Media Backgrounder
Industry 4.0 / Industrial Internet of Things (IIoT)

May 2018

After emerging in Germany in 2011, Industry 4.0 is seeing widening adoption worldwide and is beginning to deliver numerous benefits that were unthinkable just a few years ago. Through a variety of hyperconnected technologies, industrial companies can better understand operations in real-time and optimize and transform how they work with suppliers, partners and customers. In an ideal deployment, this approach could bring the production cost for an individual order very close to that for the same item when mass produced, helping industrialized regions such as Europe and North America practically eliminate their labor cost disadvantages compared to countries like China or India.

Fujitsu is focusing on Industry 4.0 to enable a future where manufacturing becomes hyperconnected, with more real-time data and visibility for improved efficiency, predictability and innovation. Hyperconnectivity is the key to Industry 4.0, as it underpins the automated flow of information, analysis, instructions and transactions from which efficiency gains can be realized. And it is the Industrial Internet of Things (IIoT) that is the predominant enabler of manufacturing hyperconnectivity. The true potential here is far more significant than only efficiency gains. That's because, when implemented effectively, IIoT has the ability to create whole new business models and to enable business to stay relevant. This is crucial considering the disruption that most industries are facing since today – businesses that have been leaders in their field have been displaced by newcomers (for example Uber or Airbnb) with new ways of operating that deliver greater value to their customers than traditional approaches.

Consequently, many businesses are disrupting themselves to address these changes and to stay competitive. Many traditional products can now be purchased via a managed services model – for example some jet engine manufacturers now no longer sell engines, instead they sell engine operating hours, some manufactures in the construction industry no longer sell excavators, they sell the volume of dirt moved, while some water pump manufacturers now charge by volume of liquid pumped. What all of these companies have in common is that their vision extends beyond the manufacturing process itself to encompass the entire supply chain, and in particular how customers actually consume the final product.

Each transformation starts with digital networks that connect the factory with both suppliers and the products that are delivered to customers. Enriching a factory with Industry 4.0 capabilities of course means that throughput, utilization, and quality are maximized, but as a result of this integration, the smart factory also knows exactly which resources are available from which supplier and can automatically order them at the most appropriate time to meet customers' changing demands. The factory is fully automated and can adapt to changes quickly and in addition, the manufactured products can then be enhanced by data-driven services – that enable new consumption models, such as engine hours rather than jet engine sales. Furthermore, the intelligence of the system doesn't end with a product sale – the sensors in each product can detect any deterioration in performance and can automatically request maintenance.

Transformational companies have another characteristic in common: they all collect a great deal of data across the whole lifecycle of their products and convert them into valuable information, essentially creating additional value around their products. They have not just optimized how their products are manufactured, they have also taken a step back to look at how to improve the customer experience. Optimizing quality and cost are still crucial factors, but the real value comes from using data to enrich the products, for example by including value adding services, such as offering pay per use models or predictive maintenance capabilities.

Hyperconnected systems can also gather performance data from hundreds or thousands of industrial machines used by different customers, so that a manufacturer of such machines can then apply advanced analytics and artificial intelligence to that data to gain insights into factors or conditions that could cause less-than-ideal performance or even machine failures.

The technology infrastructure that drives this is fundamentally focused on: first collecting and refining the raw data collected by the sensors and 'things' and storing it in a common data lake. The aggregated data is then analyzed, enabling accurate predictions based on the results. These insights make it possible to optimize both the manufacturing and maintenance of the product.

Enabling transactions within IIoT - IOTA

To open up the IIoT's full potential of machine-to-machine automation without human intervention will require the ability for transactions to be initiated and for process actions to be implemented based on data that can be trusted. The solution here comes from Distributed Ledger Technologies (DLTs), of which blockchain is the best-known example. However, there are several limitations of blockchain that make it not necessarily suitable for manufacturing processes, primarily the cost of transactions, the relatively slow transaction rate – the number of financial transactions a blockchain can handle per second - and the impracticality of micropayments.

A new alternative to blockchain is IOTA, a DLT in which transactions are stored on a ledger constructed as a network (called 'The Tangle'), rather than as a linear chain, as with blockchain. The underlying concept is a mechanism for transferring payments and information in a manner suitable for IIoT, where automation is critical, the scale and speed of transactions can be unimaginably high and where payments might be tiny or even non-existent. IOTA therefore allows automated transactions between any person or device, including true machine-to-machine transactions and has been designed with a number of features that are specifically geared to the needs of IIoT.

Although still early in the development of IOTA, there is already a high level of interest and engagement from key players in IIoT, including Fujitsu. For example, Robert Bosch of Germany announced a major purchase of IOTA tokens in December 2017. One aspect of Bosch's plans for IOTA includes its XDK Cross Domain Development Kit, which is a programmable sensor device and prototyping platform for any IoT use, and which uses IOTA for information and payment transactions. In April 2018, ElaadNL, a knowledge and innovation center for Smart Charging infrastructure for grid operators in the Netherlands, released the first electric vehicle charging station in the world to permit machine-to-machine charging and payment using IOTA. The charger is part of a new ElaadNL test site which contains all types of public charging stations used in the Netherlands.

Fujitsu's Industry 4.0 portfolio

Fujitsu is collaborating with manufacturers to push Industry 4.0 initiatives even further forward, to shape, optimize and future-proof the entire value chain with innovative technologies based on Artificial Intelligence (AI), Augmented Reality (AR), next-generation blockchain (see IOTA, discussed above) and intelligent networking. It can help customers with the process of implementing IIoT, from project definition to deployment and has a portfolio focused on enabling customers to gain new insights by analyzing data collected from both a digitized manufacturing process and from the data-enriched products themselves over the course of their lifecycles.

Working with Fujitsu to co-create their IIoT transformation means that customers can take a more holistic view beyond the pure manufacturing process, by examining everything from the product lifecycle to potential competitors, in order to transform potentially disruptive trends into opportunities.

Fujitsu's consultancy-based approach is focused on addressing individual customers' business challenges, and often involves applying analytics – a crucial factor not only because of the new insights that can be gained and applied to the manufacturing process and product lifecycle optimization but also in terms of forming the potential basis for new business models.

Fujitsu's analytics portfolio helps customers to:

- Implement non-destructive quality control testing using artificial intelligence (for example the work undertaken with wind turbine manufacturer Siemens Gamesa)
- Analyze machine and/or product parts that degrade over time to implement predictive maintenance which can also become the starting point for a pay per use model
- Analyze complex machines or even whole production lines to better understand bottlenecks caused by factors such as drops in performance, material shortages or changes in tools

- Apply intelligent algorithms for advanced condition monitoring – for example checking the status of different machine components to identify the parameters of normal operation to provide the foundation for an effective alert mechanism

In order to leverage analytics to gain new insights, Fujitsu also offers the necessary edge elements that are required to:

- Connect legacy machinery with technology. This includes support for various field bus protocols as well the introduction of new sensors to otherwise unconnected devices
- Implement an IoT security architecture that bridges the gap between Operational Technology (OT) and on-premises and cloud-based Information Technology (IT)
- Implement a fog infrastructure, i.e. applying cloud technology at the edge by using Fujitsu's INTELLIEDGE state-of-the-art network edge processing capabilities

Beyond edge and analytics, Fujitsu also offers the ability to achieve an end-to-end perspective on the entire supply chain. This end-to-end scenario is supported by Fujitsu's COLMINA platform[1], which provides Fujitsu Intelligent Dashboard as a central visualization tool that supports factory- and company-wide optimization. In a demonstration at Hannover Messe 2018, Fujitsu showed two robots and conveyor belts representing live production in different factories, while a digital twin - a digital replica of the manufacturing process and systems – ran on the Fujitsu Intelligent Dashboard, providing a real-time central visualization platform and consolidating views on critical key data and smart analytics results for reporting, alerting and predictions, based on metrics including quality, production, energy or equipment.

The Intelligent Dashboard solution delivers a top down hierarchical view of all of a customer's factories on a worldwide basis. An executive management view provides a quick overview of all production facilities while, for example a manufacturing specialist can drill down to the status of an individual production cell or machine.

Beyond the factory and supply chain, Fujitsu is also collaborating with customers to develop solutions that extend deeper into the wider value chain through 'digital transport' to create the transport and mobility systems of tomorrow in Smart Cities. Optimizing efficiency throughout the entire logistics chain results in greater safety levels for people and goods, and energy-optimized traffic flow.

Background information

- Fujitsu is a member of the German _Platform Industrie 4.0_ group, which aims to develop a consistent overall understanding of Industry 4.0 in dialogue with the public sector, business, science, trade unions and associations. In addition, it provides recommendations for a successful transition to Industry 4.0 and uses application examples to illustrate how digitization of the industrial sector can be achieved.
- Fujitsu's Industry 4.0 Competence Center in Munich, Germany focuses on accelerating digital transformation projects for its customers by bringing multiple IIoT capabilities together under one roof. Dedicated Fujitsu IIoT experts focus on enabling customers to undertake their own digital transformations by co-creating solutions for smart factories and production lines, leveraging Fujitsu's unique manufacturing expertise in combination with its extensive portfolio of IoT, security and analytics solutions. The center's consulting and solutions focus primarily on: collaborative engineering, edge computing and industrial IoT analytics.
- Fujitsu is unique among European solutions providers in that it is also a manufacturer – with a state-of-the-art factory in Augsburg, Germany that gives Fujitsu the opportunity to test many innovative Industry 4.0 projects. The factory uses Industry 4.0 technologies to produce its maximum capacity of 21,000 units/day across 2,500 configurations/week with minimum order size of one unit. An interesting outcome of this beneficial combination of Industry 4.0 and general IT experience was the development of the INTELLIEDGE fog/ edge computing platform.
- Using Fujitsu's unique IIoT and Industry 4.0 technologies, INESA Display in China has alleviated the slow speed and instability of communications in its existing large-scale network by building a low-cost system to automatically collect plant energy consumption data, including information on electricity, water, and gas. This system aggregates and centralizes manufacturing progress data collected through sensors and other IoT devices. To process and analyze the accumulated big data in real time while maintaining a high level of security, a big data analysis platform was built that enables warning signs of problems in manufacturing equipment to be detected.
- Fujitsu is also technical lead for a EU-funded innovation project that aims to make the digital world more secure by enabling the automated risk management of Internet of Things (IoT) systems in automotive, manufacturing, healthcare and critical infrastructures. Fujitsu and 13 other partners from nine EU countries will co-create solutions to protect against malicious behavior in systems and robots, with the goal of increasing the overall protection level for industry, consumers and society as a whole.

- Fujitsu is using IOTA technology in its IoT Solution INTELLIEDGE to observe and improve automated factory production lines. This special functionality permits identifying every component in the factory, which means all the individual components and the end product can be monitored throughout the supply chain and production process. This opens up possibilities for IOTA well beyond machine-to-machine payments, and include, for example, tamper-proof monitoring of the supply chain and secure identity management.
- Another way in which Fujitsu is helping to make the power of scalable and trustworthy DLT available, is a proposed Trusted Instance certified blockchain security and integrity service. The concept of Trusted Instance is that customers send (only once) an initial block (called the 'genesis block') to Fujitsu, with every subsequent transaction sent to Fujitsu as well. Fujitsu's processing resources are used to calculate the copy of the blockchain and act as a private ledger. Thanks to Fujitsu's cloud capabilities and global presence, the blockchain can be distributed globally, strengthening the demonstrable blockchain integrity for customers and avoiding data-loss through disaster (terrorism, earthquakes, fire, etc). This service would also allow a pay-per-use model, making it economically viable for projects and start-ups, where a use case has not been proven and when intense capital investment necessary for the compute power needed for private blockchain is hard to justify. Payments for Trusted Instance services could be made via IOTA, which is secure, fast and, very importantly, has no transaction fees. Because the payments are machine-to-machine, this also avoids traditional billing through a bank with its associated delay and cost.

[1]COLMINA links all kinds of digital manufacturing information, from design to production and maintenance, including the location of people and products, details and outputs of factory equipment, and all data produced throughout the manufacturing process, as well in the supply chain. The solution comprises the Fujitsu Manufacturing Industry Solution COLMINA Service, a suite of operational services for manufacturing; Fujitsu Manufacturing Industry Solution COLMINA Edge, which collects and processes sensor data, such as equipment operations, the vital signs of people, and the location of products; and the Fujitsu Manufacturing Industry Solution COLMINA Platform, which brings together the COLMINA Service and COLMINA Edge.

Going forward, Fujitsu will offer standard interfaces between the COLMINA Platform and other companies' solutions and platforms. Because this enables data on everything from design to production to be linked throughout the entire supply chain, it will facilitate the digital transformation of all manufacturing work.

Online resources

- Fujitsu IoT: http://www.fujitsu.com/global/themes/internet-of-things/index.html
- Fujitsu white paper: Manufacturing, Industry 4.0 and the hyperconnected business of the future: http://www.fujitsu.com/uk/Images/Manufacturing-Industry-4.0.pdf
- Fujitsu's Industry 4.0 competence center: http://www.fujitsu.com/fts/about/resources/news/press-releases/2017/emeai-20170523-fujitsu-s-new-industry-4-0-competence-center.html
- Fujitsu INTELLIEDGE: http://www.fujitsu.com/uk/news/pr/2017/fs-20171116.html
- Fujitsu's UBIQUITOUSWARE IoT platform: http://www.fujitsu.com/global/solutions/innovative/iot/uware/
- GlobeRanger – a Fujitsu company: https://www.globeranger.com
- Read the Fujitsu blog: http://blog.ts.fujitsu.com/
- Follow Fujitsu on Twitter: http://www.twitter.com/Fujitsu_Global
- Follow us on LinkedIn: http://www.linkedin.com/company/fujitsu
- Find Fujitsu on Facebook: http://www.facebook.com/FujitsuICT
- Fujitsu pictures and media server: http://mediaportal.ts.fujitsu.com/pages/portal.php
- For regular news updates, bookmark the Fujitsu newsroom: http://ts.fujitsu.com/ps2/nr/index.aspx

Media contact
Isabell Horvath
Director of PR,
Corporate Communications, Global Marketing
Tel.: +49 (89) 62060 4419
E-Mail: isabell.horvath@ts.fujitsu.com

About Fujitsu
Fujitsu is the leading Japanese information and communication technology (ICT) company, offering a full range of technology products, solutions, and services. Approximately 140,000 Fujitsu people support customers in more than 100 countries. We use our experience and the power of ICT to shape the future of society

with our customers. Fujitsu Limited (TSE: 6702) reported consolidated revenues of 4.1 trillion yen (US $39 billion) for the fiscal year ended March 31, 2018. For more information, please see http://www.fujitsu.com.

About Fujitsu EMEIA
Fujitsu promotes a Human Centric Intelligent Society, in which innovation is driven by the integration of people, information and infrastructure. In the Europe, Middle East, India and Africa region (EMEIA), our 28,000-strong workforce is committed to Digital Co-creation, blending business expertise with digital technology and creating new value with ecosystem partners and customers. We enable our customers to digitally transform with connected technology services, focused on Artificial Intelligence, the Internet of Things, and Cloud - all underpinned by Security. For more information, please visit http://www.fujitsu.com/fts/about/