The Internet of Things and Manufacturing

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The Internet of Things and the future of manufacturing

Executives at Robert Bosch and McKinsey experts discuss the technology-driven changes that promise to trigger a new industrial revolution.

June 2013 | by Markus Löfler and Andreas Tschiesner

In what’s called the Internet of Things, the physical world is becoming a type of information system—through sensors and actuators embedded in physical objects and linked through wired and wireless networks via the Internet Protocol.

In manufacturing, the potential for cyber-physical systems to improve productivity in the production process and the supply chain is vast. Consider processes that govern themselves, where smart products can take corrective action to avoid damages and where individual parts are automatically replenished. Such technologies already exist and could drive what some German industry leaders call the fourth industrial revolution—following the steam engine, the conveyor belt, and the first phase of IT and automation technology. What opportunities and challenges lie ahead for manufacturers—and what will it take to win? To discuss the future of manufacturing, McKinsey’s Markus Löfler and Andreas Tschiesner recently sat down for a conversation with Siegfried Dais, deputy chairman of the board of management at German engineering company Robert Bosch GmbH, and Heinz Derenbach, CEO of Bosch Software Innovations GmbH.

A new era for manufacturing and logistics

Markus Löfler: The Internet of Things has already set in motion the idea of a fourth industrial revolution—a new wave of technological changes that will decentralize production control and trigger a paradigm shift in manufacturing. My question for the group is how do we think this paradigm shift will affect the classic production process and the manufacturing value chain?

Siegfried Dais: Given the Internet of Things—or Industry 4.0 as we call it when referring to manufacturing production—it is highly likely that the...
According to the results of the American Society for Quality (ASQ) 2014 Manufacturing Outlook Survey, only 13 percent of those surveyed said they use smart manufacturing within their organization.

Of those organizations that claim to have implemented smart manufacturing, 82 percent say they have experienced increased efficiency, 49 percent experienced fewer product defects and 45 percent experienced increased customer satisfaction. (*)

“The development and adoption of the Internet of Things (IoT) is a critical element of smarter manufacturing. (**)”

(*) Sources: (*) ASQ [December 30, 2013] and (**) “Building Smarter Manufacturing with the Internet of Things (IoT)” Lopez Research (January 2014) quoted on Cisco website
What is the Internet of Things?

“The Internet of Things is a global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on, existing and evolving, interoperable information and communication technologies.”

International Telecommunication Union
IoT Definition, July 2012
Obsolescence  “Plain Old Telephone Service” (POTS) and circuit-switched networking demise, voice market saturation coupled with rise of IP and data

Sensors  Increasing availability of a wide range of macro, micro, and nano-sensors

Infrastructure and Identification  Cloud Computing and IPv6, i.e., 340 trillion trillion trillion addresses, fueling Big Data explosion

Regulation  Pollution, privacy, safety, and security

Interconnection  Global pervasiveness through a broad variety of cellular, satellite, and wireless computer networks

Society  Need for immediate feedback, remote access, control and monitoring, independence and interdependence
## Internet of Things “Building Blocks”

**IMAGE** (high-level) techno-management model

### Interface
- Automatic Identification and Data Capture (incl. IPv4 to IPv6 and Object Naming Service)
- Sensors
- Actuators
- Nano, Micro & Macro levels (incl. embedded systems)
- Over-the-Air Device Management

### Medium
- Telecom Networks (transport systems)
- Computer Networks (various spatial scopes)
- Internet of Things Gateways
- Bandwidth and Spectrum management (incl. spectrum sharing)
- Wireless, Wired & Hybrid (Mobile & Fixed)

### Application
- Middleware
- Network Functions Virtualization & Software Defined Networking
- End-User applications (incl. Augmented Reality) (B2B & B2C)
- Context awareness computing (ubiquitous computing systems)
- Application Development Platforms

### Glue
- COMPONENT INTEGRATION (incl. modeling, simulation, emulation, testing & system optimization)
- QUALITY OF SERVICE (issues with heterogeneous networks, multiple stakeholders, resilience [e.g., BC/DR] & energy [power source])
- CONFIDENCE & INTEROPERABILITY (Security, privacy, trust, ethics, identity protection, safety, quality, standards & protocols [incl. open source])
- BUSINESS & SOCIAL TRANSFORMATION (incl. innovative business models, sustainability, regulation & public policy)
- INDUSTRY AWARENESS (incl. education & training, e.g., workshops, on-campus schooling, MOOC, professional continuing education, etc.)

### Extraction
- Cloud Computing & Big Data Management (incl. Data Storage)
- Semantic Technologies
- High Performance Computing
- Machine Learning, Data Visualization, & Statistical Analysis
- Robotics and intelligent machines role in information extraction

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*foundational constituents* (core Device, Network, & Application domains)

*informational mass*

*fundamental interactions*
So many masks, so many facets…
Internet of Things’ Huge Potential

“The Known Unknown!”
Plateau is going to be reached in more than 10 years.
The Efficiency Side of IoT in Manufacturing

Transform manufacturing with the Internet of Things

Build on existing systems for big impact

Revolutionize productivity, increase efficiency and drive higher profits for industrial automation, oil and gas, high-technology and electronics, pharmaceutical, chemical and utility systems.

- Monitor equipment performance in real time, instantly and securely
- Analyze data to control costs and reduce downtime
- Drive new efficiencies with data insights

The Internet of Things drives a Jeep factory

To build a factory that can keep up with demand for one of the world’s most iconic vehicles, you have to be driven. When KUKA Systems Group set out to build a new production facility for Jeep Wrangler bodies in Toledo, Ohio, the company knew it would need cutting-edge technology to get the job done. So KUKA took advantage of the Internet of Things to create a highly automated plant that connects as many as 60,000 devices and factory-floor robots to a central data-management system.

Read more
INDUSTRIAL INTERNET: THE POWER OF 1%

Efficiency gains as small as 1% could have sizable benefits over 15 years when scaled up across the economic system.

INDUSTRIAL INTERNET BENEFITS

- **OIL & GAS**
  - $90B in savings from reduced CapEx
  - Reduces operating costs and fuel consumption while boosting availability of key equipment sets and enhancing production rates.

- **POWER**
  - $66B in fuel cost savings
  - Optimizes power plant fleet with advanced monitoring, enabling deeper integration of gas and power networks.

- **HEALTH CARE**
  - $63B from efficiency gains
  - Improves resource use and outcomes by locating and identifying the status of mobile equipment.

- **AVIATION**
  - $30B in fuel cost savings
  - Improves flight path planning and enables aircraft to tell crew which parts need replacement and when.

- **RAIL**
  - $27B in rail operations savings
  - Optimizes operator response through real-time overviews of network operations.

SOURCE: GE ESTIMATES / POSTMEDIA
“For Siemens and Intel, the way to establish the Internet of Things is to base designs on a cyber-physical system model. This model contains all the necessary features and functions to ensure connectivity and intelligence among all automation industrial devices and systems.”

Source: The Internet of Things: Game Changer or Reboot?, Leslie Langnau, Managing Editor, Design World, March 17, 2014
“But what is it (Industry 4.0) and why now?

Picture this: A product itself talks to a machine or robot, and tells it what to do next in the production process.

This smart factory of tomorrow is based on products that will be able to communicate and act autonomously within an intelligently networked production process.

Real and virtual worlds are literally colliding at the juncture of the Internet of Things (IoT), embedded software, social networking, and autonomous decision-making. It’s more than M2M on steroids.”

Source: Industry 4.0 is closer than you think, Carolyn Mathas, in EDN Network, December 02, 2013
$3.88 trillion value opportunity over the next 10 years

Manufacturers can achieve these profits by embracing business practices, customer approaches and technologies that leverage Internet Protocol (IP)...
"Despite the promises it heralds though, a new Flexera Software Application Usage Management Survey prepared jointly with IDC, suggests that while most device manufacturers are “going intelligent” – they aren’t connecting the dots – leveraging their software-driven devices to make more money. These are the manufacturers that will not survive this era of the Internet of Things.”

Source: “Australian manufacturers urged to benefit from Internet of Things”, February 14, 2014, Manufacturers’ Monthly
“Laurie Wurster, research director at Gartner, said the hyper-growth of IoT will require a rethinking of manufacturers’ underlying business models, including the manufacturing supply chain and the critical role that software plays in product development and product revenue models.”

“Device manufacturers faced with increasing global competitive pressure to reduce manufacturing costs that produce thinner margins can leverage the value created with Internet-connected products to increase revenue.

However, to secure additional revenue, manufacturers need to recognize the role embedded software and/or software applications play in the IoT, and monetize this value. Similar to the traditional software industry, device manufacturers need to protect the intellectual property contained in applications and monetize it through the adoption of licensing and entitlement management systems that control access to the Internet-connected device, its functions and features.”

Source: “Emerging Technology Analysis: Software Licensing and Entitlement Management is the Key to Monetizing the Internet of Things” by Laurie Wurster, Gartner Report, April 4, 2014
IoT Bi-directional Relationship with Manufacturing

IoT technologies optimize manufacturing processes (automation, tracing, tracking, etc.) and human-enterprise interaction

“IoT-embedded” manufactured products transform the socio-economic fabric (marketing, sales, information management, business models, service industry, etc.)

“MANUFACTURING SMART”

“SMART MANUFACTURING”

April 16, 2014
“Smart Manufacturing and Manufacturing Smart are two symbiotic emerging trends that are central to both the radical transformation of the entire manufacturing industry and the development of the Internet of Things.”

Dr. Ben Wang
Executive Director - GTMI
Thank You

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