DESIGNING FOR MANUFACTURING'S INTERNET OF THINGS

By Badrinath Setlur

Connected devices made possible by the Internet of Things (IoT) present unprecedented opportunities across industry sectors and processes.

Designing new business models that support IoT-enabled capabilities requires companies to take a multi-pronged approach, to redesign business models and bring a multitude of technologies together.

Businesses need to deploy sensors, communicate with multiple devices and implant advanced analytics to distill actionable insights. Accomplishing all this requires an approach that embraces design thinking aimed at optimising IoT.

In an IoT network, each object represents a node, continuously transmitting a large volume of data about itself and its surroundings — we call these digital footprints code halos. Products built with this capability are often referred to as the new breed of connected products. A recent report by IT research firm Gartner states that the installed base of things (excluding PCs, tablets and smartphones) will grow to 26 billion units in 2020, a near 30-fold increase from 0.9 billion units in 2009.

This means that the code halos surrounding products will offer organisations unprecedented access and insight into product usage.

In this landscape, the physical world is highly intertwined with the information world, with every object across the value chain sharing and receiving context-specific information for performing a particular task.

How IoT enables informed manufacturing

An informed manufacturing organisation contains four elements: informed products, processes, people and infrastructure.

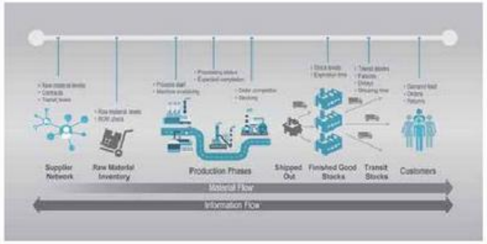
- **Products:** Advanced sensors, controls and software applications work together to obtain and share real-time information with the potential for autonomous machine action.
- **People:** Connecting people across all business functions and geographies, and providing them with relevant information in real time allow for intelligent design, operations and maintenance, as well as higher quality service and safety.
- **Processes:** By emphasising bidirectional information-sharing across global manufacturing value chain, informed processes lead to a flexible and adaptable supply chain.
- **Infrastructure:** Using smart infrastructure components that interface with mobile devices, products and people, informed infrastructure helps manage complexities more effectively and improve efficiencies.

All parts of the manufacturing value chain can benefit greatly from a deep penetration of digital sensors that enable enhanced visibility and better control of production processes, as well as increased automation of tasks.

A range of possibilities exists across core functional and process areas

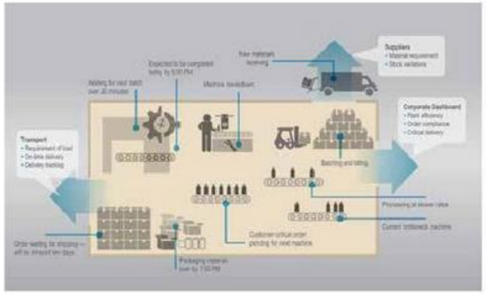
Connected supply chain: By connecting the production line to suppliers, all stakeholders can understand interdependencies, the flow of materials and process cycle times. IoT systems can enable location tracking, remote inventory level monitoring and automatic reporting of material consumption.

Access to predictive analytics based on real-time data helps manufacturers identify issues before they happen, lower inventory costs and potentially reduce capital requirements.



Plant floor control automation: The IoT data and network provide interconnectivity between the shop floor and top floor, which enables the automation of specific processes and reduces the human intervention required to address issues or deviations. Continuous parameter monitoring by sensors enables alerting when deviations occur from preset control limits, triggering automated process adjustments. IoT can also advance shop floor visibility by providing continuous status at multiple checkpoints.

The benefits of increased visibility extend beyond the enterprise to suppliers and third-party providers, avoiding stock-out and material carrying costs.



Remote monitoring and management of critical assets: While remote asset monitoring has been around for decades, the ability to issue corrective commands is rapidly maturing.

Consequently, equipment suppliers have a more direct role in the operations and maintenance of manufacturing plants if they embrace new service offerings and business models.

Models can pivot around hours of operation rather than equipment sale, and the buyer gets to use the equipment 'as-a-service'. This can create entirely new and closely linked business relationships between manufacturers and their suppliers.

Energy management and resource optimisation: Energy is among the highest contributors to cost overhead for manufacturing facilities. IoT systems and automation of environmental controls, such as HVAC and electricity, can create additional cost savings for manufacturers.

These systems also offer integrated weather data and prediction analysis to help manufacturers optimise energy usage. Smart HVAC concepts are being extended into building and home management systems.

Pro-active maintenance: Manufacturers have widely accepted the concept of preventative and condition-based monitoring, but many are still in the process of implementing these programs. If the manufacturer has equipment that needs to operate within a certain temperature range, the company can use sensors to monitor actively when it goes out of range and prevent malfunctions. Measuring vibrations to detect operations that are out of spec is another example.

Overcoming design challenges

IoT can improve and automate decision-making across the manufacturing value chain. However, numerous challenges must be addressed before the full potential of IoT can be realised.

Standardisation: A key issue concerns the numerous networks that operate in silos—each designed differently and serving different purposes. IoT applications are often created for specific purposes and offer limited applications in other areas. Interfaces should be standardised and solutions made interoperable at various levels and across various platforms to promote integration and scalability. Initiatives such as International Standard for Metadata Registries (ISO/IEC 11179) and its implementation (for example, the Universal Data Element Framework, or UDEF, from OpenGroup) are aimed at supporting semantic interoperability between structured data.

Security and privacy: With hyper-connectivity, the data associated with IoT goes from big to colossal and from high-velocity to supersonic, and it spans multiple categories (for example, structured, unstructured and semi-structured). Security and privacy in this environment become even more critical. Devices must be secured on the network, and users need to feel confident both about their personal data and the controls over the flow and exchange of sensitive organisational data.

Infrastructure: The IoT requires complex interconnection between hardware and software that works at the assembly level. With so much data being captured and transferred, organisations need much more capacity to store the information. Another dimension is the kinds of data that the IoT captures. The first data type — large file data comprising images and videos — is traditionally accessed sequentially. The second, which comprises billions of small files created by sensor data, must be accessed randomly. Clearly, tomorrow's data centres must contend with the dual challenge of storage efficiency and effective retrieval of large data sets.

Analytics: Given all this data, organisations need to master the art and science of converting it into actionable insights. This will likely be the biggest challenge for many manufacturers, given the growth of the Internet of Things. According to a Stanford University estimate that the world generates around 1,200 exabytes of data per year. Data generation is expected to grow at 40 per cent each year.

Moving forward with IoT

While the challenges can be overwhelming, the following steps can help organisations to jumpstart their IoT journeys and build competitive differentiation.

- **Design Step 0: Analyse sensory architecture.**
  - Assess the embedded sensors already in your products.
  - Benchmark the product configuration with competitive offerings.
  - Assess component/sub-assembly supplier parts range for embedded sensors.
  - Humans-in-loop evaluation for your products and services.
- **Design Step 1: Create an IoT vision tailored to the organisation.**
  - Evaluate ROI based on revenue models, efficiency savings and product differentiation.
  - Design a blueprint for your organisation's connected ecosystem, including suppliers, dealers, connected workforce and partners.
  - Process: Outline a customer experience design for achieving the IoT vision.
- **Design Step 2: Initiate engagement and employee communication.**
  - Engage and integrate employees, customers, process owners, operators and partners into the IoT program.
  - Communicate with all stakeholders to solicit feedback on touchpoints and potential benefits to make it a win-win for all stakeholders involved.
- **Design Step 3: Focus on application development and infrastructure.**
  - Evaluate potential proliferation of personal connected devices within different stakeholder communities.
  - Create a BYOD implementation plan.
  - Decide on a common approach to development and deployment across multiple devices.
- **Design Step 4: Rapid deployment, monitoring and modification planning.**
  - Agile and flexible deployment with small, step-by-step implementations; get started with IoT and achieve incremental benefits.
- **Design Step 5: Developing product features and embedded sensors**
  - You are now ready to exploit the potential with additional sensors and start building alliances and partnerships. These can help with further monetisation and differentiation.

Connected devices are here to stay and the trend will only grow. Already leaders are investing in IoT solutions and reaping benefits. By embracing essentials of the design approach needed to optimise IoT, organisations can align IoT-based solutions to drive value and create a superior experience for customers. The deeper meshing of virtual and physical machines clearly holds tremendous transformative potential for the manufacturing value chain, from suppliers through customers, and at every touch-point along the way.

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