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FRAUNHOFER IN INDIA

NEWSLETTER - ISSUE 1/2017

Industry 4.0: Building the digital enterprise in India

Content

FOREWORD

The Exciting Multi Disciplinary World Of Technologies

Dear Readers,

It is fascinating how the world of technologies is getting ever more interdisciplinary in its application and the borders of science are getting thinner every day. There was a time when a Science student in his high school grade had to decide whether to specialise in Chemistry, Physics, Biology, or Engineering Sciences. Specialists were in demand and the more specialised in your field you became, the more in demand you were.

Look at the fields of Study in demand today: Environmental Economics, Neuroscience, Cyberphysics, Nanotechnology, Biomedical engineering, Bioinformatics, Engineering Design to name a few. These fields of study eschew the borders of science, arts and economics, to create an individual who can think out of the box, visualise the interconnections, and develop holistic solutions. Today, there are even degrees being offered in many Universities across the world in "Interdisciplinary Studies" that aim to foster creative thinking, integrated insights and thereby leading to comprehensive perspectives.

Fraunhofer in India is working on two large areas which are excellent examples of these approaches: Industry 4.0 / Smart Manufacturing and Smart Cities / Integrated Urban Development. The world of manufacturing is getting extremely communicative, interconnected and interdisciplinary. While technology interventions such as CAD/ CAM and automation have been prevalent for quite a few decades, the increasing complexity of demands by consumers is placing the manufacturing industry in a position, to bring in faster and more productive manufacturing processes on a continuous basis. A rich pipeline of innovations in materials and processes from nanomaterials to 3-D printing to advanced robotics, also promises to create fresh demand and drive further productivity gains across manufacturing industries and geographies. For example, to bring food fresh from 'Farm to Table', it calls for a complex web of just in-time logistics biochemical processes to ensure ripening at the right time and efficient and innovative packaging.

In a similar manner, Urban Development has become more complex owing to the influx of people into cities and the growing demands of balancing work, pleasure and family. Juxtaposing the civic services of energy, water, mobility and security which are all interrelated and need to be addressed in a comprehensive rather than piece meal fashion. For example, public buildings such as Railway stations and Airports have experienced a sweeping change in their aesthetics, construction and services, and are becoming a huge centre for recreation, shopping and consumer requirements than merely transporting people.

Keeping in mind these trends, we have focussed on Industry 4.0 in this edition, and look forward to your comments.

Happy Reading!

Anandi Iyer

A brief discourse on
Vision for the Industry 4.0 in India
with **Shri. Dr. V K Saraswat**,
Member, NITIAyog, Govt of India.

As a premier think-tank of the Government of India, NITI Aayog provides critical knowledge, innovation and entrepreneurial support to the country. What is your vision for the Industry 4.0 in India?

The vision of digital revolution, Industry 4.0 in India is deployment of significantly faster, more flexible, higher productivity & efficiency, and self-managing production processes where people, machines, equipment, logistics systems, and work-in-process components communicate and cooperate with each other directly increasing competitiveness, resulting in high quality and low cost products.

The technologies driving this vision mainly include – IOT (Internet of Things), IIoT (Industrial Internet of Things) - Robotics, Automation (RFID) - Sensor embedded systems, - 3D printing, - Virtual Reality, - Augmented Reality, - Big Data Analytics, - Artificial Intelligence, and - Cloud computing.

Are there any opportunities for public-private partnership?

Opportunities for private and public partnership exists which could be utilised for accelerating provisioning of infrastructure, faster implementation, schedule certainty and to take advantage of the developments available in the private sector for jump start. Some of the international players in industry and academia who are in the forefront of implementing Industry 4.0 can partner with public enterprises. A brief list is given below.

Fraunhofer group of institutions: (a) for cooperation in preparing Technology Roadmaps and Foresight studies, Policy recommendations on technology intensive fields, standardization and norms (b) for assisting in creating ecosystems and innovation clusters (c) Support in implementation of Production technologies, digital or smart factory, Renewable Energy installations, Innovation labs for Smart cities etc for demo and try-outs and proof of concept (d) for development of further qualification courses for Industry professionals.

Catapults of UK: (a) for Virtual reality and augmented reality solutions for complex manufacturing environments for current & future needs, (b) for creating laboratories for explorations related to reconfigurable assembly and component manufacturing, intelligent machines & process optimising and for enhancing operations & production, (c) developing virtual environments to support product design, assembly process design, training, maintenance simulation, remote support, factory layout simulation and optimisation.

SAP India and Roland Berger: for policy development, data analytics services for MSME's, IT related support and services.

Dr Vijay Kumar Saraswat, India's most gifted scientist and an accomplished researcher with more than four decades of experience spaning over several fields and areas in both basic and applied sciences of defence research. Apart from being a scientist, he is a rare combination of an innovator, technologist and visionary.

During his illustrious career, from Scientist to Scientific Adviser to Defence Minister, Director to Director General DRDO and Secretary to Dept of Defence R&D, Dr Saraswat has been credited with development of Liquid Propulsion Rocket Engines and missiles namely PRITHVI, DHANUSH, PRAHAAR indigenously. He is the principal architect of the Ballistic Missile Defence programme which included major technology breakthroughs. The successive interceptions of incoming target ballistic missiles at Exo and Endo atmospheres are a testimony to his dedicated efforts and exploitation of limited technological resources. With this India joined the select nations that have the capability to develop BMD systems.

Dr Saraswat is the recipient of many national and international awards including
PADMABHUSHAN (2013)
PADMASHRI (1998) Vikram Sarabhai Memorial Award from Indian Science Congress (2011); Lifetime Achievement Award by Ramakrishna-Vivekananda International

1. In the future, mobile assistive robots will directly assist workers in manufacturing. The Fraunhofer IFF develops technologies that enable humans and machines to work together safely. Photo Credit Fraunhofer IFF

Siemens: for tools and solutions for creating "digital enterprise for Industry 4.0" for Product Lifecycle Management, Production Planning, Product Designing, Product Execution etc.

Bosch Software Technologies: device development, development of customised technologies IT & non-IT, data analytics and apps development

Rockwell Automation: offers connected enterprise factory automation solution, hardware and software which can be networked with ERP & MIS software for productivity enhancement & decision making

Within India, the partnership eco-system is in the process of breaking ground. A case in example would be the CMTI-IISc-IMTMA collaborative proposal to address Industry 4.0 issues related to development, deployment & training for the Indian machine tool industry. **A demo cum try-out centre is proposed to be realised at CMTI, Bangalore.**

What are some of the key innovative technologies that you are looking for to integrate Industry 4.0?

The technologies driving and integrating Industry 4.0 are:

- Networked and Cyber / data Systems: Fieldbus systems, Industrial Ethernet, Wi-Fi, Machine to Machine communication, Shared databases, Big Data Analytics, Cloud computing, IOT (Internet of Things), IIoT (Industrial Internet of Things),IT / Cyber security
- Intelligent product: for online diagnostics, predictive maintenance, real-time compensation, auto identification, RFID, NFC or other tags, machine / equipment health monitoring system, Smart tags, Sensor embedded systems, Smart devices, Industrial control systems, Sensor Grid
- User level: Smartphones, Wearable, Virtual Reality, Augmented reality, Collaborative robots, Data Analysis Tools, Adaptive programming, Simulation, PLM, MES, CAE, Artificial Intelligence, centralized planning & management.
- Robotics, Automated systems: tool monitoring, loading / unloading systems, AGV's, Automatic tool storage and retrieval, In-process Inspection systems,
- Additive Manufacturing, automated micro machine and robotised multitasking machines.

What are the challenges faced by India to transform its present state of manufacturing to Industry 4.0?

- Baseline assessment of requirements and incorporation of digital manufacturing elements and existing capabilities, due to diffused nature of Indian manufacturing industry are not well documented today.

- Since more than 80% manufacturing in India is in MSME sector. The implementation of Industry 4.0 is a major challenge.
- Replacement or/and upgradation of legacy systems/machine tools/production infrastructure are major challenges because the indigenous capability of integration of IoT and Industry 4.0 system in existing production infrastructure is limited.
- Standardisation and adoption of a standard architecture similar to that of Reference Architecture model for Industry 4.0 by Germany in not existing in India. Policy for standardisation is a major challenge.
- IT Security or Cyber Security technologies for IT enabled solutions in Industry for systems, devices, machines are not very strong. As such cyber security in digital manufacturing remains a challenge.
- Demystifying Industry 4.0 among top management, middle managers, shop floor workers/supervisor is a challenge. Focused enabling programme is needed in this direction.
- Industrys are not aware of the advantages of moving to Industry 4.0 production system. Generally the impression is that it requires high capex, exceptional skills and return may not be commensurate.
- Non-availability of a comprehensive Broad-Band infrastructure is another challenge. Hopefully, it will be in place by 2022.
- There is general apprehension that introduction of Industry 4.0 production system will result in excessive unemployment. Many debates on the subject demands reskilling of workforce for Industry 4.0 environment, which is a challenge.
- Automation/ AI/ Analytics/ VR/ Machine to Machine communication have to be developed and put in place through a focused industry/academia driven R&D programme for faster and cost effective flexible, customised introduction of Industry 4.0 technology. This remains a challenge particularly in the domain of IT/electronic hardware despite having a strong base in software.
- Machine Tool industry in the country imports most of the smart machines resulting in high Capex and operating cost (Maintenance/spare parts etc.) Sustaining Industry 4.0 production infrastructure without a sound indigenous capability to design & manufacture smart machines remains a challenge as has been witnessed when CNC machines were introduced in India.
- Providing open source software and hardware with flexibility for customisation in the absence of standards in a multivendor service providers environment for automation remains a challenge.
- Overall, India needs to put in place a roadmap for graduating to Industry 4.0 involving all stake holders from industry, academia, research institutions and international collaborators to set up strong indigenous base for all the building blocks of Industry 4.0 and set out priorities for upgradation sectorwise through national & international collaboration in simulation, design of system, acquisition of smart machines, development of software and skilling of workforce.

2. Cyber Security for the Future: Cyber security is the basic prerequisite for digitalization. Whether it is in automotive, production, critical infrastructure or digital services, confidence in the safety of new technologies is indispensable.
Photo Credit Shutterstock

1

Internet of things for the Industry of the Future

Source: Fraunhofer Brochure - Trends in Industry 4.0

High Performance Centre for Digital Networking

The High Performance Centre for Digital Networking is a collaborative venture involving the four Berlin-based Fraunhofer Institutes FOKUS, HHI, IPK and IZM. Researchers here are developing technologies and solutions that take into account the increasing digitalization and networking in every area of our lives. Research is focused on basic and interface technologies as well as on solutions applicable to the areas of health and medicine, mobility and the city of the future, industry and production, and critical infrastructure.

Objects are becoming smart: they are aware of their status and can communicate with other objects. This is also known as the Internet of Things. Using the examples of a new wireless communication technology and cloud-supported maintenance of combine harvesters, Fraunhofer researchers show how industry is benefiting from this networking.

The Internet of Things allows objects to become smart and "talk" to each other, by equipping them with sensors that record the status of objects and transmit this data to a central location. Such transmissions could, of course, be made using a cellular phone network, but it is energy intensive and expensive. Moreover, messages are sometimes not completely transmitted. The Fraunhofer Institute for Integrated Circuits IIS has come up with an alternative: The Fraunhofer IIS MIOTY wireless communication technology, which can facilitate the networking of as many as one million radio nodes. Each individual node requires only a fraction of the energy needed for conventional cellular communications, and the battery lasts for ten to fifteen years. The transmitters can communicate with a receiver up to ten kilometres away. Instead of sending all the data bundled together, the researchers split it into small packets. This data is transmitted at intervals on different frequencies, which makes the transmission less susceptible to interference. To demonstrate how the technology works, the IIS researchers use an industrial piping system. This transmits its data to a mobile platform, allowing factors such as humidity, movement, light and temperature to be transferred.

Cloud-supported maintenance of combine harvesters

Objects' intelligence is important in the case of combine harvesters, too. After all, these are effectively factories on four wheels, and they need to have an extremely high level of reliability. If a machine like this goes wrong at harvest time, it can be some time until replacement parts are obtained and an appropriate specialist is flown in from another part of the world. This entails a major financial loss for the farmer. Researchers at the Fraunhofer Institute for Embedded Systems and Communication Technologies ESK know how to reduce such expensive unscheduled stoppages in the future or even how to avoid them altogether. Their principle is to have a number of sensors on every machine monitor the key components of the drive system and use a cellular phone network to send their data to a central maintenance service in the cloud. With the aid of online analytical procedures, this service can detect any irregularities very early and raise the alarm. As a result, components can be replaced even before the machine stops working. This process is also known as "predictive maintenance." Together with partners from industry, the ESK has designed a cloud-based solution that will make this possible for machines throughout the world.

State-of-the-art Technologies for the Factory of the Future

Source: Fraunhofer Brochure - Trends in Industry 4.0

The E³-Forschungsfabrik Resource-Efficient Production was opened at the Fraunhofer Institute for Machine Tools and Forming Technology IWU in Chem- nitz. Scientists here are collaborating with partners from industry to conduct research into solutions that will enable tomorrow's manufacturing to be resource and energy efficient.

This research factory in Chemnitz focuses on two areas of technology: car body manufacturing and the production of powertrain components. For example, scientists are carrying out research on car body production facilities that can be used flexibly to build different models in a car manufacturer's range. Until now, each model needed a new production line. In the current research project with VW, Audi, Phoenix Contact and Kuka, the components needed for any one model are identified in the warehouse and delivered to the facility by means of net worked logistics. The robots and grippers on the line then use actuators (drive units) to self-adjust for the production of the model at hand.

ARENA2036: Research Factory for the car of the future
On the ARENA2036 campus, scientists from the Fraunhofer Institute for Manufacturing Engineering and Automation IPA and from the University of Stuttgart are collaborating with companies such as Bosch, Daimler, Festo, Kuka and BASF. They are working together in a research factory on developing and manufacturing lighter, eco-friendly cars that can be customized and produced individually at affordable prices.

Around 5000 square meters of the University of Stuttgart campus in Vaihingen have been set aside for a research workshop and manufacturing facility. It is in this realistic setting that the scientists are due to carry out research into tomorrow's vehicle designs and manufacturing processes that will replace assembly line production. The facility's foundation stone was laid in October 2015, and construction is expected to be completed by the end of 2016.

The project partners want to replace the largely inflexible production line model that has existed until now with a manufacturing process that depends far less on conveyor belts and cycle times. "It is the task of ARENA2036 to develop sustainable automotive manufacturing methods and to support a technology transformation that will enable personal mobility with low energy consumption. The key lies in versatile forms of production networked in real time," concludes Prof. Thomas Bauernhansl, Director of the IPA. www.e3-fabrik.de/en

In addition to energy, material, time and cost, data is also becoming an ever more important manufacturing resource. The E³-Forschungsfabrik´s own information system correlates data from over 1500 sources, gathering data on operating states, energy consumption or maintenance schedules, for example. This allows new forming based process chains to be analysed, optimized and tested under factory conditions.

1. Photo Credit: Fraunhofer IWU

Digital collaborations between Humans & Machines

interview with
Prof. Wihelm Bauer,
Director, Fraunhofer IAO
about the impact of Industry 4.0 on the workplace.

Professor Bauer, last year Fraunhofer IAO initiated some pioneering research projects focusing on the digitalization of the workplace. Where do you see key developments in the coming years?

It's clear to anyone who follows current issues in business, politics and society that digitalization is going to bring about huge changes in the way we live and work. From my perspective, there are three important elements in that regard: human beings, with our modern needs and behaviors; new (and sometimes, disruptive) business models; and technology, with digital and information technology leading the way.

What impact will the digital transformation have on our daily lives?

The Internet and digital technologies are changing our everyday working lives significantly. Digital work practices have already come a long way in the office environment: we can work wherever, whenever and however we wish. And as artificial intelligence systems become more prevalent, they will make further significant changes to office and knowledge work. These developments are now also making headway in our factories: in the Internet of Things, smart networked objects communicate with each other as well as with people. Through this, we'll receive another push in automation – a positive change given our demographic situation.

Won't these developments serve to increasingly widen the so-called "digital divide"?

Yes, there is that danger. On the one hand you have the tech-savvy young people from Generations Y and Z, who socialize digitally and are "always online." They use digital technology quite naturally, including in their place of work. On the other hand you have the needs of older people, who do not find this approach so natural. We have to take them with us too into tomorrow's digital world of work, because we don't want to lose anyone with valuable qualifications as we move forward.

That requires appropriate further training measures. Setting up mixed-age teams is a good option as well. In addition, we need to have digital technology that is so user-friendly it can be handled quite readily by people of every age, culture and level of qualification. Technology therefore has to be easy to use.

"Industry 4.0" – how will the developments involved drive forward manufacturing companies?

The Internet of Things and Services puts us at the start of the next industrial revolution, which we call Industry 4.0. In practice, this means that manufacturing companies will develop digitally enriched products – that is, cyber-physical systems. And these new products will be produced in smart factories by digital and connected manufacturing systems with increasingly intelligent automation. Digital platforms will support the production of smart products throughout the entire value chain – from customer need to customer benefit.

What potential do you think Industry 4.0 has for the economy?

That's a key question, of course, which we already explored as part of a study with BITKOM in 2014. This study revealed that Industry 4.0 has the potential to revolutionize our industrial value creation in the same way as the Internet has revolutionized knowledge work. In order to realize the full potential of Industry 4.0, we need to take a holistic approach to creating the people-technology-organization ecosystem. We also need standards governing technology and practice as well as regulations covering fast and seamless communication, data protection and data security. That's something we're working on in Fraunhofer's Industrial Data Space initiative, for instance.

How will Industry 4.0 become a reality? What do you see as the challenges in implementing it?

Industry 4.0 must be introduced gradually. To that end, we need to gain experience through research and practical implementation. At the same time, it is important to train people for digital ways of working and to familiarize them with new processes. In this country we have huge potential for this, but only if we serve as providers of essential technologies and not just as a market for them. It's true that we are leaders in machinery and plant engineering, but we still lag behind when it comes to data handling. Some people say that Germany and Europe have lost the first half of the digitalization game. But now the second half is beginning – and here it's all about the real world, basic needs and the digitalization of the real economy. That was always our strength, and we now have excellent chances of succeeding.

So, are human beings coming more to the fore now in human-machine interaction?

From examples such as hearing implants, wearable body sensors or collaborative robots, we see that intelligent machines – and indeed, intelligent technology in general – are adapting more and more to individual needs and abilities. However, we are only at the beginning in this respect. Now we need to create user-friendly applications and include various user groups in the design and development process. Integrated and interdisciplinary research must be central to our approach. We should give examining ethical, social and legal issues the same priority as we do scientific, technical and economic questions. In order to do this, we need a new kind of socio-economic research that encompasses technology within it.

Professor Bauer leads a research organization with some 560 employees. He is responsible for research and implementation projects in the areas of innovation research, technology management, living and working in the future, smarter cities and mobility innovations. As a member of numerous committees, Professor Bauer is an advisor to policy-makers and the business community. He has authored more than 300 scientific and technical publications and is an associate lecturer at the Universities of Stuttgart and Hannover. Professor Bauer has been honored with the "Übermorgenmacher" distinction for innovators by the German state of Baden-Württemberg.

1. Collaboration with the big robot.
Photo Credit: Fraunhofer IPA, Rainer Bez

"People will remain the Focal Point in Industry 4.0, too"

an interview with
Prof. Michael Schenk,

Chairman of the Fraunhofer Group for Production & Director of the

Fraunhofer Institute for Factory Operations & Automation IFF

Professor Schenk, to what extent will Industry 4.0 transform the way that industrial companies work and think?

On the one hand, consumers and producers will be more digitally interconnected in the future, thus giving rise to a high level of product customization. On the other hand, demand will only exist for products combined with digitized services related to production. Digital added value will exceed pure product value, and the creative and work processes in product design, development and production will merge. This shift will be rapid and sweeping and increasingly facilitated by artificial intelligence tools. Expediently collecting and analyzing all of the data in the value chain, i.e. big data, in near real-time enables us to boost workforce and energy productivity.

Companies are using cyber-physical systems to customize more products. Custom products are cheaper to manufacture. Where are the major technological hurdles and where is there need for research?

The protection of personal data of customers and employees, known as cybersecurity, will play a major role and will have to be carefully treated and facilitated in the future. I consider the continued presence of gaps in the broadband coverage in Germany, especially in the eastern states, to be a problem. Broadband availability is very patchy there. Action must be taken quickly to remedy this situation. Here, I would draw attention to the Industrial
Data Space, an initiative launched by the Fraunhofer-Gesellschaft. Researchers are working in a funded project on reference architecture for secure data spaces and its implementation since companies' retention of sovereignty over their data is the prerequisite for Industry 4.0.

There is also a completely different kind of hurdle: If we are to make custom products on equipment from different manufacturers, then these machines have to be able to communicate with one another. Common standards are still nonexistent even for this lowest level of "smart connectivity". Industry 4.0 has sparked discussion on this issue, at least. Things get even more complicated when, for instance, semantic "understanding" and autonomous deduction of consequences for subsequent manufacturing operations are required in addition to pure data transmission. We are only at the very beginning of a development here, which still requires a great deal of research.

Small and medium-sized German companies often still have problems identifying the potential of Industry 4.0. How can we make them aware of these opportunities so that they stay abreast of global developments?

SMEs often do not have the human resources, let alone experts, to deal with this paradigm shift extensively over the long term. Building and expanding government subsidized model factories and learning platforms can provide valuable support here. Special attention should also be paid to technical trades. The concept of "Trade 4.0" has not been introduced but it plays an important role in implementation in the system and supplier network. The paradigm shift aspired to will only occur when every institution with a stake in the overall value added can partake of and participate in "4.0".

This change entails numerous challenges for employees. What are the central issues?

People will remain the focal point in Industry 4.0, too. We can increase employees' skills

approach to creating the people-technology-organization ecosystem. We also need standards governing technology and practice as well as regulations covering fast and seamless communication, data protection and data security. That's something we're working on in Fraunhofer's Industrial Data Space initiative, for instance.

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Prof. Michael Schenk, Director of the Fraunhofer IFF in Magdeburg and member of the BVL's Scientific Advisory Board, was awarded honorary membership in der Bundesvereinigung Logistik BVL for his exceptional personal commitment. For fifteen years, Professor Schenk has been active as a member of, among other things, the Board and the Research Council and as chairman of the jury for the Science Award for Supply Chain Management. He was instrumental in establishing the International Scientific Symposium on Logistics as a separate professional logistics event. A mathematician, Schenk is a recognized expert in logistics and factory planning. He became the director of the Fraunhofer Institute for Factory Operation and Automation IFF in Magdeburg in 1994. He has held the Institute of Logistics and Material Handling Systems' Chair of Logistics Systems at Otto von Guericke University Magdeburg since 2003

1. Plant Design of the Future Conference paths to digitalization.
Photo Credit: Fraunhofer IFF,
Dirk Mahler (M)

Cyber security in production: Secure connections

Industry 4.0 involves connecting machines and data – both within one company and beyond company boundaries. Fraunhofer experts are seeking effective ways of protecting manufacturers' proprietary data against hackers.

IT security for industry 4.0
In a study commissioned by the German Federal Ministry for Economic Affairs and Energy (BMWi), researchers at several Fraunhofer Institutes and various partners investigated the legal, organizational and technical aspects of IT security for industry 4.0. Their proposed recommendations included the introduction of minimum standards of IT security and corresponding legal regulations, the use of digital identities and certified products in digital supply

Up to now, very few production plants were linked to the Internet and thus exposed to cyber attacks. Industry 4.0 changes all this. On the positive side, this open networking approach enables machines to communicate with one another or with the manufacturer via a remote data link. On the negative side, annual losses of more than 22 billion euros were suffered by industry alone due to data theft, espionage and sabotage, according to the 2016 Bitkom survey.

Researchers are busy working on effective solutions to protect connected industrial plants against cyber attacks and espionage. IT security in industry 4.0 (IUNO), a German national reference project, counts 21 partners including three Fraunhofer Institutes, Bosch, Siemens and Volkswagen, all working toward a common goal. "We are developing a toolbox of IT technologies that will enable SMEs to get ready for industry 4.0," says research scientist Dr. Thorsten Henkel from Fraunhofer SIT. It defends against risks including the theft of intellectual property and counterfeiting. If, for example, a company sells the CAD data for a brake disk, the buyer is only allowed to produce a fixed number of brake disks, based on the relevant price agreement. Another challenge is that of ascribing an identity to the machine generating these data – with rights to data protection similar to those granted to humans. But what happens if the machine is altered through the addition or replacement of component parts? Under what conditions does the machine's identity remain the same, and when not?

Simulating cyber attacks
Attacks on production networks can have drastic consequences, possibly even bringing them down completely. Researchers at Fraunhofer Institute of Optronics, System Technologies and Image Exploitation IOSB have the possibility of using the institute's IT security lab for industrial control systems to simulate potential cyber attacks and, by analyzing the results, develop new defense strategies and appropriate countermeasures. Using the lab's facilities, the researchers can simulate the complex IT infrastructure of an entire factory, including the office network and the networks for planning, monitoring and controlling production. In addition to the challenges posed by cyber attacks, a recurring question when developing new security solutions is who owns the data. How can companies share information without revealing commercial secrets or losing control over proprietary data? It was for this reason that Fraunhofer launched its initiative to create the Industrial Data Space, a network of trusted data that allows companies to connect their data while retaining sovereignty over it.

1. Photo Credit: Fraunhofer SIT, Cyber security in production Secure connections

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Recent Research News @ Fraunhofer

Battery production goes Industry 4.0
Research News / 1.3.2017

A battery that can be charged in seconds, has a large capacity and lasts ten to twelve years? Certainly, many have wanted such a thing. Now the FastStorageBW II project – which includes Fraunhofer – is working on making it a reality. Fraunhofer researchers are using pre-production to optimize large-scale production and ensure it follows the principles of Industry 4.0 from the outset. Fraunhofer IPA is also applying its expertise beyond the area of production technology: The scientists are developing business models for the marketing of battery cells, they are analyzing resource availability, and they are optimizing the subsequent recycling of PowerCaps.

Industry 4.0: Virtual twin controls production
Press Release / 9.2.2017

With an innovative new concept, researchers of the Fraunhofer Institute for Production Systems and Design Technology IPK want to turn the vision of Industry 4.0 into reality. A digital twin models the entire production process and permits direct intervention into manufacturing at all times. Real and virtual production merge into an intelligent overall system.

A virtual twin simulates the entire production system. Bidirectional control: changes in the virtual twin are passed on to the real production system.Fraunhofer Institute for Production Systems and Design Technology IPK makes Industry 4.0 come alive. Professor Rainer Stark, head of the Virtual Product Creation division at Fraunhofer IPK: "The smart factory is no longer just a trendy buzzword: our digital twin concept is ready for implementation together with industrial partners."

Complex 3D data on all devices
Research News / 1.2.2017

A new web-based software platform is swiftly bringing the visualization of 3D data to every device, optimizing the use of, for example, virtual reality and augmented reality in industry. In this way, Fraunhofer researchers have brought the ideal of "any data on any device" a good deal closer.

"instant3DHub" software enables engineers to inspect industrial plants in real time. Only the visible parts are calculated on the server and transmitted to the device. Daimler, Porsche and BMW already use instant3DHub at over 1,000 workstations

PLUGandWORK connects existing machines and systems to Industrial Internet-of-Things (IIoT)
Research News / 1.3.2017

Fraunhofer solutions integrate existing machines into modern production systems such as MES and SCADA. PLUGandWORK automatically generates a communication server for data exchange with other systems or IT systems. This means that medium-sized companies are

1. Thanks to the early warning and emergency management system, impurities in the water supply can be quickly tracked down.
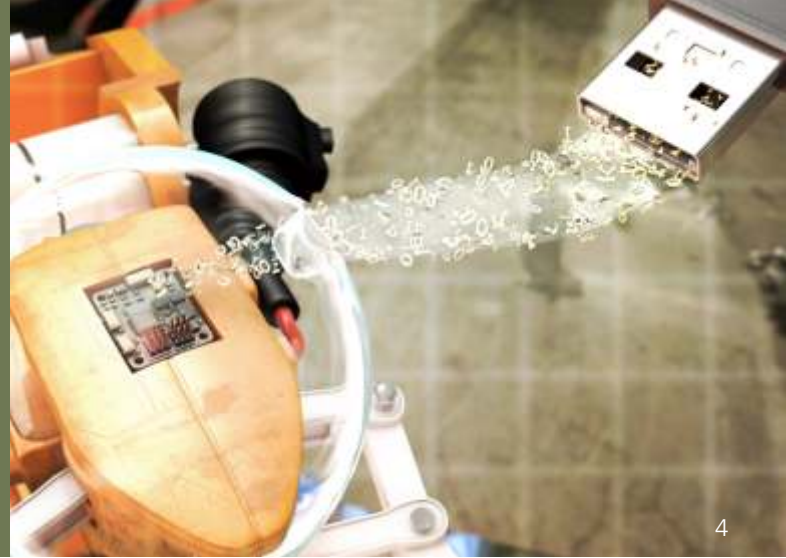Photo Credit: Fraunhofer IPA

2. Smart Factory 4.0: processed blanks are lifted onto an automated guided vehicle (AGV).
Photo Credit: Fraunhofer IPK

also taking the leap into the age of Industry 4.0. The technology is market-ready and is currently being used by several pilot customers. The researchers presented a demo at the Hanover Trade Fair in 2017.

The Fraunhofer PLUGandWORKTM solution eliminates the need for complicated configuration and setup when a system is integrated manually into production. This process may take several days or even weeks, and PLUGandWORKTM is often finished after a few hours. For many years, the Fraunhofer IOSB has been working on digital technologies that make companies fit for Industry 4.0. The experts develop the necessary standardized interfaces, software modules and data transmission protocols. In addition, the Fraunhofer experts, together with national and international partners, actively participate in the further development of AutomationML and are involved in various standardization committees.
It will surely take a few years until the vision of Industry 4.0 is fully implemented and manufacturers have brought their complete machine park up to date. Until then, the PLUGandWORKTM Cube ensures that even older machines are fit for the digital era.

Simulation tool for efficient production of non-woven fabrics
Research News / 1.3.2017

Non-woven fabrics are indispensable to everyday life. A Fraunhofer Institute has developed software that makes the production of non-woven products much more efficient and flexible. With the tool FIDYST, it has been possible for the first time to simulate the movement of fibers in turbulent air currents. A real innovation – and the breakthrough in a theory that is over a hundred years old.

Safe Navigation on Construction sites
Research News / 1.3.2017

Automated vehicles have to be able to reliably detect traffic signs. Previous systems, however, have had problems in understanding complex traffic management with different information about speed or the course of the lanes, as mainly occurs on construction sites. Fraunhofer researchers are developing technologies for the real-time interpretation of such signs, which they presented at the CeBIT in Hanover from March 20 to 24, 2017.

"Our technology enables a system to read signs of this kind with a high degree of accuracy," says Stefan Eickeler, who is responsible for the subject of object recognition at the Fraunhofer Institute for Intelligent Analysis and Information Systems IAIS in Sankt Augustin, Germany. The information is processed semantically, understood in terms of content and made available for further processing. "With Deep Learning – a key technology for the future of the automotive industry – we teach the software to recognize the classic patterns more quickly and efficiently."

3. A new web-based software platform is swiftly bringing the visualization of 3D data to every device, optimizing the use of, for example, virtual reality and augmented reality in industry. In this way, Fraunhofer researchers have brought the ideal of "any data on any device" a good deal closer.
Photo Credit: Fraunhofer IGD

4. The PLUGandWORK Cube by Fraunhofer integrates existing machines into modern production systems. This means that medium-sized companies are also taking the leap into the age of Industry 4.0.
Photo Credit: Fraunhofer IOSB

Smart City Solutions Workshop -

Global Approach Local Solutions

More than 50 decision makers from nearly 30 smart cities participated in the Smart city solutions workshop to draw out concrete ideas for improving infrastructure and services.

Smart City Solutions Workshop – Global Approach Local Solutions was organized by Fraunhofer funded by Federal Ministry of Education and Research (BMBF), in association with Ministry of Urban Development (MoUD), Government of India, the National Institute of Urban Affairs (NIUA), Government of India and with the support of the Embassy of the Federal Republic of Germany.

This workshop corroborated the objective of sharing the best practices of the "Morgenstadt Initiative (Future Cities Initiative)" which is funded by the Federal Ministry of Education and Research and implemented by a Consortium of more than 40 partners from Industry, NGO, Government, and research institutions. This consortium is coordinated by Fraunhofer and has already several Smart City Labs and initiatives across Europe.

This workshop set the platform for understanding the issues and challenges related to Smart Cities and showcased Fraunhofer's expertise in designing Smart City Solutions and models for India. Seven Fraunhofer experts from various Fraunhofer institutes participated and presented technology solutions which can aid the Indian cities to manage their assets effectively by improving the efficiency of services through a better and an interoperable infrastructure. This workshop also accentuated the fundamental and conjunctive role of the Government of India along with the respective State Governments, industry and research institutions to lay down an urban development vision for a creation of a robust system through the use of urban informatics.

The preparation of this workshop was initiated in August 2016 by Fraunhofer IAO and Fraunhofer Office India by applying to a Call for Proposals by BMBF under the title "Internationalization of Morgenstadt Initiative". Under this project by Fraunhofer, India and Vietnam are the target countries. Fraunhofer IAO coordinated the participation of 10 consortium members from Europe to share Best Practices in India. In February 2017, the preparations for the workshop in India began in full earnest. To target the decision makers and policy implementers of Smart City models, a deliberated database of Principal Secretaries of the Urban Development Department of various states, Municipal Commissioners, Special Purpose Vehicle (SPV) CEOs, Technical Directors and Chief Engineers of nearly 60 cities (selected under Smart Cities Mission) was created and invitation mailers along with the agenda were sent to the above mentioned state / city representatives in support with MoUD

Overall, the workshop received a very positive feedback from the participants.

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"This was an excellent exposure for us, and for the first time we had the opportunity to come out of our cocoon and interact with other practitioners from around the world."
Amritsar Smart City Lab

"This workshop provided a great platform for the industry to interact with the states' / cities' representatives. The content was well conceptualized as it encapsulated the Smart City technologies which are the need of an hour for Indian market and also promoted the vital role of Govt. of India, research institutions and Indian Industry to jointly work together to devise Smart Solutions for the cities in India."
Bosch and Siemens

1. L to R: Dr. Jasper Wieck, Deputy Chief of Mission (DCM) German Embassy New Delhi, Ms. Anandi Iyer, Director Fraunhofer Office India, Mr. Jagan Shah, Director, National Institute of Urban Affairs, Shri. Anupam Mishra, Economic Advisor, Ministry of Urban Development, Mr. Damian Wagner, Senior Project Manager Smart Cities at Fraunhofer Institute for Industrial Engineering IAO, Germany

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"More such interactions should be held across India and I extend my full support to Fraunhofer for the same."
Shri. Amitabh Kant, CEO, NITI Aayog

and NIUA. Along with the Government representatives, Bosch and Siemens also participated in the workshop representing the Smart City Solution providers from Indian industry.

Participating States, Cities and Participants Profiles included Decision makers representing 30 cities from 13 states. The following chart (refer Chart 1.0) shows the profiles of the participants from each of the above states / cities.

- State Secretaries
- Municipal Commissioners
- Smart City SPV CEOs
- Chief Engineers
- Technical Directors for Urban Designing and Planning
- Advisors to the Government
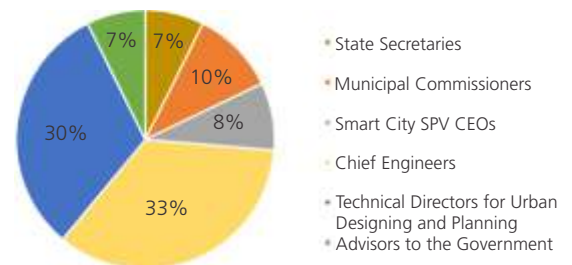
Chart 1.0

Inaugral Plenary Session - This session witnessed the participation of esteemed dignitaries and Industry experts from India and Europe. **Ms. Anandi Iyer**, Director, Fraunhofer Office India evoked the session by welcoming the participants followed by a welcome address by **Shri. Jagan Shah**, Director, NIUA. **H.E. Dr. Jasper Wieck**, Deputy Chief of Missions, Embassy of the Federal Republic of Germany in India delivered the inaugral address. **Shri. Anupam Mishra**, Economic Advisor to MoUD delivered the keynote address. **Mr. Damian Wagner**, Senior Project Manager, Fraunhofer IAO posited the context of this workshop by presenting the Best Practices-European Smart Cities. An intensive research and consultation with MoUD was conducted prior to this workshop. Based on the entailments of these exercises, the following five fundamental areas were identified in alignment with the Indian Smart Cities' requirements – Energy, Water, Mobility, ICT, Smart Governance and Management System. The above five areas were categorized into three technical sessions - Smart Energy & Water, Smart Mobility & ICT , Smart Governance & Management System, and each technical session was followed by an interactive 45 mins Q&A session.

Concluding Session - Shri. Amitabh Kant, CEO, NITI Aayog (National Institution for Transforming India), Govt. of India was the Guest of Honour for the concluding session. He extrapolated on the queries which were raised by the participants during the Q&A session. He also laid down his inferences for subsequent developments in India through formation of SPVs (Special Purpose Vehicle) for all the Smart City solutions pertaining to India and prognosticated the role of India-Fraunhofer cooperation for a paradigm shift in transforming India into an economically and technologically progressive nation which will consequentially lead to a better quality of life for the Indian citizens. He applauded the organizers and urged for more such interactions to be held across India and extended his support for the same.

Exclusive Networking Dinner - An Exclusive Networking Dinner was organized which provided ample opportunity for the participants to discuss and deliberate with the Fraunhofer experts in addition to their presentations during the technical sessions in the workshop.

This workshop resulted in several discussions for possible collaborations.

2. The German Delegation with Mr Amitabh Kant, CEO, NITI Aayog.

Recent Activities @ Fraunhofer Office India

Fraunhofer at 'Enhancing Energy Efficiency in Captive Power Plants' seminar
Date: 12th May, HICC, Novotel, Hyderabad'
Fraunhofer participated in a conference on 'Enhancing Energy Efficiency in Captive Power Plants' at one of the parallel session at Cementech 2017. This conference was organised by Confederation on Indian Industrys CII, Hyderabad.

Mr. Sanmati Naik, Manager Renewable Energy, Fraunhofer Office India represented Fraunhofer during the session and presented on "Thermo-Optical Measuring Method: To Improve the Efficiency, Economy and Emissions of Coal Fired Plants". In order to optimize the heat treatment process and to reduce CO_2 emission, the characterization and analysis of the combustion process and the combustion products and the waste materials is carried out. The presentation is well received by the participating Industries and few industry requirement is expected on Fraunhofer's TOM technology. The above topic is one of the expertise by Fraunhofer ISC.

Visit of Dr. Lorenz Kaiser, Division Director for R&D Contracts and IPR, Fraunhofer Gesellschaft (Germany)
26th - 28th April, 2017 Bangalore
Dr. Lorenz Kaiser, Division Director for R&D Contracts and IPR at Fraunhofer-Gesellschaft, visited Bangalore to address at an event World Intellectual Property Forum. The main topic of his discussion was "The role of IP in the technology transfer process". Dr. Kaiser also participated in an event organised by the Consulate General of Germany, Bangalore on 27th April addressing the German Business Group in Bangalore. At this event the main topic of his discussion was on 'Standardised technologies - The current threat situation, especially on ICT technologies, but also beyond' and International Knowledge Transfer (IKT).

Fraunhofer at the Hannover Fair 2017
Date: 24th April, Hannover
EEPC India along with Department of Heavy Industry, Government of India and other stakeholders, organised a Seminar on "Integrated Industry for achieving Industrial Efficiency". Fraunhofer participated in the event where Univ. -Prof. Dr.-Ing. Thomas Bauernhansl, Director Fraunhofer Institute for Manufacturing Engineering and Automation IPA addressed the keynote speech at the seminar. The Department of Heavy Industry, Government of India has already signed an MoU with Fraunhofer as "Technology Resource Partner" to collaborate in the field of advanced manufacturing. The objective is

1. Dr. Andreas Middendorf delivering the Keynote Speech at the India Electronics Week 2017.

2. Mr. Sanmati Niak, Manager - Renewable Energy, Fraunhofer Office India addressing in the Q and A session at the Conference on Enhancing Energy Efficiency in Captive Power Plants

to support and augment the "Make in India" Programme through increasing the innovation and technology prowess of Indian industry.

Visit of Prof. Dr.-Ing. Klaus Peter Sedlbauer and Dr. Simon Schmidt, Fraunhofer IBP
Date: 07-10 April, Mumbai, Bangalore
Prof. Dr. Klaus Peter Sedlbauer, Director, Fraunhofer IBP accompanied by Dr. Simon Schmidt , Scientific Head of Climate Culture Building, (IBP) visited India between 7th to 10 April to meet existing and prospective clients to discuss possible collaboration with organisations in India. The appointments were mainly in Mumbai & Bangalore and co-ordinated by Mr. Sanmati Naik, Manager Renewable Energy , Fraunhofer Office India.

Fraunhofer Office India at India Electronics Week 2017
2nd - 4th March, 2017 Bangalore
The EFY group (Electronics For You), with the support from the Ministry of Electronics and Information Technology, Govt. of India, Digital India & Electronics India had organised an event – **The India Electronics Week 2017** on 2nd, 3rd & 4th March 2017 in Bangalore. Dr. Andreas Middendorf from the Fraunhofer Institute for Reliability and Microintegration (IZM) was the keynote speaker at the opening session highlighting **Microelectronics for the IoT – often invisible but always indispensable.**

Fraunhofer had also organised an **Exclusive CEO Luncheon Meet** on 2nd March at the India Electronics Week 2017 in Bangalore which was attended by a cross section of 40+ decision makers from the electronics industry and the Govt sector. The main focus of the meet was to discuss **'How to support the ecosystem in Indian Electronics Sector'.**

Fraunhofer Office India at IMTEX 2017
26th January - 1st February, 2017 Bangalore
Fraunhofer Office India also participated at the 'Imtex Forming 2017', South East Asia's largest metal forming machine exhibition. The exhibition showcased several machine tool and test equipments suitable for the Indian vehicle manufacturing and component industry. It was a 7 day event that kick-started on 26th Jan to 1st Feb 2017. Imtex Forming 2017 has showcased latest machine equipments, processes, tools, accessories, software and raw materials as well as feed stocks required to manufacture formed parts in every engineering application including automotive sector. Fraunhofer Office India, showcased the capabilities of Fraunhofer IWU in Lightweighting of Automobile components.

Fraunhofer Office India at SIAT 2017
8th - 21st January, 2017 Pune
Symposium on International Automotive Technology (SIAT) is a widely covered biennial

3. Prof. Dr. Klaus Peter Sedlbauer, Director, Fraunhofer IBP accompanied by Dr. Simon Schmidt , Scientific Head of Climate Culture Building, (IBP) during their India visit in April.

4. Visitors at the Fraunhofer booth in SIAT 2017
Photo Credit: Fraunhofer Office India

international event organized by Automotive Research Association of India (ARAI). Fraunhofer was allotted a complimentary exhibition space in the theme pavilion which also displayed seventeen other themes. The theme for Fraunhofer's participation in SIAT 2017 was "Smart Innovations for Quieter Automobiles". Fraunhofer Office India exhibited the following exhibits designed by Fraunhofer Institute for Structural Durability and System Reliability LBF to corroborate the thematic display. Dummy models of an "active" engine mount and a matching power amplifier. A semi-active tuning fork for showing the principle of shunt damping and giving an example how active systems will work. There were fifteen companies who displayed exhibits under seventeen different themes and every single company was assigned a technical volunteer from ARAI to explain the gist of their exhibits to the viewers.

Erfinderland Deutschland" - How German Inventions Changed the World
30th January, 2017 New Delhi
The Goethe-Institut has dedicated this interactive exhibition to Germany, the Land of Inventors – Research in Germany, in cooperation with the Fraunhofer Institute and the Max Planck Society.

Fraunhofer was represented by Ms. Anandi Iyer, Director Fraunhofer Office India. The spotlight was on both historical discoveries and pioneering innovations – with a special focus on the research environment in Germany.

Fraunhofer experts from Baden-Württemberg accompany Minister President Winfried Kretschmann on his delegation trip to India.
22nd - 28th January, 2017
A high level delegation led by the Minister President Mr. Winfried Kretschmann , and consisting of representatives from politics, economics and science from the state of Baden-Württemberg travelled to various cities of India between 22nd and 28th January to India. The State of Baden-Württemberg and the State of Maharashtra have enjoyed close economic and cultural exchanges for many years. The importance of the city partnerships between Mumbai and Stuttgart, and Pune and Karlsruhe was underscored by the Mayor Fritz Kuhn from Stuttgart and Dr. Frank Mentrup from Karlsruhe. The delegation was accompanied by Ms. Anandi Iyer, Director Fraunhofer India, who was also closely involved in the of the delegation program in Bangalore.

The main focus of the Delegation were to explore possible collaboration on areas of 'Smart Cities' and 'Innovative Technologies'. Four of the 14 Fraunhofer institutes in Baden-Württemberg were represented during the delegation trip: Dr. Simone Kimpeler from Fraunhofer ISI, Ms. Susanne Schatzinger from Fraunhofer IAO, Dr. Peter Fischer from Fraunhofer ICT, and Prof. Dr. Katja Schenke-Layland, Director of the Fraunhofer

5. L to R: Ms. Hema Gupta (Project Manager Educational Services, Goethe-Institut / Max Mueller Bhavan, New Delhi), Ms. Anandi Iyer (Director, Fraunhofer Office India), Mr. Carl Jochen Dill (Head of Educational Services, Goethe-Institut / Max Mueller Bhavan, New Delhi), Ms. Claudia Maul (Director Language Programmes South Asia, Goethe-Institut / Max Mueller Bhavan in New Delhi), Ms. Deepika Jain (Project Coordinator, PASCH & BKD, Goethe-Institut /Max Mueller Bhavan, New Delhi)

6. L to R: Winfried Kretschmann MdL, Klaus-Peter Murawski (state minister of the state ministry), Anandi Iyer (Fraunhofer representative office in Bangalore), Susanne Schatzinger (Fraunhofer IAO), Peter Fischer (Fraunhofer ICT), Katja Schenke-Layland (Fraunhofer ITUC). Not in the picture is Simone Kimpeler (Fraunhofer ISI)

IGB. The Delegation visited several companies and organisations involved in these fields of activity.

Visit of Shri Ekkadu Srinivasan Lakshminarasimhan, Governor, Andhra Pradesh & Telangana to Fraunhofer
8th December 2016, Fraunhofer Office India
His Excellency Shri Ekkadu Srinivasan Lakshminarasimhan, Governor, Andhra Pradesh & Telangana and Her Excellency Mrs. Margit Hellwig-Botte, The Consul General of the Federal Republic of Germany in Bangalore visited the Fraunhofer Office in India on 8th December 2016. The main agenda of their visit was to discuss possible collaboration with Fraunhofer on Smart City initiatives for Andhra Pradesh & Telangana.

The meeting began with a welcome address by Her Excellency Mrs. Margit Hellwig-Botte followed by a brief introduction of Fraunhofer Office India Team. Ms. Anandi Iyer, Director Fraunhofer Office India, presented on Fraunhofer activities with main focus on Smart Cities & Smart Energy capabilities. His Excellency Shri Ekkadu Srinivasan Lakshminarasimhan, then shared his views on the possible collaboration with Fraunhofer followed by a brief interactive session and a visit to the Experience Theatre which showcases some of the latest technologies of Fraunhofer.

7. L to R: Ms. Anandi Iyer, Director
Fraunhofer Office India, His Excellency
Shri Ekkadu Srinivasan Lakshminarasimhan,
Governor, Andhra Pradesh & Telangana
and Her Excellency Mrs. Margit Hellwig-Botte,
The Consul General of the Federal Republic
of Germany in Bangalore.

8. Visitors at the Fraunhofer booth in
IMTEX 2017
Photo Credit: Fraunhofer Office India

Fraunhofer India: Recent Media Coverage

PROFILE: FRAUNHOFER

Fraunhofer-Gesellschaft

The Fraunhofer-Gesellschaft is the leading organization for applied research in Europe. Its research activities are conducted by 69 institutes and research units at locations throughout Germany. The Fraunhofer-Gesellschaft employs a staff of 24,500, who work with an annual research budget totaling 2.1 billion euros. Of this sum, 1.9 billion euros is generated through contract research. More than 70 percent of the Fraunhofer-Gesellschaft's contract research revenue is derived from contracts with industry and from publicly financed research projects. International collaborations with excellent research partners and innovative companies around the world ensure direct access to regions of the greatest importance to present and future scientific progress and economic development.

Fraunhofer Office India

Fraunhofer has been active in India for a long time through its individual institutes. However, the brand Fraunhofer came to India in the middle of 2008 with a concerted efforts to understand the Indian market and engage with Industry, Government and Academia. It inaugurated its representative office in Bangalore, India on October 30, 2012, housing an experience theatre which showcases some of the latest technologies and the Fraunhofer Innovation and Technology (FIT) Academy which conducts workshops, bringing Fraunhofer experts from various Institutes to connect with our clients and partners in India. The Fraunhofer Innovation and Technology (FIT) platform is another exciting initiative and annual flagship event which focuses on different thematic fields and showcases cutting edge technologies, innovation and solutions like never before. Fraunhofer works with 30 of the 50 leading companies in India and in the last few years, contracts worth more than 10 Million Euros were signed.

Cover Photo Source: Production 4.0 - Producing individual products quickly, flexibly and sustainably – Industry 4.0 will make it possible.
Photo credit Fraunhofer IFF

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