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SmartFix4.0

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SMART FIXTURES, SMART MANUFACTURING

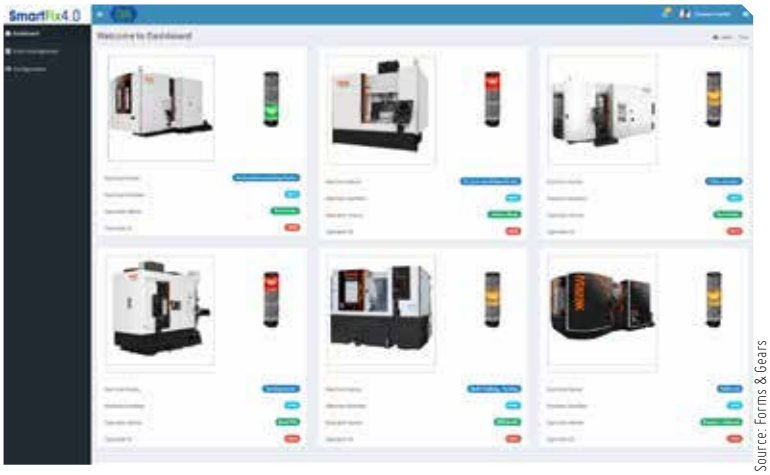
The recently concluded IMTEX 2019 bore testimony to the fact that technology has a profound impact on how factories operate today. For the first time in the 50 years of IMTEX exhibitions, a separate hall was dedicated to Industry 4.0 and IoT related technology. This is a harbinger of a smart future with more and more Indian companies gearing up to reap the benefits of making their factories smarter through the use of Industry 4.0 solutions.

Source: Forms & Gears

Source: Team MMI

The term Industry 4.0 refers to the Fourth Industrial Revolution. The earlier three industrial revolutions were characterized by rapid advances in technology that enabled humans to be less dependent on animal power, made mass production possible and brought digital capabilities to billions of people around the world.

Industry 4.0 is marked by breakthroughs and technological advances in a number of fields including Robotics, Artificial Intelligence, Nanotechnology, Biotechnology, the Internet of Things (IoT), Big Data Analytics, 3D Printing, Autonomous Vehicles etc.



Source: Forms & Gears

Dashboard View – Representation of a machines on floor along with status indicators derived from sensor data

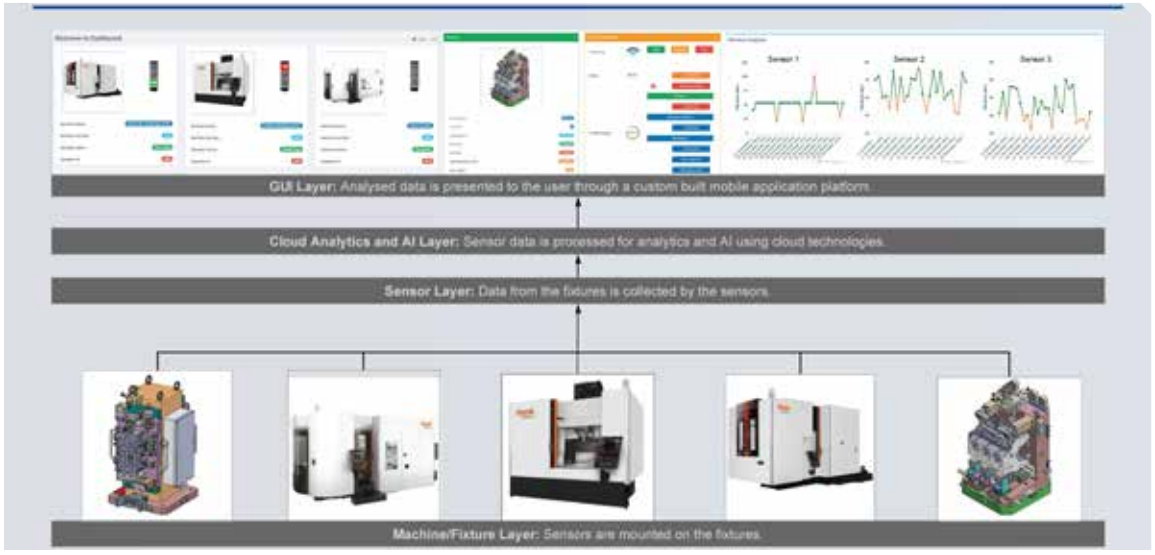
Evolution of Smart Fixtures

Of the numerous Industry 4.0- and IoT-enabled products displayed by the machine tool and cutting tool companies at IMTEX 2019, a few stood out to be the most innovative. Jointly developed by Forms and Gears, one of India's oldest and reputed fixture building companies and ASM Technologies, a Bangalore-based public limited company specializing in Product Engineering, Data Analytics and Artificial Intelligence, SmartFix 4.0 was one such product that garnered favorable attention.

Speaking on the company's new offering, Reji Varghese, Managing Director, Forms and Gears, reveals, "Over the last 47 years, we have seen seismic shifts in manufacturing. We used to do workholding for conventional machines in the 70s which slowly transformed to fixtures for indigenous machining centers to advanced workholding solutions for high-speed imported machining centers. To keep up with the advancements in the machine tool and cutting tool technology, workholding technology has also to keep pace so that the capability of the machines and the tools can be fully utilized."

He adds further, "Over the last few years we have come to the conclusion that the next revolution in workholding would be to make fixtures smarter by making them IoT- and Industry 4.0-enabled. As the technology required for making such kind of fixtures was not available in-house, we decided to look for a partner who had the know-how in electronics and IT-relat-

SmartFix 4.0 is a Precision Workholding Device with the ability to collect, transmit and analyze data in a useful format for the end-user.



Source: Forms & Gears

Smartfix process flow

Source: Forms & Gears

"To keep up with the advancements in the machine tool and cutting tool technology, workholding technology has also to keep pace so that the capability of the machines and the tools can be fully utilized."

Reji Varghese
Managing Director
Forms and Gears

Source: Yamazaki Mazak India Pvt Ltd

"There was a lot of interest in the SmartFix 4.0-enabled Tractor Cylinder Block Fixture that we displayed at IMTEX 2019. It was a regular Cylinder Block fixture but installed with the SmartFix 4.0 kit consisting of electronics and sensors which were continuously collecting and transmitting data wirelessly which was analyzed and sent back in a useful format."

Anil Bharadwaj
Managing Director
Yamazaki Mazak India Pvt Ltd

Source: ASM Technologies

"Our aim is to make Smart manufacturing affordable to even small companies in India. We plan to amortize this over a large installed base to make this an affordable solution."

Rabindra Srikantan
Managing Director
ASM Technologies

R&D in the fields of sensors, data processing and analytics, and decision-making procedures are likely to take a big leap to reduce the costs to eventually benefit many sectors including MSMEs.

ed expertise in Data Analytics, Artificial Intelligence, Machine Learning etc., and that's how our joint venture with ASM Technologies happened."

Anil Bharadwaj, Managing Director, Yamazaki Mazak India Pvt Ltd, says, "There was a lot of interest in the SmartFix 4.0-enabled Tractor Cylinder Block fixture that we displayed at IMTEX 2019. It was a regular Cylinder Block fixture but installed with the SmartFix 4.0 kit consisting of electronics and sensors which were continuously collecting and transmitting data wirelessly which was analyzed and sent back in a useful format. We hope to offer this to turnkey customers by mid-2019."

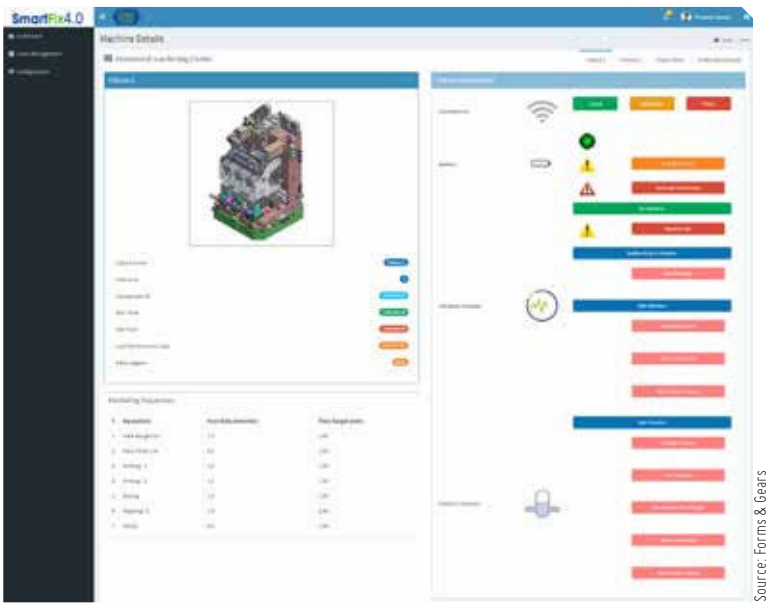
SmartFix 4.0

SmartFix 4.0 is a Precision Workholding Device with the ability to collect, transmit and analyze data in a useful format for the end-user. Developed for the first time in the world, it takes workholding devices and fixtures into the digital and cyber space.

As the fixture is in continuous contact with the component, it is the ideal device to collect and analyze data at the component level. Sensors to monitor vibration, pressure, and component sensing are mounted on the fixture. And sensors to monitor oil levels and temperature are mounted on the powerpack.

The high volume of data collected from these sensors are continuously transmitted wirelessly to the cloud where it is parsed and stored for analysis.

The raw data is then analyzed using Data Analytics and Artificial Intelligence tools and sent back to a custom-built Dashboard of the end user, which resembles their factory floor, showing all the machines in action as well as a quick summary on the health of each machine, fixture and powerpack.



Source: Forms & Gears

Machine Level View – Quick view of machine details and access to fixture level status

Source: Forms & Gears

"Highly accurate and intelligent sensors including accelerometers mounted at predesigned locations in a workholding fixture are highly helpful in getting useful data. Added to this, the data from the machine such as speeds, feeds, temperature and hydraulics etc. can be analyzed to obtain signature parameters for good output and quality."

M Lakshminarayan
Former Managing Director
Bosch

Source: Forms & Gears

"Implementation of IoT in the manufacturing industry is inevitable. But its benefits will only be seen when the Indian manufacturing industries convert the legacy machines into smart machines."

Prof N Ramesh Babu
Head, Department of Mechanical Engineering
IIT Madras

Highly user-friendly

The user can click on each machine to get a more detailed understanding of the analyzed data per fixture. Data per sensor is visualized graphically with the ability to go back and see historical performance of the machine, the fixture and the powerpack.

For example, an analysis of data collected from vibration could reveal a wide variety of information like casting tolerances, vibration level comparison between tools, idle time of the machine, number of cycles run, number of components produced and vibration comparison across machines in the plant. This real-time data, sent on a mobile platform or to the computer of the concerned people, could result in productivity increases, optimizing tool life, and increasing safety.

If the vibration crosses a set upper threshold limit, the system can be designed to shut the machine off remotely through the emergency switch of the machine.

Sensors to monitor pressure would alert the operator via their phone or on any smart device and this can again be linked to the machine's emergency switch if required to ensure that in case of a sudden pressure drop the machine is switched off. Immediate alerts for any change in the sequencing of primary clamps, work supports and secondary clamps during the loading and unloading cycles would also help in giving immediate feedback to the machine to ensure that quality related issues due to wrong sequencing are eliminated.

By monitoring the clamp/declamp cycles, alerts for maintenance of fixtures, ordering of spares and seal kits would also be automatically generated by the system and alerts sent via smartphone to the concerned people. An analysis of vibration would also give an accurate feedback to the management on how many cycles the machine has run, what the idle time per machine is, the reasons for machine downtime and the number of components produced. Machine maintenance schedules could also be linked to this information.

With Artificial Intelligence and Machine Learning, SmartFix 4.0 can also help the user be more proactive on machine, fixture and tool performance as well as how machines are performing compared to each other.

Historical data can be analyzed, and a comparison of various parameters can be made across all machines in the plant giving the management useful information to reduce costs, increase efficiencies and improve quality.

M Lakshminarayan, Former Ex-Managing Director, Bosch, who has studied the fixture closely, comments, "I am happy to note that the capturing of data from the fixtures has been worked

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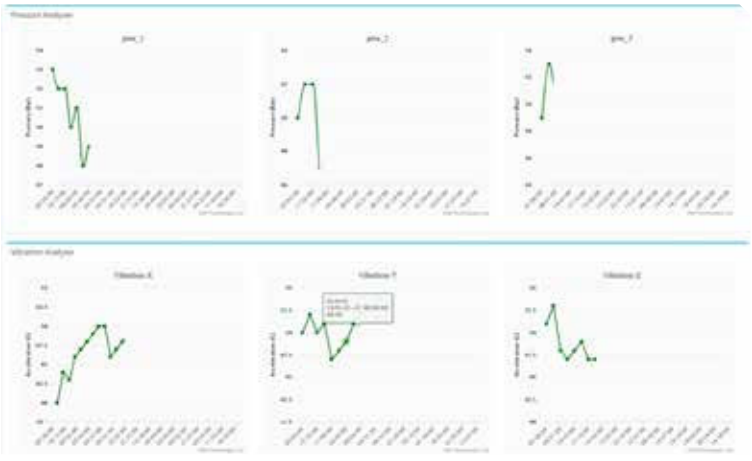

Source: Forms & Gears

Pressure and Vibration Analysis

Source: Forms & Gears

SmartFix fixture

SmartFix 4.0 can be installed even on existing fixtures running in the plant, making it a flexible and cost-effective solution to get the whole machining facility Industry 4.0- and IoT-enabled.

upon. Highly accurate and intelligent sensors including accelerometers mounted at predesigned locations in a workholding fixture are highly helpful in getting useful data. Added to this, the data from the machine such as speeds, feeds, temperature and hydraulics etc. can be analyzed to obtain signature parameters for good output and quality."

Making smart manufacturing affordable

On the cost implications of enabling Industry 4.0 solutions to Indian companies Prof N Ramesh Babu, Head, Department of Mechanical Engineering, IIT Madras, says, "Research and Development (R&D) in the fields of sensors, data processing and analytics, and decision-making procedures are likely to take a big leap to reduce the costs to eventually benefit many sectors including MSMEs. IIT Madras is engaged in R&D of all these fields and is poised to bring in a change through many other efforts such as incubation and startups."

Rabindra Srikantan, Managing Director, ASM Technologies, notes, "Our aim is to make Smart manufacturing affordable to even small companies in India. We have a sizeable team developing the IIoT, electronics, software and analytics and have made significant investments for this development. We plan to amortize this over a large installed base to make this an affordable solution"

Converting old machines to smart ones

SmartFix 4.0 can be installed even on existing fixtures running in the plant, making it a flexible and cost-effective solution to get the whole machining facility Industry 4.0- and IoT-enabled.

Babu comments on the implementation of IoT in India, "Implementation of IoT in the manufacturing industry is inevitable. But its benefits will only be seen when the Indian manufacturing industries convert the legacy machines into smart machines. This conversion can happen if we treat the physical processes in the shop floor as human beings. Then much of the information management practices of medical professionals may be applicable to the manufacturing sector as well. This humane treatment of machines and manufacturing processes may be the next generation Smart Manufacturing."

Srikantan, adds, "With SmartFix 4.0, even older machines can be Industry 4.0- and IoT-enabled by mounting the SmartFix 4.0 kit on the existing fixtures running on these machines. This is a simple and cost-effective way to convert legacy machines into smart machines. We feel the device is a game changer in the fixture building, machine tool and manufacturing business."

Worldwide potential

Professional race car driver Akhil Rabindra, who races in the GT Circuit in the UK and Europe and is also part of Forms and Gears and ASM Technologies, states, "Cutting-edge technology is the key to performance in racing as precision is key. We analyze large amounts of data from the car and our driving to go even faster. Data is extremely important for the man and the machine to win races."

"Some of the car manufacturers that I have raced for including McLaren, BMW, and Toyota spend significantly on R&D and invest in the most advanced machine tool technology. We see SmartFix 4.0 as a cutting-edge technology that can bring a lot of value to companies around the world. We are looking to bring SmartFix 4.0 into the UK, Europe and the US this year," he shared summing up.