CII MISSION MANUFACTURING

Department of Heavy Industry
Government of India

CII
Confederation of Indian Industry

3RD SMART MANUFACTURING SUMMIT

CREATING CHAMPIONS OF THE NEW

15 November 2017 | New Delhi

CONFERENCE BOOKLET

CII MISSION MANUFACTURING

Department of Heavy Industry
Government of India

CII
Confederation of Indian Industry

3RD SMART MANUFACTURING SUMMIT 2017

Creating Champions of the *New*

15 November 2017, Hotel Le Meridien, Janpath, New Delhi

Programme

Cyber-physical systems are changing the manufacturing paradigm. To win manufacturers will need to remain on top of emerging trends and build agile systems that can produce highly customizable solutions at lightening speeds. In parallel, firms will need to address momentous change and talent management challenges owing to altering production systems.

The third edition of the Smart Manufacturing Summit will help companies find answers to the following questions

- *Which cutting-edge technologies are driving the future of manufacturing?*
- *How have companies deployed next generation manufacturing technologies?*
- *What does smart manufacturing mean for you?*
- *What benefits have accrued by deploying smart solutions – production efficiency, sustainability, return on investment etc.?*
- *How are companies tackling change management globally?*
- *What does India need to do to create an enabling eco-system for smart manufacturing?*

0900 – 1000 hrs | Registration

1000 – 1100 hrs | Inaugural Session

1000 – 1005 hrs	**Welcome Address**	**Sunil Mathur,** Chairman, CII Smart Manufacturing Council
1005 – 1015 hrs	**Address**	**Chandrajit Banerjee,** Director General, CII
1015 – 1035 hrs	**Keynote Address**	**Dr Jan Mrosik**, CEO, Digital Factories, Siemens AG
1035 – 1055 hrs	**Address by Chief Guest**	**Amitabh Kant**, CEO, NITI Aayog
1055 – 1100 hrs	**Vote of thanks**	**Sunil Mathur**

CII MISSION MANUFACTURING

Department of Heavy Industry
Government of India

CII
Confederation of Indian Industry

3RD SMART MANUFACTURING SUMMIT 2017

Creating Champions of the *New*

15 November 2017, Hotel Le Meridien, Janpath, New Delhi

1130 – 1145 hrs | Context Setting Presentation

Background presentation on Smart manufacturing in the context of the Indian manufacturing ecology. This session will give a background to the subject, explore the current state of readiness in the country, scope for adoption and requirements for enabling the smart transformation of Indian industry.

1130 – 1145 hrs **Address** — **Sunil Mathur**, Chairman, CII Smart Manufacturing Council and Managing Director & CEO, Siemens Ltd., India

1145 – 1245 hrs | Technology perspectives for creating champions of the new

Be it artificial intelligence, robotics or augmented reality, all have significant potential to redefine manufacturing. This session will help industry understand platforms, technologies, products, processes and applications on the horizon that have the potential to transform future production systems and create champions of the new.

1145 – 1200 hrs **The future of making things**

The changing economics of production, shifts in consumer demand and "smart" products are pushing manufacturers to explore radically new ways of creating and capturing value. The presentation will showcase how "smart" manufacturers are harnessing the power of data and cloud computing to bring to market products that were simply not possible ever before.

Pradeep Nair, Managing Director, Autodesk

1200 – 1215 hrs **Industry 4.0 in discrete manufacturing – A perspective**

The presentation will outline Industry 4.0, Digitalization and Smart Manufacturing solutions for Discrete Manufacturing in India and will focus on challenges, creative solutions evolved and successes seen, along with a roadmap of where these trends are headed.

Chandrashekhar Bharathi, Managing Director, Ace Micromatic

1215 – 1230 hrs **The digitized supply-chain**

Digitization of supply chain is the key to unlocking value, leading to average cost optimizations of >20%. All this can be achieved by improved operational efficiency, inventory reduction, 100% compliance and reduced conflict and mismatch. Additionally, almost 90% of the data collected is discarded before reaching a CXO. This presentation will showcase of digitizing a supply chain can bring forth immense insights to take better decisions, forecast supply and analyze spend and pilferage.

Rahul Garg, Founder & CEO, Moglix

1230 – 1245 hrs **Driving innovation**

Customers expect products that are more customized to their individual needs. The Internet too provides buyers with more options than ever before; in-order to thrive, manufacturers must deliver excellence. Industry must accelerate product introductions, create more agile shop floors, and improve order fulfillment through intelligent connected operations. This session will explore emerging trends in manufacturing that will help empower manufacturers to increase their speed of doing business and deliver excellence every time.

Vishnu Bhavaraju, Industry Lead, Manufacturing, Microsoft

CII MISSION MANUFACTURING

Department of Heavy Industry
Government of India

Confederation of Indian Industry

3RD SMART MANUFACTURING SUMMIT 2017

Creating Champions of the New

15 November 2017, Hotel Le Meridien, Janpath, New Delhi

1245 – 1305 hrs | Technical Paper Presentations

A call for papers was made for the CII Smart Manufacturing Summit from various companies and academic institutions on the topic of smart manufacturing i.e. use of sensors, wearable technologies, automation, horizontal and vertical integration etc in manufacturing were invited. Following papers were selected for presentation at this Session.

1245 – 1255 hrs **_Smart Jackets: Temperature Varying Jacket Using Peltier Module_**

The presentation will talk about how a jacket is designed to produce artificial weather for the wearer. The jacket is inculcated with circuitry with the help of which the temperature inside can be varied between 5-50 degree. A 'Peltier' module has been used for heating and cooling purposes. There is an LCD display which displays the temperature inside and outside of the jacket to make it easier for the wearer to see and sense the temperature variation. The jacket can thus be used to save people from the adverse effect of weather.

Phagna Aishwarya, Prajapati Palak

1255 – 1305 hrs **SMART Electric Motors for Industry 4.0**

This paper introduces SMART Electric Motors, the future of Electric Motors. A SMART Motor analyzes its own health and predicts failures much in advance, which allows corrective actions to be taken to avoid premature equipment & process breakdowns in the industry. SMART motors coupled with various equipment also act as a pattern learning device to gather the, much needed, hidden productivity and efficiency related information

Swapnil Dol, Director, Dol Group of Companies
Raunak Bhinge, Director, Infinite Uptime India Pvt. Ltd.

CII MISSION MANUFACTURING

Department of Heavy Industry
Government of India

CII
Confederation of Indian Industry

3RD SMART MANUFACTURING SUMMIT 2017

Creating Champions of the *New*

15 November 2017, Hotel Le Meridien, Janpath, New Delhi

1400 – 1515 hrs | Boardroom strategies for Smart Manufacturing

This session will showcase strategies used by companies to become smart, solutions that were implemented, change management imperatives and benefits that have accrued with an objective to help create a blueprint for Manufacturing establishments to adopt Smart Solutions.

1400 – 1415 hrs **Smart Manufacturing in the Process Industry**

Embracing of Smart Manufacturing by the chemical industry is likely to have a ripple effect on all manufacturing and allied industries. The presentation will showcase how tenets of technology, innovation, sustainability and skill are shaping the processes industry.

Sudhir Shenoy, CEO, DOW

1415 – 1430 hrs **Industry 4.0 to Smart Manufacturing**

Industry 4.0 positively impacts people, quality, delivery and cost. Connecting people in combination with machine-to-machine communication throughout the entire value chain enables plants to be flexible, on-demand production of more and more individualized products. Industry 4.0 is the way towards Smart Manufacturing and is an enabler for Business Excellence.

Dr Michael Loh, Vice President and Plant Head, Robert Bosch

1430 – 1445 hrs **Early adoption of Industry 4.0 – A Conscious Factory Journey**

Nokia has adopted Industry 4.0 and IoT initiatives well in advance as their core strategy for manufacturing operations – 'Nokia's Conscious Factory approach'. Having piloted several IoT and Automation use cases in its own factories and having witnessed the benefits, Nokia is fully convinced with their early involvement and experiments in this field, that Industry4.0 and IoT will be a game changer in near future. The presentation will walk the audience through Nokia's experience of the Conscious Factory Journey.

Ramakrishna Patra, Head, Manufacturing Solutions & IOT Cluster, Nokia

1445 – 1500 hrs **Adoption of Industry 4.0 in India – Opportunities & Challenges**

ISB recently conducted a survey on adoption of Industry 4.0 in India. This presentation will showcase the key findings in terms of the opportunities and challenges presented by Smart Manufacturing.

Dr Chandan Chowdhury, Associate Dean and Professor for Operations Management and Information System, ISB

1500 – 1515 hrs **Smart Manufacturing in the Automotive industry**

Manufacturing is facing the next revolution based on the changes in customer requirements. The digital transformation in manufacturing will have huge impacts. Technological advances in data storage and processing makes industrial machines SMART. The presentation will showcase how Maruti Suzuki is implementing SMART manufacturing in its premises to produce with greater flexibility, react more quickly & become even more efficient – with minimal consumption of resources.

Chegu Dhanumjaya, Vice President, Production Engineering, Maruti Suzuki India Ltd

CII MISSION MANUFACTURING

Department of Heavy Industry
Government of India

CII
Confederation of Indian Industry

3RD SMART MANUFACTURING SUMMIT 2017

Creating Champions of the *New*

15 November 2017, Hotel Le Meridien, Janpath, New Delhi

1530 – 1630 hrs | Valedictory Session: Takeaways for India

This session will bring together various stakeholders to distill the various policy imperatives required for creating this eco-system. This discussion will focus on –

- *How eco-system can support the promotion and adoption of smart manufacturing?*
- *How to facilitate - process transformation, people unlearning and relearning, technology adoption?*
- *How industry and government can partner to create enabling eco-system?*

1530 – 1630 hrs	**Panel Discussion on imperatives for India** **Moderated by** **Pranjal Sharma,** Author, Kranti Nation: India and The Fourth Industrial Revolution	**Panelists** **Dr Seema Gaur**, Senior Economic Advisor, Ministry of Information and Electronics Technology **Dr Ganesh Natarajan**, Executive Chairman and Founder, 5F World **Dr Sunil Jha**, Professor, Department of Mechanical Engineering, IIT Delhi and Head, CEFC I4.0, Delhi **Gautam Dutta**, Director, Digital Factory Division, Siemens India **Dr Purnendu Sinha**, Group Technology Office, Tata Sons

--End of programme--

CII MISSION MANUFACTURING

Department of Heavy Industry
Government of India

Confederation of Indian Industry

3RD SMART MANUFACTURING SUMMIT 2017

Creating Champions of the New

15 November 2017 | Hotel Le Meridien, Janpath, New Delhi

Speakers Profile

Sunil Mathur
Managing Director and Chief Executive Officer
Siemens Limited

Mr Sunil Mathur is the Managing Director and Chief Executive Officer of Siemens Ltd since 2014. In this role he is responsible for Siemens in South Asia represented mainly by Sri Lanka, Bangladesh, Nepal & Bhutan as also Siemens Group Companies in India. He is currently a Member of the Global Leadership Team of Siemens.

Prior to 2014 he was the Executive Director and Chief Financial Officer of Siemens Ltd from 2008 responsible for the same countries. During his stint as CFO of Siemens India, he was a Member of the Global Finance Management Team. He has been with Siemens for over 30 years, holding several Senior Management positions in Germany, where he worked in the Power Generation Division as also as CFO of a Global Business Unit in the Industrial Automation Division of the Company. He has wide experience of integrating companies, creating Joint Ventures, M&A as turning around non performing businesses in an International environment and has worked in Germany, United Kingdom and the United States. Mr Mathur is on the National Councils of the CII & FICCI as also on their various Committees. He is also a Member of the Managing Committee of the Bombay Chamber of Commerce and Vice President of the Indo- German Chamber of Commerce.

CII MISSION MANUFACTURING

Department of Heavy Industry
Government of India

Confederation of Indian Industry

3RD SMART MANUFACTURING SUMMIT 2017

Creating Champions of the New

15 November 2017 | Hotel Le Meridien, Janpath, New Delhi

Speakers Profile

Dr. Jan Michael Mrosik
CEO Digital Factory Division
Siemens AG

Current position
CEO Digital Factory Division – since June 2016
Previous positions
- CEO Energy Management Division – October 2014 to May 2016
- CEO Power Transmission Division – May 2014 to October 2014
- CEO Smart Grid Division – 2011 to 2014
- CEO Energy Automation Business Unit – 2007 to 2011

and CEO Smart Grid Applications Business Unit EMEA – 2010 to 2011
- CEO Siemens Telecommunications (Pty) Ltd., Pretoria – 2005 to 2007
- Managing Director Information and Communications Mobile,

Siemens Telecommunications (Pty) Ltd., Pretoria – 2002 to 2005
Education
- Studies of electrical engineering and business administration
- Doctorate in the field of laser radar sensor technology at the Technical University RWTH Aachen

Private life
- Married, two children
- Mountain biking, skiing, reading, music

CII MISSION MANUFACTURING

Department of Heavy Industry
Government of India

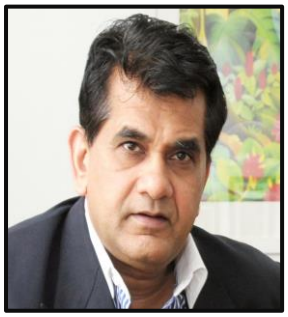
CII
Confederation of Indian Industry

3RD SMART MANUFACTURING SUMMIT 2017

Creating Champions of the New

15 November 2017 | Hotel Le Meridien, Janpath, New Delhi

Speakers Profile



Mr Amitabh Kant
CEO
NITI AAYOG

Mr Amitabh Kant is presently CEO, NITI Aayog (National Institution for Transforming India). NITI is a Government of India institution for catalysing the development process, nurturing an overall enabling environment by working in partnership with States, by being a Knowledge hub and a Think Tank by facilitating implementation. Its aim is to foster involvement and participation of State Governments in policy making and enhance cooperative federalism.

Amitabh Kant is a member of the Indian Administrative Service, IAS (Kerala Cadre: 1980 Batch). He is the author of "Branding India – An Incredible Story" and has been a key driver of "Make in India", Startup India, "Incredible India" and "God's Own Country" initiatives which positioned and branded India and Kerala State as leading manufacturing tourism destinations. These campaigns have won several international awards and embraced a host of activities – infrastructure development, product enhancement, private-public partnership and positioning and branding. He was responsible for developing Kerala as India's leading tourism destination. Kant also conceptualized and executive the "AtithiDevoBhavah" – "Guest is God" campaign to train Taxi Drivers, Guides, immigration officials and make them stake holders in the tourism development process. Amitabh Kant was also the National Project Director of the Rural Tourism Project of UNDP which made a paradigm shift in spreading tourism to Indian villages which had core-competency in handicrafts, handloom and culture.

Till March, 2016 Amitabh Kant was posted as Secretary, Department of Industrial Policy and Promotion (DIPP) – Government of India. He was responsible for formulation and implementation of industrial policy and strategies for industrial development, monitoring the industrial growth and performance of specific industrial sectors, formulation of Foreign Direct Investment (FDI) Policy and Promotion and facilitation of FDI, Policies related to Intellectual Property Rights (IPRs) in the fields of Patents, Trademarks, Industrial Designs and Geographical Indications. He was also responsible for promotion of Productivity, Quality and Technical Cooperation.

He was also the Chairman of the Delhi Mumbai Industrial Corridor Development Corporation (DMICDC) and National Productivity Council.

Amitabh Kant has also worked as CEO of the Delhi Mumbai Industrial Corridor Development Corporation (DMICDC). The Delhi Mumbai Industrial Corridor (DMIC) is being developed by the Government of India as a global manufacturing and investment destination supported by world class infrastructure and enabling policy framework. The DMIC project is aimed at the development of futuristic, smart industrial cities in India which will converge and integrate next generation technologies across sectors. The DMIC cities will address not merely the urbanization requirements

3RD SMART MANUFACTURING SUMMIT 2017

Creating Champions of the New

15 November 2017 | Hotel Le Meridien, Janpath, New Delhi

Speakers Profile

of India, but with manufacturing as the main economic base, will also contribute significantly to the economic growth of India.

Amitabh Kant has worked as CMD – ITDC, Joint Secretary – Ministry of Tourism, Government of India, Secretary – Tourism, Government of Kerala, Managing Director, Kerala State Industrial Development Corporation, District Collector, Kozikhode and Managing Director, Matsyafed. During his tenure in Kerala he structured the Calicut Airport as a private sector project based on User's Free and developed the BSES Power Project and Mattanchery Bridge under Private Public Partnership. He was also responsible for introducing new technology (fiberglass crafts and outboard motor) in the fisheries sector and launching beach level auctions which substantially enhanced returns to traditional fishermen. As District Collector, he implemented a major project of Urban Revival and Development through traditional Malabar architecture in creation of Mananchira City square in Kozhikode.

Amitabh Kant did his schooling from Modern School, Delhi, graduation in Economics (Hons) from St. Stephens, Delhi University and M.A from Jawaharlal Nehru University. He is a Chevening Scholar. He has undertaken the Mid Career Programme of Harvard University, John F Kennedy School of Government and Indian Institute of Management, Ahmedabad.

He has been the recipient of Economic Time Policy Change Agent of the Year Award, the Bloomberg TV Personality of the year Award, the NDTV Administrator of the year Award and the Distinguished Fellowship of the Institute of Directors. He is the recipient of One Globe Award-2016 for leadership in Transforming Governance for the 21st Century. He is a Member of the Steering Board of "Shaping the Future of Production Systems" of World Economic Forum.

CII MISSION MANUFACTURING

Department of Heavy Industry
Government of India

CII
Confederation of Indian Industry

3RD SMART MANUFACTURING SUMMIT 2017

Creating Champions of the New

15 November 2017 | Hotel Le Meridien, Janpath, New Delhi

Speakers Profile

Pradeep Nair
Managing Director, India and SAARC
Autodesk Inc.

Pradeep Nair is the Managing Director for Autodesk India and SAARC operations. He is responsible for the overall strategy and growth of Autodesk's business across India and SAARC region, covering all of the company's industries, product segments and strategic partnerships.

Prior to joining Autodesk, Pradeep worked at IBM Software Group (SWG), where he led IBM's software business for India and South Asia as the Director of SWG. He also led IBM's Developer Relations and Academic Initiatives that drove mass-market adoption of IBM technology among India's significant developer and student communities.

Pradeep is an engineer from the University of Bombay and an alumnus of IIM Calcutta.

CII MISSION MANUFACTURING

Department of Heavy Industry
Government of India

Confederation of Indian Industry

3RD SMART MANUFACTURING SUMMIT 2017

Creating Champions of the New

15 November 2017 | Hotel Le Meridien, Janpath, New Delhi

Speakers Profile

Chandrashekhar Bharathi
Managing Director
Ace Micromatic

He is Managing Director of AceMicromatic MIT, India's 1st mover and leader in Industry 4.0, and IIoT products – which have won prestigious awards, including Siemens, CMTI, FIE, Economic Times, PC Quest, NASSCOM and others.

AceMicromatic group is India's largest manufacturer of CNC Machines and Automation products.

An entrepreneur and technology visionary, he brings cutting edge technology and thought leadership from global leaders such as Commerce One, Merant, Nortel and other startups.

Mr. Chandrashekar's vision and leadership has helped create several *Industry-First* cutting edge software, which have been deployed in Fortune 500 companies such as GM, Ford, Toyota, Daimler, SAP.

Mr. Chandrashekar has a Masters from the State University of New York, and Bachelor of Engineering from Bangalore.

He serves as Director of the Board at Indian Machine Tools Manufacturers Association IMTMA, Member of CII's Manufacturing Council, and CII Smart Manufacturing Council.

CII MISSION MANUFACTURING

Department of Heavy Industry
Government of India

Confederation of Indian Industry

3RD SMART MANUFACTURING SUMMIT 2017

Creating Champions of the New

15 November 2017 | Hotel Le Meridien, Janpath, New Delhi

Speakers Profile

Rahul Garg
Founder & CEO
Moglix

Rahul Garg, Founder & CEO at Moglix brings in 15+ years of experience in Technology Industry across Asia. Prior to this he was Head of Advertising Exchange for Asia at Google based in Singapore, where he was instrumental in the launch of AdX. During his ~5 years stint at Google, he also wore hats on leading the strategy for Display, Mobile and Video advertising and Search products business. During the period he also led the IAB Advertising and Marketing initiatives across South East Asia. Prior to Google Rahul worked as Senior Product and Engineering leader in the technology industry and holds 16 US patents + several publications in the area of system and algorithm design for Wireless and Multimedia products. Rahul has done his B.Tech from Indian Institute of Technology, Kanpur and MBA from Indian School of Business – where he was awarded with the prestigious Scholar of Excellence. Outside of work, Rahul is an active angel investor across India, SEA, Japan and US – some of the notable being Govoyagin, Tookitaki, 1click.io, Mobikon, Catchthatbus etc.

CII MISSION MANUFACTURING

Department of Heavy Industry
Government of India

CII
Confederation of Indian Industry

3RD SMART MANUFACTURING SUMMIT 2017

Creating Champions of the New

15 November 2017 | Hotel Le Meridien, Janpath, New Delhi

Speakers Profile

Vishnu Bhavaraju
Industry Lead - Manufacturing
Microsoft India Private Limited

Qualification - MCA (Andhra University)
Executive MBA (IIM Bangalore)
Experience - 17+ years experience in consulting and sales of manufacturing industry solutions. Specializes in Analytics and AI solutions for manufacturing operations. Lead large transformation initiatives for manufacturing & resources clients in US and India
Awards & Recognition - Received multiple high perfomer awards in career. Well known speaker in manufacturing and analytics forums.
Any other achievements - Was on Director's merit list at IIM Bangalore. Currently mentoring two startups in the area of analytics and digital payments.

CII MISSION MANUFACTURING

Department of Heavy Industry
Government of India

CII
Confederation of Indian Industry

3RD SMART MANUFACTURING SUMMIT 2017

Creating Champions of the New

15 November 2017 | Hotel Le Meridien, Janpath, New Delhi

Speakers Profile

Swapnil Dol
Director
DOL Group of Companies

MBA (Temple University, Philadelphia), BE Electric (Fr. C. R. I. T., Mumbai)

Swapnil Dol is the Director of the DOL Group of Companies, an electrical engineering group focusing on manufacturing and servicing of Electrical Rotating Machines. Swapnil completed his MBA from Fox School of Business, Temple University, Philadelphia and BE Electrical from Fr. C. R. Institute of Technolog, Mumbai. During his MBA, Swapnil had an opportunity to spend few months in Siemens, Nuremburg where he earned a rich international experience.

Swapnil started his career as a trainee engineer at DOL Electric, the service division of DOL Group, where he worked on the shop floor of to get the hands-on experience on variety of complex rotating machines. By the age of 30, Swapnil had achieved a substantial knowledge of handling massive size rotating machines ranging up to 15MW. In his career, Swapnil has worked in variety of industries such as petrochemicals, cement, steel, forging, chemicals & fertilizers, etc across the nation. This tough career path gave him a deep knowledge on all types of rotating machines manufactured from across the world.

The manufacturing division of the group, DOL Motors, efficiently manufactures more than 1200 motors per month ranging from 20HP to 200HP. In DOL Motors, Swapnil took an active role in introducing lean manufacturing practices to reduce wastages and improve productivity.

Today, Swapnil heads DOL Group operations which employs more than 250 people. During the academic and work tenure Swapnil has written and published several technical papers:

1. Improvement of torque-slip characteristics by Rotor Slot Shape Modification – Fr. C. R. Institute of Technology, Vashi, Mumbai (Jul 2006)
2. Efficiency improvement of 3φ induction motor by minimum additional production cost – Priyadarshani College of Engg., Nagpur (Feb 2007)
3. MV motor redesign and output up-gradation – Dol Electric Co Pvt Ltd (Dec 2013)
4. Emerging Trends in Electric Rotating Machines Refurbishment Industry – Indian Institute of Science, Banglore (May 2017)
5. SMART Motors for Industry 4.0 – CII Smart Manufacturing Summit (Nov 2017)

When Swapnil is not working elbow deep on a rotating machine; he loves to travel, read, exercise and spend time with friends and family. He also likes to challenge himself by

Speakers Profile

participating in long distance runs and has managed completing several half marathons successfully.

Swapnil wants to bring about a strategic turnaround to the traditional product line of his business. Developing and adding products like SMART Motor™ and SMART Motor Kit™ to the existing product line, Swapnil wishes to embark a new era of innovation and sustained growth for DOL Group. Through these IIoT based products, Swapnil wishes to bring about a paradigm shift to the factory maintenance and productivity monitoring methods in the industry to reduce downtime and drive high quality and efficient production.

CII MISSION MANUFACTURING

Department of Heavy Industry
Government of India

Confederation of Indian Industry

3RD SMART MANUFACTURING SUMMIT 2017

Creating Champions of the New

15 November 2017 | Hotel Le Meridien, Janpath, New Delhi

Speakers Profile

Raunak Bhinge
Director
Infinite Uptime India Pvt Ltd

B. Tech. / M/ Tech., IIT Madras
PhD in Smart Manufacturing, University of California Berkeley
Raunak Bhinge is the Director of Infinite Uptime, Inc. based in Berkeley, CA, USA as well as its Indian subsidiary Infinite Uptime India Pvt. Ltd. based in Pune, India. Raunak completed his mechanical engineering at IIT Madras before pursuing his PhD at UC Berkeley. He interned at Cummins India for 6 months before his PhD program.

Raunak started his career at Infinite Uptime in the US in December 2015, before he moved to India in January 2017 during the formation of Infinite Uptime India Pvt. Ltd. He is involved in building the company, its distributed team and the market that the company serves today. Infinite Uptime was listed as one of the top 10 IoT companies in APAC region by CIOOutlook magazine, due its unique product differentiation and patented product delivery.

Raunak himself has 14 publications and 3 patents in the field of high-frequency predictive analytics and scalable machine digitization. His PhD revolved around the use of Artificial Intelligence in manufacturing applications and the overall concept of Smart Manufacturing. He has presented at conferences around the world, been a guest speaker at several manufacturing events, a delegate to University College Dublin and a proponent of the MTConnect Standard.

Raunak is currently involved in developing several industrial IoT solutions for the manufacturing and processing industries, one of which is the Smart Motor and Smart Motor Kit in collaboration with Dol Motors. Infinite Uptime solutions are currently deployed across multiple factories and installed with many equipment around the world including China, India, Mexico, Japan and USA.
Apart from IoT and mechanical failure predictions, Raunak is also interested in tennis, birdwatching, has travelled to 40 countries, and a past founder of the bird identification system called Avipulse.

CII MISSION MANUFACTURING

Department of Heavy Industry
Government of India

CII
Confederation of Indian Industry

3RD SMART MANUFACTURING SUMMIT 2017

Creating Champions of the New

15 November 2017 | Hotel Le Meridien, Janpath, New Delhi

Speakers Profile

Sudhir Shenoy
CEO
Dow Chemical International Pvt. Ltd

Sudhir Shenoy is the chief executive officer (CEO) of Dow Chemical International Pvt. Ltd (Dow India) located at the company headquarters in Mumbai, India. He is also the co-chair of the National Chemical Committee at the Confederation of Indian Industries (CII).

Sudhir started his journey with Dow in 1997 as an account manager for the Polyurethanes and Epoxy businesses in Mumbai. Scaling consistently within the company he moved to take over as System House director, India & South East Asia in 1999 for the Polyurethane Systems business. He subsequently assumed the role of sales director, India in 2005 and as European product manager, Polyurethanes, in Switzerland in 2007.

In late 2010, Sudhir was named regional general manager, India and South East Asia region for the Functional Materials Business Group and relocated from Horgen, Switzerland to Mumbai, India.

In mid 2012, Sudhir was named general manager for the Home, Personal & Industrial Care business in Asia Pacific, and provided regional oversight for Dow Wolff Cellulosics and Dow Microbial Control businesses within the Functional Materials division. In 2013, he moved to Shanghai, China as the commercial director for Dow Polyurethane, responsible for regional profit and loss, business strategy and organizational effectiveness. He also managed customer relationships, acquisitions and retention, as well as sourcing, developing and retaining employee talent for the business in the region.

Prior to joining Dow, Sudhir worked at Visa Petrochemicals Pvt. Ltd. in Chemicals, Adsorbents and Process Industry as a Sales Manager.

Shenoy holds a master's degree in marketing management and a bachelor's degree in chemical engineering, both from the University of Mumbai.

Sudhir is an ardent sports enthusiast and participates in adventure sports including running marathons, trekking and cycling expeditions.

CII MISSION MANUFACTURING

Department of Heavy Industry
Government of India

CII
Confederation of Indian Industry

3RD SMART MANUFACTURING SUMMIT 2017

Creating Champions of the New

15 November 2017 | Hotel Le Meridien, Janpath, New Delhi

Speakers Profile

Dr. Michael Loh
Vice President Manufacturing and Technical Plant Manager
Bosch Automotive Electronics India Pvt. Ltd.

Dr. Michael Loh has been Vice President Manufacturing at Bosch Automotive Electronics India Pvt. Ltd. in Bangalore since February 2015. He joined Bosch in March 2001 and held several leadership positions in manufacturing in Germany and abroad.

Prior to joining Bosch, Dr. Michael Loh was with General Electric in the USA and Italy. He holds a Master's degree (Dipl.-Ing.) in Mechanical Engineering from RWTH Aachen, Germany and a Ph.D. in Mechanical Engineering from Stanford University, USA.

CII MISSION MANUFACTURING

Department of Heavy Industry
Government of India

CII
Confederation of Indian Industry

3RD SMART MANUFACTURING SUMMIT 2017

Creating Champions of the New

15 November 2017 | Hotel Le Meridien, Janpath, New Delhi

Speakers Profile

Ramakrishna Patra
Head, Manufacturing Solutions & IOT Cluster,
Nokia

Currently heading Engineering services & IoT Initiatives at Nokia's Chennai factory is a Telecom professional having experience spanning over 23 years. He completed his Bachelor degree in Electronics and Telecommunications from University of Calcutta in 1994 and Joined R&D of Tata Telecom in 1994 for development of 600 MHZ Microwave Radio. He has vast experience of working in Multinationals like Siemens & Nokia Siemens, handling all communication technologies i.e. Microwave, Optics, Radio access and all leading Telecom operators in India and abroad .

His passion has been to learn all emerging technologies and strive for innovation. He is active member for the Global transformation initiatives by Nokia for Industry4.0. He is the Global Cluster owner for IoT in Nokia factories.

CII MISSION MANUFACTURING

Department of Heavy Industry
Government of India

Confederation of Indian Industry

3RD SMART MANUFACTURING SUMMIT 2017

Creating Champions of the New

15 November 2017 | Hotel Le Meridien, Janpath, New Delhi

Speakers Profile

Dr Seema Gaur
Senior Economic Advisor
Ministry of Information and Electronics Technology

Dr. Seema Gaur is a central government economist belonging to Indian Economic Service with more than 30 years of experience in key economic Ministries. Apart from Economics, she is also having a degree in Law as well as public administration. Presently, she is working as Senior Economic Adviser in the Department of Electronics and Information Technology. She also worked as Economic Adviser in the Department of Industrial Policy and Promotion, Ministry of Industry and Commerce, where she was involved inert –alia in policy for Industry 4.0. Prior to this, she was Adviser in the Competition Commission of India (CCI) for about six and a half years since May, 2009, when implementation of Competition Law started in India. She played an important role in the establishment of the CCI as a credible competition agency. She was also India's lead negotiator in negotiations for Competition Chapter in trade and investment agreements with EU, EFTA and ongoing RCEP. She has presented papers in many global conferences, published papers in peer reviewed journals as well research done for the UNCTAD's Research Partnership Platform and written chapters in books on key economic issues.

CII MISSION MANUFACTURING

Department of Heavy Industry
Government of India

CII
Confederation of Indian Industry

3RD SMART MANUFACTURING SUMMIT 2017

Creating Champions of the New

15 November 2017 | Hotel Le Meridien, Janpath, New Delhi

Speakers Profile

Dr Ganesh Natarajan
Executive Chairman and Founder
5F World

Dr. Ganesh Natarajan is Executive Chairman and Founder of 5F World, a platform for Digital Start-ups, Skills and Social Ventures in the country. He is also Chairman of Global Talent Track, a pioneer in Employability Skills Training in Asia and Skills Alpha, a new digital platform venture to transform learning processes in organizations and society.

Ganesh is Global Board Director and Chairman of the India Board of Social Venture Partners and Chairman of Pune City Connect, a unique collaborative platform that enables corporations to work with the Government on social and city innovation.

Ganesh has received the Distinguished Alumnus Award of IIT Bombay and NITIE and has been recognized by EY and the Asia Pacific HR Forum for excellence in entrepreneurship and people-centric leadership. He has two successful CEO tenures over twenty-five years at APTECH and Zensar Technologies. Harvard Business School has written and teaches two case studies on Dr. Ganesh Natarajan and Zensar's success through Vision Communities.

MISSION MANUFACTURING

Department of Heavy Industry
Government of India

Confederation of Indian Industry

3RD SMART MANUFACTURING SUMMIT 2017

Creating Champions of the New

15 November 2017 | Hotel Le Meridien, Janpath, New Delhi

Speakers Profile

Dr Sunil Jha,
Professor,
Department of Mechanical Engineering, IIT Delhi
and Head, CEFC I4.0, Delhi

Obtained PhD in Manufacturing Science from IIT Kanpur and engaged in teaching and research on manufacturing processes and related automation from last 10 years. Developed new unconventional super finishing processes and filed 6 patents on them. Some of the developed technologies are successfully commercialized.

Before joining IIT Delhi, worked with TATA Motors, Jamshedpur in the area of CAD/CAM and was engaged closely in digitization of engine components and develop foundry toolings.

Extensively worked into segments related to automation in manufacturing. Teaching Computer Aided Manufacturing and Industrial automation to UG and PG students at IIT Delhi. Conducted training programs for industry and teachers from engineering institutions.

Deeply interested in understanding new technologies, absorbing and including them in teaching and conducting state-of-art research. Currently leading IITD-AIA Foundation for Smart Manufacturing at IIT Delhi to work closely with manufacturing industry and supporting them in absorbing new technologies to make them ready for next industrial revolution.

CII MISSION MANUFACTURING

Department of Heavy Industry
Government of India

Confederation of Indian Industry

3RD SMART MANUFACTURING SUMMIT 2017

Creating Champions of the New

15 November 2017 | Hotel Le Meridien, Janpath, New Delhi

Speakers Profile

Pranjal Sharma
Author
Kranti Nation: India and The Fourth Industrial Revolution

Pranjal is an economic analyst, advisor and writer who focuses on technology, globalisation and media. He guides projects on economic forecasting, business intelligence and public diplomacy with Indian and global organisations. Pranjal creates and develops research projects that interpret policy impact on industry and society. He is visiting and guest faculty at post graduate schools and works with senior management teams of global corporations to develop thought leadership concepts. He has worked with infrastructure, telecoms and media organisations on developing their social connect strategy in global markets. Pranjal serves as a member on the Global Agenda Council on Transparency and Anti-Corruption at the World Economic Forum.

His new book Kranti Nation: India and The Fourth Industrial Revolution was launched recently. The book chronicles how technologies like artificial intelligence, 3D printing, robotics are changing India's business landscape. He is co-author of The Z Factor. Pranjal has written and edited several reports and papers on economic development.

A seasoned editor, Pranjal has spent many years analysing and tracking India's economic journey. He worked with The Indian Express and India Today before starting his television career with CNBC-TV18. At TV Today Network (Aaj Tak channel), he led a team to pioneer business news in Hindi. He received the New Television Award for Best Anchor in 2007.

Apart from his economic advisory role, he also hosts a weekly conversation show The Appointment on leadership and strategy for Zee Network and writes for Business World magazine among other publications. Previously, he spent more than two decades in print, internet and TV media, mostly in leadership roles with focus on India's economic engagement with the world.

He has served as Advisor Strategy to India's public service broadcaster Prasar Bharati, (Ministry of Information & Broadcasting, Government of India) where he helped bring in industry best practices and enabled creation of digital media teams. Pranjal conceptualised and curated a report on India's economic reforms meant for global investors. He led this effort for KPMG. It was launched by the PM at Make in India week in Mumbai this February.

As Executive Editor at Bloomberg UTV, he helped launch and run the channel. At TV Today Network, his team pioneered business news content for non-English audiences. Pranjal received the News Television Award for best business presenter in 2007.

CII MISSION MANUFACTURING

Department of Heavy Industry
Government of India

CII
Confederation of Indian Industry

3RD SMART MANUFACTURING SUMMIT 2017

Creating Champions of the New

15 November 2017 | Hotel Le Meridien, Janpath, New Delhi

Platinum Sponsor

SIEMENS
Ingenuity for life

Siemens India is a technology powerhouse that has stood for engineering excellence, innovation, quality and reliability. The company focuses on the areas of electrification, automation and digitalization. It is one of the leading producers of energy-efficient, resource-saving technologies; combined cycle turbines for power generation; and power transmission solutions. Siemens is a pioneer in infrastructure solutions and automation and software solutions for industry and also leading provider of healthcare, financing, PLM, rail automation and wind power solutions.

The history of Siemens in India dates back to 1867, when the founder Werner von Siemens personally supervised the laying of the first telegraph line between London and Calcutta. The first company office was founded in 1922. In 1957, Siemens was incorporated as a company under the Indian Companies Act and was listed on the stock exchanges in 1970. Siemens is one of the few multinational companies in India to have uninterrupted operations in India for over 90 years.

The business of Siemens Limited (flagship group company of Siemens in India) is aligned into Divisions: Power and Gas, Energy Management, Mobility, Building Technologies, Digital Factory, and Process Industries & Drives.

Power and Gas Division offers a broad spectrum of products and solutions for reliable, efficient and clean power for generation of electricity from fossil fuels and for the reliable generation of power for oil and gas applications. Customers are Utilities, Independent Power producers and Engineering, Procurement and Construction (EPC) companies as well as businesses in industries such as oil and gas, sugar, cement, etc.

Energy Management Division is a supplier of products, systems, solutions and services for transmission and distribution of electrical energy. Its portfolio ranges from systems for low-voltage grids and distribution grids to solutions for smart grids and energy automation systems to power supply systems for industrial plants and high-voltage transmission systems. Its customers are Central Utilities, State Utilities, Private Transmission and Distribution System Operators and Industries.

Building Technologies Division provides solutions for safe, secure, energy-efficient and eco-friendly buildings and infrastructures. It has solutions for applications such as fire safety, security, building automation, heating, ventilation, air conditioning and energy management.

The Mobility Division supplies solutions for passenger and freight transportation, including rail vehicles, rail automation and rail electrification systems. Government initiatives such as transparent, decentralized procurement led to various metro rail projects and large locomotive projects being awarded.

Digital Factory Division offers a comprehensive portfolio of software products and automation technologies for industrial applications covering the entire life cycle, from product design and production execution to after-sales services. Siemens helps its customers in the manufacturing sector enhance the flexibility and efficiency of their

production processes, thereby boosting their competitiveness. These solutions are supplied to customers in various discrete industries, General Engineering segments and Original Equipment Manufacturers (OEMs) engaged in machine tools, printing, packaging and electrical panel manufacturing.

Process Industries and Drives Division offers a comprehensive portfolio for Industrial application and solutions in the field of Automation and Drives for process industries such as Chemical, Pharmaceuticals, Food and Beverages, Water and Waste Water, Cement, Mining, Oil & Gas, Paper and Marines. The business environment in which Process Industries and Drives Division operates is primarily driven by core sector industries.

Siemens' portfolio is aligned with Government thrust areas: 24x7 Power, Smart Cities, Make in India and Rail Vision 2030. It has a competitive local footprint with nearly 150-year history, 22 world class factories and 57 offices pan India. Our parent company Siemens AG is committed to the flagship group company in India Siemens Ltd. in its growth plans with investments planned on structural economic upturn. After investing close to Euro 2 billion over the past 10 years, Siemens announced a further Euro 1 billion investment in 2015.

Siemens' focus is on Electrification, Automation and Digitalization, in sync with India's vision to be a global manufacturing leader through Industry 4.0. Customers rely on our specialized domain know-how and support to realize value from digitalization. It has the capability and experience to provide solutions across the customer value chain – from design and engineering to operations and maintenance.

Siemens' mission is: "We make real what matters, by setting the benchmark in the way we electrify, automate and digitalize the world around us. Ingenuity drives us and what we create is yours. Together we deliver."

CII MISSION MANUFACTURING

Department of Heavy Industry
Government of India

Confederation of Indian Industry

3RD SMART MANUFACTURING SUMMIT 2017

Creating Champions of the New

15 November 2017 | Hotel Le Meridien, Janpath, New Delhi

Silver Sponsor

JCB India Limited is a leading manufacturer of earthmoving and construction equipment in India. The company started as a joint venture in 1979 and is now a fully owned subsidiary of J.C Bamford Excavators, United Kingdom. With five state-of-the-art factories in India, it today manufactures a wide range of worldclass equipment, not only for India, but also for Global markets.

It introduced Backhoe Loaders in India close to four decades ago and has since expanded its product range to over 50 different models in eight product categories. The Ballabgarh factory near New Delhi, which is the world's largest factory for Backhoe Loaders, is also the Headquarters for JCB India. This facility, apart from Backhoe Loaders, also manufactures Skid Steer Loaders, Telehandlers, Diesel Generators and Diesel Engines.

The company expanded its operations in 2006 and 2007 by setting up two factories at Pune for its Heavyline business. These factories manufacture Tracked Excavators, Wheeled Loaders, Compaction equipment and Fabrications for the Group. With over 400 engineers, Pune also has JCB's largest Design Center outside of the United Kingdom.

A further investment in India was made at Jaipur in 2014 with the inauguration of a 114-acre, eco-friendly, green manufacturing facility. This facility today manufactures Mini Excavators, Skid Steers and Fabrications.

With all plants operating on the principle of One Global Quality, JCB India is a manufacturing hub for Global markets. Products made in these factories have been exported to more than 85 countries around the world.

Over the years JCB has invested Rs. 2,000 crores in India and today employs 5,000 people in its Indian operations. It has a network of more than 60 dealers and 650 outlets spread throughout India, who further employ 6,000 professionally trained personnel. These far-reaching outlets provide the vital product support to customers for their equipment. Five strategically set up warehouses at Pune, Chennai, Faridabad, Guwahati and Kolkata support these dealerships and outlets for parts supplies.

It has also built and supported an indiginised supply chain for the manufacturing of its products. Over 380 world-class Indian suppliers are aligned to JCB's Group objectives and have grown along with JCB through various supplier development initiatives.

JCB is also creating employment and entrepreneurship amongst youth through its 15 Operator Training Centres in India. It provides a one month certified course on machine operations and maintenance, which includes both, classroom and practical training on how to operate JCB machines safely and productively.

It has a 16 week detailed induction program at the welding training school at the Jaipur facility for ITI and Diploma graduates. Comprehensive skills developed through these programmes have helped young men and women excel in their careers, especially women engineers, who are now making their careers in traditionally male dominated areas of manufacturing such as welding and assembly.

CII MISSION MANUFACTURING

Department of Heavy Industry
Government of India

CII
Confederation of Indian Industry

3RD SMART MANUFACTURING SUMMIT 2017

Creating Champions of the New

15 November 2017 | Hotel Le Meridien, Janpath, New Delhi

JCB is committed to CSR through the Lady Bamford Charitable Trust. Registered in the year 2000, the Trust has followed an organic and consistent growth with a focus on disadvantaged communities around JCB factories in India. Today its outreach extends to 56 Government schools and nine vocational training centres through which it reaches out to about 12,500 students and trainees. The Trust is active in communities around its three factories in Delhi-NCR, Pune, and Jaipur. JCB has always remained committed to India. It has launched innovative India centric products and has expanded by way of new factories with Customer Focus and One Global Quality being at the core of its operations.

CII MISSION MANUFACTURING

Department of Heavy Industry
Government of India

Confederation of Indian Industry

3RD SMART MANUFACTURING SUMMIT 2017

Creating Champions of the New

15 November 2017 | Hotel Le Meridien, Janpath, New Delhi

Associate Sponsors

ifm electronic

ifm electronic India Private Limited, Measuring and controlling - With more than 6,000 employees in more than 70 countries worldwide ifm electronic gmbh is one of the leading manufacturers in the automation industry. In 1994 the family-owned international company opened a branch in India. As one of the first German companies, ifm realized the potential of the Indian economy at that early point in time.

ifm electronic offers a wide range of “Made in Germany” product rage across various Industry segments such as – Machine Tools, Dairy, Food & Brewery, Automobile, Steel & Coal, Mobile Machines etc.

With a presence of ifm electronic India for more than 20 years, ifm India has succeeded in achieving its name as the Top trusted brand for sensors and automation technology in India.

The Product Portfolio includes-

- **Position Sensors**
  - Proximity Switches
  - Photoelectric Sensors
  - Incremental and Absolute Encoders
  - Evaluation Systems
  - Distance / Volume Sensors
  - Contour / Code Sensors
  - Power Supplies
- **Networking and Control**
  - ASI Systems
  - CAN based Mobile Control Systems
  - IO – Link Masters and Systems
  - Sensor / MES Software
- **Fluid Sensors**
  - Inductive Sensors for Valves
  - Level Sensors
  - Flow Sensors
  - Pressure Sensors
  - Vacuum Sensors
  - Temperature Sensors
  - Vibration Sensor

CII MISSION MANUFACTURING

Department of Heavy Industry
Government of India

CII
Confederation of Indian Industry

3RD SMART MANUFACTURING SUMMIT 2017

Creating Champions of the New

15 November 2017 | Hotel Le Meridien, Janpath, New Delhi

Contact info:

ifm electronic India Private Limited
Plot No. P-39/1, MIDC Gokul Shirgaon,
Kolhapur – 416234 Maharashtra

Phone: +91 231 2672770
Toll Free: 1800 233 2065
Email: info.india@ifm.com
Website: www.ifm.com

CII MISSION MANUFACTURING

Department of Heavy Industry
Government of India

Confederation of Indian Industry

3RD SMART MANUFACTURING SUMMIT 2017

Creating Champions of the New

15 November 2017 | Hotel Le Meridien, Janpath, New Delhi

Associate Sponsor

NOKIA

Creating the technology to connect the world is a role that Nokia is well qualified to play.

Our business today goes well beyond the extraordinary technological demand of high performing networks. We are also focused on how technology is deployed and used. Because when we are talking about augmented intelligence, social and trust economics, human and machine interaction, we are talking about trends that bring huge implications for people, for society.
Creating the technology to create the world brings huge opportunity and responsibility – which Nokia is committed to meeting.

Dramatic shifts in technology will impact our daily lives… how businesses work and connect with customers, and how industries and public services run.
Nokia is not only at the heart of this massive technology disruption, we are driving and shaping it.
Six global megatrends are driving extreme innovation in how networks are designed, deployed, managed, and utilized:
1. Network, compute and storage: broadband everywhere: a distributed cloud, near infinite storage, and a supercomputer in everyone's pocket is increasingly becoming a reality.
2. Internet of Things: more than a trillion connected sensors will drive huge benefits for both individuals and businesses.
3. Augmented intelligence: new tools will assist us in decision making, and task automation will allow us to get more.
4. Human and machine interaction: virtual and augmented reality, new interfaces based on voice and gestures, implantable chips, and "smart" things of many kinds - such as clothing - with reshape how we interact with machines, just as touch screens did in the past.
5. Social and trust economics: the sharing economy (think Uber and AirBNB) will continue to expand and even the nature of money will be disrupted by digital currencies making trust and security essential.
6. Digitalization and ecosystems: businesses will continue to digitize their operations wherever possible. This will expand into the worlds of consumer and biology with radical new technologies such as 3D printing of organs for transplant.
The networks of today simply cannot meet the performance requirements of the future, and a transformation – in scale and in kind – is needed: a new system that is more efficient, more agile, and more secure.

It will involve significant new technology demands – intelligent, adaptive, and with security deeply and dynamically embedded. Access will be on a massive scale: ultra-local, converged, and with imperceptible latency.
Creating this will require many breakthroughs – of technologies and of network architectures.

CII MISSION MANUFACTURING

Department of Heavy Industry
Government of India

Confederation of Indian Industry

3RD SMART MANUFACTURING SUMMIT 2017

Creating Champions of the New

15 November 2017 | Hotel Le Meridien, Janpath, New Delhi

Corporate Sponsor

AUTODESK.

Autodesk helps people imagine, design and create a better world. Everyone—from design professionals, engineers and architects to digital artists, students and hobbyists—uses Autodesk software to unlock their creativity and solve important challenges.

For the past 30 years, Autodesk, a world leader in 3D design engineering, and entertainment software, has played a pivotal role in the design and creation of things. From our humble beginnings as the desktop-based CAD company to becoming a leader in 3D design and engineer software, our products have been involved in iconic projects like the Panama Canal, the Shanghai Tower, New York's World Trade Center, the redesign of the Ford Mustang, and memorable blockbuster movies, including the last 19 Academy Award winners for Best Visual Effects. Today more than 115 million designers, engineers, architects, creative artists, students and hobbyists use Autodesk software and apps to unlock their creativity, build better products and solve important challenges impacting the world.

Autodesk is headquartered in San Rafael, California, and features a gallery of its customers' work in its San Francisco building. The company has offices worldwide, with U.S. locations in Northern California, Oregon, and in New England in New Hampshire and Massachusetts.

For more information visit autodesk.com or follow @autodesk.

CII MISSION MANUFACTURING

Department of Heavy Industry
Government of India

CII
Confederation of Indian Industry

3RD SMART MANUFACTURING SUMMIT 2017

Creating Champions of the New

15 November 2017 | Hotel Le Meridien, Janpath, New Delhi

Corporate Sponsor

moglix Business

Moglix is fastest growing B2B e-commerce Company. With technology, supply chain at the heart of it, Moglix is bringing disruptive technology to digitize and organize the supply-chain, drive GST compliance and bring about seamless and efficient procurement for manufacturing sector. Over a brief period of last 2.5 years, the company has achieved following milestones:

- Served more than 200+ manufacturing organizations across North, South and West India with sturdy base of supply partnerships (2000+) from 20+ states across India and 200+ suppliers from China.
- Served more than 10000+ SME customers across the country using moglix.com platform
- Expanded our footprint across geographies: Singapore, Noida, Delhi, Faridabad, Mumbai, Manesar, Chennai
- Moglix has so far exported to 50+ countries.
- Established key partnerships with SAP and GSTN

This has been possible by establishing a leadership and a formidable 250+ team and guidance from renowned investors across the world like Mr Ratan Tata, World Bank, Accel Partners and Jungle Ventures. The major customers include GSK, Havells, Yamaha, Minda, JBM, Lumax, Tata Chemicals, Kirloskar Brothers etc.
Moglix team brings 75+ years of strong technology and manufacturing expertise. Leaders from across top institutes in India (IIT/IIM/ ISB/ MDI) having worked in top technology and manufacturing companies.

CII MISSION MANUFACTURING

Department of Heavy Industry
Government of India

Confederation of Indian Industry

3RD SMART MANUFACTURING SUMMIT 2017

Creating Champions of the New

15 November 2017 | Hotel Le Meridien, Janpath, New Delhi

Corporate Sponsor

Dixon

Dixon Technologies (India) Limited is the largest* home grown design-focused and solutions company engaged in manufacturing products in the consumer durables, lighting and mobile phones markets in India. Its diversified product portfolio includes:

- Consumer electronics like LED TVs
- Home appliances like washing machines
- Lighting products like LED bulbs and tube-lights, down-lighters and CFL bulbs
- Mobile phones. It also provides solutions in reverse logistics i.e. repair and refurbishment services of set top boxes, mobile phones and LED TV panels.

It is a fully integrated end-to-end product and solution suite to original equipment manufacturers (“OEMs”) ranging from global sourcing, manufacturing, quality testing and packaging to logistics. It is also an original design manufacturer (“ODM”) of lighting products, LED TVs and semi-automatic washing machines in India. As an ODM, it develops and designs products in-house at its R&D centre. It manufactures and supplies these products to well-known companies in India who in turn distribute these products under their own brands.

Dixon Technologies has six state-of-the-art manufacturing facilities which are strategically located in the states of Uttar Pradesh and Uttarakhand meeting the quality requirements of its customers, including global brands. Out of its six manufacturing facilities, three are located in Noida in the state of Uttar Pradesh and manufacture CFL as well as LED lamps and drivers and mobile phones, while the other three are located at Dehradun in the state of Uttarakhand and manufacture CFL as well as LED lamps and drivers, electronic ballasts, LED TVs and washing machines. Its backward integration process like plastic moulding, sheet metal, wound components and LED panel assembly are carried out at the manufacturing facilities in Dehradun. Most of its manufacturing facilities have been accredited with quality management systems and environmental management systems certificates for compliance with ISO 9001-2008, ISO 14001-2004 and 14001:2015 requirements respectively. Further, few of its products are also certified to be compliant with quality standards issued by the Bureau of Indian Standards. Dixon Technologies is in the process of setting up a new manufacturing facility in Tirupati, Andhra Pradesh.

Its Promoter and Chairman, Sunil Vachani has been awarded the ‘Man of Electronics’ award by CEAMA in the 2015, the “Outstanding Citizen Award 2012” by the Sindhi Chamber of Commerce and one of the “Top 100 people influencing EMS” in 2012 by ventureoutsource.com. He has held positions like Chairman of the Electronics and Computer Software Export Promotion Council of India and Co-Chair of the CII National Committee on ICTE Manufacturing and is currently the vice president of CEAMA. Atul B. Lall, company’s Managing Director, has been associated with the Company since inception and has more than 25 years’ experience in the EMS industry. He has served as a member of the Technical Evaluation Committee for Electronic Manufacturing Services under M-SIPS (Electronic Manufacturing Services-EMS) constituted by the

DeitY and served as a representative of ELCINA on the Committee for Reliability of Electronic and Electrical Components and Equipment (LITD. 02) of the BIS.

*Source: Project Rise: Indian Consumer Electronics & Appliances Market Study, issued by Frost & Sullivan India Private Limited.

IO-Link – we connect you!

More functions: Smart IO-Link sensors from ifm

IO-Link devices protect against tampering, transmit the measured value as a digital value, ensure easy replacement without parameterisation on site, and are available without surcharge. You see, there are many reasons for using IO-Link sensors.
ifm as the technology leader for IO-Link offers the highest number of smart sensors with IO-Link in the market. Take the right step into an innovative future and benefit from the many years of experience which have set benchmarks in functionality and service.
ifm – your IO-Link system partner. ifm – close to you!

ifm electronic India Private Limited
Plot No. P-39/1, MIDC Gokul Shirgaon · Kolhapur - 416234 · Maharashtra
Phone: +91 231 267 2770 · Fax: +91 231 267 2388 · Toll Free: 1800 233 2065
E-mail: info.india@ifm.com · Internet: www.ifm.com

NEW

GO THE XTRA MILE WITH THE JCB 220LC XTRA

Download the JCB AR App from Google Play Store or the Apple Store

Point your device at the machine and wait for a surprise

Watch

Video

Take on every challenge with the new JCB 220LC **XTRA** that offers endless hours of non-stop performance with high productivity and greater fuel efficiency. You can expect more of the toughest and biggest tasks to be handled easily with the new JCB 220LC **XTRA**. It's the dependable partner your business deserves.

8%* More Fuel Efficient | 7%* Higher Output - New Smart Controls with 8 Power Modes
High Operator Comfort | More Control with JCB's Advanced Telematics - LiveLink
JCB Premier Line Solutions | 650+ Dealership Outlets

To discover what makes this the Xtra performer, visit www.jcb.com or call 1800 2000 522.

Follow us: /JCBIndiaLtd

***Terms & Conditions Apply**

Visit us at:

CII EXCON 2017
12th to 16th December 2017, BIEC, Bengaluru, Karnataka, India
The 9th International Construction Equipment and Construction Technology Trade Fair
Outdoor: OD 1 & 2
Indoor: A8 Hall 1, Lower Level.

made in INDIA for the WORLD

JCB
EXPECT MORE

SIEMENS
Ingenuity for life

Digitalization

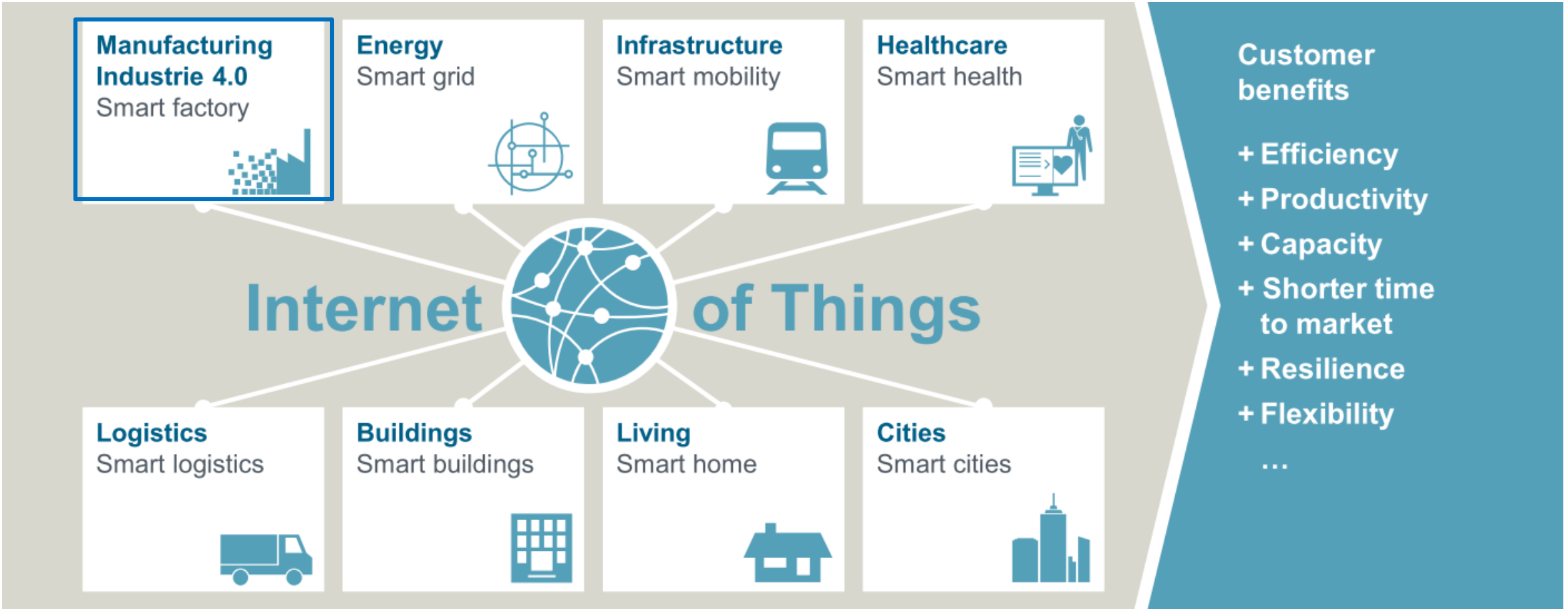
- for Next generation manufacturing

Siemens Ltd.

17th May 2017

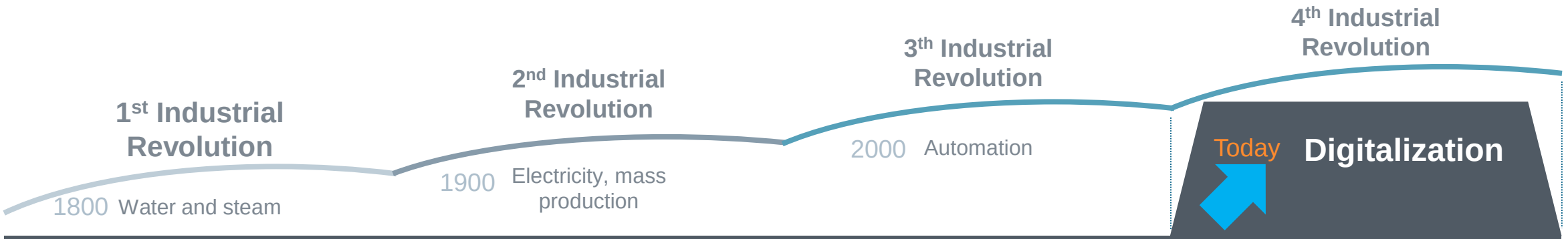
The Industrial Internet of Things is driving the digital revolution - “Industry 4.0 is the next level of manufacturing”

SIEMENS



Industry 4.0 – The next level of manufacturing towards driving the Digital Enterprise

SIEMENS



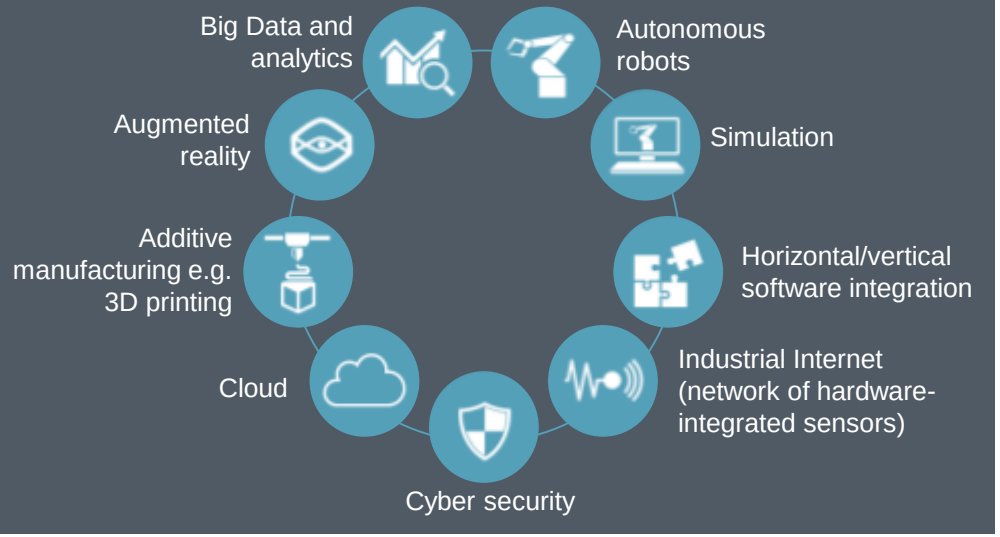
Characteristics

Humans, devices and systems are connected along the entire value chain

All relevant information are available in real-time – across suppliers, manufacturers and customers

Parts of the value chain can constantly be optimized with respect to different criteria, e.g. cost, resource utilization, customer needs

Technologies



Siemens customer survey on digitalization, published on July 21, 2015

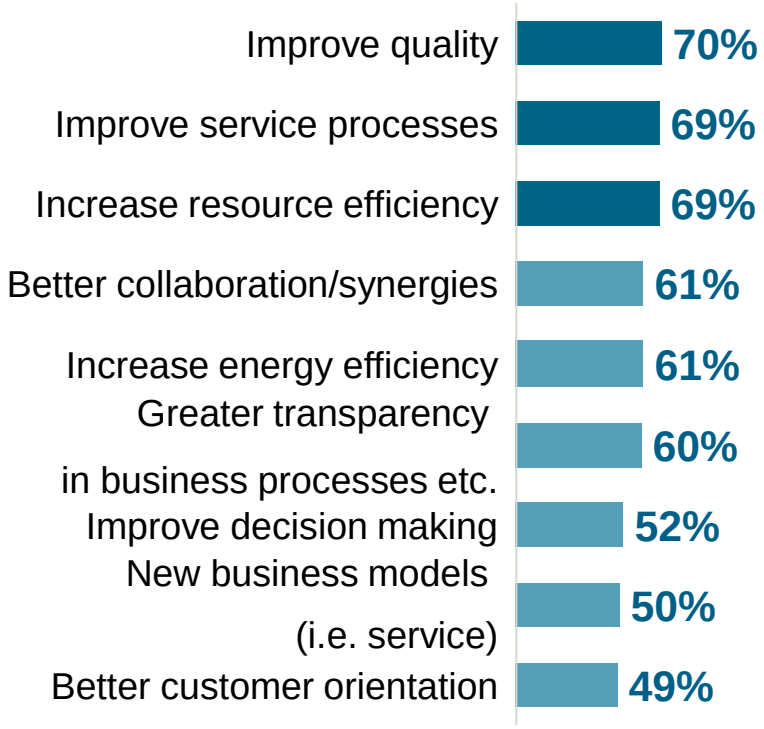
SIEMENS

What benefits do respondents expect to gain from digitalization?

Digital technologies can transform processes, products, services and also spawn new business models

Majority use digitalization to improve quality, service and resource efficiency

Every second respondent uses digitalization to develop new business models



Digital barriers

What's holding respondents back from greater implementation of digital technologies?

46% Lack of technical standards

41% Unclear benefit

39% Concerns about data security

Digitalization for SMEs

Adopting Digitalization will help SMEs, achieve manufacturing excellence

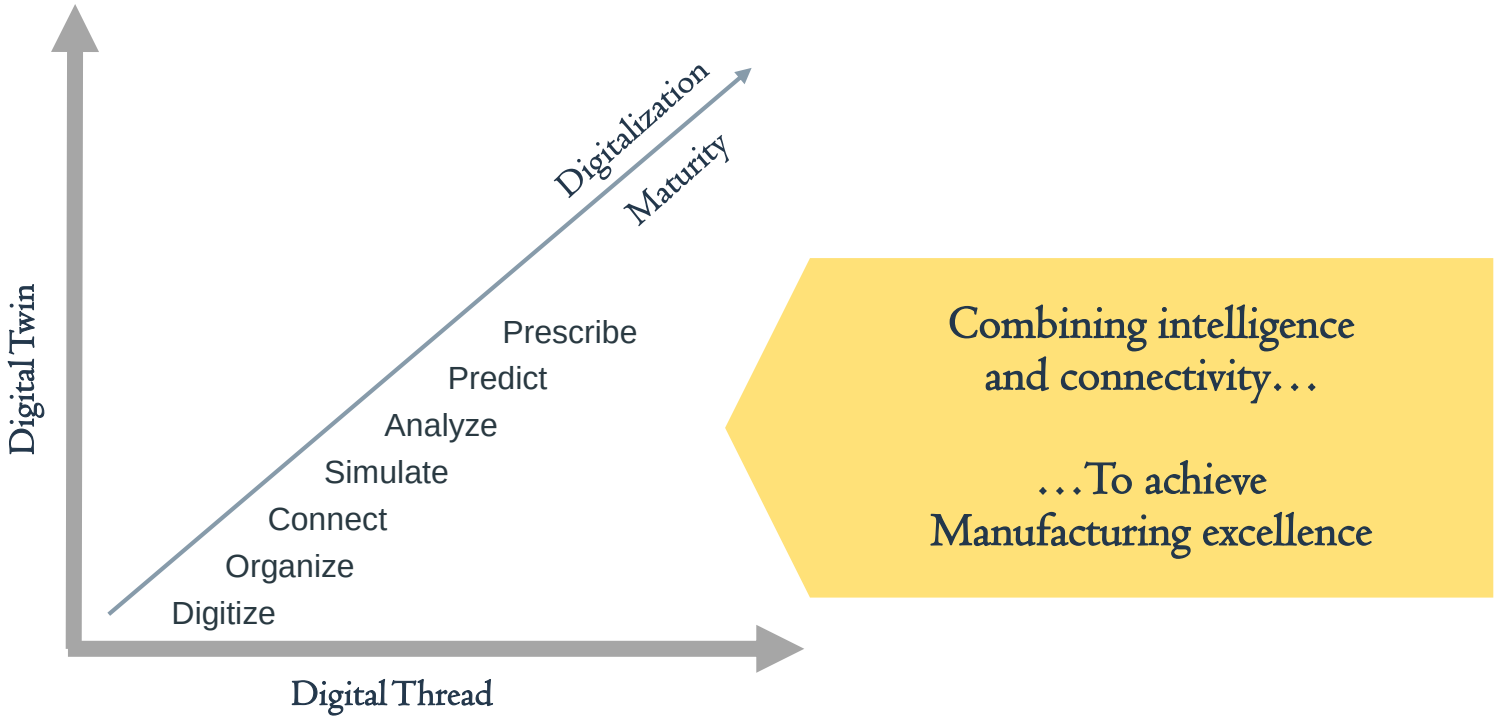
SIEMENS

Growing demands to be met by SMEs:

- … master increasing product and process complexity
- …reduce Time to Market
- …make decisions based on real-time data
- …adapt rapidly to changing market- and customer requirements
- …deliver individualized products close to mass production cost level
- …enforce product- and process compliance
- …secure continuous improvement of product and process design

Digitalization enables achieving manufacturing excellence:

- The **digital product definition** contains all necessary information including its production requirements
- That the **integrated production installations** self-organize considering the entire value chain and
- Achieves **flexible production** to fulfill individualized customer needs



Digitalization is helping improve value chains in both process and discrete industries

Manufacturing companies need to achieve enormous improvements in their processes to remain competitive and grow beyond

SIEMENS

Reducing the time to market

- Shorter innovation cycles
- More complex products
- Larger data volumes

Product and production integrated

Enhancing flexibility

- Individualized mass production
- Volatile markets
- High productivity

Flexible production

Increasing Quality

- Closed loop quality processes
- Traceability and integrated genealogy

Full process transparency

Increasing efficiency

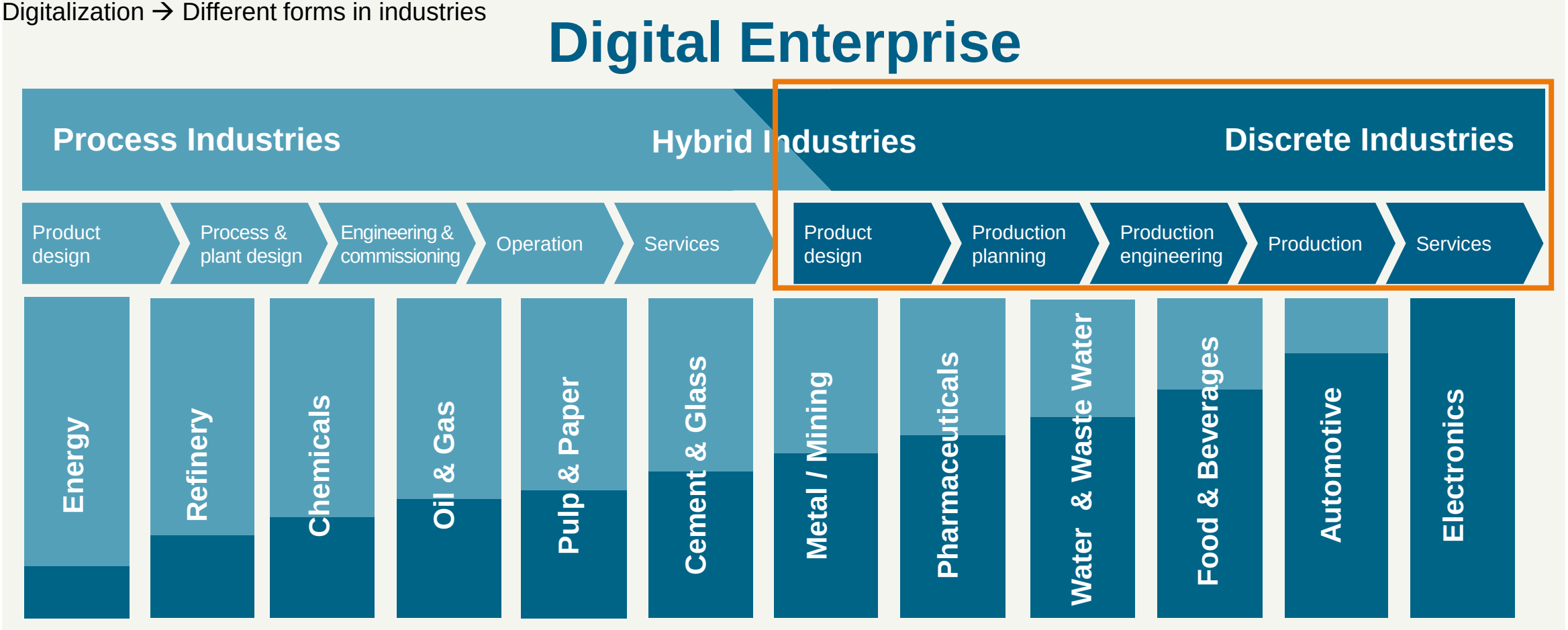
- Energy efficiency and resource efficiency as key competitive factors

Optimized production resources

Digitalization can bring in transformation in both process and discrete industries

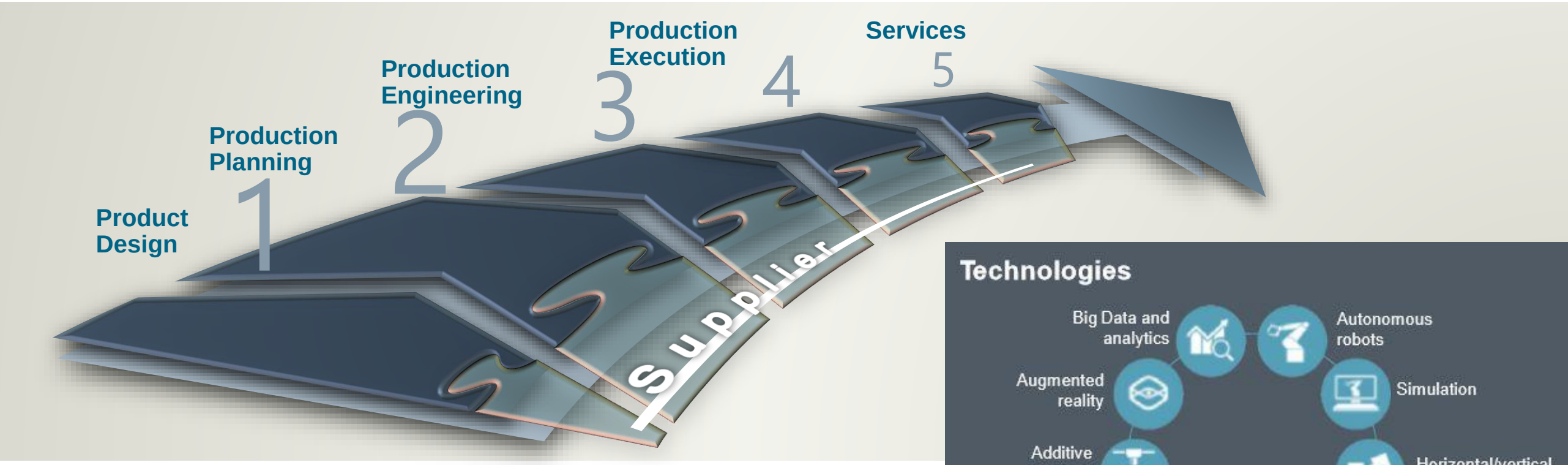
SIEMENS

Digitalization → Different forms in industries



Holistic approach to include the whole Value chain

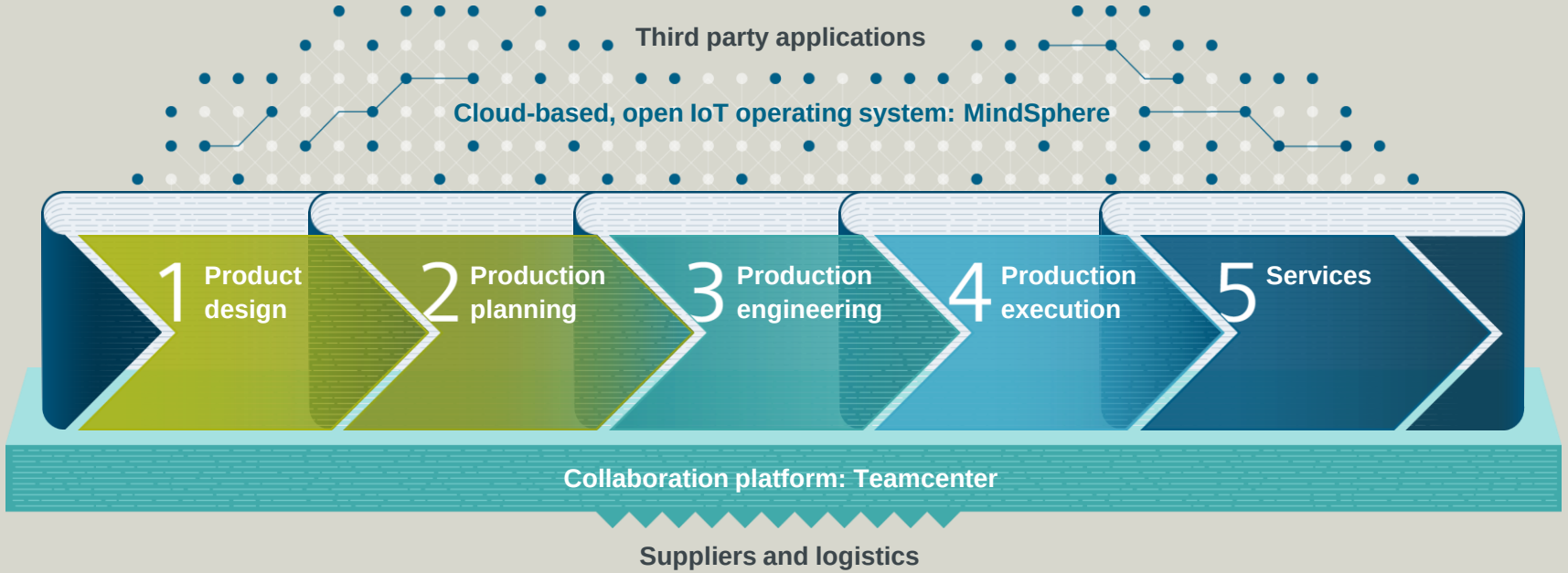
SIEMENS



Only a holistic automation approach including the whole value add chain will yield sustainable competitiveness

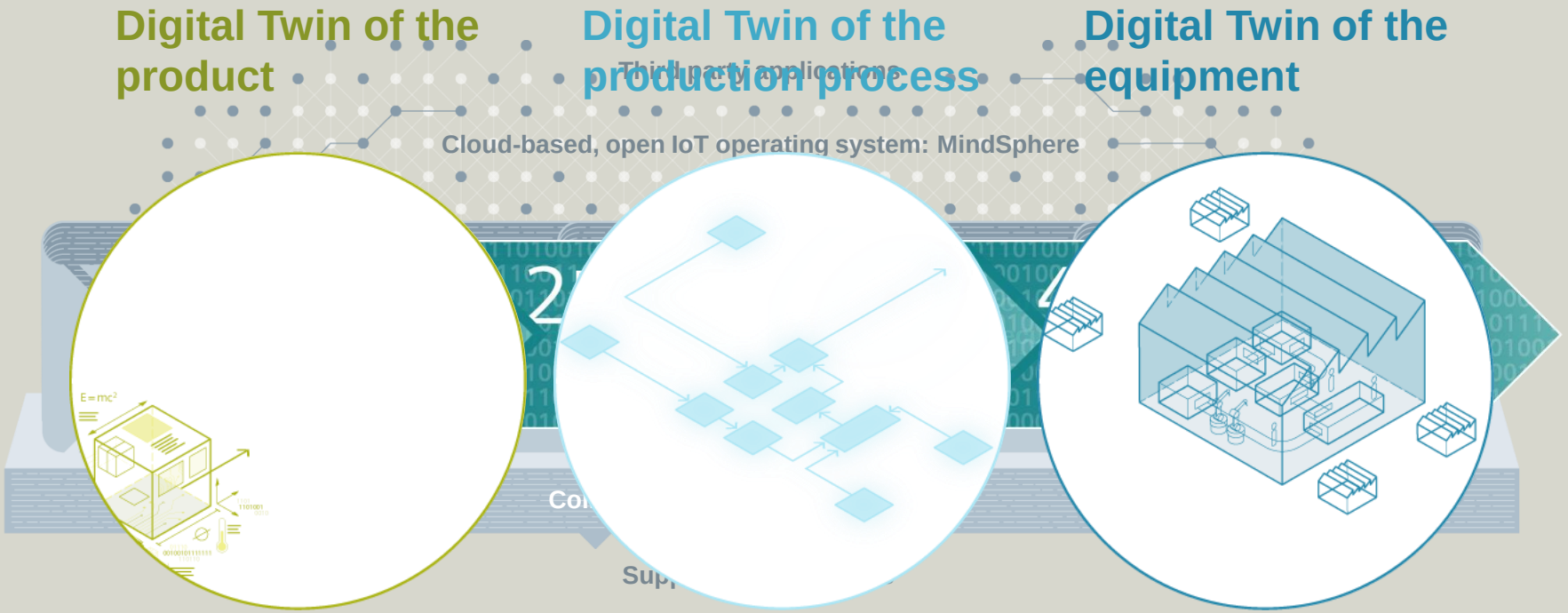
Integrating and digitalizing the entire value chain is key to staying competitive in the future

SIEMENS



Page 11 Driving the Digital Enterprise for discrete industries

Integrating technical domains (products, production process and equipment) into one data model



Page 12 Driving the Digital Enterprise for discrete industries

Global Digitalization concept for Discrete Industries - Siemens has an unmatched scope of offerings

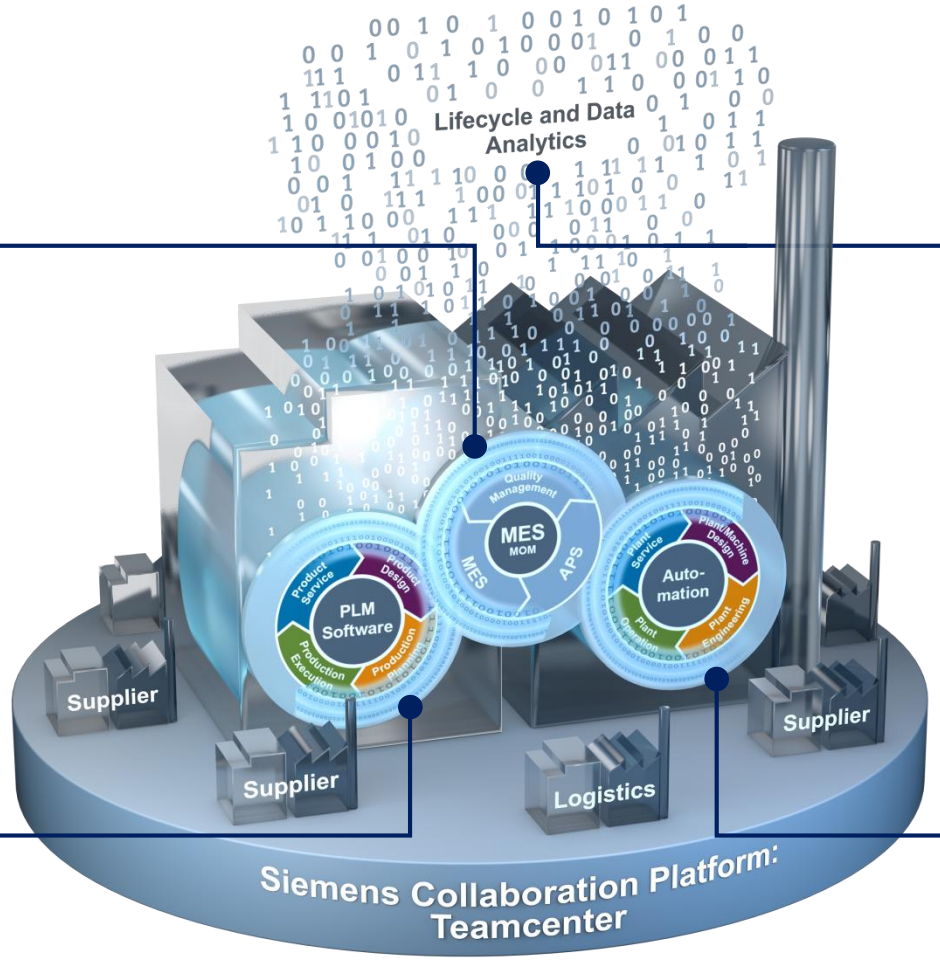
SIEMENS

MES

e.g. SIMATIC IT

PLM

e.g. Teamcenter / NX



Lifecycle and Data Analytics

e.g. MindSphere

TIA

Comprehensive Automation Portfolio

e.g. SIMATIC / SINUMERIK SIRIUS / SIMOTICS

Siemens: Realizing Our Own Digital Enterprise – Today Electronic Works @ Amberg

SIEMENS

1,000 – different products manufactured

1 million – monthly production of SIMATIC products

50 million – process items entered in SIMATIC IT each day

12 dpm – 99.9988% quality rate

1,000 – Teamcenter managed product variants shipped to

60,000 – customers worldwide each year

Manufacturer experiments with "smart factory"

"At a Siemens factory in Amberg, **machines have begun to self-replicate**. Regulating the ultra-efficient production lines are the very same automation devices … that are spat out at the end. One line, which operates 24 hours a day, requires no human intervention at all ..."

– FT, April 10, 2014

Manufacturing companies need to achieve enormous improvements in their processes to remain competitive and grow beyond

SIEMENS

Reducing the time to market

- Shorter innovation cycles
- More complex products
- Larger data volumes

Product and production integrated

Enhancing flexibility

- Individualized mass production
- Volatile markets
- High productivity

Flexible production

Increasing Quality

- Closed loop quality processes
- Traceability and integrated genealogy

Full process transparency

Increasing efficiency

- Energy efficiency and resource efficiency as key competitive factors

Optimized production resources

Siemens Unique Value Proposition – Domain know-how and expertise in combining Operating Technology and Information Technology

SIEMENS

Domain know-how

Portfolio and Applications

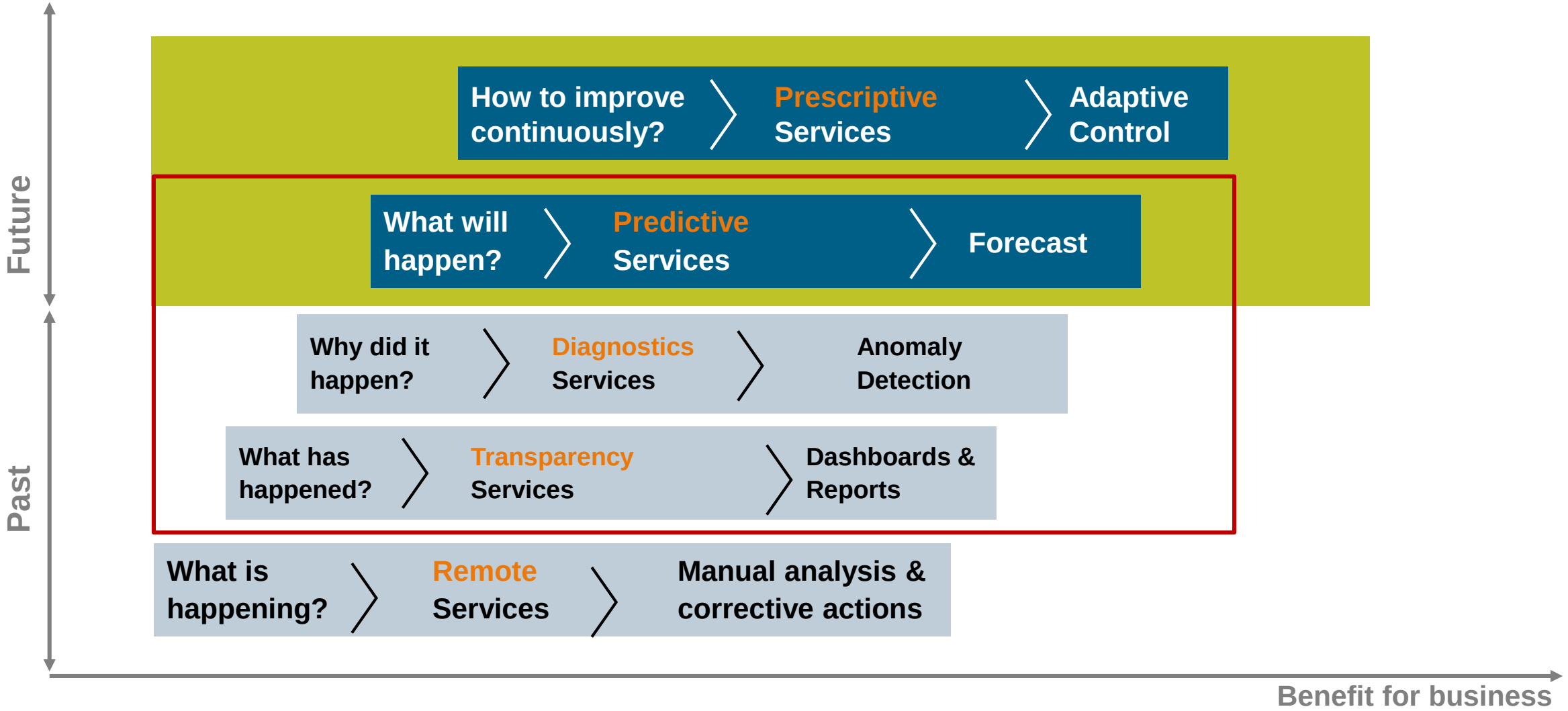
Analytics know-how

\+ \+ =

Unique Value Proposition

- **Reducing the time to market**
- **Enhancing flexibility**
- **Increasing Quality**
- **Increasing efficiency**

Growing shift towards predictive and prescriptive services
▸ Turning data into added value



How do we support SMEs in adopting digitalization?

Industry Skill Development Initiative:
Over 4 lakhs youths to get skilled by 2020

SIEMENS

Over
4 lakhs Youths
to get skilled by 2020
through Siemens Programs

Dual VET at Govt. ITIs

- German Dual VET model
- Skilled and industry ready technicians
- **13,000 Students to benefit by 2020**

Centers of Excellence

- Equipped with State-of-the-Art Tools and Technologies
- 17,768 trained till date in Gujarat
- **400,000 to be trained by 2020 in Gujarat, Andhra Pradesh and Jharkhand**

Siemens Scholarship

- Promote engineering education amongst meritorious economically disadvantaged students
- **715 students to benefit by 2020**

STEM in Schools

- Generate interest in STEM (Science Technology Engineering Mathematics) topics
- **1000 students to benefit by 2020**

Safety Skills Center

- Global Skills Center to improve safety at sites through simulated environment
- **3,500 to be skilled by 2020**

Industry Skill Development Initiative
A partnership between Institutes & Siemens

SIEMENS

Technical Institutes

Skill Development Initiatives

- **Bridge** gap between Industry needs and available Skills through Industry oriented learning
- Enable institutes to improve quality of education
- Provide state-of-the-art tools to match industry standards
- Student Training on Industry skills

Industry

Weak Education System

- Outdated Engineering Concepts
- No Vocational experience/ interaction
- Outdated tools in labs
- Faculty not equipped with industry trends & practices

Challenges Faced by Industry

- Large investment in time, effort & money to train students
- 6–18 months before recruits become productive
- Student attrition post training for better salary packages
- Affects competitiveness of companies

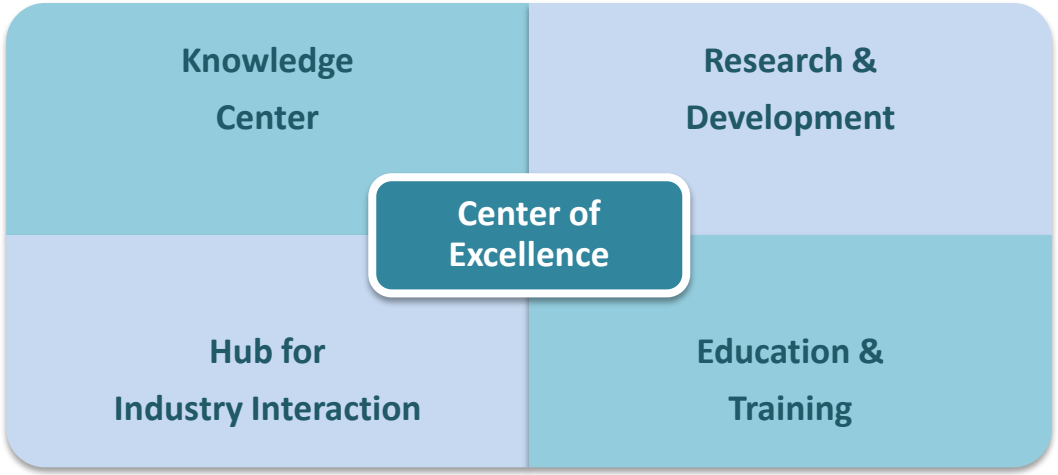
COEs are advanced knowledge centers equipped with state-of-the-art products, systems and technologies

SIEMENS

Interdisciplinary Knowledge Center

- Serve as a Technical Knowledge Resource for Industry
- Equipped with State-of-the-Art Tools and Technologies
- Hub for “Technical” Skill Development programs in State in coordination with Universities and Industry
- Catalyze Industry – Academia Partnership
- COEs are fine-tuned as per the reqts of specific industries

Activities at Center of Excellence



Infrastructure requirements

Sl.no	Lab
1	Product Design and Validation Lab
2	Advanced Manufacturing Lab
3	Automation Lab
4	Electrical & Energy Studies Lab
5	Process Instrumentation Lab
6	Mechatronics Lab
7	Test and Optimisation Lab
8	Advance Machine & Robotics Lab

Minimum Site Requirements:

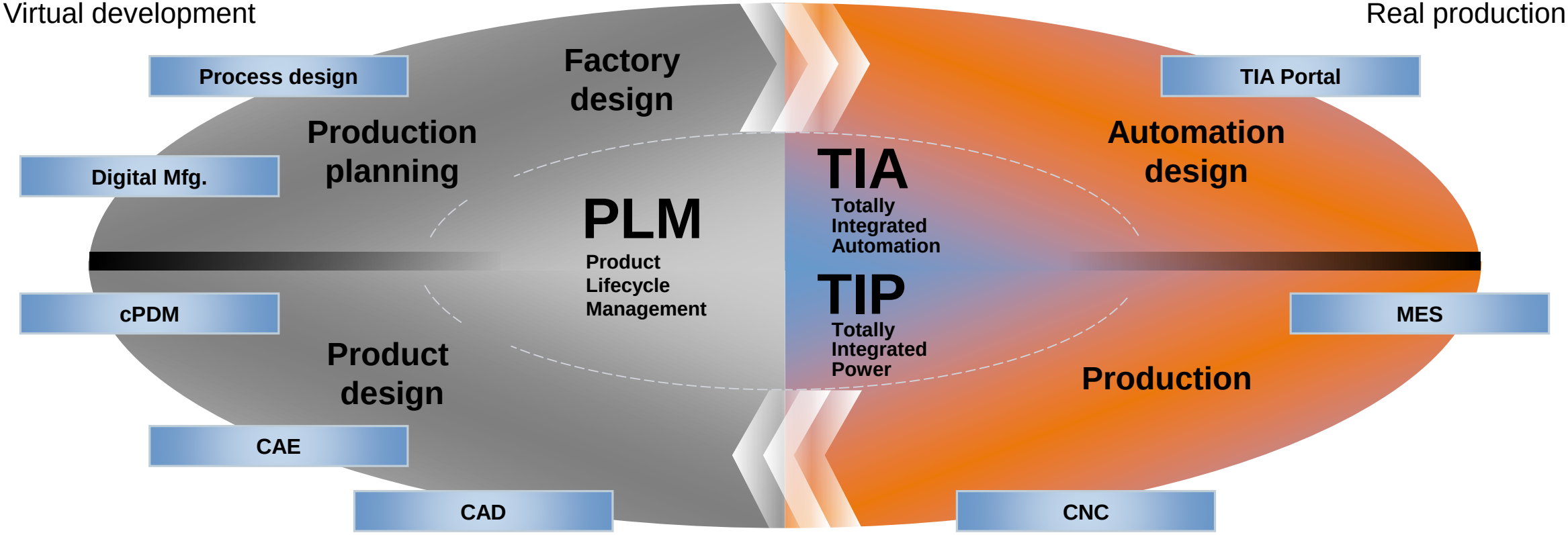
- 10,000 sft of built-up area; therein ~4000 sft of the above area on ground floor for heavy machinery labs
- Civil Work: Flooring, Partitioning
- Site-preparation : Electrical Points (3 Phase electrical supply), Pneumatic lines and hydraulic piping
- Facilities: Furniture, Air conditioning, Projectors and LAN Networking

Digitalization will merge the Virtual & Physical Worlds for Engineers & Manufacturers

SIEMENS

Design and Virtual Production
Virtual development

Physical Production Automation
Real production



The Integrated Product and Production Lifecycle


We are driving the
Digital Enterprise
together with our customers

Waste Water Management for Smart Cities

Dr D.Vakula and Yeshwanth Krishna Kolli
Department of Electronics and Communication Engineering
National Institute of Technology, Warangal
Telangana, India - 506004
Email: yeshwanthkolli@gmail.com

***Abstract*—Water is a key resource for life on earth. Clean Drinking water is one of essential human needs. With the increase in urbanization a threat of water scarcity is alarming. This triggers the idea of reuse and recycling of waste water. This paper presents the need for waste water treatment and also gives the brief description of various stages of waste water treatment. The waste water treatment plan works optimally only under certain parameters. Hence sensors can be used at different stages of water treatment for automation. This paper presents the importance and necessity to recycle the waste water and provides a solution for automation of the waste water treatment plant.**

***Index Terms*—Internet of Things; Waste Water Treatment Plant; Smart City; IoT.**

I. Introduction

WATER is one of the most vital natural resources. Without it no life exits on the earth. Up to 60% of human body is water. Hence the quality of water we consume is very important. The World population is expected to increase from 6.8 to 9.1 billion between 2009 and 2050. The urban population is also projected to 6.3 billion in 2050. This projection shows that the urban areas all over the world would have tremendous increase in population growth in the next 40 years.

It is expected that the urban population would be 3.9 billion in developing countries and 1 billion in developed countries. With this we could say that the population growth is an urban phenomenon predominantly in developing countries.

With increase in urban population the waste water generated by them would also be increased. The urban waste water when combined with untreated industrial waste could be very dangerous.

The Rural population and the slums in the city consume the water from open sources like rivers since they dont have access to treated water. Hence the waste water treatment is the need of the hour. The waste water must be treated before leaving into them into rivers.

43 countries are presently facing the problem of water scarcity. Hence it can be considered that waste water treatment is a great necessity for smart cities.

The rest of the paper is sorted in the following manner. Section II talks about the Need of waste water treatment. Section III presents the waste water treatmet plants present in Hyderabad city. Section IV describes the Working of waste water treatment plant. Section V describes the condition required for smooth operation of waste water treatment plant. Section VI presents the sensors required for automation of the plant. Section VII shows the flow chart of the sequence of operation and Section VIII concludes the paper.

II. Need for Water Treatment

Waste Water contains a variety of organic and inorganic substances dissolved which also includes toxic elements such as Cadmium(Cd), Zinc(Zn), Copper(Cu), Chromium(Cr), Arsenic(As), Mercury(Hg), Lead(Pb) etc. These may not be in present in dense concentration to affect human life but may affect plants and animal life.

Disposal of the waste water directly into water bodies like rivers and oceans may affect the aquatic animal life. The water in these water bodies are consumed by animals and also by the people living down stream. Consumption of this contaminated water leads to health problems in a long run. The water in a river or lake id normally utilized by farmers for cultivation and the presence of Micro and Macro Organisms in the water affect the agricultural growth. Hence the water is to be treated before disposing into water bodies. Also with the growth of urbanisation and the increasing scarcity of drinking water, it is necessary to recycle and reuse the waste water for agricultural purposes.

III. Water treatment plants in Hyderabad

Hyderabad is one of the fastest growing metropolitan cities in India. It is the capital city of Telangana state and is the fourth most populous city in India. The area of Hyderabad is 650 square Kilometres and has a population of 10.1 Million (in 2016). According to 2011 census, the population noted was 6.1 million which clearly shows an increase of 65 percentage of the population in the span of 5 years.

In Hyderabad there are 7.92 Lakh Connections which serve 90 Lakh population. Entire Population of Hyderabad uses 1800 MLD (Million Litres per Day) for washing, toilet and for drinking. A part from Domestic usage the water is also used for Industrial Production. Musi River flows in the middle of Hyderabad City dividing it into two parts. The entire sewage flows to River Musi through 16 Nullahs. Fig.1 shows the Nullas

There are 18 waste water treatment plants in Hyderabad with a capacity of 715 MLD. A majority of the treated water

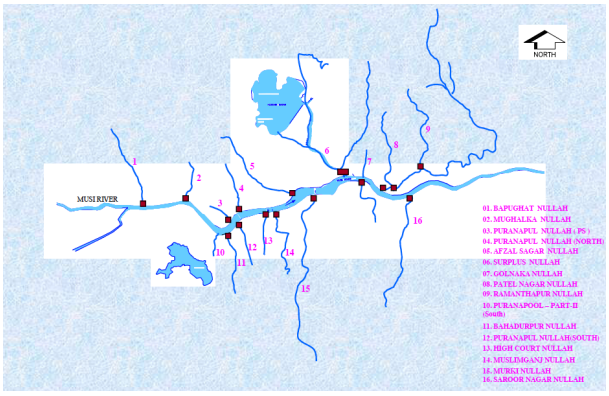


Fig. 1. Layout of Nulahs in Hyderabad

is treated at the four STPs at Amberpet, Nagole, Nallacheruvu, and Attapur. They treat 592 MLD of waste water. The rest of the water is from the STPs at Khairatabad, Begumpet, and Miralam Tank, and the other STPs. All the Treatment plants are maintained by Hyderabad Metropolitan Water Supply& Sewerage Board (HMWSSB).

All the treated water is diverted to the Musi river after proper treatment. But for proper utilization Ministry of Urban Developments mandated 28% of treated water must be recycled and reused. Hence the water is now sold in tankers of 5000 Liters for Rs 125 , as this would not only generate revenue for the Board, but would also serve as a water saving measure.

IV. OVERVIEW OF WATER TREATMENT PLANT

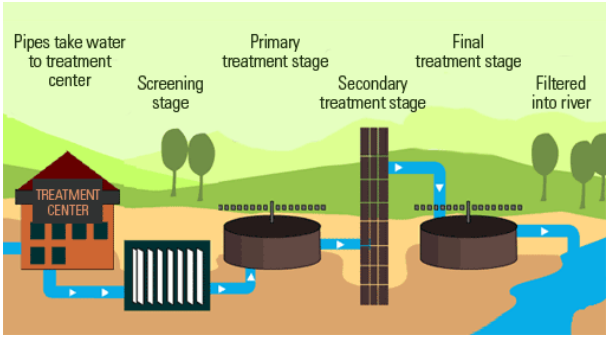


Fig. 2. Waste Water Plant Block Diagram

There are four stages in treatment of Waste Water i.e., Initial Screening, Primary Treatment, Secondary Treatment and Tertiary Treatment. Initial Screening removes all the objects all diameter greater than 20 mm. In Primary Treatment solids are made to settle by sedimentation and are removed from waste water. The secondary Treatment uses biological process to further purify the water. In Teritiary Treatment the oxygen levels are increased and foul odour is removed. Fig.2 shows the block diagram of Waste Water Treatment Plant.

A. Initial Screening

A Coarse Screen is placed at the entrance of water treatment plant to remove objects of diameter larger than 20 mm. As the Sewage Water enters the water treatment plant as it flows through the coarse screen to remove large objects like plastic items, Human hair, Wooden sticks, Stones, etc. which are present in water. Fig.3 shows the Coarse Screen present at the entrance of the Water Treatment Plant.

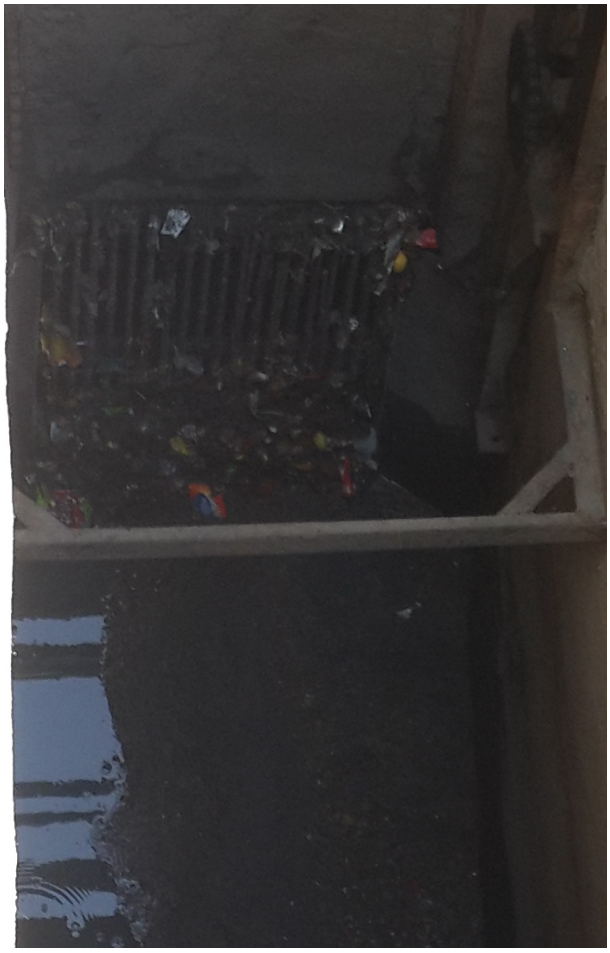


Fig. 3. Coarse Screen

B. Primary Treatment

After the water is screened, the water is flown into Main Pumping Station where the flow rate is reduced and the water is flown into fine screen which screens the particles above 6 mm dia. and removes them from water. Fig.4 shows the Main Pumping Station and Fine Screen.

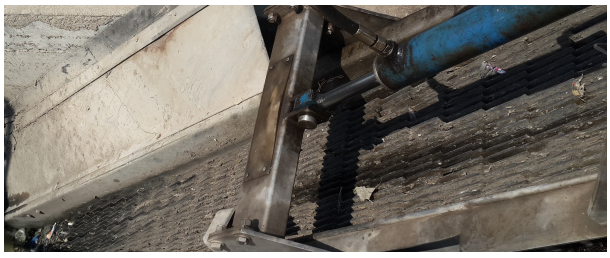


Fig. 4. Fine Screen

After the fine screening water contains Grit and dissolved bio degradable solids. Grit includes sand, gravel, cinder, or

other solid materials having higher specific gravity than organic biodegradable solids. This water is flown into Detritus Tank (Grit Chamber) for grit removal. The Detritus Tank contains a rotator fan which rotates at a very low speed i.e, one round for every 5 to 6 minutes. The heavier grit particle settle at the bottom of the tank and the water is sent to 8 Distribution Boxes by decreasing the pressure of water.

C. Secondary Treatment

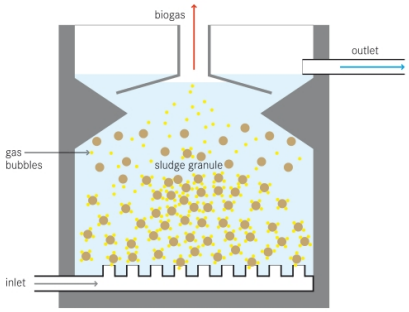


Fig. 5. UASB

Water from primary treatment enters Feedback Boxes. Each feedback box is divided into pipes each of 90 mm, which reduces the speed of water drastically. Each Feedback Box is typically a Upflow Anaerobic Sludge Blanket (UASB).

Theupflow anaerobic sludge blanket reactor(UASB) is a single tank process in ananaerobiccentralised or decentralisedindustrial wastewaterorblackwatertreatment system achieving high removal oforganicpollutants.Wastewaterenters thereactorfrom the bottom, and flows upward. A suspendedsludgeblanket filters and treats thewastewateras thewastewaterflows through it.Bacterialiving in thesludgebreak downorganic matterbyanaerobic digestion, transforming it intobiogas. Solids are also retained by afiltrationeffect of the blanket. The upflowregimeand the motion of the gas bubbles allow mixing without mechanical assistance. Baffles at the top of thereactorallow gases to escape and prevent an outflow of thesludgeblanket. As allaerobictreatments,UASBrequire apost-treatmentto removepathogens, but due to a low removal ofnutrients, theeffluentwater as well as thestabilisedsludgecan be used in agriculture. Fig.5 shows the Cross-section of an UpflowAnaerobicSludgeBlanket (UASB)reactor

D. Tertiary Treatment

The water from Secondary Treatment contains only Organic Matter(Algae), Bacteria, Carbon dioxide (Co2) and foul order. In Tertiary treatment the water is Aerated and Clorinated. In Aeration Treatment the bacteria present in the water is provide by oxygen, which in turn breaks the organic matter containing Carbon (CH2O) to form carbon dioxide (CO2) and water (H2O), with the help of oxygen (CH2O + O2 CO2+ H2O). This process is called Algal-bacterial (ALBA) wastewater treatment. Fig.5 shows the Aeration Treatment Plant of the Water Treatment Plant.

Fig. 6. Aeration Treatment Plant

From Aeration Tank the partially treated sewage flows into Chlorination Tank for removal of excess bacteria. Clorine is released in the water inorder to kill the Bacteria and to reduce odour. This process kills 99 % of the bacteria. Alternative process like treatment with UltraViolet Light or Ozone are also used.

V. Conditions for smooth operation of Water Treatment Plant

In Secondary Treatment, for effective operation of UASB (upflow anaerobic sludge blanket reactor) some parameters like pH value, Temperature, Upflow Velocity, Chemical Oxygen Demand (COD), Hydraulic Retention Time (HRT) are to be maintained.

A. pH Value

To the growth of bacteria responsible for anaerobic digestion, the pH-value is to be maintained between 6.3 and 7.85. This is very important as with high valyes of pH the ammoniac (NH4+) changes to NH3which in turn helps in growth of bacteria which produces methane.

B. Temperature

For Optimal growth of bacteria responsible for anaerobic digestion, the temperature is to be maintained between 35 and 38C. For every 1Ctemperature decrease the digestion rate decreases by 11% and the process is inefficient if the temperateure falls below 15C.

C. Chemical Oxygen Demand (COD) Loads

Optimuminfluentconcentrations for beneficial anaerobic digestion is above 400 mgCOD/L.

D. Hydraulic Retention Time (HRT)

Thehydraulic retention time(HRT) is to be maintained at least 2 hours and for the optimal upper limit for HRT is 20 Hours.The Anaerobicmicro organisms like methane that produces bacteria have a slow growth rate. Therefore, at small HRTs, there will be a possibility of biomass washout.

E. Upflow Velocity

The Upflow Velocity is the major parameter in UASB as it manages the sedimentation and upflow. The Sludge id not to be washed from the reactor and to keep the blanket in suspension a minimum velocity is to be maintained. The Optimal Upflow velocity is 0.7 to 1 m/h to keep the sludge blanket in suspension.

VI. Sensors for Automation of Waste water treatment plant

A. pH Sensor

The pH value of the water is measured by the pH Sensor. In Secondary Process the pH value is to be maintained between 6.3 and 7.85 as mentioned in Section VI.A.

Deploying pH sensor can detect any deviations in pH value and report them.

B. Temperature Sensor

These sensors estimate the maintained temperature of water. In Secondary stage a temperature sensor can be deployed to detect any deviation in temperature from values mentioned in Section VI.B.

C. Dissolved Oxygen Sensor

These sensors estimate the the dissolved oxygen level in water. A sufficient amount of oxygen is required for micro organisms to survive. The optimal Dissolved oxygen level is 2 mg/L.

D. Flow Sensor

The Flow Sensor detects the changes in flow velocity. The water flow velocity in the primary stage is to be maintained as 1 m/s. In grit removal the horizontal flow velocity of water must be maintained at 3 m/s so that the grit is settled down. In Secondary process the flow velocity must be maintained as mentioned in Section VI.E.

The deviations in the flow velocity can be detected and corrective action can be taken.

E. Photo Sensor

In Primary Stage the blockage of coarse screen and fine screen can be detected by Photo Sensor. The blockage can be informed to concerned authorities by connecting it to a micro controller.

F. Pressure Sensor

In primary stage, during screening water must be pumped with suitable pressure through the Coarse Screen and Fine Screen. The changes in pressure can be detected by pressure sensor.

G. Gas Sensor

The amount of poisonous gases can be detected by the Gas sensors. When the level of poisonous gases exceeds the threshold limit concerned authorities can be notified by connecting this sensor to a suitable micro controller.

H. Chlorine Sensor

The Chlorination is the last stage in the waste water treatment. After chlorination the amount of chlorine is estimated using chlorine sensors. The excess chlorine is detected by the sensor and that is removed by de-chlorination.

I. Water Quality Sensor

Water Quality Sensor estimates the quality of treated water. The water is released into water bodies after testing the quality of the water. The technical details of all the above mentioned sensors can be referred in [8]-[19].

VII. FLOWCHART OF Automation of Treatment Plant

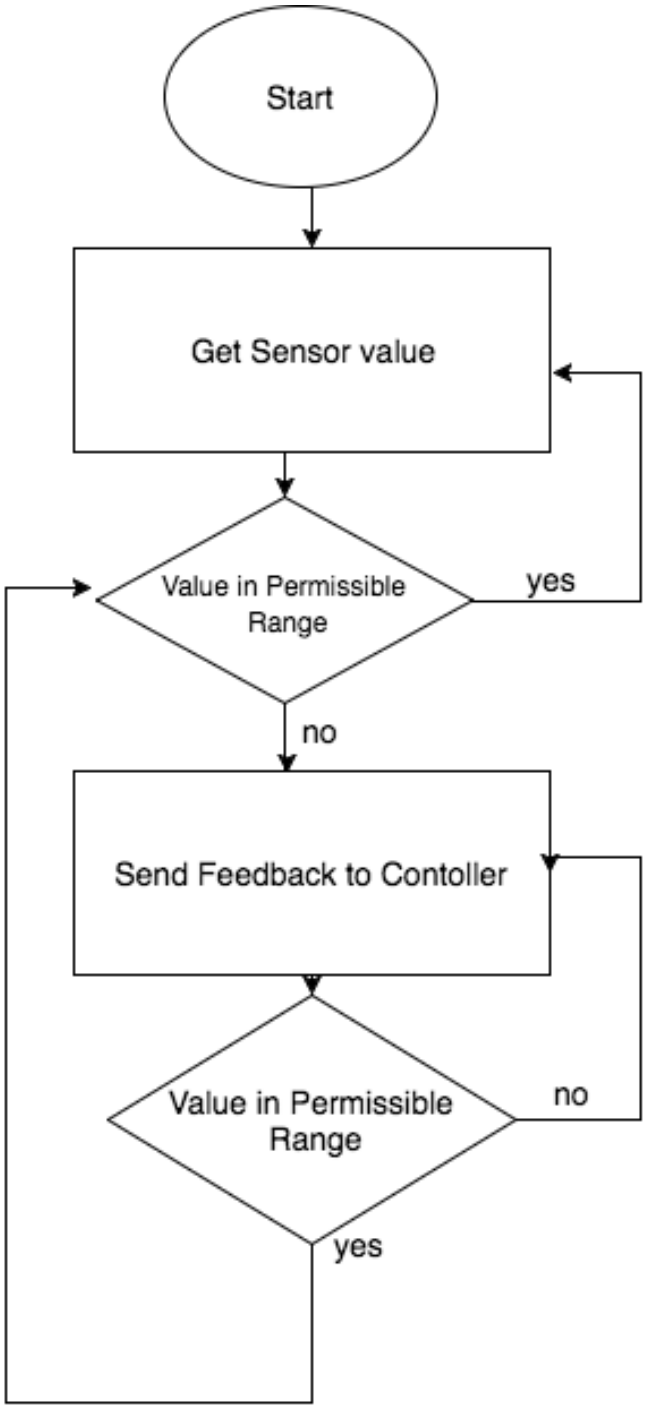


Fig. 7. Flow Chart of Automation

VIII. Conclusion

Usage of recycled water for purposes like gardening, flushing toilets, watering plants and vegetables, washing cars, cleaning of house and Fire fighting. The reuse of recycled water decreases the usage of drinking water for these purposes which indirectly helps in decrease of water scarcity. The deployment of sensors in the waste waster treatment plan leads to automation of the plant which leads to efficient use of the plant. By smart waste water treatment biggest challenge of water scarcity for smart cities can be solved.

References

[1] Ping Zhang, Mingzhe Yan, Hong Wang and Guangping Yu, "Integration Automation System of Wastewater Treatment Plant," 2006 6th World Congress on Intelligent Control and Automation, Dalian, 2006, pp. 6626-6630. doi: 10.1109/WCICA.2006.1714364

[2] B. Humoreanu and I. Nascu, "Wastewater treatment plant SCADA application," Proceedings of 2012 IEEE International Conference on Automation, Quality and Testing, Robotics, Cluj-Napoca, 2012, pp. 575-580. doi: 10.1109/AQTR.2012.6237776

[3] S. Grieu, A. Traore and M. Polit, "Fault detection in a wastewater treatment plant," ETFA 2001. 8th International Conference on Emerging Technologies and Factory Automation. Proceedings (Cat. No.01TH8597), Antibes-Juan les Pins, France, 2001, pp. 399-402 vol.1. doi: 10.1109/ETFA.2001.996394

[4] F. M. Sanchez, A. Filgueira, M. A. Seijo, M. E. Munoz and E. Munoz, "Energy audit model for a waste water treatment plant," 2009 International Conference on Clean Electrical Power, Capri, 2009, pp. 550-554. doi: 10.1109/ICCEP.2009.5211984

[5] L. Fan, K. Boshnakov and J. Lv, "Integrated control for the urban wastewater treatment system based on multivariable regulator," Proceedings of the 29th Chinese Control Conference, Beijing, 2010, pp. 4975-4980.

[6] A. Kumar, B. Maurya and D. Chandra, "Dimension reduction and controller design for a waste water treatment plant," 2015 International Conference on Power and Advanced Control Engineering (ICPACE), Bangalore, 2015, pp. 413-417. doi: 10.1109/ICPACE.2015.7274983

[7] R. Ting Pek Eek, S. Sahlan and N. A. Wahab, "Modeling of Waste Water Treatment Plant via system ID & model reduction technique," 2012 IEEE Conference on Control, Systems & Industrial Informatics, Bandung, 2012, pp. 131-136. doi: 10.1109/CCSII.2012.6470487

[8] H. Puta, G. Reichl and R. Franke, "Model based optimisation of a waste water treatment plant," 1999 European Control Conference (ECC), Karlsruhe, 1999, pp. 1920-1925.

[9] "Light Sensors" retrieved from *http://www.electronics-tutorials.ws*

[10] "The rights and wrongs of measuring flow in waste water" retrieved from *https://www.wateronline.com/doc/the-rights-and-wrongs-of-measuring-flow-in-wastewater-0001*

[11] "Liquid level sensors- different types of level sensors and their working" retrieved from*https://www.efxkits.co.uk/liquid-level-sensor-and-types-of-level-sensors/*

[12] "Fundamentals of pressure sensor technology" retrieved from *http://www.sensorsmag.com/sensors/pressure/fundamentals-pressure-sensor-technology-846*

[13] "RPM measurement-sensors and techniques" retrieved from *http://electronicsforu.com/technology-trends/test-measurement/rpm-measurement-sensors-techniques-2*

[14] Lukasz Guz , Grzegorz Lagod , Katarzyna Jaromin-Glen, Zbigniew Suchorab, Henryk Sobczuk and Andrzej Bieganowski*"Application of Gas Sensor Arrays in Assessment of Wastewater Purification Effects "*

[15] Gernaey K, Bogaert H, Vanrolleghem P, Van Vooren L And Verstraete W.*"Sensors for nitrogen removal monitoring in wastewater treatment"*

[16] "Temperature sensors" retrieved from*http://www.electronics-tutorials.ws*

[17] "How to calculate pH value? Basics and working of pH sensor" retrieved from *https://www.elprocus.com/basics-working-of-ph-sensor/*

[18] Emerson process management *"Dissolved oxygen measurement in waste water treatment"*

[19] Nikolaus Peter Schmitt, Wolfgang Rehm, Thomas Pistner, Paul Zeller,Hermann Diehl, Peter Nave E*"The AWIATOR airborne LIDAR turbulence sensor "*

[20] Heinz D. Unbehauen*"Control Systems,Robotics and Automation"*

[21] Waste Water treatment in Hyderabad,
http://www.waterandmegacities.org/wastewater-treatment-in-hy
http://cseindia.org/userfiles/HMWSSB_presentation.pdf

[22] Hyderabad Population,
http://www.indiaonlinepages.com/population/hyderabad-population.html

[23] Smart Cities Mission,
https://en.wikipedia.org/wiki/SmartCitiesMission

Low Cost Smart Parking System for Smart Cities

Dr D.Vakula and Yeshwanth Krishna Kolli
Department of Electronics and Communication Engineering
National Institute of Technology, Warangal
Telangana, India - 506004
Email: yeshwanthkolli@gmail.com

***Abstract*—Nowadays the idea of Smart Cities had become very popular. With the advent of Internet of Things, the concept of smart cities can be readily achievable. An extensive research is ongoing in the field of Internet of Things to increase the quality of services offered in cities and to improve the productivity and reliability of urban infrastructure. Internet of Things is addressing the most common problems faced in cities like availability of car parking and traffic jams. This paper presents an Internet of Things based Parking system for Smart Cities. The proposed parking system contains an IoT module deployed on-site for managing the available parking spaces. A platform providedin the form of portal for booking the parking spaces.**

***Index Terms*—Internet of Things; NodeMCU; Smart Parking; ESP8266; Raspberry Pi3; Smart City; IoT.**

I. Introduction

THE concept of Smart Cities has gained the utmost importance in past couple of years. With extensive development of ICT Infrastructure and IoT, the goal of building 100 Indian Smart Cities can easily be achieved. However, one of the prominent problem experienced by people in smart cities is the scarcity of car parking amenities and traffic supervision.

With the advent growth of urban population, the number of vehicles on the road are increasing day by day exponentially. According to a survey, In India, Delhi has the highest number of four wheeler vehicles at 7.35 million, which is followed by 4.1 million in Bangalore, 3.7 million in Chennai, 3.3 million in Hyderabad and 2.2 million in Pune. The above data accounts to density (per Km of road) of vehicles as Chennai (2093), Pune (1260), Hyderabad (723) [15].

The above data clearly illustrate the demand for parking infrastructure. In busy cities like Hyderabad and Pune, it is near to impossible to find a vacant parking slot easily during peak hours. The drivers tend to move around in search of parking slots which indirectly leads to traffic jams and traffic congestion. The groping around for parking leads to increase in utilization of Petrol/Diesel which indirectly cause pollution and affect the environment. Accident chances tend to raise as the driver's mind would be half occupied in searching parking.

Smart Parking system is an Internet of Things based parking system wherein which drivers can identify vacant parking slots easily with the help of their Smart Phone or a Computer. Smart parking system also accounts for online booking of a parking slot. The main idea behind this concept is computerized allocation of parking slots without any human intervention.

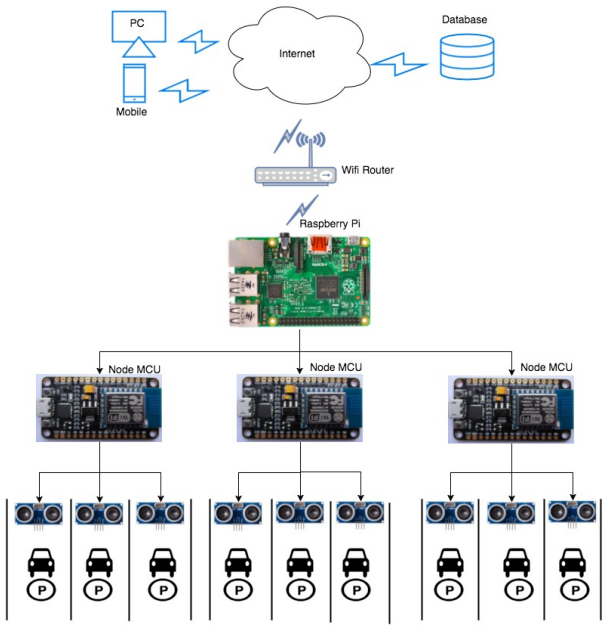


Fig. 1. Block Diagram of Smart Parking System

The proposed system helps user to book their parking slots online, by monitoring the parking spaces on a real-time basis for their availability. The rest of the paper is sorted in the following manner. Section II talks about the parking challenges in Hyderabad city. Section III presents the Smart Parking Architecture. Section IV describes the Working of the system and its Implementation. Section V gives an overview of all hardware components used. Section VI addresses challenges faced in implementing smart parking system and Section VII concludes the paper.

II. Parking challenges in Hyderabad

Hyderabad is one of the fastest growing metropolitan cities in India. It is the capital city of Telangana state and is the fourth most populous city in India. The area of Hyderabad is 650 square Kilometres and has a population of 10.1 Million (in 2016). According to 2011 census, the population noted was 6.1 million which clearly shows an increase of 65 percentage of the population in the span of 5 years [16].

The four-wheeler population in December 2016 is 8.5 lakhs which were 3.75 lakhs in 2008 which shows an increase of

vehicles by 126 percent in the span of 8 years. The projections clearly show that parking in Hyderabad would be one of the biggest concern in very near future.

On studying and analysing the current parking problems in Hyderabad city the following are identified as the major categories of problems:

- **Search of Parking space:** Searching for parking space is a tedious and time-consuming process. It increases the frustration levels among the drivers as is completely based on trail and error basis. In addition to the above fuel is wasted in this process.
- **Parking Fees:** Currently the parking places accepts only cash mode of payment and the availability of coins to pay for exact change is a problem. Another problem faced is that the minimum charged amount which is charged irrespective of considering the time utilized.

By analysing the above problems, the deployment of Smart parking system is clearly advantageous, as it saves both time and fuel. In addition to the above Online booking system eliminates the problem of carrying exact change and the amount charged is based on time the parking is utilized.

III. Smart Parking Sytem Architecture

In many cities, people would appreciate their luck if they could find a parking slot smoothly. People keep roaming around in search of vacant parking slots, and after a lot of struggle, they find one. Due to lack of a proper mechanism to identify free parking slots, they move randomly in search of parking space wasting a lot of time. This problem can be solved if the drivers could check the availability of parking spaces in and around their intended destination.

The proposed system addresses the parking problems faced in the city of Hyderabad and will be useful for future deployment in Smart cities. This system monitors the number of free parking spaces on a real-time basis and displays vacancy status on a portal. It also provides an interface for the user to book a slot online. Fig.2 shows a flowchart for Online booking and Fig.3 shows a flow chart for Smart Entry Management System.

A. Online Booking

The user queries for the availability of vacant slots and the system checks the Database for the existence of free slots. The system displays the number of free slots and the user is prompted to select a slot and proceed for payment to book the desired slot. After the confirmation of payment, the database is updated, and a barcode is generated for the user.

B. Smart Entry Management System

The Entry Management system contains a Barcode scanner, DC Motor, and a Display. When a user enters the premises of parking, he first scans the barcode in the barcode scanner. The display shows the booked slot, and then the DC Motor opens the gate. The system also provides a facility to park the vehicles offline. The offline user manually pays the cash to book a slot, and the paper-based barcode is generated.

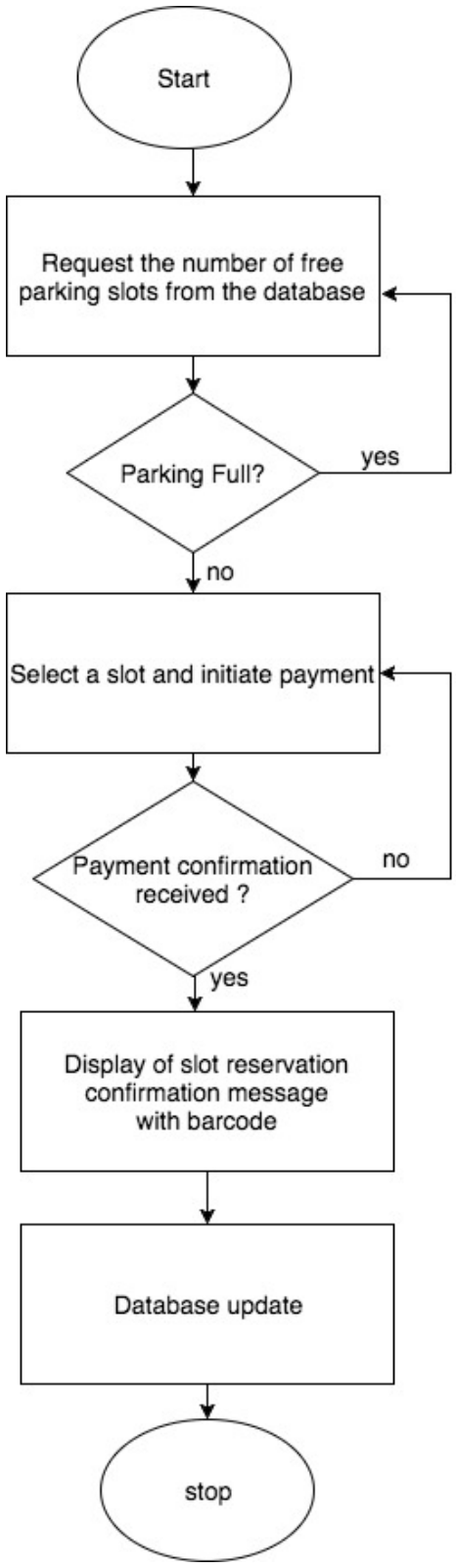


Fig. 2. Flowchart for Online Booking

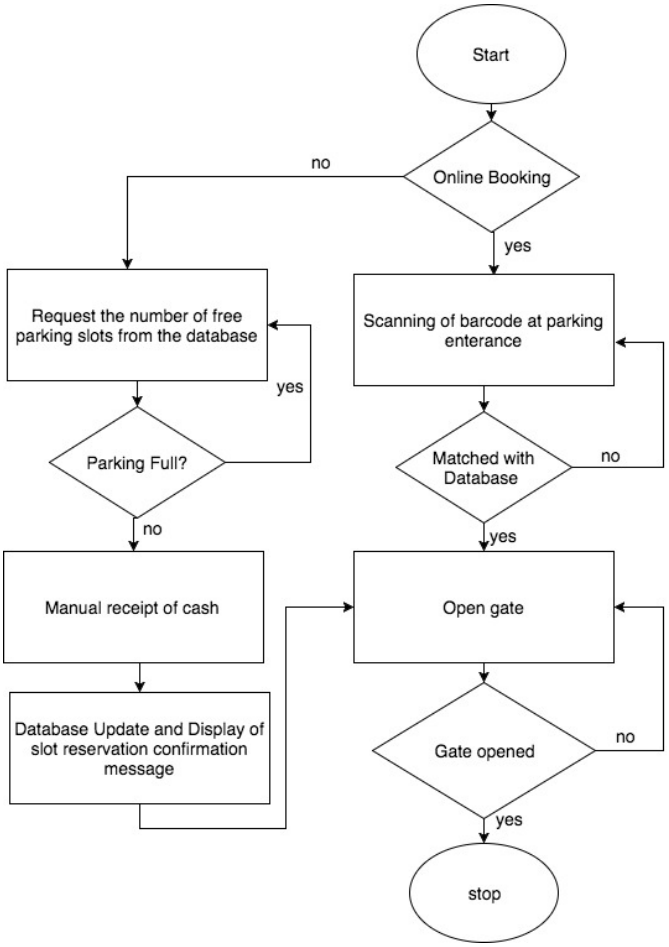


Fig. 3. Flowchart for Smart Entry Management System

IV. Implementation and Working

Each parking slot is fitted with an ultrasonic sensor which checks the status of the parking slot (Occupied or Vacant). This section provides a typical connection diagram for three parking slots in a parking facility. The three ultrasonic sensors (HC-SR04) are interfaced with ESP8266 based NodeMcu board as shown in Fig.4. Esp8266 has 3.3V tolerant pins. Hence Echo pin of HC-SR04 is connected to Esp8266 via resistor network formed using 2.2K and 4.7K. Here 2.2K is connected to Echo pin, and 4.7K is grounded.

The Trigger pin of 1st HC-SR04 is programmed with GPIO04 (D2), and Echo pin of it is programmed with GPIO05 (D1) of the board via above resistor network. Similarly, the Trigger pin of 2nd HC-SR04 is programmed with GPIO12 (D6), and Echo pin of it is programmed with GPIO14 (D5). The Trigger pin of 3rd HC-SR04 is programmed with GPIO15 (D8), and Echo pin of it is programmed to GPIO13 (D7) of the board via above resistor network.

NodeMcu is connected to Raspberry Pi3 as shown in Fig.4. The Rx pin and Tx pins of NodeMcu are connected to GPIO14 and GPIO15 of Raspberry Pi3 respectively.

VCC pin of all sensors, 5V pin of Raspberry Pi3 and Vin pin of NodeMcu board is connected to 5 V. The GND of all the sensors and GND of both ESP8266 board and Raspberry

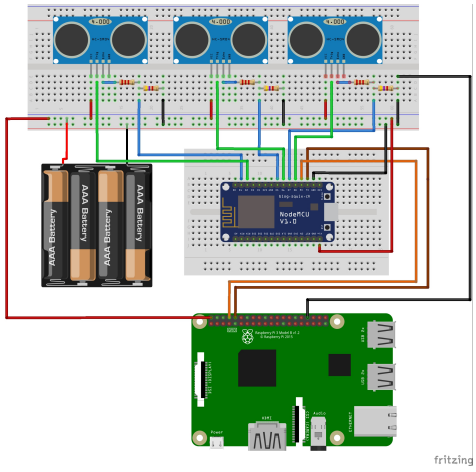


Fig. 4. Circuit connection of the system

Pi3 module are connected to Ground as shown in Fig.4.

Each of HC-SR04 sensor finds the parking slot is empty or occupied and send the data from Echo pin to NodeMcu, which is programmed in such a way that it processes the data and communicates the number of free parking slots to Raspberry Pi3 every 30 seconds. The Raspberry Pi3 collects information from all the NodeMcu's and updates the database with the total available free slots.

Mobile application and an online portal are developed to display the number of free parking slots in a location by obtaining data from the database. A user interface to book a parking slot online is also provided to the users.

V. Hardware Aspects

A. Node MCU

NodeMCU is a low-cost development kit based on ESP8266 which integrates GPIO, PWM, I2C, ADC, UART, SPI in one board. It includes USB-TTL. It contains 10 GPIO pins which can be programmed to PWM, I2C or 1-wire. It also contains and on-board WI-FI module and a PCB antenna. All the application specific devices and sensors are integrated to ESP8266 using GPIO Pins.

The Esp8266 present inside the NodeMcu is integrated with 32-bit TenSilica L 106 microcontroller unit which features extra low power consumption[13]. The low power management

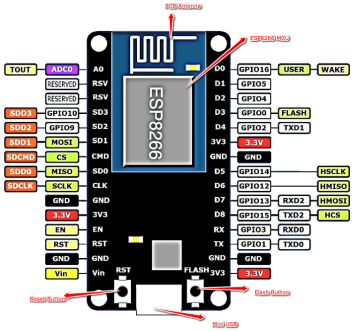


Fig. 5. Node MCU Development Board

is due to the power saving architecture as it operates in three modes: Sleep mode, Active mode and Deep Sleep mode. There are 13 GPIO pins in NodeMCU, Hence it can be interfaced with 6 HC-SR04 sensors.

TABLE I
NODEMCU SPECIFICATIONS

Specifications	Values
MCU	32 bitTenSilica L 106
RAM	36Kb
Clock Speed	80MHz/160MHz
Operating Voltage	3.0V 3.6V
Operating Current	80mA(Average)
Available GPIO Pins	13

B. HC-SR04

HC-SR04 is most popular and low cost Ultrasonic Sensor available in market. It has four pins, i.e., Trigger, Echo, VCC and GND. The GPIO port of NodeMCU triggers a signal of 10us square signal to the TRIG pin of HC-SR04, which sends eight 40khz ultrasonic waves and starts listening for echo. Once the echo is received the distance based on the time spent waiting for the wave to come back is calculated.

The comparison of Ultra Sonic Sensor (HC SR-04) and IR Sensor (SHARP GP2Y0A21YKOF) on the basis of their cost and specifications are shown in Table II [12]. Thus, it shows HC SR-04 sensor is more accurate and profitable for implementing smart parking system.

TABLE II
TECHNICAL SPECIFICATION OF SENSORS

Parameters	IR Sensor (SHARP GP2Y0A21YKOF)	Ultra Sonic Sensor (HC SR-04)
Range	10cm-80cm	2cm-10m
Beam-width	75 Deg	30 Deg
Beam Pattern	Narrow (line)	Conical
Frequency	353 THz	40 KHz
Unit Cost	750 INR.	130 INR.

C. Raspberry Pi 3

Raspberry Pi3 is a Debit card sized single-board computer with an operating system Raspbian installed. The specifications of Raspberry Pi3 are given in Table III [14]. The

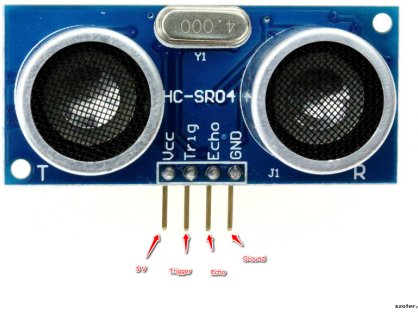


Fig. 6. HC-SR04 Sensor

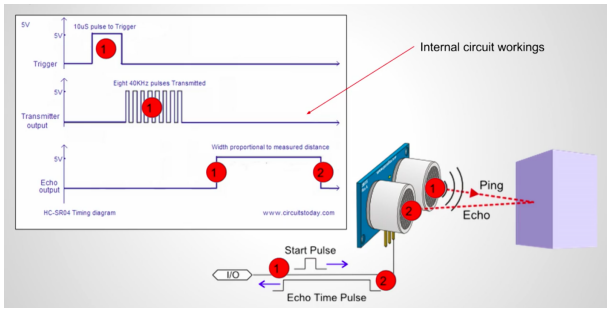


Fig. 7. Working of HC-SR04 [6]

Raspberry collects the number of parking slots from each NodeMCU and processes the data and updates the database with a total number of vacant slots. Fig.8. [18] shows the available interfaces in Raspberry Pi3.

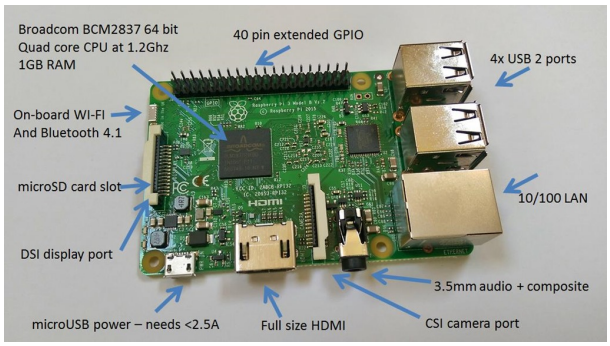


Fig. 8. Raspberry Pi3 Board

TABLE III
RASPBERRY PI 3 SPECIFICATIONS

Specifications	Values
CPU	1.2GHz 64-bit quad-core ARMv8 6
RAM	1 GB
USB Ports	4
GPIO Pins	40
Other Features	Bluetooth 4.1 Bluetooth Low Energy (BLE) 802.11n Wireless LAN Full HDMI port Ethernet port Combined 3.5mm audio jack and composite video Camera interface (CSI) Display interface (DSI) Micro SD card slot VideoCore IV 3D graphics core

VI. CHALLENGES OF SMART PARKING SYSTEM

The following are the Design and Implementation challenges faced in implementation of smart parking system

- Lack of a single technology to take care of all the requirements of the end user.
- Due to lack of Interoperability among all Internet of Things systems design of a perfect system with less cost becomes a difficult job.
- Knowledge of various domains of engineering is required for implementation of smart parking.

- In Internet of Things all the nodes and devices requires Internet and it is a major challenge to provide internet connection at every place.
- The power consumption of all the IoT Devices installed leads to an increase in maintenance cost.
- The theft of installed equipment is also a major concern.

VII. Conclusion

The Smart City Mission is the primary goal of the Government of India. The aim is to develop 109 smart cities all over the country [17]. The present growth in IoT and Cloud Computing makes data accessible anywhere and on any device. In this paper, an online based parking booking and management system are presented to address the parking issues in Hyderabad city and for deployment in Smart Cities. The users can book parking slot at anytime and from any location with their Mobile Phone or with a Computer.

References

[1] S. Lee; D. Yoon, A. Ghosh, Intelligent parking lot application using wireless sensor networks, International Symposium on Collaborative Technologies and Systems 2008, pp. 48-57, 19-23 May 2008, Chicago.

[2] International Parking Institute, 2012 Emerging Trends in Parking.

[3] Rico, J., Sancho, J., Cendon, B., and Camus, M. (2013, March). Parking easier by using context information of a smart city: Enabling fast search and management of parking resources. In Advanced Information Networking and Applications Workshops (WAINA), 2013 27th International Conference on (pp. 1380-1385). IEEE.

[4] Zheng, Y., Rajasegarar, S., and Leckie, C. (2015, April). Parking availability prediction for sensor-enabled car parks in smart cities. In Intelligent Sensors, Sensor Networks and Information Processing (ISSNIP), 2015 IEEE Tenth International Conference on (pp. 1-6). IEEE.

[5] A. Khanna and R. Anand, "IoT based smart parking system," 2016 International Conference on Internet of Things and Applications (IOTA), Pune, 2016, pp. 266-270.

[6] A. Dimitrov and D. Minchev, "Ultrasonic sensor explorer," 2016 19th International Symposium on Electrical Apparatus and Technologies (SIELA), Bourgas, 2016, pp. 1-5.

[7] A. I. Niculescu, B. Wadhwa and E. Quek, "Technologies for the future: Evaluating a voice enabled smart city parking application," 2016 4th International Conference on User Science and Engineering (i-USEr), Melaka, 2016, pp. 46-50.

[8] A. Roy, J. Siddiquee, A. Datta, P. Poddar, G. Ganguly and A. Bhattacharjee, "Smart traffic and parking management using IoT," 2016 IEEE 7th Annual Information Technology, Electronics and Mobile Communication Conference (IEMCON), Vancouver, BC, 2016, pp. 1-3.

[9] Megatrends 2015: Making sense of a world in motion,Uschi Schreiber.

[10] K. Hassoune, W. Dachry, F. Moutaouakkil and H. Medromi, "Smart parking systems: A survey," 2016 11th International Conference on Intelligent Systems: Theories and Applications (SITA), Mohammedia, 2016, pp. 1-6.

[11] T. N. Pham, M. F. Tsai, D. B. Nguyen, C. R. Dow and D. J. Deng, "A Cloud-Based Smart-Parking System Based on Internet-of-Things Technologies," in IEEE Access, vol. 3, no. , pp. 1581-1591, 2015.

[12] S Adarsh and S Mohamed Kaleemuddin and Dinesh Bose and K I Ramachandran "Performance comparison of Infrared and Ultrasonic sensors for obstacles of different materials in vehicle/ robot navigation applications" IOP Conference Series: Materials Science and Engineering,149 (2016) 012141 doi:10.1088/1757-899X/149/1/012141

[13] NodeMcu Documentation, https://nodemcu.readthedocs.io/

[14] Raspberry Pi Documentation, https://www.raspberrypi.org/

[15] Vehicle population in Indian cities, http://www.livechennai.com/detailnews.asp?newsid=18802

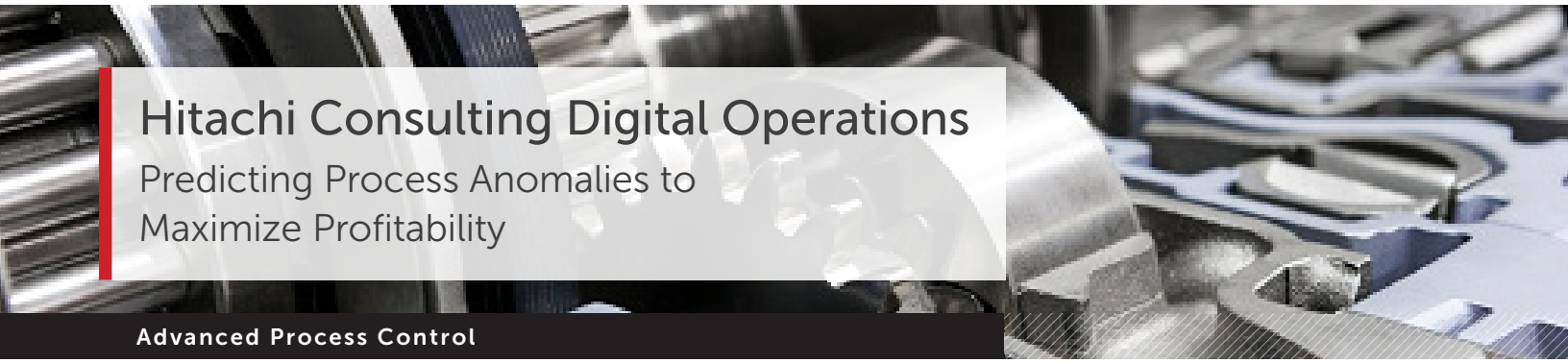
[16] Hyderabad Population, http://www.indiaonlinepages.com/population/hyderabad-population.html

[17] Smart Cities Mission, https://en.wikipedia.org/wiki/SmartCitiesMission

[18] Raspberry Pi3 Configuration, http://www.databook.bz/?cat=56"

Solution Overview

HITACHI
Inspire the Next



Hitachi Consulting Digital Operations

Predicting Process Anomalies to Maximize Profitability

Advanced Process Control

With the squeezing margin levels, manufacturers continuously face the challenge to optimize operating costs. Leveraging classical process improvement techniques and methodologies, most manufacturers have attained a certain level of process efficiency. Many have also invested in state-of-the-art machineries or upgradation of existing processes. Given the limitations on capital investments possible, it is imperative to extract efficiency and agility from existing processes. Hitachi Advanced Process Control (APC) techniques help track, control, and optimize the impact of a multitude of variables in real time for complex processes across the value chain, thus offering business benefits.

Background and Business Challenges

Despite the advancements in processes and technologies, companies continue to incur high costs on account of rework, quality rejections, quality inspections, sampling, and start-up or changeovers. The analysis shown in Table 1 highlights top issues identified by our clients across different verticals.

Table 1: Key Challenges across Different Verticals

Key Challenges	Automotive	Metals and Mining	Chemicals and Polymer	Consumer goods	Heavy Engineering	Power
High process waste and rejections	■	■	■	■	■	■
Unstable operating parameters	■	■	■	■	◆	◆
Inefficient asset operations	◆	■	■	●	■	■
Overtime hours on account of rework	■	■	■	■	●	●
High start-up losses	■	■	■	◆	◆	●
High calibration and maintenance costs	■	●	●	◆	■	◆
High sampling/appraisal costs	■	◆	◆	■	●	●

High ■ Medium ◆ Low ●

As apparent from Table 1, a high proportion of quality rejections remains a reality for manufacturing companies despite implementing process excellence programs and introducing automation. Many RCA exercises ascribe these rejections to operator inefficiencies, poor compliance to SOPs, and poor traceability. However, this approach, endemic to most manufacturing companies, glosses over the fact that multiple parameters, such as upstream process variables and changing material properties may have a role to play in the output quality for a given process.

Mature manufacturing organizations have deployed traditional improvement methodologies, such as 4M and DoE with varying degrees of success. DoE, in particular, has helped address multi-variate process optimization leveraging historical data which often is in the form of a snapshot of the actual process. This approach struggles to address inherent variabilities beyond those observed in the snapshot period—resulting in stagnating or even diminishing of benefits realized. The other challenge with existing approaches, much of it due to feasibility constraints (capturing the right data at right frequency), is the lack of comprehensiveness to address process variability.

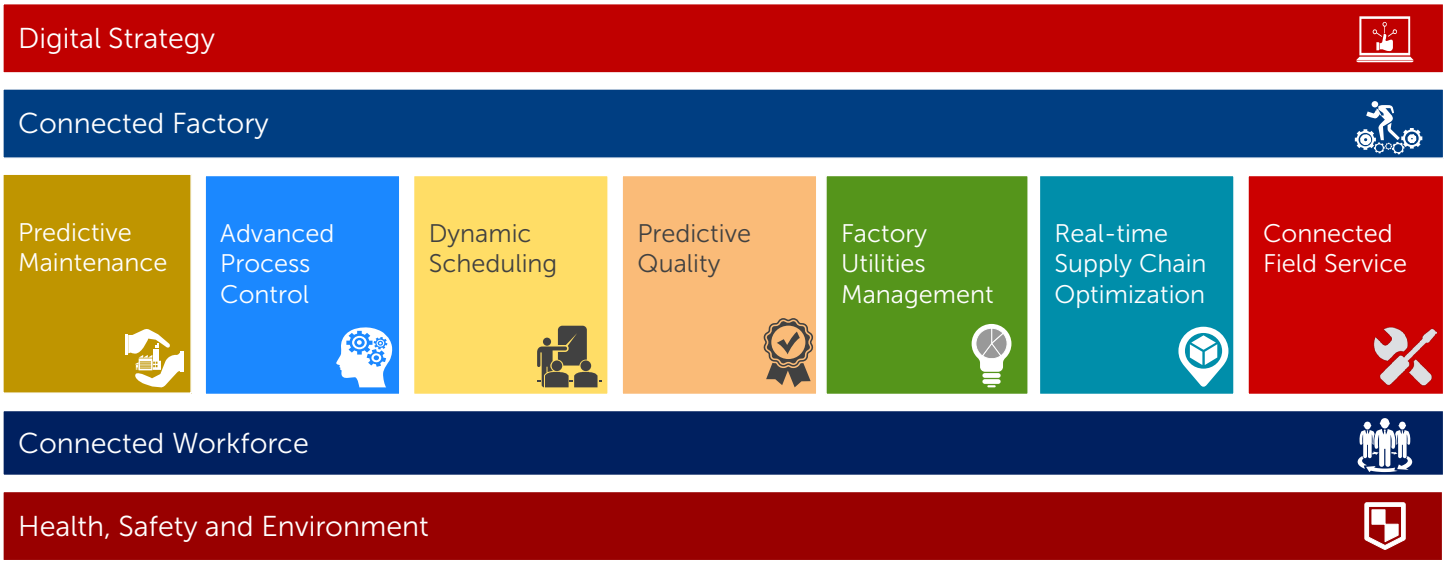
It is critical for the process experts to deploy a solution which can track all dependent and independent variables from an incoming raw material process to each of the in-process stages, output parameters for each in-process stage and compare it with the desired outcome as per customer's TDC. Variations within a process may be due to either an internal SSV where control is high or an external SSV where control is relatively lesser.

Manufacturers are increasingly articulating the lack of real-time process control mechanism or solution to enable immediate course correction or, even further, predict process anomalies to take preventive controls before problems occur. The need is not limited to just identification or prediction of a problem—these companies are looking at a closed-loop, remote operating system that would enable them to deploy corrective measures at any point across the globe.

In summary, traditional business excellence tools and techniques still form the foundation of continuous improvement across all manufacturing companies. The task at hand is to identify the incremental potential, visualize and optimize the hidden losses, and unearth the complex and intrinsic process dependencies which need substantial ingress into the processes.

Solution and Approach

Hitachi Consulting has a broad umbrella of offerings under its Digital Operations Suite.



Within this suite, Hitachi APC is a comprehensive process management solution that performs multifaceted tasks, such as:

- Integrating with the entire value chain (from upstream processes to downstream processes/output) and helping establish an end-to-end relationship between factors responsible for process variations
- Real-time tracking of all dependent variables within the process and across the value chain
- Unearthing the extent of relationship and impact of various variables
- Enabling supervisory control against the anomalies detected—ensuring a closed-loop control

Select Industry-specific Use Cases

Industry-specific application use cases and KPIs impacted are highlighted in **Table 2**.

Table 2: Application Use Cases and KPIs by Industry

Industry	Application use case	KPI impacted
Steel	■ Controlling the Zinc over coating process and dross optimization ■ Optimum operation of furnace parameters to ensure right quality output and optimized cost	■ Processing cost ■ Quality cost
Automotive	■ Optimizing welding parameter settings ■ Reducing the defects from molding of oil seals and radial shaft seals	■ Processing cost ■ Quality cost
Utilities	Monitoring and control for high pressure piping operation to prevent breaching of safety limits for equipment, such as compressors and steam generators	■ Uptime% ■ LTIFR
Petrochemical	Controlling auxiliary units and processes for by-product plants, thereby ensuring continuous running of by-product as well as primary operations	■ Processing cost ■ Uptime% ■ Utilities cost
Cement	Predicting and ensuring efficient raw material blending for optimum level of clinker operations	■ Conversion cost
Electrical goods	Real-time control and optimization of molding parameters, such as hardness and pressure, for enhanced RFT	■ Quality cost

Thus, in terms of applications, Hitachi APC can:

- Supplement traditional business excellence programs by extracting value beyond the limits of realized benefits
- Achieve quality and cost benefits in existing operations independently of business excellence programs

A typical deployment of Hitachi APC includes three levels of process management as shown in **Table 3**.

Table 3: Hitachi APC Process Management

Level-1	Level-2	Level-3
Process Monitoring	**Process Analytics**	**Process Control**
■ Shortlisting the process based on business impact ■ Ascertaining the extent of variation by extensive analysis of data of a 3-6 month period ■ Mapping the SIPOC chain of the process and mapping the dependent/ independent variables through SPC ■ Capturing the data available from existing PLC/SCADA ■ Installing sensors, actuators or connectors wherever infrastructure is not capable ■ Setting up database historian/ acquisition infrastructure	■ Setting of boundary conditions (UCL/LCL) for all variables ■ Developing anomaly detection algorithms and advance clustering techniques (Vector Quantization Control and Local Subspace classifier for desired accuracy and precision) ■ Enabling flagging for any status changes in the variables ■ Developing direct and interaction effects of variables through realtime ANOVA	■ Developing an optimization model using MPC ■ Performing sensitivity studies ■ Conducting trial runs ■ Revising or upgrading SOP as needed ■ Capability building for the operations team
4-8 weeks	8-10 weeks	4-6 weeks

Hitachi APC aims to manage complex interactions within a process in such a way to reduce process variability and allow the plant to run closer to the operating constraints. This results in higher energy efficiency and product quality. One of the USPs of Hitachi APC is the holistic perspective with which the whole value stream is analyzed and optimized. After Connected Factory, the Advanced Process Control is a logical next step in ensuring a robust process baseline.

Contact Us

info@hitachiconsulting.com

List of Acronyms

APC	Advanced Process Control
RCA	Root Cause Analysis
SOP	Standard Operating Procedure
4M	Man-Machine-Material-Method
DoE	Design of Experiments
TDC	Technical Delivery Compliance
SSV	Suspected Source of Variation
LTIFR	Lost Time Injury Frequency Rate
RFT	Right First Time
UCL	Upper Control Limit
LCL	Lower Control Limit
SIPOC	Supplier-Input-Process-Output-Customer
MPC	Model Predictive Control
SPC	Statistical Process Control
PLC	Programmable Logic Control
SCADA	Supervisory Control and Data Acquisition
ANOVA	Analysis of Variance
USP	Unique Selling Proposition

Hitachi Consulting

Hitachi Consulting Corporation
Plot #9, Nanakram Guda, Gachibowli,
Hyderabad, Telangana, 500032

Hitachi Consulting is a leading global professional services company and business integrator for the IoT era. We engage with clients to solve complex business challenges with innovative and integrated solutions across industries in the spirit of our parent, Hitachi, Ltd., a global leader in technology and social innovation.

August 2017

SMART Motors for Industry 4.0

Swapnil Dol
Dol Motors Private Limited, Rabale, Navi Mumbai

Raunak Bhinge
Infinite Uptime India Private Limited, Bhosari, Pune

Abstract
With the world moving towards the era of Artificial Intelligence (AI) and Internet of Things (IoT), there is a need for technologies that align with the customer expectation of making their plants more intelligent and communicative in a wireless manner. The currently trending concept of Industry 4.0 introduces what has been called the "smart factory," in which cyber-physical systems monitor the physical processes of the factory and make decentralized decisions. The physical systems become Internet of Things, communicating and cooperating both with each other and with humans in real time via the wireless web[1].

Electric motors are the workhorses of the industries. Electric motors have been the prime drivers in industry for decades and shall probably remain so for several years in future. Today, almost 45%[2] of global electricity generated and 70%[3] of total industrial electricity consumed is by Electric motors. The breakdown of Electric Motors leads to large amount of financial, production and reputational losses to the industry. Also, electric motors being prime movers of almost all dynamic machinery in industry, a large amount of productivity and efficiency data can be generated from them which is currently untapped.

Production outputs of the industries require continuous running of processes and the equipment therein used for the processes. Any failure of the equipment or stoppages result in high production losses. Electric motors are prone to failures due to number of reasons like misuse, wrong maintenance practices, unhealthy electric supply, aging, harmful ambient conditions etc.

Today, in the industry, there is no scalable way to collect data from the equipment. Majority useful data is lost due to unavailability of a suitable intelligent technology. Through this paper, DOL Motors addresses these concerns.

The paper introduces SMART Electric Motors, the future of Electric Motors. A SMART Motor analyzes its own health and predicts failures much in advance, which allows corrective actions to be taken to avoid premature equipment & process breakdowns in the industry.

SMART motors coupled with various equipment also act as a pattern learning device to gather the, much needed, hidden, equipment productivity and efficiency related information. This information can be a very useful MIS data to improve the productivity, efficiency and Overall Equipment Effectiveness (OEE) for the industry.

DOL Motors, in collaboration with its business partner, Infinite Uptime, has developed a working model of a SMART motor. The SMART motors, through complex and advanced edge computing, communicate and transfer the useful data to a cloud. The health and productivity data from the motor can be remotely & wirelessly accessed through internet from anywhere in the world. SMART motors are provided with an easily accessible and user-friendly dashboard that organizes the data in a readable and analyzable manner.

In future, SMART Motors can lead to various useful applications such as remote wireless controlling of equipment, inter-machine communication and multiple equipment data aggregation. This technology is a step towards a completely automated and wireless industry or in other words a step towards Industry 4.0.

The Need for SMART Motors

Proactive Maintenance

Historically, industry has seen three main revolutions in the field of maintenance of Electric Motors.

- Breakdown maintenance

  In earlier times the maintenance activity on a rotating machine was carried out only after breakdown of the machine. Users preferred running the motors till the end of its life and

extract maximum production possible. The breakdowns resulted in heavy loss in terms of time, money and reputation to the users. The repair costs were very high if the breakdowns were resulted through faults such as winding failure, bearing seizure, shaft breakage etc. This led to heavy maintenance budgets for the users.

- Preventive maintenance

  As the user began to realize the loss due to breakdown, he began to have planned shutdowns and conduct preventive maintenance activities which included cleaning & re-impregnation of windings, bearing replacement, dynamic balancing of rotors etc. Preventive maintenance reduced the breakdowns to considerable extend. However, shutdown of the complete plant or section still incurred losses. During plant shutdowns, certain activities such as bearing replacement were performed on motors unnecessarily even though the bearings were in good condition.

- Predictive maintenance

  It was necessary to identify which machine actually needs maintenance in order to curtail unnecessary shutdowns and high budgets for maintenance. Solutions such as condition monitoring & residual life analysis (RLA) were introduced. The equipment cost and the cost of the trained team to analyze the health of the motor was extremely high. Users depended on the third-party agencies to conduct the condition monitoring activities on their motors. The consultation fees of these parties were also very high. The main issue with this type of maintenance was that the motors remained unmonitored for long time between two measurement sessions. Users faced breakdowns between the two sessions of condition monitoring, hence only partially severing the purpose of avoiding an unplanned breakdown.

With the introduction of SMART motors, DOL Motors wishes to address both these major concerns. SMART Motors will further revolutionize the Electric Motor Maintenance field. This will be the 4th revolution in the Electric Motor Maintenance field that will be known as Proactive Maintenance or Maintenance 4.0. The users of the Electric Motor can have a 24X7, 365 days monitoring of their motor health.

Improved Productivity

Today, the world has limited natural resources and unwanted losses are a major concern. Any improvement in the productive and efficiency of the industrial machinery can lead to the much-needed relief. Also, in today's competitive world where information plays a vital role in the survival of the companies, there is tremendous data loss due to unavailability of smart equipment to capture the same.

SMART Motors can capture vital information such as output per day, pressure, flow, strokes per day, downtime, idle time etc. that can be then analyzed for running the plants more efficiently.

SMART Motors Technology[4]

The SMART motor technology comprises of an Industrial Data Enabler (IDE) embedded inside the motor body comprising of an apparatus with vibration and an acoustic sensors, a processing unit and a wireless communication device for data transfer. A USB micro type B port provides the necessary power to the device. The IDE is powered by a 5V DC supply. The 415V AC supply is tapped from the two phases of the motor and converted to 5V DC through a custom built AC/DC converter.

The IDE has two streams of real-time data available wirelessly, namely vibration data and acoustic data. An acoustic sensor sampled at 48000Hz provides high frequency and instantaneous condition of the noise from the motor. Data from the acoustic sensor is collected in a serial buffer. A 9-axis Inertial Measurement Unit (IMU) sampled at a frequency of 10000Hz, based on the acoustic sensor callback, provides high-resolution data of vibrations of the motor. Data from the Micro-Electro-Mechanical Systems (MEMS) accelerometer is collected in the same buffer as acoustic data. As soon as the acceleration data is collected these two sources of data are combined together and sent wirelessly in a single data package to a data-monitoring dashboard on the cloud. The wireless communication system used, in this embodiment, is a Bluetooth Low Energy (BLE) module. The information received by the BLE router in-turn transfers and stores the data on cloud through Internet.

The 9-axis IMU communicates using the I2C protocol whereas the MEMS microphone communicates using the I2S protocol. The Bluetooth data communication is over serial. The

output data of the BLE router is made available on a customized, cloud-based, dashboard for motor condition monitoring and process optimization.

The details of the components used in the sensor system are as under:

- A digital 9-axis accelerometer
- A low-noise microphone with I^2S digital output
- A powerful microcontroller
- A Bluetooth Low Energy communication module

The IDE was developed at the University of California, Berkley by the founders of Infinite Uptime as their doctorate project and is patented at the US Patent and Trademark Office (USPTO).

SMART Motors

With years of hard work and R&D; Infinite Uptime, the partner company of DOL Motors; has created the Industrial Data Enabler (IDE). The IoT based device, IDE, gets embedded inside the motors to capture essential health & productivity data of the motors and wirelessly transfers the same to a cloud space. This data can be accessed from anywhere in the world and the health & productivity of the motor can be analyzed.

Fig. 1: IoT based condition-monitoring device

The data collected is presented in a customizable format on the computer, tablet or smart phone screen on a very simplified dashboard.

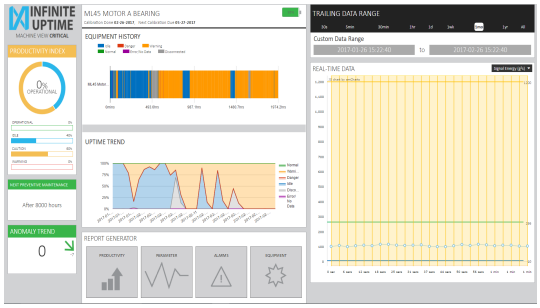


Fig. 2: SMART Motor dashboard

The SMART Motor is capable of capturing

- Tri-axial vibration in the form of acceleration, velocity and displacement
- Body temperature
- Noise, Frequency spectrum & RPM
- Number of running & idle hours
- Any remotely configurable frequency spectrum parameter, such as the vibration energy in a specific frequency band
- Equipment productivity parameters

The most unique feature of the SMART Motor is communicating the alerts related to non-conformities in the motors to the users through SMS and emails. This ensures 24X7, 365 days monitoring and corrective action can be taken in the early stages of faults. The SMART Motor also captures the idle time and the running hours. User can use this data to plan the re-greasing cycles and overhauling activities. Another key feature of the SMART Motors is the conversion of the raw time-domain vibration signal into a frequency domain spectrum through FFT. Today, FFT spectrum is widely used to analyze the source of vibration. By carefully tracking the high peak frequencies by a trained person the source of vibration can be detected fairly accurately.

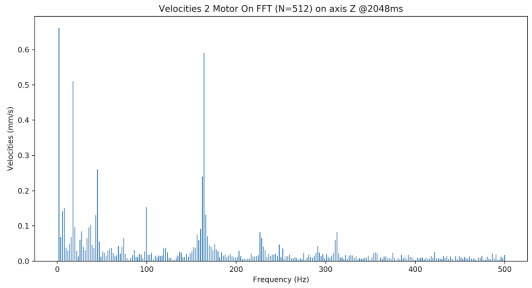


Fig. 3: Sample FFT Spectrum from the SMART Motor Dashboard

The operating schematic of SMART Motor is shown in Fig. 4. The SMART Motor captures useful data and transfers it to a router via Bluetooth. This router then transfers the data to a dedicated cloud space which can be accessed from anywhere in the world with the help of a user ID and password.

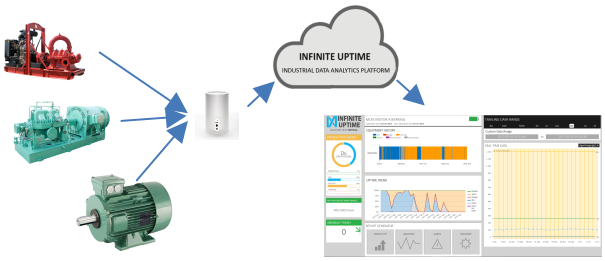


Fig. 4: Operating schematic of the SMART Motors

The R&D on the SMART Motor is still in progress and various features shall be incorporated in the device to give a holistic condition monitoring solution & productivity parameter of the motors. Some of the key parameters expected to be incorporated are as under:

- Electrical parameters such as voltage, load current, input power, power factor, efficiency etc.
- A provision to capture the data from already existing monitoring devices such as winding RTD/PTC/Thermocouples, bearing temperature detectors etc.

As the SMART Motor evolves DOL Motors expects to cover more and more parameters pertaining to health, efficiency & productivity of the motors to provide a complete solution to the industry and in turn reduce the down time and increase productivity to a greater extent.

Converting Existing Installed Base of Motors to SMART Motors

SMART Motors developed by DOL Motors have a completely embedded system within the motor to capture the motor health parameters and productivity parameters. The sister concern of DOL Motors, DOL Electric Co Pvt Ltd has developed the ability to convert the existing installed capacity of standard motors in the industry into SMART Motors. With minor modifications to the regular motor, DOL Electric can embed the IDE inside the motors.

In case the user is averse to modification of the motor, DOL Electric can also provide the IDE which gets mounted on the motor body externally with the help of a strong magnet or with a suitable industrial epoxy.

The embedded IDE or the externally installed IDE can make the standard motor to act as a SMART Motor

Case Studies: Pilot Installations

While DOL Motors developed the SMART Motor, a number of trials were conducted at various motors in the industry through the externally mounted IDE. During the 2 weeks or 3 weeks trials, a large amount of useful information was captured which was otherwise lost. This information led to several corrective and preventive actions on the motors, equipment and process in the industry to reduce the unwanted breakdowns and improve the overall equipment productivity. Some of the sample case studies are as under:

Case 1

The system was installed on a 600kW, 6.6kV, 1000RPM cooling tower motor in a petrochemical plant. Even though this motor was running without any issues and with vibrations well within the limits, the system was installed on this motor to assess the diagnostic abilities of the system. The driving end of the motor was running satisfactorily. However, the non-driving end showed some issues. Following observations were made in the NDE of motor in the two weeks trial:

- Widely varying temperature profiles which had a continuous repeatable pattern in the first half of the day
- Sharp peak / increase in temperature on one particular night at 2 am which was tagged as anomalous by the system. It is more pronounced on the drive end than the non-drive end
- Average temperature of around 42 degrees, but high standard deviation indicating a loading and unloading pattern or varying load patterns
- Similar temperature profiles in drive end and non-drive end indicating a loading pattern rather than a faulty bearing
- Much lower variation in temperature at the drive end than the non-drive end

These observations were acquired from the trending of the temperature profile over a period of two weeks. The trend can be seen in below picture:

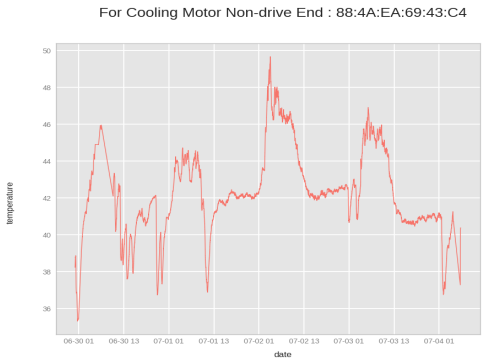


Fig. 5: Temperature Vs. Time Trend of the NDE bearing of Cooling Tower Motor

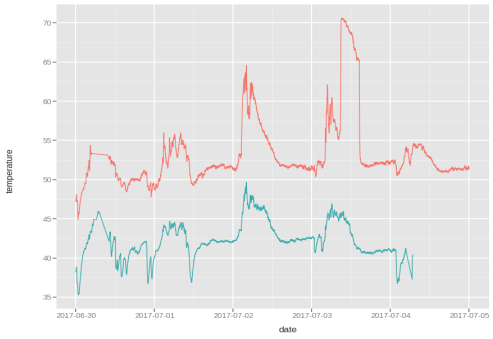


Fig. 6: Temperature Vs. Time trends of the DE & NDE bearings for Cooling Tower Motor

The data distribution graph of Temperature also revealed some load site factors affecting the motor behavior as under:

- Concentration of the temperature was found in the 52 degrees region
- Anomalous behaviour in the 70 degrees region which was not uncommon, and had occurred multiple times
- Unusual distribution of temperature between the 65 to 70 degreed regions with a long tail indicated a heavy loading which either lasted longer than normal or occurred multiple times

The distribution data is shown below:

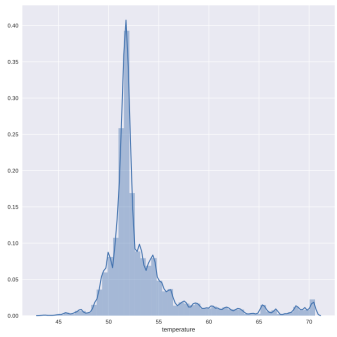


Fig. 7: Temperature data distribution chart for Cooling Tower Motor

The vibration levels were found to be fairly low and much within the limit. However, the point to be noted was that the vertical vibrations were found to be distinctively high as compared to the horizontal and the axial vibrations.

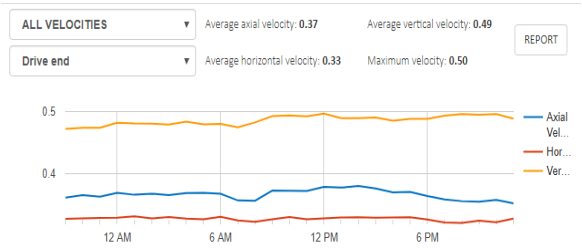


Fig. 8: Comparison of vibration velocities on the DE

The high vertical vibrations could be due to the mounting foundation losing the rigidity over the years or the motor body warping causing soft foot condition.

Case 2

In this case a high-speed multistage pump was identified by a company which used to breakdown prematurely with no warnings in their internal condition monitoring system. This used to create tremendous production loss and chaos during the emergency repairs. A two-week trial was taken on these pumps to reveal distinct anomalies. The time vs temperature graph revealed following information:

- Widely varying temperature profiles which had a continuous repeatable pattern
- Sharp peak / increase in temperature on one particular day which was tagged as anomalous by the system
- Average temperature of around 50 degrees but high standard deviation indicated a loading and unloading pattern or varying load patterns
- 2 peaks a day seemed to recur repeatedly

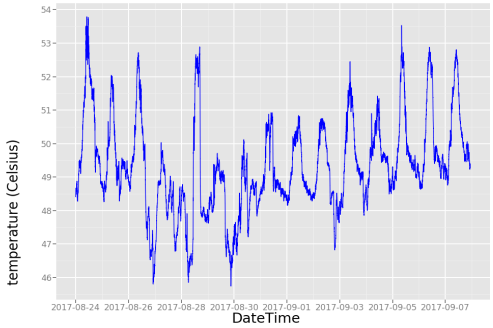


Fig. 9: Time Vs Temperature graph for high speed pump

The vibration trend over few days indicated two anomalies, one lasting for 3-4 days and one for only one day.

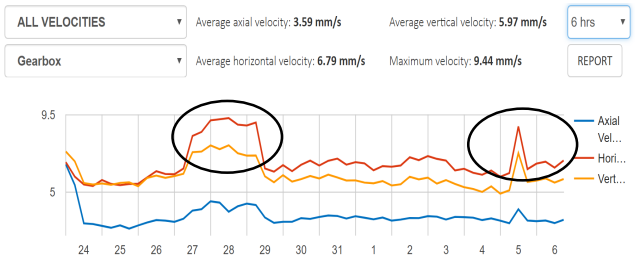


Fig. 10: Vibration velocity trends showing peaks at two different occasions for multispeed pump

Customer was informed about the same through email and SMS alerts.

The FFT spectrum of the vibrations in axial axis was found to be very unusual with multiple peaks and anomalous harmonics in the 2x, 3x and 4x regions (first two even and first odd harmonics). This may be due to the multiple speeds that the different sections of the pump run at or it can also indicate looseness and misalignment.

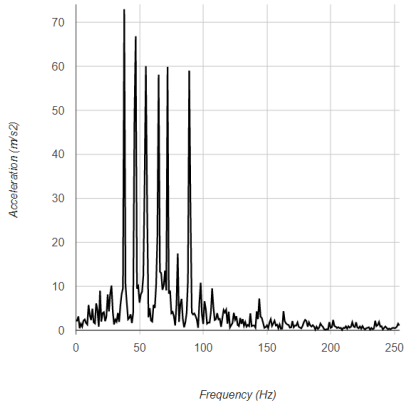


Fig. 11: FFT Spectrum of the vibrations in axial axis of the multi speed pump

Customer then analyzed the anomalies detected during this two-week trial. As the trial for short period, the customer could not get enough data to conclude the causes of these anomalies. Customer had planned to install the system on 10 nos. of pumps to gather large sample data to arrive at a conclusive explanation for the anomalies and hence take corrective action to reduce the unplanned breakdowns.

The above two case studies acted as successful pilot projects for the development of the SMART motors by DOL Motors which can prove substantially beneficial for the Industry.

Future Scope for SMART Motors

This paper elaborates how the SMART motors can diagnose its health parameters and identify the productivity anomalies through pattern learning technology. However, the SMART motors are not restricted to only these two features. Once the motor starts communicating useful information through a cloud based system, it opens doors to possible future usability. Some of the future developments envisaged by DOL Motors are as under:

- SMART motors can lead to communication between various equipment operating with SMART motors, leading to scheduling of production cycles
- SMART motors can be developed to communicate with other smart devices in the industry to lead to a real functional smart factory.
- SMART motors can be developed to communicate with smart device aggregator software

With the above developments in SMART Motors, DOL Motors is aimed to completely eradicate the need for PLC based control systems that extensively drove the 3rd revolution in the industry. By beginning a new era of IoT based communication solutions through the SMART Motors, DOL Motors has taken the first step towards the trending concept of Industry 4.0

---

[1] "*What Everyone Must Know About Industry 4.0*" - Bernard Marr, Forbes.com

[2] Clean Technica

[3] Industrial and Commercial Power Systems Technical Conference, 2008. ICPS 2008. IEEE/IAS

[4] Provisional Patent filed in US Patent and Trademark Office (USPTO), Attorney Docket No. BK-2016-109-1

Automation: Effect on Employment Opportunities

KM Rama Krishna Prasad

Abstract:

Time and again innovations and improvements in industry have caused apprehension on causing job losses. Despite such discernment, industrial revolution that was founded on mechanisation and automation has only increased to engage more people providing employment to millions and increasing productivity. Notwithstanding the increased standard of living that was a resultant of increased automation, despite being enthusiastic in using the automation in our daily lives, there is a constant fear of losing jobs.

Well, here we revisit the effect of Automation on employment opportunities. Increased automation only demands more skilled people to handle it. There is a need to increase skills of people and make them competent so they can handle various aspects of automation from designing to maintenance. This involves increasing academic standards in technical schools. Apart from skill enhancement, there is an immediate need to standardise the automation systems so there would be less similar skills that would be in demand. Instead of worrying over fears of job losses, it is time to prepare all institutions to engage automation in a way it would generate more jobs, apart from increasing quality and productivity in a safe working place.

Introduction:

The history of human evolution is the story of making and pursuing right choices, after each invention. Fire, the dangerous element used to thwart enemies was used to cook food. Even in modern days, only after bombing two cities, nuclear energy is used to power industries and homes. Time and again, humankind had faced this dilemma of fearing the *new*, but subsequently, with relentless perseverance, has learnt to use the supposedly bad things like fire and atom bomb too to improve lives. How come then, a better topic like 'Automation' be bad for us? Well, these are not my words as an Automation Engineer, but only as an observant human being.

If it is automation in the modern world, it was mechanisation in the medieval world. Somewhere I read that English Queen didn't want sewing machines to be made – so the tailors, who stitch clothes for others – manually, would not lose their jobs. And, the sewing machines not only helped people domestically, but went on to become an integral part in the industrial revolution.

Perhaps it is simply not relevant to discuss about the 'ill effects' of Automation on Employment. India had witnessed the opposition to “Computers” based on fears that they may replace people and cut jobs. It only took one and half decade for India to establish itself as one of the IT majors in the world. However, pushing Automation, citing the experience of Computers without proper study and evaluation amounts to thrusting opinions on others.

Why the fear of Job Losses?

People fear of Automation only because the first question the client asks the sales representative explaining the features of latest automation system is: “How many people it can replace”?

The modern managements aspire to run businesses with less manpower so there are less problems to deal with. However, they forgot one critical learning from the history, that of the British Empire. One of the reasons the British Empire could almost envelope the world was they were good in dealing with people. With more advanced machinery at their disposal, all the Americans could do was to decimate nations, but *not rule* them. The art of 'managing people' is the basic trait of doing business. *Those who feel they shall do business without engaging with people have no business to be in business.*

Systems do replace People. Isn't it?

On the face of it, this appears to be true. Well, now a days no one would drive bullock carts. Tractors have replaced them. Same is the fate of hand pulled and pedalled rickshaws, which were omnipresent few decades ago, but are largely confined to few towns now. Where are the STD booths now? Once a huge profit making business, now a public telephone is one of many equipment in general stores. And, what happened to the manufacturers of type writers? Even the latest of all, tape recorders and CD players have vanished from the houses. The most significant of all, the personal computer in its original form of various components connected together, itself is now on its way out, making place to Laptops and Cellular Phones.

Did all these new equipment replace people? On the contrary, employment opportunities have grown with the induction of new equipment. Of course, people are no longer employed in the same old jobs they were doing. *They started doing new jobs, by learning and upgrading their skills.*

Is Techno-Phobia Unwarranted?

The current discussion about job losses due to automation has originated in the west. Even there, the official stance by the administration about Artificial Intelligence replacing people is expected to happen only after a century, though the technical group feels it would only be a matter of few years.

However, there remain few unanswered questions that need to be looked into. Let us discuss the driverless truck that is expected to carry goods rendering drivers jobless. Will driverless trucks carrying goods be allowed to ply on the roads along with passenger cars and buses? What happens if the truck develops a snag and causes an accident? What would be the cost of losing human lives? As long as these questions are not addressed, should the drivers fear of losing their jobs? The answer is a big NO.

The fundamental difference between AI and Human intelligence is Humans learn and evolve with time. So, if a Robot is programmed to learn and evolve, where will it lead to? Though this question is hypothetical, some bright minds overseeing AI have expressed reservations to what extent AI can be developed without affecting human safety.

Even when automation takes over fully, don’t we need people to maintain them? We certainly do need more people to design, install and maintain new automation in growing proportion. *Only, they need to have sufficient skills to handle the continuously evolving automation.*

It is All about New Skills

We all were constantly bombarded with *“Change is the only Constant Thing”* - a slogan promoted by Jack Welch. What Welch did when he was at the helm of affairs was needed at that time. And now, it is time to talk about *“The More things Change, The More they remain Same”*.

In the current context, this can be rephrased to “The more innovations and automation, the requirement for skills is more”. With Automation, some good old skills learnt by workmen by doing things manually, which transformed them into fine craftsmen have been forgotten. Are they not needed? They are certainly needed. And, few wise organisations like Toyota have started cutting down on automation and making an optimal mix of people with machines with an aim to have higher quality and productivity in the long run.

Automation in Indian Industry

Automation in Indian industry is guided by two needs. When the plant is too big involving a complex process or when the quality demand of the produce is too vital for the survival of the unit. Plants are automated because there really is no alternative. Automation in these industries involves process control, equipment safety. Coupled with safety systems, ERP they form the core market for big automation companies.

Automation exists in small enterprises too ranging from auto-ancillary units to plastic and metal extrusion units to various assembly units. Here, the automation is strictly the bare minimum, unless the owner is a tech-savvy guy.

Then, there are heavy equipment used in mines, industries and for infrastructure building. Most of this equipment are automated for ease of operation and control.

Scope for Automation

The scope for Automation in existing industries is twofold. One is to automate processes to improve efficiency/productivity and quality and the other one is to install/improve automation to enhance safety of operations and personnel.

The first one is where the processes are not too complex and do not call for automation by default. These are normally medium to small industries with low investment and few employees. This is the domain of the automation companies, but it is really difficult for any marketing team to identify opportunities and convince the client to go for automation as the availability of capex is less. But, there is a huge scope.

The other one is to automate systems for improving safety of operations and ensure plant operations are adhering to environmental norms. Well, it is not that these plants do not have safety systems and apparatus installed. They do install safety apparatus mandated by the statute. The question is about the sufficiency. In larger plants safety audits are conducted and opportunities for improvement are identified. But, in small units, the unsafe conditions and practices become the norm over time and the much needed systems are not properly maintained leading to their malfunction in time of need.

How to proceed with?

Automation companies shall try to educate medium and small industries to operate their plants in a safer, efficient manner. The loss of running the plant in an inefficient way needs to be explained. Local statutory authorities shall arrange a knowledge exchange programme between technology suppliers and industries. Each industrial area shall have a nodal officer who would be responsible for identifying opportunities to improve safety and efficiency of plant operations – by adapting new practices or systems. It would be good if this nodal officer is recruited or contracted by the group of industries, rather than being a government appointee. This would eliminate the ‘fear’ of government inspection while helping the industries to improve themselves.

It is time to identify industries that release untreated emissions into the air and effluents into public drains/canals. A plan for transforming industries into environment friendly ones needs to be prepared and executed.

Each industrial area shall also identify units that are releasing pollutants into the atmosphere – be it gaseous emissions or liquid effluents or even solid waste. Addressing this issue on priority would not only lead to the health of employees of these units, but even the general public living in the vicinity. Once it is decided to stop further pollution, the cleansing of the processes would involve new equipment that would be state of the art.

Where the new jobs will be?

Scope for automation is proportional to the growth of general industry and its modernisation. As such, Indian industry itself has so far not grown to its full potential. The defence sector is just opening up. Food processing industry is still in its nascent stage. The biggest growth without government's intervention may be seen in the Agriculture sector.

Mechanisation of Agriculture in India is very little except for the usage of tractors. All processes of farming, from sowing to harvesting would be mechanised in the next two decades. Farming land in India is second largest in the world and so the scope for mechanisation would be tremendous. The demand for labour in agriculture sector is seasonal and labour availability has become a concern in the last one decade. This would force farmers to embrace mechanisation. Improved mechanisation means more demand for the equipment for the manufacturing sector. The need to have cold storage facilities and food processing units was already felt and would be in the focus. These food processing units would have to be stringent norms of operations and quality – the stimulus to have automation. Cold storage & Food processing units would be providing employment to people throughout the year, instead of engaging them seasonally.

In the urban areas, municipalities would be forced soon to have waste treatment facilities. These would be providing continuous employment. Even the waste collection and segregation would be critical. Though waste collection may remain in the present form, heavy automation would be needed for ensuring waste segregation untouched by human hands.
There is a need to mechanise some jobs like cleaning sewers, cleaning glasses of skyscrapers as these workers are exposed to risk of accidents and health hazards. And, this mechanisationwould in fact create more jobs. More jobs would be created in the manufacturing and service sectors to sustain the level of mechanisation and automation that would happen in the coming decades.

Challenges:

The challenge with increased automation is the availability of skilled professionals to sustain the automation – from engineers to technicians. Though the basic requirement is to enhance the quality of education in engineering colleges, there is a need to include some practical aspects of industrial automation in the syllabus so the graduates would know about various processes and automation techniques. At present, some system houses of big automation companies are conducting training courses for qualified graduates and diploma holders. As such programmes are few and cannot prevent the time lost by the student in preparatory years, there is an immediate need to impart these skills as part of curriculum.

Especially in polytechnic colleges that deal with Electrical and Electronics, there is a need to teach about function of and handling latest protection devices, PLCs. ITIs in close vicinity of large industries shall be adopted by those industries so the students would be well versed with techniques of their trade and will not remain just helping hands with a certificate and start learning only during on job training.

As of now, percentage of practising engineers in academic stream is very less. It is time to have certain percentage of teaching staff from industry. As technical institutes have grown in an exponential way in the last two decades, most of fresh graduates have been inducted into teaching stream. The growing demand of technical knowledge and skills could not be imparted to the students.

The interaction between academic institutions and industries should increase much more from the present levels of having only some project work being done in the industry. This would help to grow a robust Research & Development environment on its own, in both industry and academic institutions and is vital for the general growth of Indian industry.

Negative impact of Automation in Industry and its Prevention

The negative impact of automation in the industry is experienced only after considerable time, and not before at least there is a generation change. Operators running the plant before automation are normally well versed in the operations. They do operate the plant manually and respond to routine changes and contingencies in the most efficient way. They develop a feel about the health and condition of the equipment and process. However, the group of operators who enter into an automated plant know only to respond to few critical aspects to which they were trained. Imparting process training is done in some plants to keep their operators abreast of the situation.

However, in production units with assembly lines, operators would simply be feeding parts and press buttons in the predefined sequence. The craftsmanship deteriorates over time and this was what Toyota has experienced and tried to create an optimal combination of human skills and efficient machinery.

So, it is vital for any industry to have a skilled team that can handle all situations so that the plant can sustain over long term. This only can be done by continuous training of employees involving tests. Indian industry is far from using automation to its full potential and this would depend on the skill sets available with automation engineers and technicians.

Standardisation: Responsibility of Automation Companies

There is a need to increase standardisation in the automation industries. Hardware and software components of control systems need to be standardised. If we expect automation to percolate industry the way cellular phones entered our lives, this is of vital importance. There is a need to have controllers developed with modular structures wherein CPUs and IO cards made by various manufacturers can be used together. At present, the seamlessness between systems of different makes is restricted to only communication protocols, accessing & transmitting data and physical communication ports.

Though few decades ago, the need to protect intellectual property was a genuine requirement, it is no more a valid reason in the present scenario. The need for a client to keep inventory of all makes is an avoidable investment. Let the standards be defined to have various grades of controllers, interfacing cards and other components of hardware. Leave it for the customer to choose the quality they would like to have. If the customer feels he gets controller of manufacturer A is better and IO cards of manufacturer B are better, it shall be possible for him to do sochoose as per his requirement.

Standardisation would help customers to get spares for their systems – irrespective of solvency of any automation company, obsolescence issues and minimises the inventory cost. After the initial hiccup period, such standardisation would only increase the overall market for genuine manufacturers with long term presence.

The same type of standardisation is needed for the programming software used in PLCs too. The three popular modes to build logic i.e., the Ladder, Blocks and Coding may be standardised on a generic platform that can communicate to all controllers and IO cards. In other words, there shall be two or three platforms, much like OS for computers/phones. All hardware being produced shall be compatible with these platforms. This would reduce the level of skills needed to maintain automation systems from small to moderate sizes.

If everyone makes the same thing, how the Automation Companies would survive and earn profit?
The same way manufacturers of computers and phones do. There was a time when even the operating stations in the plant fall under the category of proprietary nature and shall only be bought from OEMs. Now, most of the control systems are based on servers made by a regular computer manufacturer. The strength of Automation Company is not in the hardware and software, but process control i.e., in application engineering that would control the process efficiently ensuring

the safety. The specialised products nowadays being offered by many automation giants function at a higher level in the structure of automation and so the demand for them would never be affected.

The standardisation would free the automation companies from the routine of manufacturing and marketing the basic hardware and software. Those who are offering products specific to oil industry, steel industry or power sector should realise that their strength is ‘process control’ and not electronic hardware manufacturing. Let the hardware manufacturing be a separate wing that would look into reliability issues of these components. Similarly, let the OS developers worry about finding and fixing bugs in the system.

It is better to identify and differentiate the skill set needed to design/manufacture hardware, software and application as three different domains so it would be easy to concentrate on each domain with focus. It would also reduce the skill level required to maintain the control system and will thus increase wide acceptance for automation in all sectors.

Standardisation would help automation to percolate to various sectors hitherto using customised controllers by in increasing reliability and availability. Once this standardisation is complete, even training institutes would mushroom to train people in programming these devices like it happened in case of computers two decades ago.

The Future

Irrespective of the discussion automation will be occupying a significant role in Indian Industry. This would demand a change in the way we perceive and utilise automation. If embraced willingly, the results would be pleasant and profitable to all stakeholders. Even otherwise, the change would be forced upon. It is prudent to work on the enablers so the results would be on expected lines. The growth of Indian industry may be rapid and so the need to work on the enablers.

Enhancing skills of people, Standardisation of automation equipment are the need of the time. The collaboration between Industry and Colleges would be vital for developing skilled people at an accelerated rate. To avoid burdening these skilled employees to learn various types of hardware and different platforms of software, standardisation of automation is vital.

The accelerated growth of new sectors like defence, agriculture would provide increased job opportunities. The immediate need is to develop people for the future requirement.
Suggested Actions:

- Increased Collaboration between Industry and Colleges
- Increasing participation of people with industry experience in Educational Institutions
- Standardising Hardware and Software used for Automation
- Identifying Opportunities to improve conditions of industries in Medium and Small sectors.

Augmenting Industrial Transportation System with Internet of Vehicles paradigm

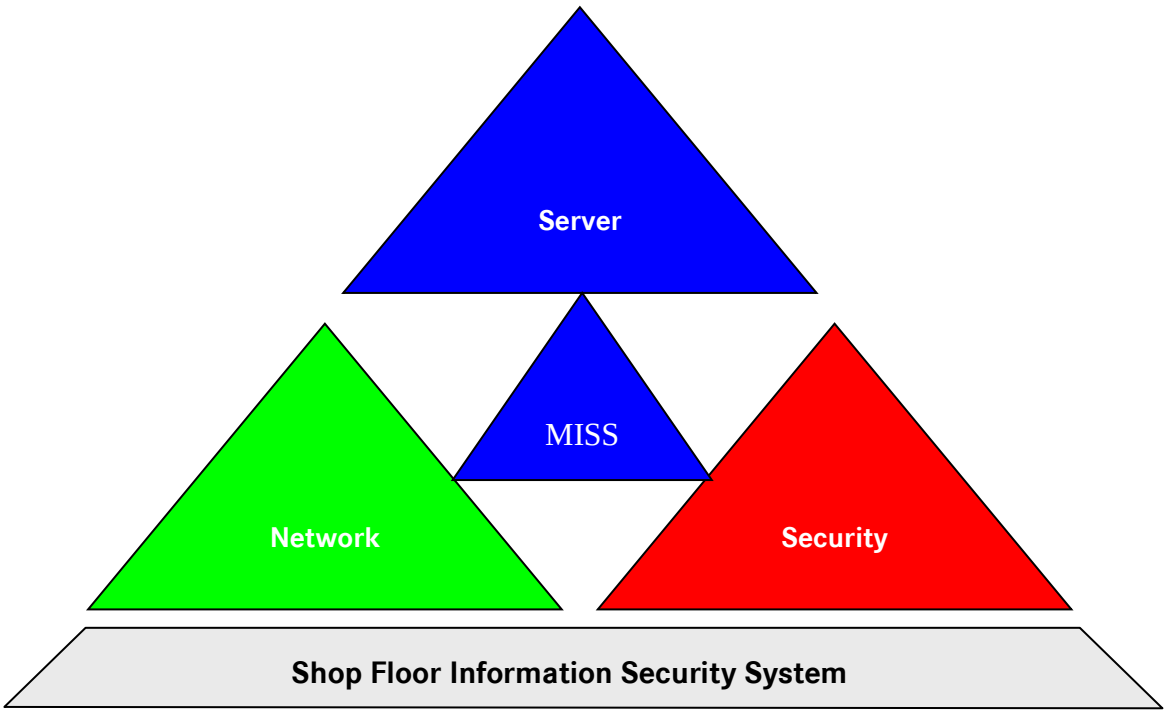
Sanjai Pathak[1], Ashish Mani[2], Mayank Sharma[2] and Amlan Chatterjee[3]

1- HCL Technologies, Noida, UP, India
2- Amity University Uttar Pradesh, Noida, UP, India
3- California State University, Dominguez Hills, USA

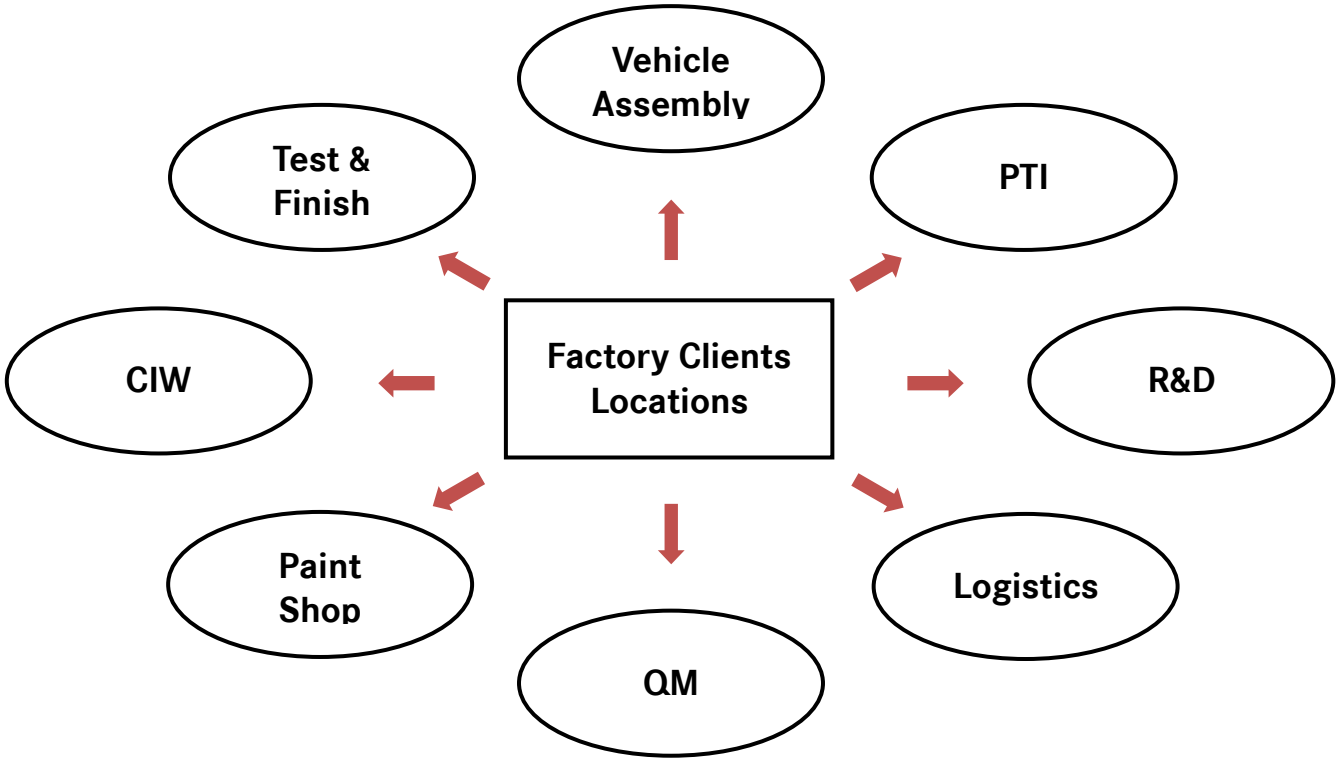
Industrial Transportation System comprises of transport vehicles and services used by industrial enterprises for moving objects (animate and inanimate) within the organization or outside organization. Industrial transport is an integral part of supply-chain management. There is lack of adequate transportation infrastructure in our country, which severely impacts business growth. Some of the issues with traditional transportation can be overcome by interconnecting the transportation system through high speed information system, also known as Internet of Vehicles (IoV). Industrial transportation vehicles can be augmented with Internet of Vehicles paradigm to provide connectivity within the vehicle as well as with its external environment, which includes vehicle to vehicle, vehicle to Internet and vehicle to road infrastructure communication. Wireless Technologies play an important role for establishing an infrastructure of Internet of vehicles. IoV paradigm will help in addressing major challenges faced by industrial transportation system such as slow traffic flow, roadway congestion and accidents, unreliable delivery time, higher labor cost, human error, increasing polluting emissions and reduced energy efficiency. However, IoV do suffer from some challenges like network connectivity issues due to high vehicle mobility. One of the solutions to challenges in IoV is to use advanced antennas or the active RFID technology. This paper discusses the advantages of Augmenting Transportation System with IoV paradigm along with various obstacles which would be required to overcome, for ensuring successful implementation of Internet of Vehicles paradigm. Further, a novel architecture for augmenting industrial transportation system with IoV paradigm has also been proposed in the paper.

Manufacturing processes have reached a new level with the advancement in technology; right from the physical layer until the application layer. Smart manufacturing: The transformation which is happening in Operation Technology, the objects at operation layer are getting advanced in terms of generating data, connectivity and controlling mechanism. This is becoming an enduring possibility by enhancing their capability to connect themselves to the Network (IoT). This smartness in operational technology (OT) is reverberating through the entire Manufacturing technology (MT) and the Enterprise Resources Management (ERM). For this eco-system, where the connectivity between the layers are getting stronger day-by-day, there is a need for stronger security systems which must be in place to ensure hassle-free operations. Certain questions arise when it comes to securing operation layers: 1) Do we need separate strategy and policies for OT layer? 2) Will all the machines support the policies? 3) Should we have facility based rules? 4) How are the multiple process zones connected & how to secure the data generated from the layer? This article ***"Manufacturing information security system (MISS)"*** deals with such questions and provides viable solutions for the shop floor and, provides a vision on future advancement in OT & MT and how to secure them.

A system for shopfloor information security essentially integrates between network layer, server layer and the security systems in this layers. MISS an inhouse system developed by Daimler india commercial vehicles for securing the information from the manufacturing layer



An example of shopfloor client distribution in multiple process areas for a truck assembling plant



When a information security system is tought of for such distribution “MISS” was planned. To make MISS as MISS”ES” Effective system a six step approach is followed in DICV.

Step 1: Identify different layers that are available in the entire process value chain

- Control layer [includes field sensors, PLC, HMI etc.,]
- Equipment layer [Includes machines performing process like robort]
- Application layer [Process control system, MES etc.,]
- Enterprises layer [DMS, WM, IM etc.,]

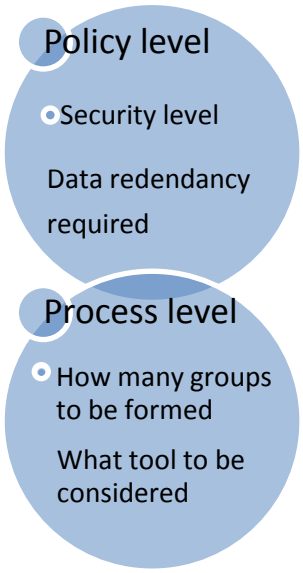
Step 2: Once different layers are marked then identify data generation sources from those layers.

- Control layer : PLC, Sensors, Manual inputs from HMI etc.,
- Equipment layer : Robots, machines, tools, testing equipment’s etc.,
- Application layer : Quality module, order management module etc.,
- Enterprises layer : BOM, Master data, Drawing details etc.,

Step 3: Once the data sources are identified then classify the data sources based on the criticality.

- High Critical
- Medium critical
- Low critical

Once first three steps are done then the process of finalizing the security policy and process needs to be finalized. To decide on that it's important to understand the relation between the layers, data and its criticality. This was done in two levels.



Level 1: Identify policy level requirements

	Control layer	Equipment layer	Application layer	Enterprise layer
High (Policy A)	PLC, HMI inputs	Testing equipment, Online process level equipment	Online production application order management, quality management, Product testing application	Business to business interface applications Security related applications
Medium (Policy B)	Direct process level sensors	Sub-process level equipment's	Sub-assembly, pre-assembly process applications, supply trigger and supply chain management application	Day to day business running applications like WM, IM, production module etc
Low (Policy C)	Secondary field level sensors	Support level, rework area equipment's	Production scheduling, sequencing, buffer management	Scheduled job application

Level 2: Process level requirement

It involves the methods of security inbuilt in one or combination of more than one of below process level

1. Managing at port level
2. Managing at switches level
3. Managing at firewall
4. Managing with antivirus

Step 4: Once policy level and process level was identified, we Finlaise and created the security packages for different levels and layers of manufacturing. It covers all facilities that are connected on to network.

Step 5: Deploy the solution in production and validate for business operations and stabilization. The major validation involves operation of equipment. Where some of equipment don't communicate if antivirus is installed. Such cases the process level will be changes to appropriate level as recommended by original equipment manufacturer.

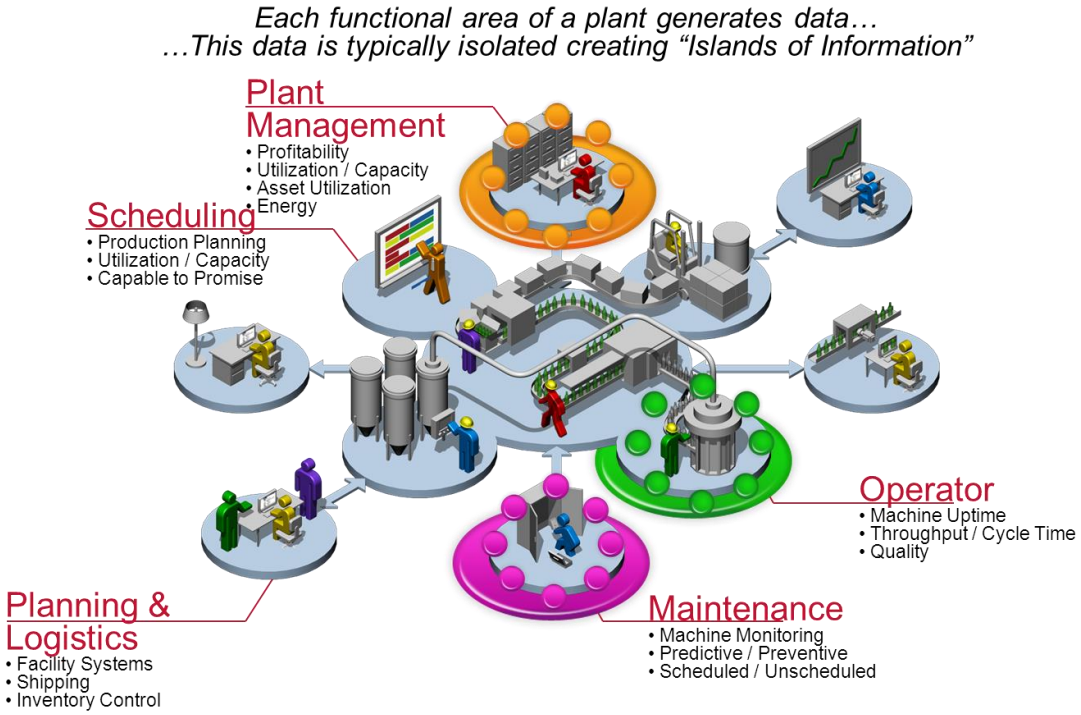
Step 6: sustaining the security level. It involves regular maintenance and patch updates. Monitor for any new threats and prepare the security system to contain them. Based on change in business continuity and business resistance time, changes in policy level and process level is done. Also in corporate new facilities, machines and equipment which are getting added at appropriate process and policy level.

We at Daimler India commercial vehicles follow this approach and running an effective manufacturing connected enterprises. And we are in regular habit of being in step 6 sustaining the system, which is more critical than creating the system.

Connected Enterprises

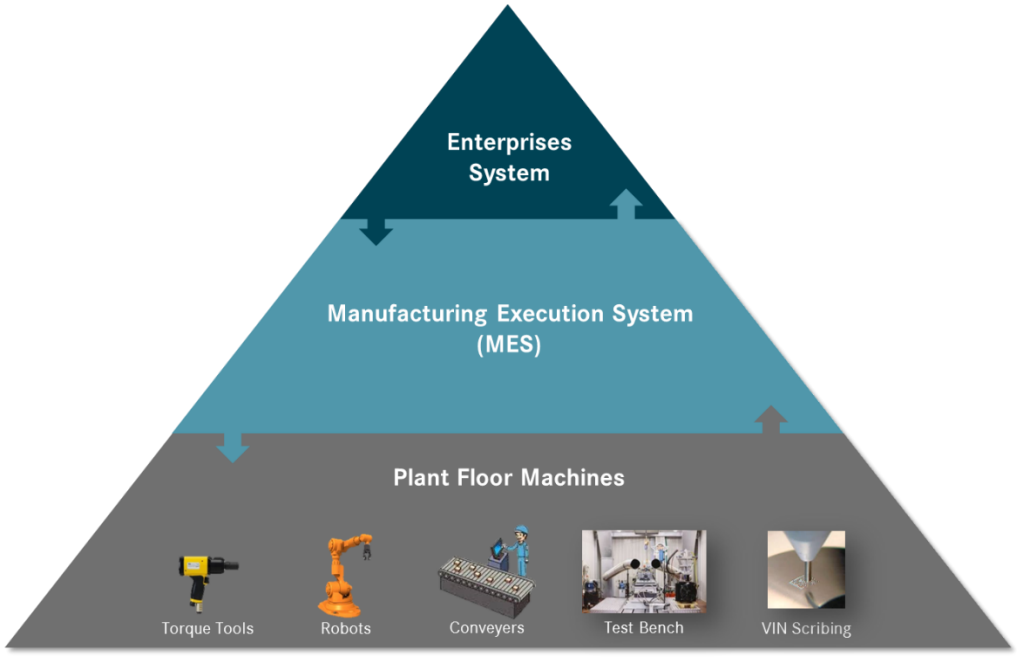
Connected enterprises is the lifeblood for smart manufacturing. Smart manufacturing doesn't mean that having smart machinery in place, it is more about how it is connected to exchange the information between the man, machines and enterprise systems. Connected enterprises will bring more visibility in to process and delivering right information to the right people / machine at the right time to make better decisions.

In general many industries will have smart machineries in place to achieve better productivity and Enterprise system to plan better. But it will work in silos. Connecting both plant level and enterprise level is the key thing to achieve smart manufacturing. ***Manufacturing Execution System (MES)*** is doing the key roll on connecting the both world. It connects People, Process and Machine securely using technology.



Daimler as a pioneer of automotive industry, we have thought through this well in advance during the planning phase of establishing the Daimler India Commercial Vehicles Pvt. Ltd. (DICV) plant at Oragadam, Chennai.

We have implemented MES from the day one. As mentioned above, it is connecting the Enterprises system, Plant floor machines / equipment as well as the people. It is receiving the information from enterprises system and delivering the same to people and plant floor machines at right time. The same way information from plant floor machines and people will be sent to enterprises system. This collaborated eco system provides more visibility and data, decisions can be taken based on the data. Data driven decision will be the better decision.



What is MES?

Manufacturing Execution System is the computerized system which can be used to Monitor and Control the end to end manufacturing life cycle wright from the raw material to finished goods. Basic functionalities of MES will remain same but utilization of the functionalities may customized and vary customer to customer. Different functional modules in MES which will be used by various business stakeholders involved in manufacturing process (like Operations, Quality, Planning, etc.) and it will support manufacturing processes executed in such a way that the desire output can be achieved. It will bring more visibility on what is happening on real time basis and decisions can be taken immediately. Also MES act as an intermediate system between ERP and Shop Floor Control System.

How MES connect with ERP?

In general there are many ways to establish the interface between ERP and MES. Some user will have manual interface. Plan/Production data will be downloaded manually from ERP system in specific format and the same will be uploaded in to MES manually on pre-defined frequency. Some user will have automatic interface. Plan/Production data will be automatically pushed to MES from ERP using the interface.

In DICV, as part of the enterprises system architecture we have Enterprises Interface Gateway (EIG). Which will connect the both ERP and MES and transfer the data from ERP to MES and wise versa. This EIG designed such a way that it ensures the given data has been transferred successfully to the destination system. It has feedback loop to check the status of the transaction.

How MES connect with Shop Floor Control System?

There will be different types of equipment will be used in the shop floor to do different types of operations. e.g.: Conveyers, Robots, Test Bench, Welding Fixtures, Name Plate M/c, ect.. Each equipment will be unique and manufactured by different OEM/SPM, so it will have different types of control system (e.g.: PLC, PC, Embedded System, etc.). The equipment will be controlled by that control system and most of them will work independently.

Passing the production information which has been received from ERP system to those equipment on structured way is the key challenge in any manufacturing industry. MES makes that job easily.

In DICV, equipment interface standards has been defined during the phase of plant designing itself and equipment manufactures has been instructed to manufacture the equipment based on the DICV interface standards. It made our life easy on establishing the interface between the equipment and MES. Using that interface production information will be passed to the equipment at wright time and the status of the equipment and production information will be taken on real time. It brings more visibility and visibility brings more control.

How MES connect with People?

There are many functional modules in MES which will be used by the different users from different function who involved in manufacturing life cycle. Some of the basic functional modules in MES are listed below,

- Order Management
- Child Order Management
- Line Management (Tracking)
- Quality Management
- Buffer Management
- Genealogy
- Data Collection (e.g. Torque Tool, Test Data, etc.)
- Error Proofing
- Kitting
- Pick to Light
- Reports and Dashboards
- Communication Management

Process digitization for manufacturing

Introduction :
In today's digitized world, there have been significant advancements made in every industry thus improving productivity and yield. The penetration of computers and internet have redefined business processes to a great extent.

However, in the manufacturing sector, although there have been great application of information technology, there still exists a vast scope to bring about automation. Paperless manufacturing would bring about such a shift and change the way we have been carrying out manufacturing activities in the past.

For example, in the Automotive Industry, still the vehicle build in the assembly line happens with the physical Bill of Material (BoM). We still have different software packages for design and manufacturing but do not create the right interfaces so that they can communicate easily. This could be automated with directly linking the BoM with the line side work instruction sheet. This would result in constant updation of the information and also in the right fitment of parts in the assembly line.

Also in the event of a machine breakdown. the maintenance department could get automated mobile alerts so that response could be quicker.

The other ways where we could eliminate manual paper based work is to automate the kanban system. Traditionally kanban operates with the tags that communicate the replenishment time of pull. With the e kanban where we can automate through computers and some sensors, we can bring about better efficiencies in manufacturing.

Like these there are various methods used to achieve the productivity and some required to move step ahead, all are being detailed out in this paper. They are very cost effective solutions that require minimal investments thereby improving the yield.

Digitalization

- Smart manufacturing
    - Paperless manufacturing
    - Man & Machine
    - Flexible manufacturing
    - Wireless communication
    - Data into down the line
    - Operator wanted
- Logistic
- Data Analytics
- Information Security

Smart Manufacturing : Paperless Manufacturing

Use cases in Daimler India vehicle assembly

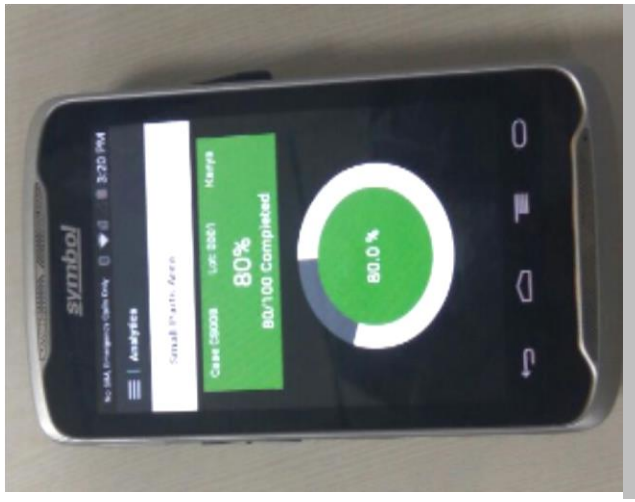
- More use of Toughbook (handheld and wireless) in line side as build card.
- Facility like display of BOM, safety alert, Q alert, special instruction in tough book.
- Forward broad casting instead of printing into direct machine or Mobile device .
- In Daimler, TC 55 android device used for assembly information

Replacing the existing QFL 3 paper check sheets with tough pad integrated to MES system

Device is used for display of BOM in line

➢ Advantages

1. Paper check sheets are eliminated
2. Automatic reporting and data capture



Mobile device TC 55 is the android mobile In Daimler, it is used for material call, delivery, information pass, forward broadcasting of station data to start preassembly.

➢ Advantages

1.Less cost and easy handling

2. Paper check sheets are eliminated

3. Automatic reporting and data capture

4. Mobile technology and wireless communication

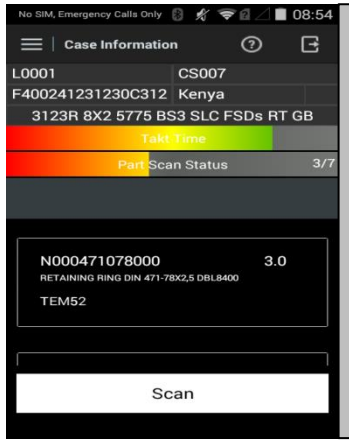
Concept of development

- Automatic part deviation
- NC though system and approval and will be reflected in shop floor
- Auto Quality alert and for example any bolt is not achieved the torque, auto text to Q team(Respective person) with Tools ID, bolt no, station code and vehicle identification no.
- Predicting alarams in advanced with 100% accuracy

Smart Manufacturing :Man and Machine

- All machines and equipment are networked with one another.
- Mobile device with wireless communication will be more in shop flor.
- Accessibility and control of real time machine status any where in factory.
- In order for smart production to run smoothly, the humans and machine involved have to continuously report exactly what they are doing and for example how much torque is required to tighten one bolt in cylinder head.
- Sensors have replaced human hands, resulting in less wasted time and materials.
- Sensors cameras replace visual inspection and alerting to take measures if required.

Used cases in Daimler

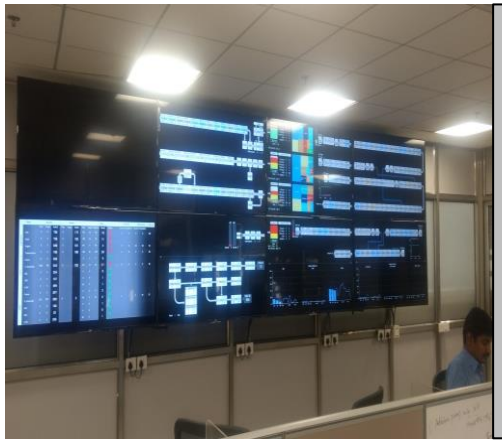


- ☺ Easy to carry and user friendly
- ☺ Efficient User Interface
- ☺ Mobile Technology
- ☺ Graphical enhancement

Android-Apps/ solutions for digitalization

- ☺ In house developed system
- ☺ Low cost and easy maintenance
- ☺ Autonomous material movement
- ☺ Low cost autonomous solution
- ☺ It is safe to use

In house AGV for transferring the material with the help of magnetic lines



- ☺ Real time Monitoring of process on each station.
- ☺ Instant access to real time production statistics.
- ☺ Track station and operator performance.

Real time dashboard used in Daimler by production control team

Concept of Development

- Auto call for maintenance, if machine break down through mobile device.
- Everything taking place in the real factory will be represented in parallel in the virtual factory. So that the export can analyze it any where outside of the factory
- Use of proglove instaed of manual scanner .

Pro glove:
1D and 2D scanner
Wireless communication
It cab used with any gloves or in direct palm
Variable size adjustment
It can be interface with any system

Smart Manufacturing : Flexible manufacturing

Used cases in Daimler India Plant

- Flex manufacturing of both business process as well as manufacturing process
- At any time business process can be changed in the concept of plug and play.
- Auto sequence change of manufacturing process based on the output of the machine results and for example if any chassis got skipped from the main line aggregate of the respective chassis needs to move to loop or buffer as per the requirement.

In Daimler India, in Cabin EMS (electro mono rail system), the loop has created and program made automatic to move the cabin into loop, if the respective chassis got skipped/ rejected.

- Electro mono rail system(EMS) for heavy aggregate pickup and drop. In Daimler EMS is used to carry Cabin, engine and tyre from pre assembly area and dropping in respected mounting point.

- Transports cabin from trim line to assembly line through electro monorail system overhead.
- Synchronized with the assembly line for better placement.
- Reduces time for transportation
- Efficient way of placing cabin over chassis.

Cabin EMS

- Time tracked for resolving the defect is shown on the tv-screen at bay station with expected time
- Track time taken to resolve the defects.
- Track station and operator performance.
- Know the efficiency of the rework bay.

Individual display repair status in shop floor using android TV

Concept of development:

- Flexible on manufacturing line like building of HDT(High duty trucks) on MDT(Medium / law duty truck line) platform. (Independent of platform based concept)

Smart Manufacturing : Data into down the line

Use cases of Daimler India in Transmission line

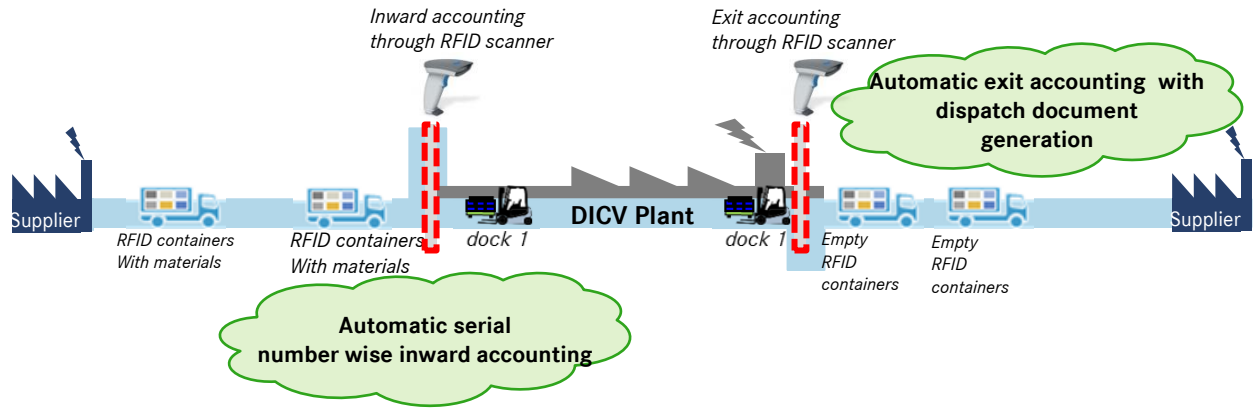
- Source of data should be one and must be available in structured and for example in Daimler India the source of data is R&D for documentation and product specification is M&S and available in system.
- Bill of material (BOM), drawings(Vehicle, parts etc), new part addition list, assembly instruction, station recipe made available for real time access.

Smart Manufacturing : Wireless communication

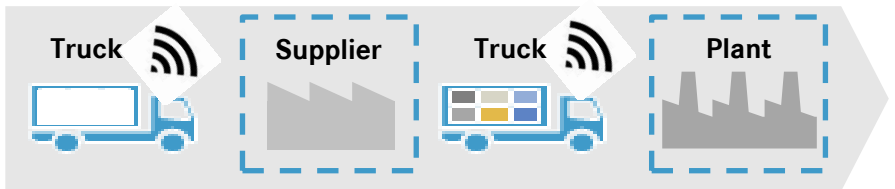
Use cases of Daimler India

- Geo-fencing for supplier trucks via GPS
- RFID-chip for –tracking
- Smart watch for transportation
- Using of more toughpad, tablets, wireless scanner, Mobile device

Used cases in Daimler India



Real time tracking of returnable steel pallets using RFID

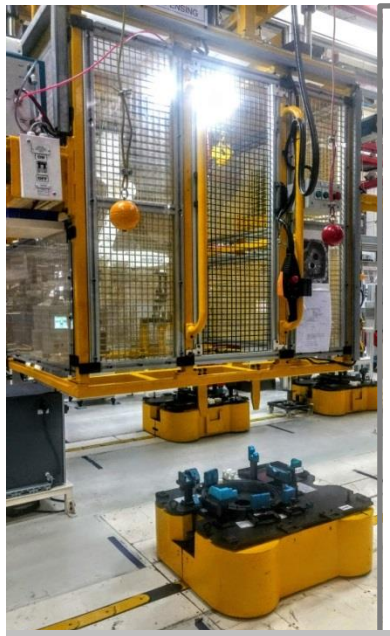


Geo-fencing for supplier trucks via GPS

Smart Manufacturing : Operator wanted

➢ More Robos are in shop floor to avoid skilled operator which leads cost impact to manufacturing

Used cases in Daimler



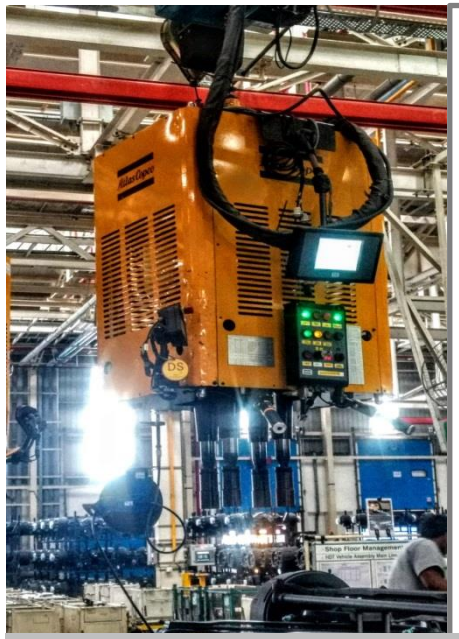
Description of details

- ➢ Designed and configured only for sealant application on automotive component.
- ➢ Robotic vision system helps robot to apply sealant to changing periphery.

Advantages:

- ☺ Measured and calculated quantity of sealant applied.
- ☺ Ensures less time for sealant application.
- ☺ Eliminates sealant wastage.

Robotic sealant dispensing



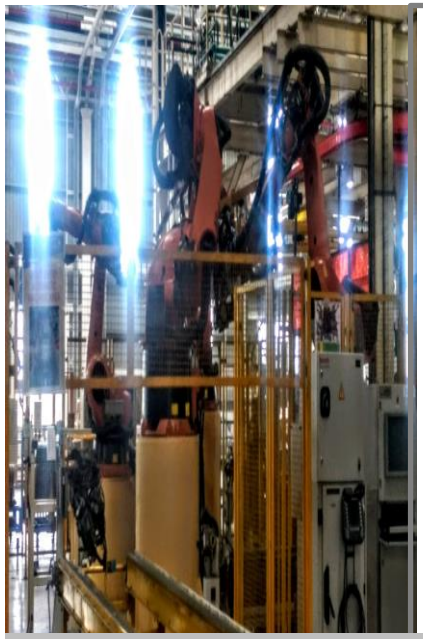
Description of details :

- ➢ Automated bolt tightening machine.
- ➢ Helps operator in tightening many bolts at a time.
- ➢ Applied torque can be changed accordingly with changing vehicle variant.

Advantages:

- ☺ Less operation time.
- ☺ Provides ergonomic assistance to the operator.
- ☺ Applied torque can be changed easily.

Multi spindle



Description of details :

- ➢ Fully automated from picking up the panels for operation to placing the finished panels after completion by robots.

Advantages:

- ☺ Automatic spot welding provides consistent welds and increases the quality of the product.
- ☺ Multiple configuration can be done to accommodate all the different variants.

Robotic spot welding

➢ Automatic detection of defect by using advanced camera instead of visual inspection

Description of Activity:

- ➢ Monitors assembly of main shaft gears through camera fitted at the station.
- ➢ Ensures proper assembly of syncro-hub onto the main shaft during gear assembling
- ➢ If any main shaft part assembly goes wrong transmission line stops.

Advantages:

- ☺ Eliminates gear sequencing error while assembling the main shaft gears
- ☺ Error detection and correction at the station itself.
- ☺ Eliminates part missing error

Logistic

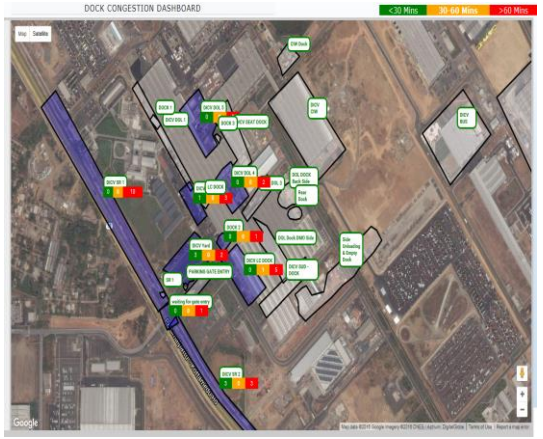
Use cases in logistic

- Logistics coordination via mobile devices
- Extension of E-Kanban system triggered by sensor(Material delivery based on auto call, real time data flashing from data ware house.)
- Order based kitting and pick to light in Logistic and kitting interlock at line side
- Smart watch used by tugger driver to transport the material
- DICV plant location geo-fenced to track truck waiting & prioritize inwarding

E kan ban used for material call and delivery through Mobile device (TC 55)

Pick to light in Daimler used for kitting preparation

Smart watch used by tugger driver



In plant Geo fenced to track truck

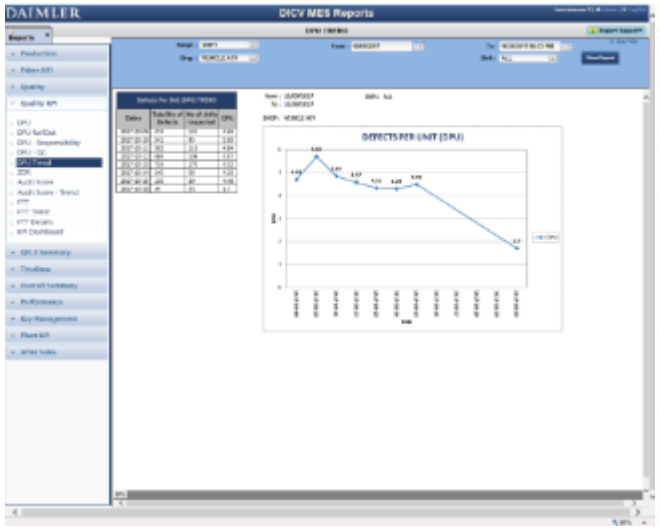
Concept of development

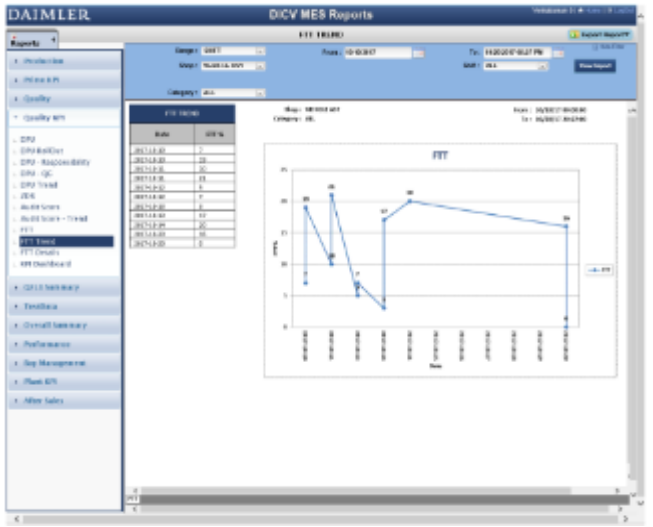
- Material call based on the order availability.(If orders and parts are not available at line side , it will not call for material feed unless order will be available for the parts)
- Extension of martial call, material unavailability, stock exceeding information into text message
- Fully automated logistic wire house
- Automated sorting systems for managing kit bins

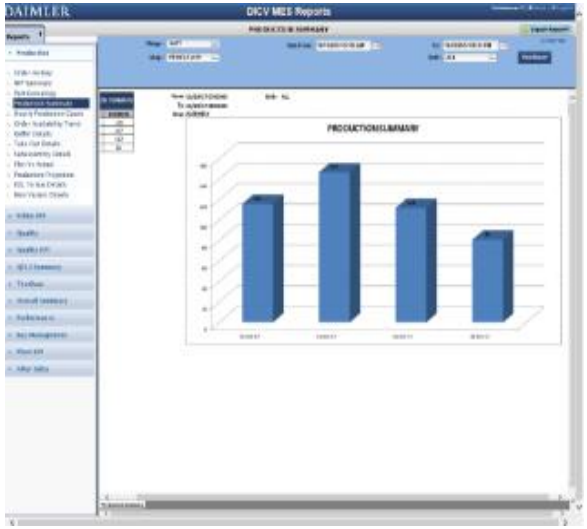
Data Analytics

Used Cases of Daimler

- All the manufacturing data are available in one portal in FTVP (factory talk vantage point (product of Rockwell automation)
- All the reports are available for quality analysis and for business team .
- Any time anywhere, it is available n Daimler network







Concept of development

- Reports and production details can be available in mobile for all employee with restricted access
- System will monitor both the process and product, will intimate to the respective team when the deviation occurred..
- One tool for all reports like manufacturing, business process data, financial data, Logistic, inventory which will lead to cost saving and easy maintenance
- Tningworx – a product by PTC – one tool for all the modules like reporting, real-time data display, auto monitoring, process capability calculation, advanced analytic, augmented reality etc

Information Security

- All manufacturing data are critical and subject to risk, so IT system should be always secured to protect the data
- In Daimler India, all the system are well managed of firewall and antivirus
- IT system follows audit for the data security
- Central system is available for auditing the IT manufacturing and IT system
- All the manufacturing systems are connected to the Daimler with managed network

Blueprint for building smart factories

Sivaram PV
Managing Director
B&R Industrial Automation Pvt. Ltd.
8,Tara Heights, Old Mumbai Pune Road
Wakdewadi, Pune - 411003
+91-20-41478999
sivaram.pv@br-automation.com

1 ABSTRACT

This paper aims to explore the importance of adopting new technology of smart manufacturing practices. Within the ongoing fourth industrial revolution, smart manufacturing is a stated priority of major economies. Smart manufacturing is mostly framed in terms of better use of big data, machine connectivity, particularly using the Internet of things. The big data evolution affords an opportunity for managing significantly larger amounts of information and acting on it with analytics for improved diagnostics. Smart manufacturing combines advanced manufacturing capabilities and digital technologies throughout the product lifecycle. These technologies can provide decision-making support to manufacturers through improved monitoring, analysis, modeling, and simulation that generate more and better intelligence. These technologies can make manufacturing industries more competitive, with intelligent communication systems, real-time energy savings, and increased productivity.

In this paper, we analyze the current Indian status of factories and suggest possible ways to leverage future technologies.

1.1 Keywords

Smart manufacturing; Industry 4.0, Big Data, Data analysis; performance measurement; productivity; SuperTrak, Orange Box , Human robot collaboration, openRobotics, B&R; Automation Studio; mapp Technology, Digital twin, Big data

2 INTRODUCTION

The fourth industrial revolution is the first to be rooted in new technologies such as digitalization. This digitalization enables us to build a new virtual world from which we can navigate to the physical world. Looking at the world today, highly developed countries are rapidly moving forward on the path to becoming Industry 4.0 ready. However, it should be noted that developing countries are taking a different and a rather slower path.

Today, the industries are aiming to connect all production processes to enable real time interactions. Through technology, communication among the different objects in production line is possible with cloud, Big Data analytics and the Industrial Internet of Things. Smart factory is a complete digital factory, including supply chain. The goal of building smart factories is to provide competitive internal and external intelligence.
Smart factories utilize data analytics, which includes gathering data, analyzing it and using it in business processes, at the same time considering people. Collecting data and making it available to a wide audience within a plant and across the business leads to almost immediate returns. If everyone from a factory has access to appropriate information at the

relevant time, it will always result in a better way. People that are more productive lead to better decisions and more profit.

When the term, ‘Industry 4.0’ was first introduced, the aim was to use high innovation to make industries more competitive. Industry 4.0 aims at having highly intelligent connected systems that will create a digital value chain. It particularly is based on cyber physical production systems that integrate communications, IT, data and physical elements; 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. Industry 4.0 improves factory efficiency and increases flexibility by introduction of automation in start to end processes. Smart factory is an important aspect of Industry 4.0. New technologies, such as analytics, big data, IoT, cloud, etc., have made us switch to Internet based thinking. Industry 4.0 is all about data. The main objective of Industry 4.0 is the task to convert this data into information and then into knowledge in real time, in order to make the process more productive, more flexible, to improve the quality and so on.

Forward-looking equipment manufacturers are starting to incorporate built-in communication as well. Manufacturers comprehend that by providing connectivity, they can moderate the total cost of ownership of their equipment, and help their customers optimize their operations.

India has become a focus of a lot of investment backed by government initiatives. The main question we must ask ourselves is whether we as a manufacturing nation are ready for this revolution.

3 Challenges in the adoption for Indian manufacturing

- Ownership of adopting advanced technologies go with the top management usually in MSMEs. If the top management is not willing to trust these next generation technologies, there is a slowdown in approach
- Lack of a common protocol connecting field devices and shop floor.
- IoT generates a lot of data but it is difficult to find out its relevance. With a lot of control systems being installed for the automation, it is important that relevant data comes to use. There is no point in having so much of data if it can’t be used for any good
- Many MSMEs worry about data security and the misuse of data, in case their production information leaks outside due to cyber-attack.
- Level of investment
- Workforce skilling and training
- Cost of investment and the delay in reaping the returns.
- Awareness of new technologies in India
- Most of India is populated with brownfield plants where the systems have been operational for decades. Technology upgradation and connecting factories and plants a major concern.
- Lack of greenfield projects

4 Solutions for the digital future

The Industrial Internet of Things is changing value chain and leading companies to rethink their business models from the ground up. What is the best way to implement the digital transformation necessary to remain competitive in this new environment? It needs complete hardware and software solutions, comprehensive service and hard-earned expertise in the automation and digitalization of machinery and equipment. By systematically analyzing and networking large volumes of data, factories can improve production efficiency and target customers more effectively. Optimizing the collection and processing of digital data can yield particularly large benefits for legacy equipment. Tap into previously unavailable information and eliminate information loss at the interfaces between functions, sites and companies. The connected factories of the Industrial IoT generate and process enormous volumes of data in order to perform automated responses that boost performance. Solutions should help enterprises to get the best real-time performance out of their network. After pre-processing data locally, edge devices are needed to send data for remote storage and analysis, which needs more network capacity.

4.1.1 The Digital Twin: Key of Industrial IoT

The whole point of a digital twin is about making the right decisions at the right time. It helps to use relevant data from things, when needed. Digital twin is a key concept for bringing Industry 4.0 to variety of industry domains including Energy, Supply Chain, Health Care, Mobility etc. It provides technical benefits for different use cases and solves many of the day-to-day problems while fulfilling industry requirements such as batch size 1, authenticity, tracking, optimization, auditing and compliance. As Internet of Things is growing, Digital twin is becoming a standard tool for data analysts and engineers wishing to use all this new data to automatically understand and respond to what is going on in the real world. The rise of digital twin is creating the next chapter of this evolving relationship between IoT and business. Enterprises are leveraging Internet of things (IoT) technologies for their digital business journey.

In industry, digital twin offers unlimited possibilities beyond the conventional design process. Using an in-line digital twin accelerates design process and minimizes risk of redesign and losses. B&Rs Automation Studio, a powerful single tool for programming has an in-built simulation, which is capable of simulating electronics right down to the motor. This helps machine and factory builders to start programming even before the machine and factory is mechanically and electrically complete. Integrated automation is necessary for today's users who need not program the system again with the actual hardware. This same program developed for simulation works directly without a single change, reducing time-to-market and increasing profitability. With MapleSim and Matlab in addition to Automation Studio, development and simulation environments, users are now able to simulate even the mechanics. This helps in confirming their selection of components and feasibility of mechanical design even before the actual production. The use of MapleSim allows the machine designer to create a virtual prototype of the machine design, directly from the CAD representation, and integrate it in Automation Studio, a development environment by B&R Industrial Automation as a Functional Mockup Unit (FMU). It is possible to validate designs earlier and test the configuration of the machine control system and reduces risk of failures and errors in critical phases of the lifecycle. Users thus can configure and test the virtual machines even before building the real machine and factory. This accelerates the implementation and commissioning process, reduces risks and costs. Today innovations are helping everyone transform factory operations into digital enterprises – resulting in smarter products and smarter machines.

4.1.2 Industrial IoT for Brownfields

It is everyone’s wish to become Industry 4.0 ready and leverage the benefits arising out of OEE calculations, remote diagnostics, energy & condition monitoring and many other technologies. Implementation of such solutions at brownfield sites is a challenge mainly due to unavailability of data and difficulty of extracting this data from legacy systems.

It is now very much clear to the operators of production plants that the optimization potential of a production infrastructure has to be used through the use of intelligent automation. This is the only way enterprises can survive in international competition. The three parameters as total plant efficiency (OEE), total operating costs (TCO) and return on investment (ROI) are observed and further optimized. This is only possible if the operating data are precisely recorded and evaluated. In addition, the conclusions of these evaluations must also be transferable to other production sites, irrespective of whether they are new plants or existing plants - so-called brownfield plants. There are, in reality, a number of hurdles to overcome in the implementation process: in many production plants, equipment, machines and systems often work independently from three or four different decades without connection to a higher-level production system. In order to get the necessary overview, a lot of manual work is still required: Data must be read by individual machines, manually recorded and finally entered into excel sheets or in production systems. This is not only time-consuming but also error-prone, expensive and inefficient. In addition, this may entails a loss of information. In many cases, it is very simple to obtain the most important information from an existing machine for online evaluations and to use it for optimization purposes.

It is of utmost importance to retrieve these parameters and provide them to the factory owners and have a possibility to be viewed at any time with as possibility to compare different production lines, shifts or workdays. The Orange Box is composed of a control system and mapp. These are preconfigured software modules of mapp Technology. The controller collects operating data from any machine via I / O modules or directly via a fieldbus connection. From this data, the mapp components generate key figures, for example total plant efficiency (OEE), which can then be displayed. The obtained data and information can also be transferred to higher-level systems with OPC UA. The Orange Box gives possibility to generate the data for their evaluations and optimizations in an automated manner. The special thing is that no major development projects are necessary. Smart and easy is the approach of B&R's Orange Box. Instead of programming, it is configured and projects can be implemented during operation. Moreover, they are very manageable and scalable. Factories can use the most important information to make the first attempts with orange box and gradually add more data points.

The Orange Box is completely flexible and modular. In order to collect and analyze basic operating data, a 25mm wide compact controller and the software component mapp OEE are sufficient. For further functions - for example, alarm management or energy monitoring - the solution can be easily extended with other software components and, if necessary, more powerful controls. Web standards are used for the visualization, so that the evaluations are displayed in a device-independent manner. For OEMs, the Orange Box is the basis for interesting business models. With B&Rs Orange Box, all the required parameters are available to factory owners at their fingertips and can be viewed at any time with as possibility to compare different production lines, shifts or workdays.

4.1.3 Human Robot Collaboration

Smart factories have not only sped up the factory processes, but also have made the workplace safer for employees. The use of industrial robots in automated production lines is exponentially increasing. However, factories who have installed robots have to pay special attention at the safety of humans working around these robots. Predominantly, robots have always been restricted to cages and barriers, which provided safety for humans on the shop floor. In this case, opening of the cage results in stoppages of the production lines. With the rise of Industry 4.0, this is no longer acceptable. The production lines not only demand round the clock machine operation but also robots working together with humans.

Industrial robots are used in automated production lines and their usage is exponentially increasing. Many of the research papers suggest that the number of robots used in plants would double its figures in coming three or four years. With safety in mind, they have been isolated in cells to ensure the safety of those working in their proximity. It is the easiest method of ensuring safe operation in factories. However, this method has multiple drawbacks and the production units are no longer satisfied with these methods. There is a change in the market trend and automation vendors are working closely together to satisfy the demands of the users. Today, humans and robots have to work hand-in-hand to increase productivity and at the same time enhancing the safety features. Human robot collaboration is the need of the hour and safe robotics plays a vital role in accomplishing these needs.

B&R offers the most advanced form of integration – with robots incorporated seamlessly into the machine control logic. In any system, the machinery and robots utilize the same processor, memory and timing. Robot and machine are fully synchronized with a jitter <1 µs. The common DC bus for machine and robot drives enables maximum energy efficiency.

Benefits for robot integration

- Highest productivity due to robot-machine synchronization
- Energy efficiency
- Universal engineering tool for simulation, programming, testing and commissioning
- Web-based diagnostics and remote maintenance

4.1.3.1 openROBOTICS

With openROBOTICS, COMAU robots can now be completely and seamlessly integrated into machines and production lines equipped with B&R automation components. openROBOTICS allows a level of usability, performance and precision that would never be possible with cumbersome conventional interfaces between robot and machine control. These robots are a plug-and-play component within B&R Automation Studio and supports a user-tailored HMI.

4.1.3.2 Communication with robot control via POWERLINK

Numerous robotics manufacturers have already integrated POWERLINK in their robot controllers, allowing robots to be incorporated into machine automation systems. These details of multiple vendors can be availed on the community website for Ethernet POWERLINK Standardization Group. For machine manufacturers, this advancement considerably simplifies programming of robots. The robots are controlled and programmed using IEC 61131 languages. Any controller programmer or an embedded engineer easily

understands these programming languages. The robots are integrated in the B&R programming tool Automation Studio. As the numbers of components are reduced the hardware costs are drastically reduced. Due to this openness and multi-vendor approach, there is a possibility to integrate a large number of robotic platforms.

4.1.4 B&R SuperTrak conveyor system with mass customisation

Another recurring demand of factories is mass customization with batch size 1. The SuperTrak transport system from B&R enables advanced manufacturing concepts for flexible, efficient production at any batch size. Programming takes place in the Automation Studio software development environment. It is observed that consumers are willing to pay a premium for personalized products. At the same time, increasingly responsive production technology is making it possible to create them under mass production conditions without a corresponding increase in unit cost. For manufacturers, the resulting margin boost is an enticing prospect. Mass customization requires modular machines to enable automatic adaptation of production to real-time demand. B&R's intelligent SuperTrak system is the reliable, industrial-grade transport solution for flexible production lines that enable mass customization. All these aspects enable factories become smart. B&Rs unique propositions make it possible to make brownfield sites too Industry 4.0 ready in a cost effective method.

4.1.4.1 Anti-sloshing with SuperTrak

The term “slosh” is used to describe the behavior of liquids in moving containers. If sloshing can be controlled, products can be moved faster. Minimizing oscillations on the surface of liquids is particularly important in the packaging industry.

Industrial-grade, service-friendly SuperTrak is the only long-stator linear motor based system on the market to feature anti-sloshing technology. This prevents spills during transport and positioning and allows filling lines to be operated at higher speeds. Independent SuperTrak shuttles allow mass customization with minimal time lost on stoppages and changeover. SuperTrak, suppresses the formation of oscillations on free surfaces, thus preventing liquids from spilling over container edges during transport. Specially developed movement profiles prevent positive feedback loops from developing on the surface of the liquid, ensuring that it remains calm when moving. This minimizes downtime and increases productivity, especially when handling open containers. The anti-sloshing technology can also prevent the formation of air bubbles and foam in liquids. The downtime that might otherwise be needed to allow the liquid to settle is thus reduced dramatically or eliminated entirely, resulting in a substantial improvement in packaging line productivity.

Three steps to data transparency

Sivaram PV
B&R Industrial Automation Pvt. Ltd.
8,Tara Heights, Old Mumbai Pune Road
Wakdewadi, Pune - 411003
+91-20-41478999
sivaram.pv@br-automation.com

1 Abstract

This paper aims to explore the importance of data transparency in an enterprise and steps of data transparency. Industry 4.0 is a vision of tomorrow's factory and a culmination of concepts such as smart factories, cyber physical systems, Internet of Things (IoT) and big data. Along with other essential factors for achieving smart factories, the importance of data management with its manifold significance and criticality has been the most cross-concept between the experiences exposed by the featured companies. The acquisition, management and analysis are key to transforming data into useful information, to streamline the production process or to create new business models. However, with IoT, comes the need to handle massive amount of data, which has to be safe and secure. In this paper, current Indian status of smart manufacturing is analyzed and future technology development directions are suggested.

KEYWORDS

Big data, analysis, APROL PDA (Process Data Acquisition), OPC UA (Unified Architecture), Industry 4.0, Business intelligence, Middleware

2 Introduction

Traditional methods of analysis, based on manual reporting are gradually disappearing into the past and giving way to a more intelligent method of exploratory data analysis. With large amounts of data, its correlation is unclear, whereas the algorithm of exploratory analysis with the help of graphic visualization helps to understand information and to form hypotheses. It is essential to access data from all sources for analysis, which will help the factory operators to identify important cause-effect relationships. The APROL PDA by B&R is necessary for data collection and provide an ideal platform for not only data acquisition but also energy and condition monitoring. APROL system features a wide range of analysis and reporting tools that allows the factory operator to create special reports simply at the click of a button. The software is able to generate standard as well as customized reports. Specialized reports, control panels and mobile access with server-side authentication ensure that the information needed by factory operators is available when and where it is needed. In addition, it is available in the format the factory operators need.

3 Challenges of big data

- Lack of transparency
- Availability of data from the field
- Security of data

- Analytics

4 What is APROL?

A complete and thorough process control system from the field level to the management level that allows central engineering for all systems. Its powerful functionality enables seamless integration of upstream, downstream, and auxiliary processes, while its powerful interface modules ensure compatibility among disparate industry interfaces.

4.1 What does APROL do?

- Provides solutions for factory, plant, process & infrastructure automation
- Interconnects different energy systems
- Integrates safety-relevant components
- Completely scalable - 50 to 200,000 data points
- Enables local data processing as well as seamless data transfer to databases and the cloud
- Supports high-level security and encryption
- Offers remote manageability of all systems
- Delivers a high level of system consistency and reliability
- Integrated energy and condition monitoring system

4.2 Data analytics with APROL

In the era of Industrial IoT, companies are looking to extract the untapped value, which will unlock new business models. With APROL, and several stand-alone and integrated solutions, B&R offers a wide range of possibilities to monitor, analyze, and control data and converting it into valuable information. It acts as a middleware for factories. B&R's APROL PDA solution makes it very easy to collect process, production and quality data from the field. Acting as a middleware it gathers the data form the field and moves it to the upper layers for analytics. This serves as an edge controller and enables the convergence of the Information Technology (IT) with the Operational Technology (OT). Centralized process data acquisition enables complete online performance monitoring and visual overviews. Powerful and extremely reliable long-term archiving makes it possible to track quality for the entire process. Highly flexible reports with integrated analysis functions provide support for production optimization. The combined display of ongoing data, alarms, and events considerably increases traceability. Visualization applications can be grouped in overview images. At the same time, it allows multiple plant visualizations to be shown concurrently in a process graphic with any scaling, regardless of the respective platform. Also available with PDA is a web widget for embedding web pages in various ways, such as in HMI applications based on HTML 5, IP cameras, and business intelligence reports. With the PDA solution, factory operators reduce their investment risk drastically. Its scalability allows an entry-level solution to be scaled up and adapted as needed.

5 Three Steps to data transparency

1. Acquisition
2. Analysis
3. Presentation

5.1 Acquisition

5.1.1 Mastering data access and collection

In a factory, it is of utmost importance that the shop floor data has to be collated and sent vertically up for analytics. This is the biggest challenge for big data as there currently gathering data is very difficult. The main reason for this, is the issue of lack of interoperability, and compatibility. In addition, the issue of having non-standardized interfaces and legacy systems on the shop floor adds to these challenges. A system is of supreme importance, which can communicate with machines on the shop floor and gather data as well as convert it into meaningful information. This system is a middleware. Communication is very important to have such seamless data transfer from field to the cloud. This can only be achieved with the help of open source, vendor independent communication standards.

5.1.2 Why OPC UA ?

OPC Unified Architecture (OPC UA) is a vendor-independent, open source communication protocol for industrial automation applications. It is based on the client-server principle and allows seamless communication from individual sensors and actuators up to the ERP system or the cloud. The protocol is platform-independent and features built-in security mechanisms. Since OPC UA is flexible and completely independent, it is regarded as the ideal communication protocol for the implementation of Industry 4.0. It is even acknowledged by the reference architecture model for Industry 4.0 as a common layer communication protocol, which facilitates linking the digital and the physical worlds. This open source protocol is increasingly playing a vital role in the convergence of IT and OT. Due to its vendor independence, it has a key role in the machine-to-machine communication on the shop floor. This is thus enabling the vertical and horizontal communication.

OPC UA bridges the gap between the IT world and the production floor. It provides a single networking platform for transferring data for machine-to-machine and machine-to-cloud. OPC UA is a standard for factory level communication. B&R since inception has always relied on open source technologies such as Ethernet POWERLINK, openSAFETY and OPC UA.

B&R relies on OPC UA for vendor-independent communication in the APROL process and factory automation platform too. APROL integrates an OPC UA server and client. An OPC UA server and OPC UA client are now available directly on APROL's Linux-based runtime servers to allow open, vendor-independent communication. Programming is just configuration and using PLCopen function blocks. Motor management and control units, compact OPC controllers and other third party devices can directly exchange important operating, service and diagnostic data with APROL. In addition, HMI panels or SCADA systems can be connected to APROL.

5.2 Analysis:

5.2.1 Data Mining and Machine Learning

Factories are always under pressure, to optimize their processes in order to remain competitive. Increasingly this means using big data analytics tools to mine enormous volumes of production data. When these tools utilize cloud services, there are a number of important factors to consider. Days are gone when data could be stored and analyzed on a single computer. Now-a-

days may companies are moving towards database solutions or internally hosted private clouds. Operating a private cloud requires an in-house data and IT specialist working around the clock to ensure availability. This could be expensive, for small and medium sized enterprises; hence, they instead turn to solutions offered by large cloud service provider. Data mining refers to detecting patterns in large volumes of data. It allows machine vibrations to be compared during different periods or even future developments to be predicted. Comparisons between different machines are also possible. This makes it easier to optimize production processes and prevent total failures by detecting potential disturbances earlier.

The business intelligence platform aggregates and displays a clear overview of analysis results. Thus, valuable information is readily available to make well informed decision that help optimize production. The database can also be evaluated using data mining tools offered by the public cloud service provider. However, in some cases, enterprises are dealing with huge volume of data, which is mostly very sensitive. So, sending such an unfiltered data into public cloud is not recommended. Here, an alternative is to preprocess the production data and upload only what is necessary into the cloud. This approach is known as edge computing, which can retain all the advantages of a public cloud and IT infrastructure with limitless scalability, world wide availability and big data analytics service. B&R's APROL process control system makes implementation of such solutions very easy. One instance of APROL is, installed it on an industrial PC at the production site to handle preprocessing and data compression. Another instance is, running on a cloud-based virtual machine, collects data from any number of local APROL systems. So, a company with 50 production sites around the world can easily aggregate all of its important data in a single system. Where data is compressed to reduce transfer volume and highly sensitive data can be restricted to local storage only.

In the cloud, enterprises can take advantage of APROL's built-in-analysis and reporting tools, such as powerful business intelligence suite. The business intelligence platform aggregates and displays a clear overview of analysis results so valuable information is readily available to make well-informed decisions that helps in optimization of production, the database can also be evaluated using data mining tools offered by the public cloud service provider.

To transfer data between local and cloud APROL systems, B&R relies on the vendor-independent OPC UA, MQTT or AMQP protocols.

5.3 Presentation:

Once the data is analysed, the crucial stage is data interpretation and presentation. Interactive and adaptable dashboards, graphs and reports should be viewable even on mobile phones. Use of the reporting functions is not limited to a single target group. Traditional analysis based on reports with fixed content has been replaced by exploratory data analysis, where only the sources of data are defined, not how it is presented. Reports and evaluations can be compiled individually and modified at any time with the ease of drag-and-drop.

Traditional analysis methods based on rigidly defined reports are gradually giving way to more creative exploratory approaches. When dealing with large data sets whose correlations are not fully understood, exploratory data analysis is an approach that uses graphical visualizations to provide insight and help form hypotheses. With access to data from all sources, the analysis can expose important cause-and-effect relationships. APROL features a comprehensive selection of reporting and analytical tools able to generate custom reports at the push of a button. Designing a custom report is as easy as using drag-and-drop. Ad-hoc reports, dashboards and mobile access with server-side authentication ensure that the information you need is available when

and where you need it. Figuring this out does not need specialists with IT knowledge. The analytical and reporting features really round off the APROL automation platform. They are a key part of what makes it the ideal tool for meeting the challenges of the future.

With the business intelligence solution in APROL, this is possible for any user. The reports can even be configured for display on mobile end devices, whereas server-side authentication means that all data is protected – even in unsecured networks. Business intelligence enables systematic analysis of recorded operating and process data. Users can gain valuable information for the decision-making process with the help of standard reports, personalized interactive reports and ad hoc reports. Native iPhone and Android apps are available for mobile access.

Policy Led Realization of the Vision of Digital Manufacturing in India

Dr. Lovneesh Chanana, Vice President, Digital Government, SAP India Private Limited,
Ms. Sudakshina Ghosh, Digital Business and Enterprise Architect Lead, SAP India

Abstract

Smart or digital manufacturing, commonly referred to as Industry 4.0 or the fourth industrial revolution signifies the next phase of digitization in the manufacturing sector following the lean revolution of 1970s, outsourcing phenomenon of 1990s and automation wave of 2000s. It is widely acknowledged today that smart manufacturing offers tremendous opportunities for Indian manufacturing sector to leapfrog the technology cycle and achieve global competitiveness. It also offers an opportunity as an enabler for the realisation of Indian Government's vision of increasing the manufacturing share in India's GDP to 25% and creation of 100 million jobs. However, Smart manufacturing in India (and the emerging world) may require an approach which is strategically different from that adopted by the developed world. The efforts in India may be required to be focused around developing technology capabilities, transformation of industries and enterprises, and equipping workforce with smart manufacturing capabilities. Given the current status of manufacturing digitization in India, a proactive and supportive policy environment may enable fast tracking the journey. Also, since the adoption of digital technologies in India's manufacturing sector is still evolving, it is important to trigger a thought process on key policy initiatives which may require attention. This paper identifies some of the policy areas and highlights concrete India-specific action areas in each one of those. The scope of the paper covers the application of digital technologies for smart manufacturing. Some of the policy areas highlighted in this paper include internet of things (IoT), cloud, cyber security and public safety, work organization and redesign, standards and interoperability, regulatory framework and skill building.

Introduction and Background

Smart or digital manufacturing and design, referred to as 'Industry 4.0' or as the 'Industrial Internet' is essentially the application of a group or basket of digitally-enabled technologies that include advances in production equipment e.g. 3D printing, robotics, and adaptive CNC machines; smart finished products e.g. connected cars, devices with embedded sensors and software; data processing and analytics tools across the value chain.

The first three industrial revolutions came about as a result of mechanization, electricity and IT-enabled automation. Now, introduction of the Internet-of-Things and services into the manufacturing environment is ushering in a fourth industrial revolution. We are currently in a phase which signifies the next wave of digitization of the manufacturing-sector following the lean-revolution of 1970s, outsourcing phenomenon of 1990s and automation wave that took off in 2000s.

Unlike prior industrial revolutions, smart manufacturing is not about replacing existing assets with new ones, but about mastering the managerial challenges and opportunities that emerging technologies bring about along the following along the following three different dimensions:

- Driving '**digital transformation'** across entire organization
- Building new '**business-models'** based on shifting value-pools
- Achieving the next horizon of '**operational effectiveness**'

Infact we are already beginning to see manufacturing organizations using the rise in data-volumes, computational power, connectivity, and emerging forms of human-machine interactions (e.g. touch-interfaces, augmented reality) as means for competitiveness.

Enterprises today are creating tremendous business value by leveraging hundreds of millions of potential connections on the Internet. More recently, we're starting to see massive volumes of connected sensors and smart devices being leveraged to transform business models and simplify complex tasks. When these changes are coupled with improvements in network infrastructure (being put in place through the Digital India initiative), rapidly increasing maturity of big data analytics, and proliferation of smart applications – all connected in the cloud – businesses will enter the era of true hyper-connectivity.

Additionally, 3D printing has moved from only being applicable to polymers and metals to a broad range of materials, including glass, bio-cells, sugar and cement. Also, technologies like advanced robotics and increasingly cost-effective options for storing energy and innovative ways of harvesting energy have become more relevant enabled by significant advances in artificial intelligence, machine-vision, and machine-to-machine communications.

'Make in India' and Smart Manufacturing

Indian manufacturing sector contributed 15% to the country's GDP in 2014-15 and contributes only 2% to the world's manufacturing output. To boost the manufacturing sector, the Government has set a target to increase manufacturing's share in GDP to 25% and create 100 million jobs by

2022. To achieve this, several flagship programs such as Make-in-India, Digital India, and Skills India have been launched.

India is thus uniquely positioned to tap into the potential of smart manufacturing. The 'Make-in-India' vision which converges with smart manufacturing evolution marks the next big wave of technology-driven manufacturing transformation.

Adoption of technology (robotics, planning, Big Data & Predictive analytics), skilled work-force and resource efficient systems are key elements for successful transition to smart manufacturing. By bringing in elements of digitalization, smart manufacturing will ensure a smooth transition of more labor-intensive traditional manufacturing processes to a sophisticated set of IT-based processes, thereby enhancing manufacturing sector's contribution to GDP, thus enabling Indian

Large-scale adoption of smart manufacturing will improve India's brand image as innovation-driven technologically-advanced, high quality and safe manufacturing base. To meet the goals of zero-defect sustainable manufacturing processes that operate with optimum resources executed in smart factories, a comprehensive set of manufacturing solutions that form the foundation for digital manufacturing is needed.

Smart manufacturing in India – Areas for a conducive policy environment

A comprehensive partnership among industry, academia and government is required to craft the right policy and create an enabling environment that will significantly transform India's manufacturing competitiveness. Following key areas may require attention in India based on similar experiences in Germany (reference document: Recommendations for Implementing the Strategic Initiative Industrie 4.0 – Acatech, National Academy of Science and Engineering, Germany) and elsewhere

- **Enabling Policies on IoT, Cloud and Analytics:** smart manufacturing will require an integration of efforts in cyber and physical space and therefore the enabling policy environment on IoT, cloud and analytics be finalized in an integrated and holistic manner in India.
- **Broadband Infrastructure:** Quality of communication networks will have a direct bearing on cyber-physical systems. It will, therefore be essential to integrate connectivity to industrial clusters and manufacturing zones either as a part of Digital India connectivity plans or otherwise.
- **Cyber-Security and Safety:** Cyber-resilience will form a key requirement of risk management process for production-networks. It will also be important to ensure that cyber controlled factories do not become a risk for safety of people or environment. This will call for integration of safety and cyber security standards.
- **Work Organization & Design:** Technology is transforming industrial workforce. Greater use of robotics and automation may reduce number of jobs in assembly and repetitive production operations – but this will be offset by new job in IT and data science. Education systems should seek to provide broader skill-sets to close impending gap.
- **Training, Skills and Capacity Building:** Requirement of jobs in smart manufacturing will require radically different skill and competence profile. It may require attention from the perspective of the skill development policy.

- **Regulatory Environment:** Adoption of smart manufacturing will require a supporting legal and regulatory environment to ensure protection of data, effective handling of liability issues, privacy concerns etc.
- **Standardized Reference Architecture:** smart manufacturing will lead to inter-company integration through value networks. This will only be possible when we have a single common set of standards. Reference Architecture Model for Industry 4.0 (RAMI 4.0)) can serve as base-line to define the networking and communications frame-work
- **Modelling Complex Production Systems:** With manufacturing growing complex, there will be a need to equip workforce with tools and techniques for development of models for complex production systems.
- **Resource Efficiency:** Smart manufacturing and its impact on environment will need to be studied in detail and policies built around the same.

Program Management for smart manufacturing in India

The following can be identified as the key stakeholder groups in India's journey to smart manufacturing:

a. Government represented by (not limited to) Ministry of Electronics and Information Technology, Ministry of Telecommunications, Ministry of Skill Development and Entrepreneurship, Ministry of Human Resource Development, Ministry of Finance, Ministry of Law and Justice, Ministry of Commerce and Industry, Ministry of External Affairs, Ministry of Micro, Small and Medium Enterprises, Ministry of Labour and Employment, NITI Aayog and Department of Heavy Industries.
b. Academia and research
c. Industry Associations and industry representatives
d. Standardization bodies including international standardization
e. Trade Unions

The German platform for Industrie 4.0 is a good reference for a program structure which brings together 250 stakeholders from over 100 companies, associations, unions, academia and political organizations. It is steered and chaired by Government Minister and has five working groups in the following areas:

- Reference architecture and standardization
- Research and innovation
- Security
- Legal framework
- Labor and training

As the first step towards the journey, it is important in India too to create a multi-stakeholder task force comprising of government, academia, industry and international bodies to chart out an action plan.

The journey towards smart manufacturing will be an evolutionary process. It will deliver greater flexibility and robustness together with the highest quality standards in engineering, planning, manufacturing, operational and logistics processes. It will lead to the emergence of dynamic, real-

time optimized, self-organizing value-chains that can be optimized based on a variety of criteria such as cost, availability, and resource consumption.

Using Digital as the path to the future of manufacturing will allow Indian manufacturers to do more than upgrade their equipment and eliminate inefficiencies to increase production effectiveness. It will also give them the freedom to make the right strategic decisions and re-invent their business models, while preparing them to maintain a competitive-edge globally.

Conclusions

To promote a holistic ecosystem for adoption of smart manufacturing tools and technologies by Indian manufacturing sector, the following priority areas for policy intervention can be suggested:

a. IoT, Cloud and Analytics
b. Broadband infrastructure
c. Cyber security and safety
d. Work organization and design
e. Training, skills and capacity building
f. Regulatory environment
g. Standardization and reference architecture
h. Modelling complex production systems
i. Resource efficiency and environment

To arrive at a specific action points in each of the above areas, a program management structure can be proposed. The program structure may include representatives of Government, academia, industry and industry associations, trade unions, research and political organizations. The structure has already been successfully used in Germany with specific working groups for each of the above identified areas.

References

1 http://www.plattform-i40.de/I40/Navigation/EN/Home/home.html

2. Recommendations for implementing the strategic initiative Industrie 4.0, Final report of the Industrie 4.0 working group, Acatech, National Academy of Science and Engineering, Germany

3. http://www.omg.org/news/meetings/tc/berlin-15/special-events/mfg-presentations/adolphs.pdf

4. http://www.makeinindia.com/home

Temprature Varying Jacket using Peltier Module

Aishwarya Phagna, Nirali Monani, Palak Prajapati

Abstract- **It is basically a jacket designed to produce artificial weather to the wearer. The jacket is inculcated with circuitry with the help of which the temperature inside could be varied between 5-50 degree. For heating and cooling purpose we have used Peltier module. When we apply 2 Amp current to it one side of it produces heat and the other produces cold and we can use either of the side for our purpose. So we have used 2 peltier module 1 for heating and other for cooling. Whereas the switching unit between cooling and heating is relay circuit. The relay circuit is operated by the Atmega328 which performs the handling and controlling part of our product. There is one display unit in our circuit it is LCD display which displays the temperature inside and outside of the jacket. So it becomes easier for the wearer to see and sense the temperature variation. There temperature sensing is done by the LM35 who sense the temperature from the jacket and outside of jacket and give data to ATmega32 which then send the data to seven segment LCD display for displaying the temperature on screen and relay circuit to switch the Peltier module. This is how our jacket works**.

Index Terms-Jacket, Peltier, Liquid Crystal Display, ATmega328, LM35

I. Introduction

When we began with our work to find out the topic on which we can work on and make something worth resolving it seriously it was Brain Storming. But one day during our search we saw the news in the paper which displayed the sad demise of the LansnaikHanumanthappa who died because of multiple organ failure,Then we searched about him and we got to know that he was found in Siachen 4 days back under the bed of snow he was there for couple of days and when some troupe who was passing from there found him and when he was rushed to hospital he was deeply affected but the cold.And after a brave survival of 4 days he lost his life.After a couple of weeks heat wave affected the India a lot some places in India even crossed 50 degree celcius. Due to which people were affected a lot by Sun stroke,vomiting,etc.Keeping all this in mind we we thought why not just take this concept for our final year project and make something for everyone to save them from these adverse effect of weather. Our world is blessed with different seasons. But some parts of earth face the adverse conditions of this weather like this year the lowest temperature recorded on earth is -89.2degree celcius in soviet vostok Station in Antarctica. Whereas in India this year the Highest temperature recorded is 52.3 degree celcius. In India there are places like Siachen and Jammu Kashmir where the Army persons have to face extreme weather conditions and then also fulfill there duties. Keeping all these things in mind a new innovation has taken place which is named as "Temperature Varying Jacket".

We made many researches and after that we decided to use peltier module for both heating and cooling purpose. when a drop of water is palced into a small cavity at the junction of two bars made of bismuth (Bi) and antimony (Sb). When the electric current flowed in one direction, the drop of water froze. When the current flowed in the opposite direction, the frozen water melted. This experiment showed that when an electric current flows through the junction of two dissimilar conductors, that junction will either absorb or release heat, depending on the direction of the current flow. This phenomenon is called as Peltier effect.. But using peltier module for cooling purpose was difficult as high power usage and high power dissipation are the biggest problems related to peltier cooling Peltier modules, in the process of operating it for cooling give off a relatively large amount of heat. For this reason, we used fan with an heatsink for releasing access amount of heat high power usage and high power dissipation are the biggest problems related to peltier cooling, We have used Lm35 as temperature sensor. The next step was programming our Atmega 328 and we have interfaced seven segment display with it which is used to display outer temperature and inner temperature of jacket as well as the Relay circuit helps in switching which is explained in next section deply,

Component Table

Table 1 Component List

Sr no.	Component Name	Quantity
1	Peltier Module	2
2	Thermoelectric Fan	1
3	LM 35	2
4	IC 7805	1
5	Ceramic Capacitor	2
6	Electrolytic capacitor	2
7	Quartz crystal	1
8	Relay	2
9	Atmeaga328	1
10	LCD display	1
11	Resistors	2

II. Jacket Operation

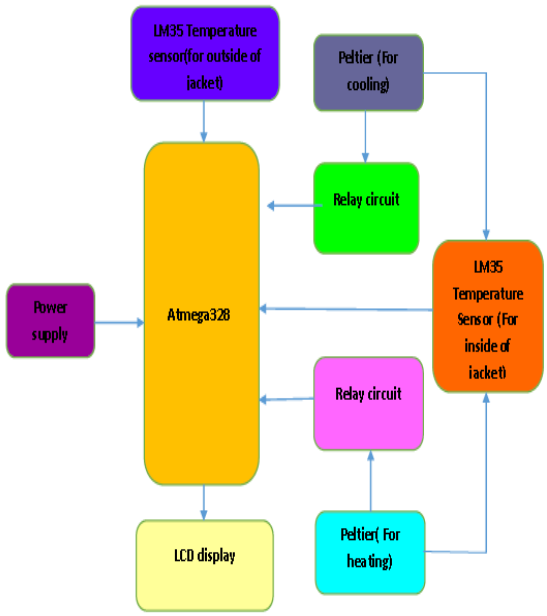


Figure a. Block Diagram

This is the main functional block diagram and work flow of our "Temperature Varying Jacket". Our work flow starts from the block power supply it is the part from which the circuitry of the project will get the input for the proper functioning. Our circuitry needs input of 12V and 6A. Which is sufficient for the functioning of the project. Then after comes the block the ATmega32 It is the Brain of our project it handles all the component and supply power and performs the switching in our project. In our project if the temperature rises above 40 degree the peltier module used for the cooling will start and if the temperature drops below 30 degree then peltier for the heating purpose will start. And for switching these peltier the atmeg32 takes data from LM35 and does the needful task. Thereafter comes the block LM35 it is the part which senses the temperature of inside and outside the jacket and gives it to the Atmega 32 and the temperature is displayed on the LCD screen. The block LCD display takes data from the Atmegaa 32 and dislplays the temperature. The block Relay circuit performs the switching between the heating and cooling type of peltier module. Now the block Peltier module is the heart of our circuit it performs the main function of our purpose the heating and cooling. The peltir module used for cooling is sticked to the thermoelectric fan to sweep out the excess heat and give much cooing. This is how our product works and how they are interconnected to each other for proper functioning and provide best result.

Cooling and heating due to the thermoelectric effect is given by (peltier effect)

$$Qc = \alpha I T_c$$

$$Qc = \alpha I T_h$$

For the cold junction

$$Q_c + 0.5\, I^2 R + U\ (T_h - T_C) = \alpha I T_C$$

For the hot junction

$$Qh + U(T_h - T_c) = \alpha I T_h + 0.5 I^2 R$$

This products working can be seen in two ways like in suumer season the temperature sensing LM35 senses the temperature from outside the jacket and send it to Atmega32. Atmega32 send it to the LCD display and also meanwhlie switches ON the Relay circuit for cooling Peltier module as the temperature has dropped below 40 degree so the Peltier module for cooling starts cooling and the LM35 for sensing the temperature inside the jacket and sends it to ATmmega32 and Atmega sends it to LCD display and we can see the output on LCD and the temperature inside the jacket decreases. Whereas in Winter season the temperature read by the LM35 for outside of jacket is lower than 40 degree than the Atmega32 switches ON the relay circuit for heating purpose and as the relay switches the Peltier module for heating switches ON and starts heating. The LM35 for reading the temperature inside the jacket sends it to the Atmega32 and Atmega32 sends it to the LCD display and we can see the output temperature on the display.

Figure b. Temperature Varying Jacket using Peltier Module

Performance Curve at Th=27ºC Performance Curve at Th=50 ºC

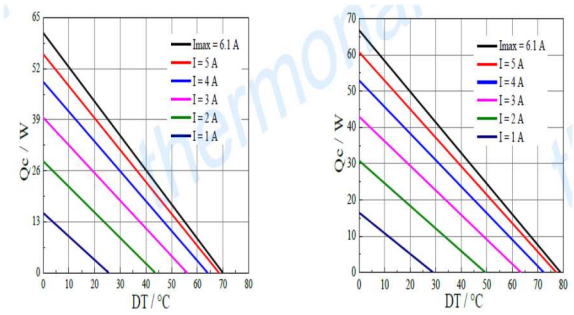


Figure c. Standard Performance Graph Qc= f(DT)

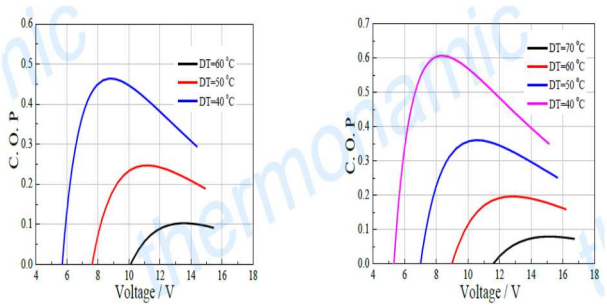


Figure d. Standard Performance Graph COP = f(V) of ΔT ranged from 40 to 60/70 ˚

III. Features

1. This can provide heating and cooling in real time.

2. The components used are highly reliable.

3. The circuitry is low cost.

4. It can withstand any temperature.

5. It is highly manageable as we are making any wardrobe.

6. It is light in weight composed to others existing same technologies.

7. The experience of it is comfortable.

8. Friendly to humans.

9. As jacket is prepared no other circuitry to be carried.

IV. NOMENCLATURE

Q heat flow per unit time, heat power (W)

COP coefficient of performance

I electric current

Qh Peltier pellet hot side heat flow (W)

Qc Peltier pellet cold side heat flow (W)

P electric power supplied

α Seeback coefficient (v0 c -1)

Tc cold side temperature(K)

R thermal resistance (K/W)

V voltage to the thermoelectric module (volt)

V. Conclusion

By the use of the circuitry we can create artificial temperature inside the jacket and the intended temperature is achieved in the jacket. Up till now the products developed likely to our product where mostly based on heating and cooling with base of water, which was not appropriate as they can't be used daily. Either were based on chemical due to which human were affected a lot.in our product we are using the peltier module for both heating and cooling purpose, which is totally different from existing one and all high reliable and manageable and does not use water or chemicals due to which can be highly used as well as they can withstand any temperature not like existing technology.

REFERENCES

1) Taylor, R.A., Solbrekken, G., Comprehensive system-level optimization of thermoelectric devices for electronic cooling applications, Components and Packaging Technologies, IEEE Transactions on (Volume:31, Issue: 1)

2) ElCosnier W., Gilles M., Lingai., An experimental and numerical study of a thermoelectric air-cooling and air-heating system. international journal of refrigeration, 31,1051 – 1062,(2008).

3) Sujin., Vora and Seetawan., Analyzing of Thermoelectric Refrigerator Performance. Proceedings of the 2ndInternational Science, Social-Science, Engineering and Energy Conference, 25,154–159,(2000) .

4) Riffat and Guoquan., Comparitive investigation of thermoelectric air- conditioners versus vapour compression and absorption air- conditioners. Journal of Applied Thermal Engineering, 24 , 1979-1993,(2004).

5) Astrain D., Vian J.G., & Domınguez M., Increase of COP in the thermoelectric refrigeration by the optimization of heat dissipation. Applied Thermal Engineering, 23, 2183–2200,(2003).