MSMEs). The study has attempted to find out, whether the manufacturing industries follow only the traditional criteria for supplier selection or they also include green criteria for supplier selection. Data for the study were collected from 50 different gear manufacturing industries in the MSME sector and the relationships proposed in the framework were tested using Analytical Hierarchy Process (AHP). Results with respect to the main criteria followed in the study show that cost, quality, delivery and environmental manufacturing management are considered prime criteria for supplier selection. Similarly, for all sub criteria, rank given by the respondent and pair-wise comparison matrix were calculated. Results show that AHP is one of the best techniques for evaluating the complex criteria structure at different levels.

OPT16173

Optimization of Injection Moulding Process Parameters using Taguchi DOE Methodology

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Abstract: This study explores the experimental investigation performed for parameter optimization of a Plastic Injection molding process that uses acrylic material, by adopting the Taguchi Methodology DOE. Experiments were conducted to evaluate the effect of Injection Temperature, Injection Pressure, Packing Pressure, Injection Speed, Packing Time, Injection Time, and Cooling Time on % defectives – Response for the experimental run – with shrinkage as a major defect. Orthogonal Array L₁₂ of Taguchi Method was used with two levels of each factor and results obtained were analyzed using Signal to Noise Ratio. Injection pressure, Cooling Time and Injection Temperature were found to be the most significant parameters for minimizing the % defectives during the Plastic Injection molding process.

OPT17189

Optimization in EDM of D2 Steel With Multiple Surface Roughness Characteristics Using Hybrid Taguchi Method

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Abstract - The present study presents a multi-response optimization problem by applying Principal Component Analysis (PCA) combined with Taguchi method. The aim of the study is to evaluate the best process environment which could simultaneously fulfill multiple Surface Roughness characteristics. As traditional Taguchi method cannot solve a multi-objective optimization problem; to overcome this limitation, Principal component analysis has been coupled with Taguchi method. Taguchi method assumes that the quality characteristics should be uncorrelated or independent which is not always fulfilled in actual condition. PCA is applied to remove response correlation and to calculate independent (uncorrelated) quality indices known as principal components. These principal components combined with weighted principal component analysis (WPCA) are used to calculate overall quality index denoted as Multi-response Performance Index (MPI). This investigation combines WPCA and Taguchi method for forecasting optimal setting. The predicted result by this method was validated through confirmatory test proving the efficacy of the process.

OPT18196

Application of SOPT Algorithm to Minimize the Vertical Deflection of an I beam

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Abstract – meta-heuristic algorithms are gaining widespread applications in solving non-linear optimization problems because of the drawbacks of traditional optimization techniques. Traditional techniques are often get stuck to local optima in solving complex real world multi-modal optimization problems. Simple optimization (SOPT) algorithm is an easy to understand and easy to implement optimization algorithm to solve complex problems. In this paper SOPT algorithm is coded in MATLAB and used to solve a benchmark design problem defined in literature. Result of optimization is compared with an effective cuckoo search algorithm.

OPT19198

Optimization of Baffle Inclination in Shell and Tube Heat Exchanger

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Abstract - The Shell and tube heat exchanger is the most common type of heat exchanger widely used for commercial purpose. In the present work, a study has been made to optimize the inclined segmental baffles in shell and tube heat exchanger (STHEs) to get desired results. In order to obtain an understanding of the underlying mechanism of segmental baffle inclination augmentation inside the shell and tube heat exchanger, the present study uses SOLIDWORKS software. The parametric study and numerical analysis has been done using SOLIDWORKS for optimization of baffle inclination. The flow pattern of the fluid flowing longitudinally is observed to be rotational. The segmented baffles are inclined at various angles which increases the heat transfer coefficient and pressure drop inside the tube bundle. The heat transfer coefficient and pressure drop vary periodically along with the axial direction. All the analyses are done with respect to Tubular Exchanger Manufacturers Association (TEMA) standards. The numerical and experimental findings show a better result at 5° inclination of baffle followed by experimental verification to make the analyses robust.

OPT20207

Optimization of Surface Roughness for Economical Feasibility of Coated Ceramic Tool in Hard Turning Using RSM-PSO Approach

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Abstract - The paper addresses the modelling and optimization study of surface roughness in finish dry hard turning (FDHT) of AISI 4340 steel (49 HRC) with PVD-TiN coated ceramic tool by considering the cutting speed, axial feed, depth of cut, and nose radius as machining parameters. Thirty sets of longitudinal turning trials based on central composite (CCD) design of experiments (DOEs) are performed and response surface methodology (RSM), particle swarm optimization (PSO) and finally, Gilbert's approach are subsequently applied for mathematical modeling, response optimization, tool life estimation and economic analysis. The RSM model combined with PSO leads to minimum surface roughness value similar to cylindrical grinding of 0.2021 μm , which ensued the total machining cost per part of Rs. 21.76 due to higher tool life (44 min), reduction in downtime and enhancement in savings, which finds economical benefits for industrial point of view.

OPT22076

Selecting and Scheduling Influencers for a Product Promotion in Social Networks

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Abstract- Social networking sites are one of the biggest source for influencing the customers and boosting purchase intentions. At each stage a group of users are selected as influencers under given time and budget constraints. For all the users the level of positive or negative opinion on a product is calculated and thus the influencers are scheduled to influence so as to make the users opinions to cross a threshold value. It makes the users to exhibit his/her interest in purchasing the product. A mixed integer programming is developed to represent this scenario where the effect of untimely influence is also considered. An intelligent search approach is proposed in order to schedule effective influencers over a time period. Results show the effect of timely promotions and forgetfulness factors on advertising through social networks.

OPT21217

Multi-criteria Modular Decision Support System for Evaluating and Selecting from Road Network Design Alternatives

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Abstract – Increasing traffic congestion and demand for travel is placing a huge strain on the existing road infrastructure. In such a scenario, it is essential to determine the improvements to the existing road network in the form of link additions or capacity enhancements. Such improvements are traditionally made by a network planner at the national, state or regional levels by solving a road network design problem which uses selected pre-defined objective functions. This approach fails to consider the deterioration in the performance of the system as demand increases. In this paper, the design of a multi-criteria modular decision support system is proposed for selecting and evaluating road network designs, which considers global and local performance measures and measures deterioration in the network performance with varying demand. This approach suggests network improvements that ensure performance measures are at a level defined by the modeler.

OPT23077

Optimizing Variations in Speed of Batch of Trucks in Continuous Stage Shipping Problem Under Uncertain Demand

Jasashwi Mandal

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Abstract - In this study, the issue of varying speeds of a batch of vehicles in a truck shipping problem is explored considering fuel consumption and carbon emission for the vehicles. The aim is to minimize the supply chain cost including the transportation costs, holding costs and back ordering costs where transportation cost consists of fuel cost, cost of the trucks, driver costs and also the carbon emission caused by the vehicles. The shipping problem is divided into some sub problems leading to a set of differential equations of the total chain cost and solving these differential equations the optimal dynamic speeds are obtained. Furthermore, a numerical case study related to truck transportation is given to realize the advantages of varying speed policy.

OPT24078

Direct Channel Fulfilment Strategies When Manufacturer Operates in Omnichannel Environment

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Abstract- Traditionally a manufacturer delivers its product to retailers, from where a customer makes the final purchase. But recently in the presence of internet channels, both retailer and manufacturer got direct reach to the customers. These results in price competition between retailer and manufacture. Moreover, in recent times we find customers are becoming more and more omnichannel where they switch channels while they search, feel and touch, purchase, and post-purchase phase. In the omnichannel environment, manufacturer could decide to coordinate with the retailer for final delivery, and to cater for direct channel customers. However, the manufacturer needs to decide on how to use the retailers to maximize total channel profits and to share the gain. The manufacturer needs to decide when to go from drop shipping, direct shipping or delivery from the retailer's store. We present a game-theoretic model where manufacturer determines the strategy along with price offered to the customers and wholesale price offered to the retailer.

OPT25109

Retailer Optimal Pricing Policy for Controllable Deteriorating Items of Two-warehouse Inventory Problem With Stock, Price and Advertising Cost Based on Demand Under Partial Backlogging

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Abstract - This paper presents a controllable two-warehouse deteriorating inventory model under the effect of stock price and advertising cost based on demand. We considered two warehouses, i.e., first one refers to rented warehouse to store the goods and the second is firm's own warehouse that deteriorates with controllable rates. On one hand, deterioration of products can be reduced by investment on the latest equipment and technology. On the other hand, consumption of goods within shelf life prevents deterioration, which can be achieved by bulk sale. In order to accelerate the selling, the advertising cost policy must be considered. The purpose of this study is to build the inventory model to find out the optimal price, advertising cost, optimal investment cost to preservation of technology, and optimal order quantity to maximize the profit. In order to validate the proposed model, we used two numerical examples including concavity (both theory and graphs) test of the optimal profit and sensitivity analysis of parameters.

QEG01001

A Grey-Taguchi Approach for Parametric Appraisal in Drilling of GFRP Composites

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Abstract – The present work focused to evaluate the favorable machining condition in drilling of GFRP composite. In this work, spindle speed, feed and drill diameter has been chosen as machining variables whereas the thrust force, torque and surface roughness are considered as the machining evaluation characteristics. Taguchi has been utilized to prepare the design of experiment. Here, L16 Oa has chosen for conduction of experiments. The work also implemented the grey relation analysis in order to obtain the optimal machining condition.

QEG02003

Control of Angular Distortion in A-TIG Welding of Stainless Steel 304L Using Silicon Dioxide as a Flux

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Abstract – Tungsten inert gas (TIG) welding has an inherent difficulty in achieving deeper penetration. The depth of penetration that can be achieved in 6mm thick Stainless steel plate with conventional TIG welding is approx. 2.5 mm which can be enhanced by silicon dioxide flux powder mixed with acetone. The aim of the research work is to identify the effect of silicon dioxide flux on weld geometry and analyse it. Silicon dioxide flux plays a major role in influencing the various properties of stainless steel TIG welds. Input parameters of A-TIG mainly welding speed, current, Arc frequency etc. have been taken to find out the effect of input parameters on weld bead geometry. However, investigation is based on Taguchi method to determine the influence of process parameter, optimize them and to get optimal parameters in order to control angular distortion which occur during welding.

QEG03006

Recent Developments in Quality Inspection of Spur Gears Using Machine Vision Technology

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Abstract – Gears being one of the important components for power transmission in manufacturing, automobile and aerospace industries as a very effective mode of power transmission, any manufacturing inaccuracies can significantly affect the quality of operations, level of dynamic forces, noise and vibrations which in turn greatly impact power transmission. Hence their inspection is critical however complex due to large number of quality parameters. Gears are generally checked for composite errors in traditional approach. Machine Vision based inspection of gears has a research potential that can provide cost-effective and efficient solution that can measure all individual errors. This paper reviews the research work and recent developments in this research domain. The previous work carried out by various researchers for quality inspection of spur gears using machine vision is systematically reviewed and represented. From the literature reviewed, the fact is established that machine vision has a potential to provide a non-contact type of measurement system for inspection of spur gears. However achieving measurement accuracy and robustness upto the level desired by the industry is challenging due to limitations including image quality, resolution, noise. The research work carried out by various researchers provides motivation for further research in the field in terms of devising image acquisition, pre processing and processing approach that is capable of measuring major dimensions of spur gear upto micron level for more robust, precise and accurate measurement system that can be accepted by the industry. The paper provides systematic review of recent developments in the field of quality inspection of spur gears using machine vision, identified the research gaps and provides directions for future developments.

QEG04007

Prioritizing the Pipe Material Properties for Sugar Industry by Using Triangular Fuzzy AHP Method

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Abstract - The material plays a significant part in an engineering design process. The suitable pipe material selection for sugar industry is one of the important tasks for the designer. In order to complete the pipe material requirements, designers need to investigate the performance of various pipe materials and mark suitable pipe materials with specific functionalities. The presence of large number of materials with various properties, the material selection for pipes in sugar industry is difficult and time consuming task. Therefore there is a necessity of efficient and significant approach towards material selection to choose best alternative material for pipes. The aim of this paper is to explore and prioritize the desirable important material properties for pipes in sugar industries. For this fuzzy analytical hierarchy process (AHP) method is proposed in this paper. Also the empirical study is presented to illustrate the proposed method. Total 13 important material properties are identified through literature review and finalized through expert's opinion. Then fuzzy AHP method has been applied for selection of materials properties. The result of this study indicates that 'density', 'yield strength', and 'tensile strength' are three most important material properties for pipes in sugar industries.

QEG05014

Performance Analysis and Optimization of Molded Case Circuit Breaker for Short Circuit Condition Using Taguchi Approach

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Abstract - Circuit breaker is electromechanical device used to protect the electrical systems from damage during abnormal condition. Abnormal condition occurs due to overload, short circuit or ground fault. The purpose of this experimental work to find effect of various components of MCCB on current difference between two poles during short circuit condition. Four factor including slider, spring, mechanism & release housing along with five levels are taken into account. Taguchi method was used to minimize the number of experiments. The experiment were carried on 400 A MCCB. After experimentation we found that Slider, spring and release housing are most influential factor on current difference between poles than Mechanism. The percentage of contribution of these factor on current difference were obtained by using ANOVA and its value approximately 40%, 26%, 8% and 26% for slider, spring, mechanism and release housing. This paper gives information about MCCB and DOE.

QEG10086

Application of DMAIC Methodology in a Small Scale Auto Component Manufacturing Industry

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Abstract - The purpose of this paper is to reduce excessive primer consumption by replacing equipment and material and proposing a better method of placing components during priming process. DMAIC methodology has been used to analyse the problem of excessive primer consumption. The paper focuses on finding alternatives of spray gun (i. e. equipment) and brand of paint (i. e. Material). Also it focuses on changing the method of placing components during priming process. The proposed methodology can be implemented to find better alternatives of equipment and material in many industries where spraying operation is performed. The paper proposes better alternatives for equipment and material and proposes new method which leads to reduce cost of primer consumption.

QEG11104

Quantifying Productivity Targets for Direct Unionized Labor

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Abstract - Productivity targets for assembly lines are set by small increments of using lean manufacturing tools. Based on these tools, managers are given a year-on-year performance targets. Given by top management, these range from 5-15% depending on the type of line, industry, parts, wages and work content. There is no literature as to the arrival of these target expectations as there exist more than 30 lean manufacturing tools. Line balancing is used for the execution for some of these tools. Most researchers who have studied line balancing problems over the last 50 years have assumed that the time required to perform the task is independent from learning of operator(s) for repetitive tasks. This study aims to bring in new ideas and ways to set productivity benchmarks. Learning curve has been used as a tool to quantify these to convert these intangible expectations into tangible goals.

QEG06021

Prediction of UVAT Response Parameters by Using Linear Regression Analysis

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Abstract - Recent decades improving the quality of the product with respect to the cost is quintessential. For obtaining such type of quality product, it is necessary to develop new manufacturing techniques which can improve the machinability characteristics. In recent years many researchers are investigated sensibly towards improving the machinability characteristics. Ultrasonic vibration assisted manufacturing process is one of them, which has gained a lot of attention due to its sporadic cutting mechanism for achieving a better quality product. In this present paper, concentrates on ultrasonic vibration assisted turning (UVAT) process because turning is one of the important manufacturing processes which can shape the metals by removal of the undesired material to get a required shape and size of the product. For understanding and easy industrial use of UVAT technique, a full factorial design of experiments (125) has been performed. A linear regression mathematical model has been developed to validate the UVAT experimental results.

QEG07035

The Relationship Between TQM and Business Performance: A Structural Equation Modelling Approach

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Abstract - The main purpose of the present study is to examine the interrelationship between factors influencing successful implementation of total quality management (TQM) and business performance in industrial setting. Structural Equation Model (SEM), being a robust mathematical tool has been employed to examine the relationships between TQM and business performance of manufacturing industry in eastern, India. A Total of 300 manufacturing industries among 750 senior executives are chosen for comparison purpose. It has been observed that there is a significant positive relationship between the factors influencing successful implementation of TQM and business performance of manufacturing industries. RMR and RMSEA values of the hypothesized model are 0.067 and 0.046. CFI value of 0.90 or larger is obtained considered to indicate acceptable model fit. The distinctive data being dependent on the perceptions of the senior executives and the fact that the sample companies came from different sectors constitute the limitations of the present study. Assumed the value-added rate of the companies that adopt quality assurance standards, the organizational performance improvement as well as the competitive advantage in the market can be obtained through a valid quality management model, as specified by the TQM principles.

QEG08041

Framework for Lean Six Sigma and Knowledge Management to Reduce Cost of Quality

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Abstract - In today's world which is marked with competition in almost every sector of business; to survive and to get an edge over other industries; it is an ardent need to cater the diverse demands of customers without compromising on quality of products produced. Lean Six Sigma which focuses on waste reduction is proven technique of process quality improvement in industry. For better quality management; companies now realizing the importance of data and knowledge generated during execution of processes and producing parts. Such recent trends are transforming present manufacturing scenario to next generation; namely industry 4.0, based on integrating industrial engineering philosophies with ICT's. This paper presents a literature review and its analysis concerning a possible framework for integrating strategies of Lean Six Sigma and Knowledge Management to reduce Cost of Quality in Industry 4.0 perspective. In particular, analyzing current situation from which future research direction has been suggested.

QEG09068

Lean-Green-Six Sigma Approach in Global Manufacturing Using Industry 4.0

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Abstract - The purpose of this paper is aligning IoT and industry 4.0 with LGSS methodology so that organizations can better leverage huge amounts of data to make operations more efficient from a sustainability point of view and provide better products and services to customers. The approach for industry 4.0 is the social manufacturing which can directly link to customer's need, but must be based on enabling technologies. Our research will focus on future insights of Industry 4.0 methods as possible combating tools of the Lean-Green-Six Sigma in manufacturing industries. In industry 4.0, there is a significant “evolution” of many methodologies of Continuous Improvement, such as, e.g., Lean, Green and Six Sigma (LGSS) which maximise efficiency and enhance customer value. Most of the tools of LGSS depend on data, turning that data into actionable business intelligence still requires a consistent and successful strategy that drives the companies into efficient working environment. Organizations that implement and maintain integrated LGSS systems will reap viable rewards in terms of improved operational, financial and environmental performance. Little research exists on the subject of LGSS and industry 4.0; hence, it is still questionable as to whether industry 4.0 covers the requirements of LGSS. This paper draws the perspectives in regards to the LGSS and the future impacts gained through industry 4.0.

QEG12120

Numerical Analysis and Optimization of Design Parameters of a Plate Heat Exchanger Using Different Fluids

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Abstract - This work investigates the effect of design parameters on thermal and hydraulic performance of plate heat exchanger. Also to use Taguchi optimization technique to optimize the design parameters for maximization of heat transfer rate and minimization of pressure drop. A numerical analysis of plate heat exchanger using different fluids (i.e. milk, orange juice and water) is presented in this paper. Different fluid systems which are considered for this present study are case-1 (milk-water), case-2 (orange juice-water) and case-3 (water-water). Different models are built by varying the design parameters of the plate heat exchanger. 600 chevron angle corrugated plates are considered. Different design parameters taken for this study are length of the plates, space between each plate, amplitude of corrugation on the plate and pitch of corrugation on the plate. L16 orthogonal array system of Design of experiments is adopted to conduct the numerical analysis. The effects of design parameters on the performance of plate heat exchanger are studied. An attempt is made to optimize the design parameters by using Taguchi optimization technique, in order to maximize the rate of heat transfer and to minimize the pressure drop. In the process industry like fruit juice processing or milk pasteurization, in order to maximize the heat transfer and minimize the pressure drop during processing, optimum sized plate heat exchanger should be used. The present work will provide the optimum geometrical parameter of the plates to achieve desired output for different inlet temperatures.

QEG13135

Reduction of Supplier Quality Cost Using Six Sigma

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Abstract - The cost of Quality would help in analyzing the operating costs for effective and profitable business management. In the era of cut throat competition, the success accomplished by market leaders is credited to their improvement initiatives. Cost and Quality are two essential aspects to be globally competitive, to capture market share, to retain customers to be in business and to achieve business excellence. Managing quality of suppliers is of prime significance in the manufacturing industry to minimize costs arising due to poor-quality products and services. Six Sigma is the powerful methodology to drive improvement initiatives and reduce cost of quality. This paper presents a Roadmap for Supplier focused Six Sigma and Original Equipment Manufacturer(OEM)-Supplier best practices to enhance the quality and reduce the Cost of Quality.

QEG14140

An Approach for Identification of Success Factors and Performance Measures for Quality Circles in Manufacturing Industries

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Abstract - Quality Circles are quite popular and are commonly used in the medium and large scale manufacturing industries in India as a technique of workers participation in organizational performance improvement. When implemented successfully, they contribute towards improving the quality, productivity, safety, delivery etc by solving the work related problems and implementing improvement projects by applying innovative solutions. They also help in improving the job satisfaction and morale of the workers and bring about their self and mutual development. A study has been carried out to determine the Critical Success Factors and the Performance Measures of the Quality Circles in Manufacturing Industries in India. The various input and output variables were identified through the literature review, a questionnaire was developed and data was collected from large no of respondents. By analyzing the data, variables were grouped into factors and correlations between input and output factors were established.

QEG15143

A Conceptual Review of Kano Model to Prioritize Customer's Satisfaction

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Abstract - The purpose of this paper is to review the most useful Kano model. Kano model is majorly used to develop or re-develop a product/service by measure customer's need, satisfaction and delight. This paper gives a basic idea to understand the Kano model and provides marketing reference guide to the researchers. A brief literature about Kano model and its methodology to apply is explained for marketing/management/design decisions. The Kano questionnaire is an approach that is capable of classifies satisfaction attributes for manufacturing and service industries. Model provides guidance to features and designs that can be focused to enhance satisfaction of customer. This study provides base guidelines for many companies and researchers those who have tried to design their products to being modular. They therefore understand that different customers view different features differently. By building modularity in the product using Kano model, they can provide everyone with the features they need and therefore create customer satisfaction.

QEG19206

Survey Data Validation Using Cronbach's Alpha

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Abstract: In today's modern competitive world, data collected in the form of surveys is of highly important in decision making. Information gathered in various fields like social sciences, marketing, medicine, and business involves the use of survey data. Many a times the data collected is unorganised and needs reliability validation & consistency testing. Hence there is a need to validate this data. This paper discusses data validation using Cronbach's alpha approach for the data collected pertaining to the various factors influencing facility location in the state of Goa. This research is useful for validating the data collected from the experts in any domain.

QEG16175

Factors Influencing Information System While Implementing in MSME Using ISM Model

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Abstract - Micro Small and Medium Enterprises (MSME) are the backbone of developing countries. Contribution in nation's economy by industrial base and exporting goods, MSMEs contributes Gross Domestic Product (GDP) rate. Introducing advanced technologies as Information System (IS) in MSME is unavoidable. While introducing IS in MSME, organisation should consider many critical success factors and its significance. These factors helps to attain the success of any business especially MSME. These factors should be identified and evaluated. Identification of critical success factor has set of ways. There are 14 critical success factors are considered in implementation of Information System in MSME. Interpretive Structural Modelling (ISM) has been used as methodology. ISM technique uses expert's experience and also by support of many management tools and techniques. Factors and relationship among these are identified through ISM model. Output of ISM model has been given as the input for (Matriced' Impacts Croise's Multiplication Applique'e a UN Classment) MICMAC analysis. MICMAC analysis helps to identify driving power and independence power of all considered factors. Result of MICMAC analysis mentions most significant factor as Commitment and Initialization of top Management, it drives all other 13 factors. This analysis helps to identify factors while implementing IS in MSME.

QEG17058

Strategic Planning of Productivity Enhancement in Indian Cement Industry: A '5S' Quality Approach

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Abstract - Improving efficiency of production line is widely acknowledged in order to reduce downtime rates by meeting higher levels of market demand. Cement Industry considered to be the '*lifeline of Indian economy*' is facing numerous real time challenges in quality production. Major challenges are the capability to adopt and continue improvement approaches with latest technologies by which productivity enhancement can be made. Productivity issues in relate to cement is considered as one of the ideal examples of manufacturing sector where it is established to demonstrate '*lean philosophy*'. Here, an attempt has been made to investigate and address of implementation of 5S concepts under '*lean philosophy*' in a cement plant. Contribution of this study may direct the decision makers in line of flexibility that '*lean philosophy with 5S is the proposed solution in future*' by which not only waste can be minimized but also productivity can be improved. Pre and post implementation of '*5S and lean quality policy*' in the plant is critically discussed. The case of not achieving expected quality of implementing lean is not only the limitation; however misconception of this philosophy is amongst main failure's factors. Implementation of '*lean*' helps manufacturing organizations to improve productivity and efficiency through '*minimizing wastes and non-value added activities within production line*'; though numerous organizations have failed to achieve benefit from this philosophy.

QEG18204

Investigation on Persisting Defects in Green Sand Casting Process Using Taguchi Technique

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Abstract - This study identifies most influential parameters those are responsible for occurrences of defects which are found persisting in a foundry industry situated in central India and engaged in producing castings in gray cast iron by the green sand casting process. First stage of study involves study of large data available with industry related to the percentage of castings rejected due to the presence of defects to identify persisting defects and selection of essential process parameters. Taguchi's orthogonal array (OA) is used to conduct screening experiments with selected parameters. In the second stage, based on experimental results, Signal-to-Noise ratio (S/N) and analysis of variance (ANOVA) used to set optimal levels of parameters along with identification of most influential parameters. As a great number of process parameters are involved in the green sand casting process, a selection of essential process parameters during the initial stage of study is difficult task and could make possible through collaborative efforts with expert foundry personnel and review of literature of research personnel who made great strides in this domain. The outcome of this study shows that though a great number of parameters associated with green sand casting process and variations in the same is responsible for the occurrences of persisting defects, minimization and elimination of such defects are possible by adequately controlling of most influential parameters during the initial course of actions.

RME02020

Implementing the Office Total Productive Maintenance ("Office TPM") Program in a Library of Engineering Institute: A Case Study

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Abstract - In this paper, the authors have implemented an important pillar as "Office TPM" in the Library of Engineering Institute. Authors have discussed the implementation of Office TPM in Library of Engineering Institute. A engineering Institute has been selected for this case study. It describes the reasons and benefits of its implementation. Also describe the methodology used in this case study. This paper describes the objectives and methodology used to implement this TPM pillar. 5S play an important role in the implementation of Office TPM in the Library. TPM program is used to increase productivity and to improve employees' morale and job satisfaction. This paper has discussed the benefits of its implementation. Implementation of TPM Program always needs the full commitment of higher management. 5S is the Japanese term. It is the duty of higher management to organize some training programs for the employees to accomplish the successful implementation of Office TPM. An expert has advice to assist the practitioners in the successful implementation of Office TPM. This paper helps to understand the utilization of Office TPM in an office of ant organization. Also, other authors can understand how to use this office TPM in any organization.

RME01005

Industry 4.0: Literature Review and Future Research Directions

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Abstract - The purpose of this paper is to investigate the existing literature of Industry 4.0 and to seek the various development happened in the domain of industry 4.0. To select the research papers for review the literature, method of inclusion and exclusion is used. Further, the literature is divided into three parts based on the framework and research field. The paper highlights a research field that is growing very fast. Moreover, the various framework of industry 4.0 from production, manufacturing, environment and ergonomic areas are identified to plan the future research. Future research direction of this paper can be used by researchers to focus on specific research areas and will be helpful in developing a generalized framework. Many frameworks have found in the literature for different sectors, which will enhance the productivity of the organization. This paper will be helpful for selecting future research direction.

RME03065

Industrial Engineering 4.0 - Productivity Improvement in Industry 4.0 Implementations - Process Steps - Proposal

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Abstract - To propose the process steps to be followed in utilizing industrial engineering principles, methods, techniques and tools to improve productivity in industry 4.0 implementation projects right from the first project to investigate adoption feasibility. Synthesis of literature reviews, observations, analysis, findings and conclusions of existing research and knowledge to come out with modified theory of value to the discipline. Industrial engineers have to monitor technology on a continuous basis. In that activity they have to identify new technologies related to industry 4.0 and then can initiate IE related tasks. Industrial engineering departments have to adopt new technology productivity evaluation and improvement process. Provides framework for the involvement of industrial engineers in the emerging new engineering activity system that is characterized as smart or industry 4.0 environment.

RME04072

On the Condition Monitoring and Maintenance Approaches for Corrosive Sulphur Deposition in Oil-Filled Electrical Transformers

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Abstract - The purpose of this study is to establish an efficient maintenance plan based on relevant Condition Monitoring (CM) to reduce unplanned hazard failures due to presence of Corrosive Sulphur Deposition (CSD) in transformers. Many investigations have been reviewed to get sufficient data to understand and describe applied CM used in the maintenance plan. Problem addressed is: is the currently applied CM relevant for early detection the corrosion to reduce the probability of failures? The major result is the described gaps between the currently applied CM and selection of relevant CM suggested for providing specific indication of corrosion fault to approach cost-effective Condition Based Maintenance (CBM). The main conclusion: there is a need to develop a relevant CM technique to detect CSD at early stage and establishing a cost-effective CBM to reduce the negative impacts of failures such as industries economic loss and hazard effect on manpower life as well as environment.

RME05164

Reliability Analysis and Condition-Based Maintenance of Marine EngineSwapnil Kamble¹, Suraj Rane²¹Industrial Engineering Department²Mechanical Engineering Department

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Abstract - Engine dependability will specifically influence the operating costs of the ship. Anticipating and locating the faults of the marine engine system at the earliest is one of the key aspects in marine engineering. A condition monitoring program applied to diesel engines improves safety, increases serviceability and reduces maintenance costs. The aim of the research work is to model failures, analyze for reliability and perform condition-based maintenance of the engine. Failure Mode Effect Analysis (FMEA) is used to identify and eliminate current and potential problems thereby improving the reliability of sub systems to ensure and enhance the bottom line of engine. Fault Tree Analysis (FTA) is performed identify the basic cause for failure and obtaining failure probability of the system. Financial implications of failures were also analyzed using Condition-based maintenance approach.

RME06024

Service Sector Performance by Non-parametric Approach: A Critical Review

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Abstract - To present a literature survey of studies focusing on the performance of the service sector using the non-parametric technique. However, the study covers the literature on DEA from a broader perspective by categorizing the sectors as – manufacturing, non-banking, and banking sector. Critically reviewed a significant number of studies published across the globe over a decade. The study highlights the literature in chronological order to identify the models used and the varied set of input, output, and exogenous variables. In the non-parametric approach, data envelopment analysis is extensively applied to evaluate a bank's efficiency and productivity. Studies conducted in developed countries are now emerging with diverse models of DEA. Similar studies in developing economy like India are limited. Implications of finding may prove beneficial for the managerial and regulatory decision-making process. Practitioners in the different areas of the service sector may expect an improved performance by using the DEA approach. The paper will be valuable for scholars interested in literature on data envelopment analysis. The future directions of the paper will prove beneficial for the Indian banking sector to design a framework that extensively analyzes the performance.

RME07228

Factors of Entrepreneurial Motivation: A Study of Chhattisgarh Region

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Abstract - Entrepreneurship has become an important driver for economic growth and development of productivity in every nation due to its ability to generate employment, promote innovation, produce competition and create economic wealth. The contribution of the entrepreneurship and Small & Medium Enterprises (SMEs) to the economy has attracted the attention of researchers and policy makers in both developed and transition economies. The main objective of the study is to identify the factors of entrepreneurial motivation in Chhattisgarh state of India. Using a simple random sampling technique, data were gathered through a self-monitored questionnaire survey. Factor analysis was applied to find the factors associated with entrepreneurial motivation. Based on the factor analyses, this study has identified seven factors of entrepreneurial motivation in Chhattisgarh and their reliability analysis has been done.

SCM01025

An Integrated Approach with MOORA, SWARA, and WASPAS Methods for Selection of 3PLSP

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(Deemed to be University under MHRD Govt. of India)

Abstract - Mobile production in India has already crossed the 100-million-units mark, and is set to touch 500 million in the next two years. In the turbulent business environment, the companies must promote alternative uses of resources that may be cost-effective and ecology friendly by extending products' routine life cycles. In the present work problem related to recovery of used cell phones is formulated by various MCDM approaches namely MOORA (multi-objective optimization by ratio analysis), SWARA (step-wise weight assessment ratio) and WASPAS (weighted aggregated sum product assessment). SWARA method is used to find the criterion weight of alternative and the other methods such as MOORA and WASPAS is used to give the rankings of alternatives and chooses the best alternative from the rest. All known multi-attribute methods cannot value the attribute weights as one weight of attribute is higher or lower significant than the other attribute, SWARA allows expert opinion about significance ratio of the attributes in the process of rational decision determination. In WASPAS method, we combine the subjective weight expressed by decision makers with objective weights to obtain more realistic weights which help to increase the stability of the proposed approach. This approach is efficient and well consistent with other methods. MOORA method is a general method and can consider any number of quantitative and qualitative attributes simultaneously and offer a more objective and simple decision making-approach. The present approach links the financial and nonfinancial, tangible and intangible, internal and external factors, thus providing a holistic framework for the selection of an alternative for the reverse logistics operations for EOL cell phones. Many criteria, sub-criteria, determinants, etc. for the selection of reverse manufacturing options are interrelated. Thus, MCDM methods proposed in this paper provides a more realistic and accurate representation of the problem for conducting remanufacturing logistics operations for EOL cell phones in Indian business environment.

SCM02028

The Brief Discussion About Enablers and Hurdles Through Sustainable Supply Chain Management Practices

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Abstract - The main purpose of this precept of description to categorize the enablers to ecological balance within the deliver chains and perceptive their mundane modalities. Interpretive structural model (ISM) analysis is one of the tools to identify the interior and external enablers and other factor which affects the success of an organisation. Main approach to study and analysis of tools is found to be very much applicable in a textile and fabric organization. During study prepared feedback form based survey and ISM modeling move toward has been useful in this empirical study. During this study identified 29 factors such as top executive support, customer voice, Government environmental policy etc. In this study the evaluate of the literature, after study of research article and identified effective factor observed that there are sundry elements had been recognized to manipulate an society in making the selection towards the SSCM execution. a set of enablers that comprise high driving energy and coffee dependence, requiring most attention subsists. This study and analysis of all research article and finding effective enablers and hurdles which purpose to support them to fixate on individuals variables to facilitate are maximum paramount for the transitions of the deliver chain sustainability.

SCM03033

A Novel Hybrid MCDM Approach Based on DEMATEL, AHP and TOPSIS to Evaluate Green Suppliers

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Abstract - This study presents a hybrid decision making approach for group multi-criteria evaluation for Green Supply Chain supplier selection, which clubs many green processes with order allocation for dynamic supply chains to cope with market variations. More specifically, the developed approach imitates the knowledge acquisition and manipulation in a manner similar to the decision makers who have gathered considerable knowledge and expertise in procurement domain. DEMATEL is first applied to find the causal relationship between the criteria and to find out the most affecting criteria. Then AHP method is used for evaluation of green supplier criteria weights, which are qualitatively meaningful. Thereafter, using TOPSIS method, the criteria application is quantitatively evaluated for order allocation of suppliers. As a result, the approach generates decision-making knowledge, and thereafter, the developed combination of rules for order allocation. To demonstrate the applicability of the proposed approach, a real case study is presented and the results are analysed accordingly.

SCM04034

Design of Multi Echelon Supply Chain Network in Manufacturing Environment: A Simulation Study

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Abstract – This study aims to design simulation based production and multi echelon supply chain network of gear job shop manufacturing. Network design and development by Simulation software, ARENA Rockwell automation studio 15.1 version. Study provide solution to low productivity and improper resources utilization within plant. This study lightened the resources effective utilization and improved productivity without changing any routing, planning and operation timings for the existing network. Helps to curb inefficiencies in multi echelon supply chain network of job shop scenario. This paper explores the real job manufacturing environment, their implications and shortcomings. Results of this study shows improvement of key parameters which strengthen supply chain efficiency.

SCM07066

End-of-Life Vehicles Management Initiatives in India

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Abstract: Every motorized country is facing the issue of end-of-life vehicles (ELVs) and environmental degradation caused by them. Vehicle production in India was more than 20 million in 2014-2015. India is one of the top ten countries in the world in vehicle production and sale. But ELV recycling industry is in early stage. There are many serious issues in ELV recycling industry. The paper reviews the ELV recycling practices in India and the major initiatives taken by government and automotive manufacturers in order to improve the ELV management. The paper also provides recommendations for the development of ELV recycling system in India

SCM05045

Supply Chain Management Process Improvement in Operations Department in Service Industry - A Case Study

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Abstract - This paper aims at reductions in operations costs of insurance proposal forms and policy documents of insurance companies by implementing SCM in operations department of life insurance companies. The entire process of how the forms are distributed starting from the policy proposal form from suppliers to the customers, passing through various departments and their flow from one location to another for various underwriting requirements are detailed out. Various costs associated with distribution network of policy documents have been discussed in detail. Also discussed is the time required for a proposal form to become a part of a policy document for a customer. Emphasis is given on restructuring those practices which are not required but still prevail. The paper develops the supply chain performance measurement framework using the facts primarily revealed through survey and personal interviews. The survey revealed that despite heavy cost incurred in processing of documents at various levels, problems faced by customers, failures in channel development due to operational issues, loss in market share, loss of customer base and loss of business, companies have not found any alternate methods of functioning. The present research encourages Insurance companies to adopt better and cost effective technique for operating their business and offers a background why SCM is important for them. Few vital solutions have been provided through this paper on how operational delays can be minimized with reduction in operations cost and how customer retention and channel development can be done in a proper and systematic way.

SCM06048

Performance Measures for Hospital Supply Chain Management: A Brief Review

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Abstract - The frequency of patients is increasing day by day and thus reducing the facilities available for each patients in terms of safety & satisfaction of patients. This phenomenon is indirectly affecting the quality of hospital. Concurrent improvement in quality & efficiency leads to make customer demands more expensive. In India the doctor to patient ratio is very poor, approximately it is one doctor for 1700 patients. Supply chain management has its impact in enveloping entire function of an organization. Effective and efficient functioning of supply chain management needs performance measurement system. Hence, the purpose of the paper is to identify the performance measures for hospital supply chain management. A brief overview of the literature available on healthcare supply chain management and hospital supply chain is conducted. Discussion with the experts from the region's corporate & rural hospital is held. Also, government reports are reviewed to understand the present scenario of healthcare sector in India. In all, total, 7 supply chain efficiency criteria are extracted along with 65 sub-criteria are studied. Also, hospital supply chain has two major operation viz., supporting/ allied operation (SO)& medical treatment operation(MTO). Paper presents on overview of hospital supply chain performance measurement avenues. The proposed concept is much needed in Indian context, where it is expected to have shortage of 100000 doctors by 2020, cost of treatment, quality of patient care etc.

SCM08079

A Study on Targeted Public Distribution System of Rice: A Supply Chain Perspective

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Abstract - The existing rice supply chain in general and Targeted Public Distribution System (TPDS) of rice in Odisha in specific is studied with respect to supply chain stages and various activities in the respective stages. In order to understand the three flows (i.e. product (paddy), information and cash flows) and to analyze critically along various dimensions, the cycle view and push/pull view of the rice supply chain is made. Recommendations have been suggested in order to modify the existing TPDS on the basis of supply chain configuration and critical analysis so that it will be more efficient and agile. The proposed TPDS of rice supply chain is discussed along these three flows. This work is predominantly a qualitative analysis and its feasibility should be checked before its adoption. The proposed TPDS is flexible in its application and it can act as the model for government supported supply chain with some customization.

SCM09082

Drivers and Barriers of Green Supply Chain Management in Construction Industry

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Abstract - Supply chain system became popular in production and distribution of goods in any organization business network. Environmental issues are gaining importance and became international agenda for last few years. Now the focus is expanding to all the industries to establish long term buyer supplier relationship. Green supply chain management is a proven concept for establishing the environmental considerations in the traditional supply chain management and aims in satisfying the needs of environmental issues in the supply chain process. The present research paper aims in addressing the drivers, barriers, challenges in the construction contractors supply chain. so the current practices in construction supply chain is reviewed through questionnaire method and analysis is made using SPSS software to find the barriers and challenges of green supply chain management in the Indian construction industry.

SCM10087

Challenges Faced by Industrial Engineers in Enriching Sustainable Perishable Supply Chain

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Abstract - Recently supply chain management industry in India has been receiving greater attention. In spite of India's huge potential, the growth of this sector has not kept pace which has led to uncertainty, vulnerability and mitigation in supply chain which is affecting India's wider economy, thereby being a threat to our future competitiveness. The acceleration in industrial production, population growth and changes in consumption patterns have resulted in a high demand for basic and specialized logistics management, both at the local and global levels. In this paper we have made an attempt in understanding the various challenges faced by the food supply chain in India by considering a case study the Supply chain practice at a typical farming sector.

SCM11099

Identifying the Barriers in Humanitarian Supply Chain Management and Prioritizing Using AHP

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Abstract - The purpose of this paper is to identify and analyze the barriers in humanitarian supply chain management with reference to all phases of the disaster life cycle management that hampers the performance of relief operations. The study identified barriers through an exhaustive literature review and brainstorming sessions with experts. All the identified barriers were prioritized using Analytical Hierarchy Process. The results indicate that lack of coordination, lack of performance metrics, and lack of IT resources are the major barriers which obstructs the successful implementation of disaster relief operation. Further study is required to identify the solution of all these barriers for efficient and effective humanitarian supply chain management. This study would enable academicians and policy makers to understand different barriers with their relative importance.

SCM12121

Role of IT as Moderator Between Supply Chain Resources & Practices and Fresh Produce Supply Chain Performance

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Abstract - In this study, the moderating role of information technology, considered as per transaction cost economics theory, on the relationship between fresh produce supply chain resources and practices and fresh produce waste, fresh produce quality and fresh produce supply chain performance is investigated. Data collected from the actors in the fruits and vegetables supply chain including aggregators, wholesalers, retailers and food processors. The hypotheses were tested using structural equation modeling. Fresh produce quality can be retained when IT is combined with cold storage infrastructure and coordination among supply chain entities. It is important for the actors in the fresh produce supply chain to embrace IT enabled supply chain resources & practices which would address the critical issues of fresh produce quality, waste and chain performance. By capturing the perspectives of the stakeholders, this study extends the perishable food supply chain management literature particularly in the context of developing economy.

SCM13146

Green Supply Chain Management: A Literature Review for Manufacturing Industries in Malaysia

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Abstract - Green supply chain management is popular due to customers and government pressure for environmental friendly products. Large number of organizations are tending to adopt green approaches throughout their entire supply chains. Aim of the paper is to give a review of the literature critically to discuss the GSCM within the context of Malaysian manufacturers. Manufacturing is an important sector in Malaysia as it accounted for 24.5% of the nation's gross domestic product (GDP). However, manufacturing is also responsible for almost half of all water pollution. The negative impact of manufacturing activities on the environment has become a major concern of the Malaysian government. The literature review will provide the actual situation of GSC in the manufacturing industries in Malaysia. The paper discusses different GSCM practices implementation in the manufacturing industries in Malaysia and the effect of implementation of GSCM practices on the environmental performance and economical performance of the manufacturing industries. The study shows that there is need to call stakeholders and government for the effective implementation of the GSCM in the automobile industries in Malaysia.

SCM14148

The Supply Chain Models and Methods of Analysis

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Abstract – For years there has been an extensive and exhaustive research in the field of Supply chain management by various researchers and practitioners. The objectives of this paper are to: (1) provide a focused review of literature in multi-stage supply chain modeling and (2) define a research agenda for future research in this area. This paper elaborates various supply chain models and their applications. This paper also discourses various supply chain performance measures i.e. quantitative, qualitative based on cost, customer responsiveness etc. The paper also enlists the various supply chain issues, Their ways of optimization followed by their future scope. Based on the existing body of research in supply chain modeling, suggestions has also been made for future research in various areas like-evaluation and development of supply chain performance measures, development of models and procedures to relate decision variables to the performance measures, consideration of issues affecting supply chain etc.

SCM15018

Modelling Green Supply Chain Management in Automotive Industry: A Reliability Perspective

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Abstract - The automotive industry is one of the largest manufacturing sectors, it has a deep impact on the society and environment. Automotive industries started adopting the green concept in their supply chain management to reduce environmental issues, but green supply chain fails due some faults. The industries need to make a new framework for green supply chain by identifying and eliminating reasons of failure to increase the reliability of their green supply chain, hence developing a reliable green supply chain is essential. The research proposal includes the methodology of Literature Survey, Plan for Expert Interviews, Problem Definition, Hypothesis statements, Data Collection plan, Plan for Data Analysis, Hypothesis Tests, Research Plan, Technical Feasibility check and Economic Viability check, Plan for use of Multi Criteria Decision making Tools. The paper presents a complete proposal for the research undertaken which offers the framework and strategies for Modelling Green Supply Chain Management in Automotive Industry: A Reliability Perspective. This research will provide a new framework of green supply chain management for automotive industries, which improve the reliability of green supply chain by identifying and eliminating reasons of failure. It also reduces the hazardous for the environment and reducing the risk of failure of green supply chain. Ultimately, this research will offer the new strategies to improve the reliability of green supply chain management. Looking at the various industries like automobile and auto component industries will improve the reliability of green supply chain. It will create the new further opportunities for the researcher to take up research project. The research will also develop the reliable green supply chain model by using Multi Criteria Decision Making Tools.

SCM16010

Prioritizing the Enablers of Construction Supply Chain in Industry 4.0 Environment

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Abstract - Industry 4.0, the fourth generation industrial revolution is not only changing the manufacturing industry but others also like, construction industry and the related supply chain issues. Construction industry has its own challenges e.g., temporary work and involvement of high coordination among others. This study is an attempt to explore the enablers to overcome these issues and prioritize them. Decisions are more complex if they are intangible, non-expressible, qualitative etc. To overcome this problem in the present study, AHP technique is used. With the help of AHP, 4 enablers and 14 sub-enablers of construction supply chain are prioritized. E-Supply chain management is ranked first followed by, digitization, tracking and localization, and cloud computing. In case of sub-enablers web service technology comes at first rank whereas management information system comes at fourteenth rank. This study will help the managers and professionals in construction organizations in building a good setup by focusing on these explored enablers. This study is a first attempt for prioritizing the enablers of construction supply chain management.

SCM17152

Digital Supply Chain Planning for Indian Chemical Industries

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Abstract - Supply chain planning in the chemical industry is difficult because of the complexities associated with this industry. In the supply chain planning market, the chemical industry often seems like an afterthought. Certainly, most of the writing on supply chain planning has a distinctly discrete manufacturing industry flavor to it. Complex manufacturing is a hallmark of the chemical industry. Typical factories include many tightly interconnected operating units for blending, separating, reacting and packaging of final products. Tanks are used everywhere, within operating units, between units to balance operations, and for temporarily storing materials, work-in-process, and finished goods inventory. Production planning solutions must reflect a deep understanding of the product and the manufacturing processes to ensure that plans are realistic and support stable product transitions. But in addition to modeling manufacturing, a good supply chain solution needs to also model demand and inventory. This is important because the central process in supply chain management is sales & operations planning (S&OP), which is increasingly being referred to as “integrated business planning” (IBP). Advanced digital technologies, such as big data, analytics, cloud, connected devices and social media, are driving new opportunities to integrate along the business value chain, develop smarter products and offer innovative services.

SCM18167

A Deterministic Inventory Model of Aluminium Refreshment Cans in Reverse Supply Chain

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Abstract: The aim of this paper is to display a unique model for the generation and reverse chain of aluminium refreshment cans. It is presumed that disposed of 250ml aluminium cans are gathered from the retail outlet. The cans are thereafter arranged into non-tainted and tainted divisions. The non-tainted aluminium cans are either reproduced or utilized as remachining blended with parent aluminium metal for creation of new cans to fulfil demand. The tainted cans are either sent to vendor utilizing poor quality aluminium or discarded in a scrapyards. Mathematical models are utilized to outline the conduct of the model, with an importance on investigating the reduction of total inventory cost of system and the amount of cans disposing into a scrapyards. Mathematical investigation under the model explained that the quantity of cans gathered were having biggest effect on the result of the total cost. Substitute metals to aluminium metal are studied and applied to exhibit a critical decrease in the cost of scrapyards transfer.

SCM19176

Industry 4.0: Efficient, Agile and Customer Focused Digitally Enabled Supply Chain

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Abstract - The supply chain today is a series of largely taken through marketing, product development, manufacturing, and distribution, and finally into the hands of the customer. Digitization brings down those walls, and the chain becomes a completely integrated ecosystem that is fully transparent to all the players involved - from the suppliers of raw materials, components, and parts, to the transporters of those supplies and finished goods, and finally to the customers demanding fulfillment. If the vision of Industry 4.0 is to be realized, most enterprise processes must become more digitized. For many companies, their supply chain is their business—so critical that even small increases in efficiency can produce major earnings gains. A critical element will be the evolution of traditional supply chains toward a connected, smart, and highly efficient supply chain ecosystem. Digitization creates a disruption and requires companies to rethink the way they design their supply chain. At the same time, customer expectations are growing: recent online trends have led to growing service expectations combined with much more detailed orders. The digitization of the supply chain enables companies to address the new requirements of customers, the challenges on the supply side, and the remaining expectations in efficiency improvement. Eliminating today's digital waste and adopting new technologies together form a major lever to increase the operational effectiveness of supply chains. The paper focuses on the evolution of digital supply chain and the potential impact of Supply Chain 4.0 on today's enterprises.

SCM20193

Formulation of Strategies for Performance Improvement of Green Supply Chain Using Balanced Score Card Method

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Abstract - Effectiveness of a Green supply chain can be proved by measuring its performance and validation. The purpose of this paper is to formulate the strategies for improving performance of green supply chain. Through a thorough literature survey, 21 performance measurement parameters were identified and five criteria were defined for measuring the performance of green supply chain. Using Fuzzy TOPSIS method, the criteria and alternatives were ranked and finally strategies are formulated using balanced score card method to improve the performance of green supply chain. This paper presents the research on Performance measures that can be considered for evaluation of Green supply chain and use of MCDM methods for analysis of the factors. It was found that Green supplier development is topmost Performance measurement index. Hence need to be given more attention for making greener supply chain. The focus of study was on Automobile supply chain hence it is required to extend the research and findings for other industries and also explore more criteria for performance measurement. The researchers are working on models and methods for replacing the traditional supply chain with green supply chain. Green supply chain management is gaining the importance in Industry as well as academic sector due to government Policies and norms worldwide for reducing emissions and encouraging Environment friendly production systems. We have done a categorization of all performance indicators and used TOPSIS to do ranking of criteria based on expert survey by academicians and Industry experts from Automobile industry in India. The balanced score card method used for formulation of strategies that help in identifying the measures and initiatives to be taken to improve performance of green supply chain.

SCM21201

Exploring Interactions Among the Supply Risk in Lean Implementation Using ISM

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Abstract - Lean implementation is heavily affected by supply risk, identifying and eliminating the supply risk in lean implementation at right stage can reduce the waste dramatically and improve the profit of the an organization. This research paper aims to investigate the interaction between supply risks in lean Implementation using Interpretative Structural Modeling (ISM) Approach. This research is design by referring a literature survey of peer-reviewed journal articles, survey reports, master theses, doctoral theses etc. From the literature thirteen supply risks have been identified. ISM model gives the interrelation between these supply risks. This research is primarily focused on exploration of interactions among the thirteen prominent supply risk in lean implementation. This research work provides a platform to develop a strategy to tackle supply risk in lean implementation.

SCM22202

A Framework to Mitigate the Risk Involved in New Construction Projects: A Perspective of Industry 4.0

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Abstract - The government has introduced new policies for the construction industry as increased in environmental issues and solid waste. However, the construction industries faced many risks from new technology and material. This situation of construction industry motives to develop a framework and to identify risk involved in a new construction projects (NCP) to increase the success rate of the project. The purpose of this research is to identify the risk involved in the NCP and develop a framework to mitigate the risk. A comprehensive literature survey was carried out to know the different risks involved in the NCP. Also, the framework was developed based on Industry 4.0 to mitigate the risk involved in a NCP. This study has identified the different categories of risk and technologies involved in industry 4.0 and developed link between Industry 4.0 and the different stages of risk mitigation. The developed framework is helpful to mitigate the risk as fast as possible associated with NCP. Also, increase the success rate of the new project as enhance the quick decision.

SCM23211

Some Issues in Closed Loop Supply Chains: A Survey of Select Literature Review

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Abstract - The purpose is to enlighten on closed-loop supply chain issues based on environmental, social, and economic factors have attracted attention amongst academia and practitioners. This attention is conspicuous by the publications in scientific journals which have been published in recent years. The studied articles are selected on the basis of structured review methodology by using database and keyword selections, articles collection, inclusion/exclusion criteria. The researchers have considered parameters in terms of quantitative and some qualitative analyses. Thus, there is scope of research in closed loop supply chain. A total 75 articles published between January 2013 to May 2018 are selected and reviewed to get the knowledge about the current status of the topic. The selected articles are analyzed and categorized to construct a useful groundwork of past work. This paper surely helpful for getting the future research direction in the field of Closed loop supply -chain.

SCM24212

Productivity Enhancement of Manufacturing Operation Through Lean Manufacturing: A Case Study in a Polycover Packing Line

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Abstract - The implementation of lean manufacturing strategy and philosophy with automation represents a robust contribution to the phase sequence that leads to operational excellence and the continuous improvement through the elimination of non-value added activities. The paper aims to demonstrate the positive effect of a Lean management approach in a Polycover packing line to increase the efficiency, even a company which is subject to critical market issues. This paper conveys the implementation of lean philosophy through various tools like Line balancing, Value Stream Mapping, Multiple Activity chart, Micro standard operating procedure, Root cause analysis and Failure mode effective analysis, Poka yoke etc. The productivity per man power was increased from 209 to 496 numbers with an annual cost savings of 7.2 lakhs per annum. The result of this study provides a reference for academia as well as the business field.

SCM25231

Multi-item Supply Chain Model With Promotion Effort Effects: A Mixed Integer Heuristic Approach

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Abstract - The paper studies the multi-item and multi-echelon supply chain to realize considerable savings by aggregating the replenishment. This multi-echelon multi-item replenishment policy has already been widely applied in a variety of industries. This study deals with a multi-echelon and multi-item replenishment problem with promotion effort and mixed integer. Most existing studies about promotion effort and mixed integer focus on a single-item replenishment policy. However, multi-echelon replenishment has been extensively applied in many industries to take advantage of economies of scale in promotion. Since it is difficult to solve this problem directly, the necessary and sufficient conditions with these properties are derived; a solution procedure and an algorithm using heuristic approach are developed to obtain the optimal solution. Numerical examples, comparative analysis and sensitivity analyses are also provided and tested to elucidate the impact of mixed integer and promotion. The results reveal that the extensions of the model provide a wider and reasonable situation in practice, so that the annual channel profit can be maximized.

SCM28236

Review of Lean Management Application in Food Industries

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Abstract - In recent years due to increasing competition between manufacturing and processing industries especially in the food sector and increasing awareness among the consumers it is necessary to maintain a positive brand image among consumers. No organization wants to lose loyal consumers. But with the increasing case of contaminated products and food recall. It becomes a necessity of industries to ensure safe and a good quality food while maintaining sustainability in value chain and production. The main challenge for researcher and academicians is to improve food quality and reduce food losses in the food chain system. There are various technologies through which this problem can be addressed. The main objectives of this review paper is to provide insight of lean tools applicability to optimize the production, to reduce the losses, to identify and reduce variations and defects in the food industry for maintaining brand reputation and increasing profitability.

STM01015

Exploring Green IS Through the Lens of Enterprise Architecture

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Abstract – Reflecting on the need to support environmental sustainability of firms within the IS domain, this article raises the question how environmental sensitivity can be integrated within the information systems, including the challenges this would lead to for IS and for the organizational information space to cope with. Use of Zachman Framework from Enterprise Architecture literature to study Green IS and reflect on plurality of views and its emergence and complexity properties. Instead of analyzing isolated views of interacting elements of IS/IT, a synthesized view of green IS is generated by bringing together technology, data, and processes, and interactions of participating elements. This helps in understanding how sustainability goals and enacting strategies impact organizational information space and green IS (as a field of study). To bring coherence to multiple views involving greening needs of technology, systems, processes, and people within an organization.

SCM26004

A Supply Chain Management Model with Non-convexities

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Abstract - The purpose of this paper is to present a supply chain model with objectives and constraints which involve both convex and non-convex functions. The proposed theoretical model studies a multi-criteria constrained optimization problem. The solution process uses mostly heuristics methods. A standard optimization model which approximates real life situations usually assumes convex functions in the objective as ideal in order to guarantee a unique optimal solution. In practice this is far from reality. Nonlinearity and non-convexity are involved in almost every process in a supply chain. The results indicate that heuristics methods are effective for non-convex problems. The increasing number of applications of supply chain management has created new challenges in the field of modelling and optimization. Network optimization, life-cycle assessment, equilibrium models, multi-criteria decision making, analytical hierarchy process are some of the indispensable components of supply chain management in any industrial organization.

SCM27136

An Integrated Sustainable Facility Location-Allocation Problem of Food Grain Supply chain

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Abstract - The developing countries moving towards the modernized food supply chain system due to the growing population and post-harvest losses of food. In this study, a novel integrated multi-echelon, multi-period and multi-modal mathematical model is formulated to design the sustainable food grain supply chain network. The model comprises of procurement centre, base silo, field silo and demand points. The objective of the model is to minimize the total cost encompassing fixed cost of base and field silo establishment, transportation cost, inventory cost, operational cost and cost of emission. The various restrictions associated with the problem include supply, demand, capacity, inventory flow balance and vehicle capacity constraints. The model supports the strategic decisions of selection of base and field silo locations and their capacities along with tactical decisions of assignment between the various echelons and determination of shipment as well as inventory quantity. The mathematical model is solved with CPLEX solver.

STM02027

Challenges of Remanufacturing in Future Industry and Selection Method of Cores Using Fuzzy TOPSIS

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Abstract - Industrial revolution started from mechanization then mass production systems and now in computer and automation era. Future of the industry will be cyber physical systems. Industries are intended to produce more and more components for society. But due to scarcity of resources they have to focus on different recycling methods so that old products can be brought in main stream with updating. Remanufacturing is adopted by many firms as it gives opportunity to bring back the product in use with specifications almost nearer to newer one. Performance of the remanufacturing depend upon collecting and selecting cores for it. As the cores are collected from society quality of cores is unpredictable. This article outlines the challenges for remanufacturing in future as well as selection of the cores using Fuzzy TOPSIS method. Case study of tyres are taken to enumerate selection process

STM03029

Capturing the Relational Aesthetics for Green Manufacturing at Indian Cement Industry

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Abstract - The purpose of this paper, is to explore the strength of relationships between critical success factors (CSFs) and performance measures (PMs) for cement industry (an important process industry known for its environment unfriendliness) supporting green manufacturing initiatives. It also attempts to resolve controversies concerning the relationships between CSFs and PMs influencing quality and innovation performance. Green Manufacturing (GM) is a term employed for describing manufacturing practices that do not harm the environment during any part of the industrial processes. The study data were drawn from cement industries across India. The analysis and assessment of relationships was carried out by examining two competing models with full and partial mediations. The study implies that GM needs to be supplemented with other resources so as to more effectively realize the strategy/GM Framework in achieving a high performance levels and innovation needs.

STM04031

Industry 4.0: Leapfrog Opportunity and Challenges for Indian Manufacturing Industry

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Abstract - This paper aims to develop taxonomy of challenges and identify opportunities for Indian manufacturing industry associated with Industry 4.0. A literature review based approach is used to identify opportunities and critical challenges for manufacturing sector. The paper also highlights the key initiatives of government towards Industry 4.0. The findings indicate that opportunities to manufacturing industry are in abundant but the challenges in realization of Industry 4.0 are diverse. Research indicates that Indian automotive manufacturing sector is on the forefront in the adoption of technologies related to Industry 4.0. The proposed taxonomy of challenges may help researchers and other stakeholders to develop an indigenous roadmap to Industry 4.0. This paper may help academicians and practitioners to obtain insights into Industry 4.0 opportunities and potential challenges for Indian manufacturing industry.

STM05040

Performance Improvement of CPV Module by Way of Various Active and Passive Cooling Techniques – A Review

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Abstract - In a Concentrated Photovoltaic (CPV) system amount of light not converted into electricity is converted into heat. This waste heat is responsible for increasing the operating temperature of CPV module. since the cell operating temperature plays a vital role in the electrical efficiency of CPV module ,both electrical efficiency and power output of CPV module depend linearly on Cell operating temperature. Solar cell performance deteriorates with increasing operating temperature .To obtained a optimum performance of multijunction solar cell module with high reliability ,power output and codal life ,the operating cell temperature must be within the range prescribed by standard test condition. This paper focuses on review of various active and passive cooling techniques suggested by researchers and their results.

STM06043

Linkages Between Critical Success Factors and Organizational Performance Factors for Indian Remanufacturing Industry

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Abstract - The aim of this research paper is to present the linkage between critical success factors and performance measurement factors of remanufacturing and form an interpretive structural model for Indian remanufacturing industry. The research approach is to extract critical remanufacturing factors from field data, to evaluate those factors which have positive impact on the organizational performance and to develop a model linking both critical success factors and performance measurement factors. Results were analyzed and validated through case studies. The present work developed the research instrument for remanufacturing industry. The result of this empirical study has established the strong and weak linkages between critical success factors and performance measure factors. The simplified method for establishment of remanufacturing industry and identification of factors affecting its performance was not available. The survey identified the practices for remanufacturing industries. It also compared the remanufacturing-enablers on degree of performance to measure the relative weightage of CSF's towards implementation issues in manufacturing industries. This research attempt linkage between critical success factors and organizational performance for Indian remanufacturing industry. The research has utilized to prepare a model for performance measurement factors (output parameters) of establishing remanufacturing and implementation in Indian manufacturing industries.

STM07053

Ranking the Barriers of Industry 4.0 for the Indian Manufacturing Sector

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Abstract - The purpose of this paper is to identify and rank the barriers of Industry 4.0 for the Indian manufacturing sector. The study identified 29 barriers through extensive literature review and expert opinion. The paper utilized two methodologies, namely analytical hierarchy process (AHP) and technique for order performance by similarity to an ideal solution (TOPSIS). The results indicates that lack of technical standards and reference architecture, lack of comprehensive broadband infrastructure and poor telecommunication network, huge capital investment requirement are the top most barriers among the 29 identified barriers. The weights are obtained through the judgment of industry experts. It is the only subjective judgment and any biasing by the person who is judging might influence the final result. The study provides useful insight regarding the identification and prioritization of major barriers in implementing Industry 4.0 in Indian manufacturing system. The results will be useful for business managers to understand the Industry 4.0 barriers and overcome these barriers for adopting Industry 4.0 with the existing ICTs system in the organization.

STM08069

The Role of Lean Manufacturing Practices in Greener Production: A Way to Reach Sustainability

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Abstract - The main objective of this research is through literature review, investigating how the lean and green practices and tools are being used for improvements in environmental and operational performance of the manufacturing industry. In the last decades, sustainability have increasingly gained importance to manufacturing industry and lean approaches are becoming more and more outstanding in order to improve performance in cost, quality and on time delivery. While greener production help to make environmental friendly processes by adopting best practices and eliminating waste generation processes. Hence, this synergetic approach of lean-green has been applied to reach sustainability in manufacturing. The finding show that, a strong synergy between Lean and Green and that many lean practices and tools can positively contribute to environmental sustainability which will help for both academicians and practitioners to take the advantage of their synergistic effects for achieving sustainable development in manufacturing industry. The practical application of this research is to identify and eliminate waste generation processes to make efficient and greener production processes. This research could be applied in any manufacturing company to improve operational and competitive performance.

STM09081

Future Energy Scenario in Industry 4.0 – An Indian Perspective

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Abstract - The complexity and dynamics of India's economy, coupled with its democratic policy and mounting aspiration of 1.3 billion people have made the energy segment a vastly diverse one. Problems stare us as challenges and get unfolded as opportunities. All the stakeholders in India's energy industry, few of them are global, are striving to ensure energy availability and accessibility to all, at affordable price, within the framework of inclusive growth. Industry 4.0 which includes digitization, IOT, AI, Robotics etc first uses the produced energy for its development and then these advancements are used to reduce energy consumption to a greater extent and also replace man by machine at hazardous places. Thus Industry 4.0 helps the society to move towards clean and green environment.

STM10106

Prioritisation of Sustainable Manufacturing Enablers (SMEs) Through Application of Fuzzy AHP Approach

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Abstract – Sustainable Manufacturing (SM) is considered to be one of the most beneficial areas, which are focusing on the integration of the triple bottom line (profit, people, and planet) of the business. The present study represents the identification of Sustainable Manufacturing Enablers and prioritization of those enablers by application of Fuzzy Analytic Hierarchy Process (FAHP). A total 15 enablers were identified by literature review and expert opinions which were prioritized by applying FAHP. The result of the empirical case study indicates that top management commitment, investment in innovation, and awareness of customers are having the highest influence on the successful adoption of Sustainable Manufacturing. So it was suggested to the case organization to select these enablers while making choice. The present study demonstrates the usefulness of FAHP to the management for making a decision when there is a case of selecting the few enablers from a large number of enablers or factors.

STM11112

Identification and Evaluation of Parameters Influencing the Remanufacturing Business

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Abstract - Unlike developed countries, developing nations like India and China are struggling with the implementation of remanufacturing activities. It is found that many research articles have analyzed the operational issues of remanufacturing but only few studies have highlighted and evaluated the critical factors of remanufacturing business. Therefore, this study contributes further to the literature of remanufacturing by exploring and evaluating the critical parameters of remanufacturing business. This research uses DEMATEL (Decision-Making Trial and Evaluation Laboratory) technique as a tool for evaluating the vital parameters. The results show that acquisition policies, production strategies, government regulations and technology are the main influencing parameters of the remanufacturing business. Moreover, causal relationship is developed between the critical factors to visualize the inter-dependency between them. This research provides insights to the decision makers in developing effective strategies for the success of remanufacturing business.

STM12116

A Review Paper on Foundry Wastes and its Impact on Environment

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Abstract - Ferrous foundry industry is a primary industry mainly catering to the needs of the casting required for mainly automotive sectors and machine tool industries. Foundry industry is one of the major industrial sectors polluting the environment. There is a dearth of research in measuring impact of pollution in foundry. Two major factors polluting the environment are foundry waste and hazardous air pollution is considered for this study. The objective of this paper is to focus on major pollutants in foundry industry and review the measures taken and suggested by the researchers to overcome the pollution. This paper review on the status of environmental impact and get to know about environmental issues related to foundry. The literature also revealed the need to carry out development of techniques for treatment of waste as presently available techniques are costly. A low cost alternative is essential to counter foundry wastes and hazardous air pollution. In a nutshell this paper review on status of foundry wastes, environmental issues and find out suggested remedy.

STM13118

Identifying Avenues for Sustainability Reporting: Environmental Assessment of Atorvastatin Calcium (API) Manufacturing in Indian Pharmaceutical Industry

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Abstract - The manufacturing of an Active Pharmaceutical Ingredient (API) is a complex process involving multiple stages of chemical synthesis. Consequently, the energy consumption of the manufacturing process is very high resulting in increased emissions and undesirable environmental impacts. Therefore energy-intensive production of APIs has an associated environmental footprint. The purpose of this study is to present an assessment of the environmental impacts of manufacturing of API employing an appropriate method. This is expected to be helpful in achieving sustainability by addressing environmental impacts under different impact categories. The environmental impact assessment can be done by various methods, one of the most favourable among which is performing Life Cycle Assessment (LCA) of the product or the process. The LCA methodology has been adopted in this study and results of LCA of an API (Atorvastatin Calcium) manufacturing process and its environmental impact under different environmental categories have been presented. Results have been interpreted accordingly for better understanding of environmental impacts of API manufacturing. Thus it is helpful for managers, scientists and researchers by providing future scope to increase the chances of overall improvement in traditional process from product designing to manufacturing stage, resulting in lowering of the environmental burden. Results of LCA have been presented in terms of various indices like global warming potential, ozone depletion potential, acidification, eutrophication potential etc., depicting the environmental footprint of the API manufacturing process. The results of this study can act as one of the guidelines for future use of LCA for better understanding of environmental footprint of single product, process or comparison between two or more products for competitive advantage and to adhere to the sustainability compliance.

STM16125

Aspects of Local Imbalance in Socio Economic Development of Rajasthan: A Regional Level Analysis

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Abstract - The purpose of this paper is to empirically test the relationship among the factors affecting Socio Economic development of Rajasthan. The loadings of the selected components (correlation coefficient between the component and the original values interpreted very much in a similar way) are used as weights of the standardized values of the given variables for working out component scores corresponding to each of the observation "PCA describes the variation of a set of correlated multivariate data (X's) in terms of a set of variables (Y's), known as . Each Y is a linear combination of the original variables X. Thus successful efforts have to be made to reduce these disparities in various indicators through massive private investment to be done on development for backward districts in the state of Rajasthan. Relative position of socio economic development indicators in Rajasthan such as Socio-Economic Development, Agriculture Sector, industrial Sector, Infrastructure sector, Demographic Sector. Government will strive to remove disparities at various levels and will take immediate measures to ensure sustainable and balanced development in the entire region of Rajasthan. Rajasthan has been divided into three regions (i) Highly Developed Region (ii) Moderate developed Region (iii) Low developed Region.

STM14119

Challenges of Implementing Lean Manufacturing with a Focus on Tyre Industry

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Abstract - The lean manufacturing is a concept which is based on cost reduction and flexibility by focusing on processes improvements through the reduction or elimination of all wastes in turn increasing the cost of the company. Traditionally, the lean paradigm has been applied to discrete manufacturing of items especially in automotive and automobile industries. On the other hand, in process industry raw materials are converted into organized units that are merged into final products that cannot be disassembled and then reassembled. Tyre manufacturing which comes under process industry is often faced with a host of issues like improper scheduling, unwanted inventory, high defect and scrap rate, excessive material handling, employee's skills and motivation, absenteeism, equipment inefficiency and improper layout. The paper primarily focuses on the recent literature pertaining to implementing challenges of lean in different production systems, with a special reference to tyre manufacturing.

STM15122

Productivity Improvement at a Sheet Metal Press Components Manufacturing Unit

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Abstract - In today's world of rapidly depleting resources, it is essential to develop strategies for effective utilization of resources i.e. productivity improvement. The present case illustrates the study of application of productivity improvement measures in press shop at a small-scale industry. The objective of the study is to eliminate the NVAs and solve the problems of low production rate, excess material handling and improper arrangement of dies and tools. Methodologies like 5 S, methods engineering and material handling were used. The overall productivity improvement potential varies from 32.3% to 100%. This approach can be utilized by the managers for improvement in small and medium sector industries using batch or job shop type production. This is also beneficial to the researchers in the field of productivity improvement as well as the industry personnel to explore the hidden productivity improvement potential.

STM17128

A Systematic Literature Review (SLR) for Identification of Various Challenges of Industry 4.0 Practices in Manufacturing Sectors

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Abstract - In modern era, Industry 4.0 is gaining interest from academics perspective as well as industry perspective all around the globe. In the present literature, the key focus is to review literature survey as more as possible and after that analysis of academic development in response to industry 4.0 practices in a well defined chronological order. The study will suggest some research gaps which might be useful for researchers to do research work in fourth industrial revolution related fields. The SLR not only include general information of various published research papers, but also identifies some barriers in adoption of Industry 4.0 practices in various manufacturing units. The current literature will be able to answer why economies like India are not that much capable to utilize Industry 4.0 practices. This paper aims to open up new doors of research in the field of fourth industrial revolution and its related topics.

STM18133

Development of a Framework for Consumer Buying Behaviour for Green Personal Care Products

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Abstract - The purpose of this paper is to identify factors affecting Green buying behavior and to develop a comprehensive framework. First a literature review was carried out for the identification of important factors and then a Comparative/Domain analysis was performed to carefully select the variables. 22 factors were identified from the literature out of which 18 were used in the study. A comprehensive framework was built having all the relevant factors. The study is pioneering in sense that all the factors identified have not been tested before together in any of the previous framework. The paper informs about main predictors of GBB, which would help policy makers and managers in formulating and implementing strategies to encourage GBB.

STM19141

To Rank the Challenges Found by Pest Analysis Towards Sustainable Production and Consumption

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Abstract - Sustainability may be defined as, fulfilling all the needs of today but ensuring all the needs of future generation to be fulfilled without any compromise. Three core areas towards sustainability were identified in 2005 in The World Summit on Social Development i.e. Economic development, Social development and Environmental protection. Adopting Sustainable Production and Consumption practices may result in sustainable development as Unsustainable production and consumption practices results in rapid depletion of natural resources. There are various barriers in the way of Sustainable Production and Consumption. Finding these barriers and ranking these barriers will help managers, researchers and decision makers to adopt Sustainable Production and Consumption. In this research work, by PEST analysis, we found various barriers towards Sustainable Production and Consumption and ranked these barriers by AHP (Analytical hierarchy process) technique.

STM20149

Future of Computer Vision Technology Based Models for Prediction of Quality and Yield in Citrus Industry

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Abstract- Recent advances in postharvest technology have to some extent helped in minimizing losses and increasing fruit availability with acceptable quality. Hence, the present study was conducted on citrus fruits to assess the factors responsible for quality management in post harvest processing. The studies revealed the generalized framework model for post harvest citrus sector and further extensive studies may be carried out to integrate information technology with prediction models, considering the prevailing field conditions (weather parameters, soil type, irrigation, biotic and abiotic factors) and input factors related to citrus cultivation, which also plays an important role. The integration of quality and yield prediction models help us to arrive at an earlier responsive decision in order to prevent the vulnerability in the intermediary stages of citrus processing industry.

STM21009

Tribology and its Importance in Maintenance and Asset Management Practices of Industrial Assets

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Abstract - There are a large number of rotating and sliding parts in industrial assets. Tribological behaviour plays a significant role in influencing friction and wear and in turn the life of these parts. Review the importance of tribology and understand the significance of Information and Communication Technologies (ICT) in maintenance. A synergistic approach to maintenance and asset management bringing out the issues and challenges in applying the principles of tribology and ICT. Understanding tribology can help in better maintenance. Big data and IoT can assist in informed decisions, but there are challenges in implementing them in asset management. Beneficial to engineers and managers to understand and appreciate the relationship between Tribology and maintenance for improved asset management. Valuable contribution connecting tribology maintenance, asset management and ICT.

STM22155

Effect of FeCl₃ and Diethyl Ether as Additives on CI Engine Emission

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Abstract - Improving the performance of IC engine and reducing the pollution by applying the advance technology is the main key to safe guard the nation economy and health. The present investigation is to compare the emission of the single cylinder four-stroke diesel engine by adding proper additives ferric chloride (FeCl₃) and diesel-diethyl ether (DEE) with diesel. The present investigation is motivated to compare the performance of the engine when run with diesel alone and when it is run with additives like ferric chloride (FeCl₃) and diethyl ether. The experiments in the laboratory establish lowering emissions of CO, HC and smoke (excluding NO) with diesel and DEE additives compared to that with diesel and FeCl₃ additives and diesel alone.

STM23174

Methodology for Reduction of CO₂ in Vehicles: A Review

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Abstract - This review paper is to discuss the impact of vehicles on emission of CO₂ and its techno-economic perspective on automotive industry and its effects towards change in climate. To determine the global warming effects, the emissions of CO₂ are considered the most important indicator. Considering the negative impacts of transport related CO₂ emissions on our environment. It gives a review on the factors affecting CO₂ emissions and fuel consumption and the technologies that has been implemented by automotive industries to mitigate the emission of CO₂. A clear cut distinction about a fleet of vehicles towards climatic change and steps taken to reduce the emissions of CO₂ as well as other pollutants by new age vehicle technologies. It gives a conclusive idea about the effect of various factors, estimate and process to reduce CO₂ emissions.

STM24177

An Effective Heuristic to Solve Assembly Line Balancing Problem

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Abstract - As a part of manufacturing and continuous process improvement, the assembly line balancing problem has acquired a promising research priority. This paper presents a case study on the longest operation time based heuristic approach to balance an assembly line by minimizing the number of workstations for resourceful increase in line efficiency of an Antenna manufacturing company in Goa. The effectiveness measures such as elapsed time, cycle time, lead time, number of workers, and balance delay of the existing assembly line are investigated and an improved configuration is achieved through vigorous application of line balancing techniques. This work presents considerable improvement in the work station design resulting in significant reduction in the number of workstations, manpower, smoothness index and the overall operational cost.

STM25197

Total Factor Productivity Estimation in Manufacturing Sector of Odisha

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Abstract - Manufacturing sector aimed at an efficient and technologically developed industry with a view to boosting country's level of competitiveness through a rise in productivity. Thus, productivity explains the relationship between production and means of production. Growth of efficiency in manufacturing sector has been assessed on the basis of Total Factor Productivity (TFP) index. In this paper, an attempt has been made to estimate the TFP of manufacturing sector of Odisha over the decades. The findings of the study revealed that the productivity index is more than 100 for most of the years indicating the growth in the manufacturing sector. The TFP index reached the highest level i.e. about 200 in the year 2004-05.

STM27218

Assessing the Present State of Art of Sustainable Manufacturing Adoption in Manufacturing Industries

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Abstract – As the needs and demands for the natural resources is growing the effect of it is rising day by day indirectly or directly to the environment. Hence for an organization to conduct a smooth working there needs a sustainable way that must be followed. The current era demands a better technology to adopt sustainable manufacturing. One needs to look upon a way a process which leads to better environment all over. New business models along with new lifestyles will play a vital role in sustainable manufacturing. A continuous effort needs to be put upon for a long period of time so a clear roadmap will be promoted for sustainable manufacturing for current generation as well as for the future. As in all the manufacturing needs which will be created or accomplished will play an important role to every sector in the future.

STM26203

Ethanol Production using Solar Power an Overview

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Abstract - Ethanol (alcohol) is now a day an attractive alternative fuel substituting the fossil fuel. Ethanol could be derived from crop containing sugars. The sugar-containing crop is then fermented. The fermented liquid mixture of ethanol and water is then separated through distillation process. The conventional Distillation process used, consumes great amount of energy for providing heating the liquid mixture. With rising energy and environmental concerns there is a need to reduce the energy required in distillation. Hence to get the Ethanol at competitive cost with less environmental effect it is necessary to explore various technologies used to produce it. State of the art in solar heating technology has ample potential to cater this demand. Study reveals that using solar energy for distillation process proves to be best solution for Ethanol production.

STM29230

Study of Open Innovation Practices: A Literature Review Using Crossan and Apaydin's Multidimensional Organizational Innovation Framework

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Abstract - Open innovation is the new segment of innovation used for inflow and outflow of knowledge for internal innovation in the firms. Open innovation practices give a new hike in innovation process of firms. The purpose for framing this article is to discover different open innovation practices under Crossan & Apaydin's multidimensional organizational innovation framework. A literature review process of already published articles along with qualitative analysis of data using MAXQDA software was conducted for this paper. Remarkable numbers of open innovation practices were discovered under three dimensions – Leadership, Managerial levers and Business process. These open innovation practices may benefit firms to apply open innovation in their system for gaining growth and performance improvement.

GEN01235

Role of Strategic Communication in Enhancing Industrial Growth

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Abstract - The overall idea of our approach is that economic crises have not only a negative impact on the societies. Considerable social turbulence drives often to a more consistent moral behaviour in terms of public consciousness and responsibility. In the given context, we would like to examine the role of communication in the context of industrial growth. We would call the present post-recession time a period of “fall of economic narcissism”. Our proposal is composed of an integrative approach based on theoretical considerations and some qualitative inputs obtained through literature survey, with the aim of concluding if strategic communication practices have changed in the last years of organisation work ethics, due to moral concerns and alterations of public expectations.

STM30232

Process Improvement Studies Through Lean Methodologies in a Steam Turbine Industry

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Abstract - The steam turbine market in 2014 was valued at \$14.3 billion globally and is expected to reach \$19.3 billion by 2020 with a compound annual growth rate of 4.4%. The need for high quality, low cost, high productivity have put a demand on the performance of the steam turbines in various sectors. This paper reports the work carried out in a steam turbine. The objective of the work was to improve the processes with goals of reducing lead time by 10%, direct cost by 15% and inventory costs by 20%. The work mainly focused on improving the processes by eliminating wasteful activities. Product Process Matrix and RRS Analysis were performed to arrive at one specific product to focus on. Brainstorming meetings and one to one interviews were conducted to chart down the processes constituting clear materials and information flows. Process Flow charts were prepared to highlight all the processes. Current State Value Streams was mapped and Kaizen bursts were identified. Upon discussions, solutions were identified and Value stream design was proposed. The value stream design revealed the following outcomes, the lead time was reduced by 16.66% in the assembly process. The direct costs and inventory costs reduced by 20%. This paper can serve as a case study for students and organisations who intend to learn about successful implementation of lean manufacturing.

STM28163

Sustainable Manufacturing: Challenges Ahead

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Abstract – In this globalized economy with competitive business environment and new era of manufacturing, sustainable practices have received a fair amount of attention from researchers and practitioners alike. Sustainable manufacturing practices seek to optimize production efficiency while minimizing environmental impact and maintaining social equity. Research has shown that companies that adopt sustainable practices are able to achieve increased product quality, increased market-share and increased profits. There are many challenges as well as opportunities that arise from the growing pressure to find sustainable ways of conducting business. This paper focuses on the impacts on manufacturing firms of increasing compliance and regulatory issues, social expectations and demands for innovative technologies. The critical activity of developing the manufacturing workforce by implementing new skills, new technologies and lean manufacturing practices are suggested as primary strategies in meeting the challenges. This paper also discusses some of the other challenges that companies face and the tools they can use to overcome those challenges as they embark upon this journey.

MDD07240

Physical Factor Plays an Important Role in Perthes's Disease of Hip

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Abstract – Perthes's disease of hip is one of the morbid conditions encountered in children, is of idiopathic etiology. Many a speculation has been advocated but nothing has stood the test of time so far. However, analysis of mechanical aspect of physical forces prevailing around hip joint could throw light on most possible definite source of cause production of deformities in perthes's diseases of hip. This also renders an idea to achieve a laudable outcome applying these mechanical principles for its management. Modifying the mechanical aspect of physical forces, active concentric reduction of capital femoral apiphysis could be feasible, which is the essential objective in management of perthes's disease of hip, in addition to the age of the child and early detection of this malady greatly influences the ultimate prognosis.

DFE21241

An Improvement Intended for Multiple Crack Diagnosis Adopting Manfis-GA Model

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Abstract- In the existing article, an innovative combination technique has been implemented to recognize the position and intensity of the transverse surface crack in a fixed-fixed shaft. The rod is fixed on two bearings at both ends including axial and twisting load for the the same angular arrangement with its longitudinal direction. The fluctuation parametric measure so as expected frequencies, mode shapes are interrogated in the proximity of two crack depths (bi) with their locations (Li) using stress intensity factor. Stress intensity factor is a function of compliance matrices. It is estimated as implementing one end of the shaft as the fixed bearings with the help of an analytical method. The identical shaft is designed to determine the vibration signatures at respective vicinity using an experimental procedure. A methodology MANFIS-GA (an inverse technique) is implemented to identify the position and intensity of crack from any one of the bearing. MANFIS system consists of four ANFIS layer. The input to every ANFIS step is equipped with the first three fundamental frequencies along with their modal values. The output of the ANFIS part prognosticates the interim crack positions and depths. The interim outputs from four ANFIS (MANFIS) are taken as the inputs to the G.A. system. The outputs from the G.A. system are final crack locations along with crack depths. The potency of the MANFIS-GA results is authenticated by correlating the results with the experimental setup. By interpreting the outcomes, it is presumed that this recommended methodology is valid for online and time saving for fault analysis of the cracked structure.

DFE22242

Characteristics of a Triple Pipe Heat Exchanger

Subhrajit Beura, Vairab Prasad Mishra, Sankar Narayan Das, Upendra Kumar Mohanty

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Abstract - An innovative triple concentric pipe heat exchanger is proposed, designed and experimentally investigated for heat transfer between flowing fluids at three different temperatures. The three fluids being considered are normal tap water, hot water and cold water. The effects of different flow arrangements like N-H-C and C-H-N with different mass flow rates are studied. Further the N-H-C and C-H-N flow arrangement are tested with different flow arrangement, (with and without corrugated surface on the periphery of middle pipe). The temperature distribution of fluids along the length of heat exchanger is monitored experimentally and presented for the different flow arrangements. The effectiveness of heat exchangers is calculated and compared for each arrangement.

CPS10243

Intelligent Transportation Systems: Current Status and Opportunities for Research

Soumya Kanti Mondal, Sachin. S. Kamble

National Institute of Industrial Engineering, Mumbai

Abstract - With increasing pressure on transport infrastructure, particularly in urban areas, smart transport is emerging as a new area of research. Smart transport makes use of current digital technologies for addressing transport related problems. This paper reviews contemporary research on smart transportation under six broad categories: big data approach, logistics transportation, cyber physical systems, dynamic QR code, algorithms for smart transportation, and public transportation. This paper presents the major findings from the literature review of 52 research papers published during 2007-2017. Our survey indicates that public transportation and smart transportation systems will play an important role in design of future urban transport systems.

CPS11244

Evolution of Industry 4.0 Compliant Sensors, Controllers And Mechanisms

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Abstract - The concept of modifying natural motion of rigid bodies is almost three centuries old. Watt's rotative engine is one of the early, and revolutionary, attempts to deploy mechanisms for motion alterations. Controlling of mechanisms to produce designed motion was the next step. Since the inception of this change (Industry 1.0) till almost Industry 3.0, the domains of Sensors and Mechanisms have remained in the mm to meter range. Mechatronics has reversed the trend in terms of size. At the dawn of Industry 4.0, Micro-Mechanisms and Nano-transducers is a reality. The transformation of straight line mechanisms from multi body – multi joint assembly to a monolithic structure is possible due to the young science of Compact Compliant Mechanisms. Robotics, the strong pillar of Industry 4.0, is going to derive the benefit for this smooth transition in size of Mechanisms and Smart Sensors.



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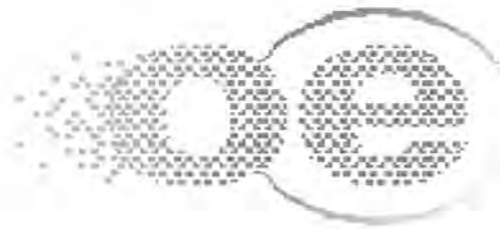
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