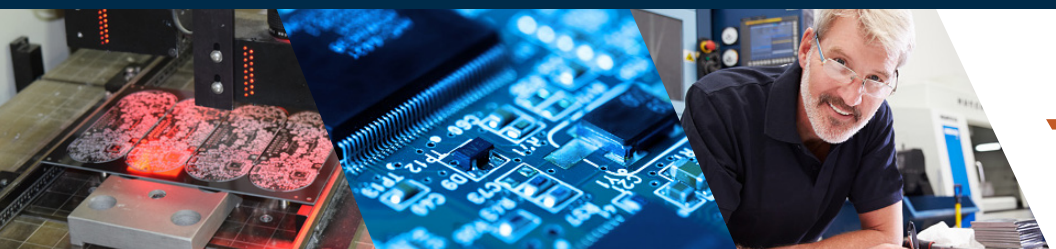
IoT CONSIDERATIONS WHEN DESIGNING ELECTRONIC PRODUCTS



RBB

It's Fair to Say That We Love Data

We want to know more and understand more. We want new ways to gather information. And we want that information at our fingertips, wherever we are. The Internet of Things (IoT) fulfills this need. So it's not shocking that consumers and industries have embraced the IoT, particularly in the areas of safety, preventative maintenance, productivity, and health.

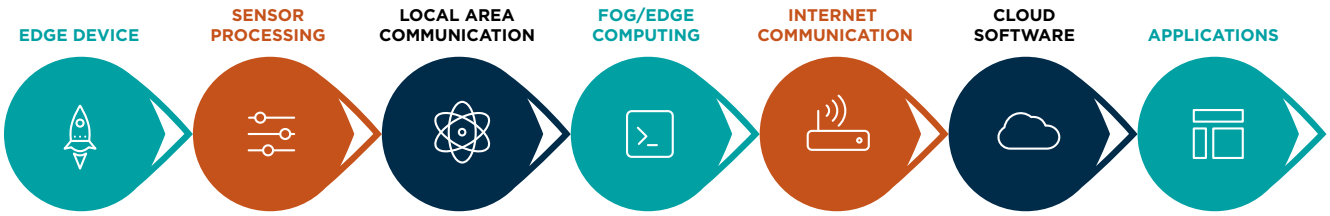
Consumers are relying on the technology to monitor habits, remotely control home operations, and even alert medical help via remote monitors. Industries are using the IoT to reduce downtime in industrial facilities, track assets in warehouses, and even monitor road surfaces to warn drivers of dangerous conditions like ice and potholes well in advance.

At a high level, the IoT's architecture is a network of sensors and machines using the cloud as a backdrop to gather data (executing complex data algorithms) and make it available for consumption in an almost endless number of formats.

How the IoT Works in Manufacturing Applications

When machines are networked, data reports measure multiple indicators. This multidimensional approach relies on sophisticated sensors within the equipment or finished piece to accurately capture data. A gateway uses a wireless device or transmitter to send the data to the cloud, where it can be manipulated, organized, and then accessed by the end user. Cloud computing is one of the innovations that allows the IoT to exist. The ability to move and retain data from multiple sources using the internet enhances security, increases access, and allows virtually unlimited amounts of data to be stored and analyzed.

In manufacturing and industrial applications, the process and results go beyond looking at the traditional metrics of operational efficiency. The intricacies and interdependencies of today's operations call for even more sophisticated levels of connectivity across more equipment and more data points to yield more accurate data collection. Engineering design for this level of complexity requires specialized skills that only experts can bring to the process.



When data is sent to the cloud, software can analyze the data across multiple points to recognize trends, spot irregularities and look for opportunities to improve performance. The ability to retrieve data in any number of configurations and manipulate the data with algorithms provides a robust database of complex information for the user to consider.

The IoT provides the necessary means for sophisticated data collection. However, the addition of the software, hardware, and firmware required to support IoT functionality may cost almost as much as a large, sophisticated piece of equipment. As a short-run assembler of printed circuit board assemblies (PCBAs), we (RBB) know many are finding that the cost is worth the ability to include the IoT, now or as a future enhancement.

Data, Data, Data

Almost any aspect of the manufacturing process can be measured and analyzed. In manufacturing, some of the more common information collected via the IoT involves machine operations like:

- Balance and function
- Accuracy and tolerances
- Efficiency and productivity
- Temperature
- Operator utilization patterns
- Parts wear
- Quality of output

Collecting data via the IoT requires sensors to be placed in circuit boards at assembly. At RBB, our attention to technical accuracy ensures that the sensors contain the finely tuned specs the IoT requires. This enables the edge technology and gateway to function accurately and seamlessly.

Using the IoT brings together many data sources to create volumes of information ready for in-depth analysis. When appropriately analyzed, the data will provide new insights into product performance and usage over time.

Considering the IoT

Engineers and product managers may struggle with the decision to include IoT functionality in their product designs and production. There are several common barriers to entry that warrant consideration.

Resource constraints may be prohibitive. Along with the design, production and analytical expertise needed to leverage the IoT, the hard dollar cost to include IoT sensors, software, hardware, and firmware can be high. If the ROI is not clear, IoT functionality can be viewed as a “nice to have” instead of a “must have.” For many companies, especially smaller ones, this barrier can prevent IoT implementation.

Not everyone embraces the disruption that drives the IoT. Some manufacturers are comfortable with historically proven measurements, methods, and processes and don’t see the need for additional sophistication or for the analytical resources required to make the most of the data. IoT proponents argue that standing still in a time of change and innovation can put businesses at a competitive disadvantage, as clients continue to demand robust data in both consumer and industrial applications.

Initial Design Considerations

Despite the barriers, at RBB we are seeing more and more IoT inclusion in our short-run assembly jobs. Our partner, USA Firmware, tells us the same from a design-services perspective and adds that many “younger, nimbler” companies are demanding IoT capabilities in product designs across industries.

Incorporating IoT capabilities into product designs takes more time up front. This requires flawless execution using the highest levels of technical accuracy. At RBB, our partnership with USA Firmware guarantees that, from early design to PCB assembly, products are made with the IoT capabilities our clients want and need.

When feasible, incorporating IoT functionality with initial design is the safest, most reliable method of ensuring the capabilities deliver to the need. Once implemented, the data-rich environment can increase the capacity to analyze results, foresee issues, and lay the groundwork for the next generation of products.

When the initial cost or disruption to a business is too great of a risk, planning for future IoT capabilities may be the answer. While hardware and firmware can be designed early to encompass the necessary sensors later, several considerations should drive this critical decision to do it later.

Design Considerations for Future IoT Capabilities

Even when IoT functionality is a future consideration, the initial design *should* still include firmware that can receive wireless updates and the appropriate sensors. Circuit board assembly must incorporate the support circuitry that enables the sensors to be used later.

Technology is accelerating at an ever-increasing pace. Forecasting the right technology to match the predicted IoT implementation timeframe is critical. Choosing a waning communication technology means that designs and components probably won't allow IoT capabilities to be smoothly integrated later. If you're designing for IoT functionality to be included in the future, selecting the correct communication protocol is critical to future usability. The same considerations are true of edge computing technologies (those that process data locally, or at the "edge" of a network, before it goes to the cloud), fog computing technologies (those that connect edge devices to the cloud), gateways, and even cloud capabilities.

Designing with components that have longer lifecycles reduces the risk of obsolescence before the IoT is incorporated. Established partners and providers of components for your IoT application should offer support guarantees that match your IoT timeline.

The key to successful product development and innovation, including the IoT, is the creation of partnerships of experts, which allow designs to incorporate new technologies that have significant lifecycles.

Many manufacturers and assemblers, especially those like RBB at the niche end of the market, don't maintain the engineering expertise in-house to create the IoT technology. Thus, partnerships, like the one between RBB and USA Firmware, are critical to successful end results. USA Firmware provides the engineering and consulting expertise for design and relies on RBB to embed sensors that gather IoT-enabling data into PCBAs. It's these partnerships that create innovation, engage true product development expertise, and allow products—that are technically viable for a significant amount of time—to reach markets more efficiently and effectively.

Potential Outcomes of Industrial IoT Applications

In the following examples, we look at the types of alerts and data that can save time and money and deliver better, more useful, long-lasting devices.

Performance

Sensors and the resulting data can alert operators to off-balance conditions, which, left unrecognized, could contribute to costly maintenance or even shutdown. Realignment earlier rather than later can save time and money and keep equipment in better operating condition for a longer period.

Recognizing parts wear and tear before malfunction, a sensor can trigger reordering before the part is worthless or causes damage. Reordering early also helps maintain appropriate inventory levels, ensuring excess parts don't sit idly on shelves. In industrial settings, keeping parts in top condition increases overall performance throughout the manufacturing process.

When machines reliably perform as designed, entire manufacturing operations run more smoothly.

Productivity

Measuring output using IoT technology allows manufacturers to understand both the quantity and quality of production. Using volume and quality sensory devices, a continual data feed captures the amount of output across time and can continually capture shifts in production output levels.

Productivity measures also allow a manufacturer to understand which machines are at full capacity and which are sitting idle and for how long. While this information can be captured using more traditional methods, the reliability of IoT technology allows continuous monitoring versus captures from specific points in time. As productivity trends develop, scheduling improvements can be implemented.

Efficiency

Efficiency measures are critical in manufacturing and assembly processes. Higher efficiency equals lower cost and, ultimately, higher margins. Where LEAN manufacturing is used, the IoT can capture information that ensures anything not of value (i.e., waste) in a process is eliminated—which is the core of LEAN principles. Being able to sense excess movement in parts or equipment is one example where efficiency measures can be assisted by the innovation of the IoT. As with many manufacturing principles, efficiency encompasses measures found across the process, including resource allocation and inventory control.

Safety

Analyzing equipment parts within a manufacturing environment can help indicate potential operator safety risks. For example, an improper, repeated motion taken by an operator (i.e., one that falls outside of an acceptable range of motion or is inefficient) can lead to stress injuries or accidents. Sensing how a machine is being operated and having that information accumulate over time can reduce safety risks through improved training efforts.

Sensing environmental factors and analyzing data obtained can keep a manufacturing facility operating within safety guidelines. Gamification using IoT data creates simulations to foresee potential safety issues and to train operators how to minimize safety risks.

Output Quality

Different manufacturers produce varied end products or components. IoT metrics can be developed to measure quality specific to each. This ability to customize standards allows meaningful quality measures to be gathered and analyzed, promoting consistency in output, which is key to a manufacturer's success.

The Future

For the manufacturing industry, the IoT's sophistication is likely to give rise to new analysis, which will produce new processes and innovation. More data requires new skill sets, more partnerships, and continued disruption of production business models.

Partnerships that match expertise with development and implementation will make the IoT a part of businesses today and in the future.

If you'd like to learn more about ways RBB and USA Firmware are working together to bring the IoT to complex circuitry assembly, contact **RBB at 330-567-2906 or USA Firmware at 844-874-4185 (select "sales") or info@usafirmware.com.**

About RBB

Since 1973, RBB has serviced thousands of mission-critical circuit boards, box builds, and control panels. Over the decades, the RBB team has developed unparalleled expertise and execution in recurring batch PCBA production—in fact, 90% of RBB's jobs are for 100 units or less. Whether it's cutting-edge technology, legacy systems, or anything in between, if it's made in a recurring batch, RBB is finely tuned to handle it.

About USA Firmware

USA Firmware's turnkey, custom design services take your production from initial concept through feasibility, design, prototypes, pilot runs, and final production. The USA Firmware team is highly experienced in modern technologies, product design, and project management. This results in accelerating your time to market and producing a greater return on your investment. USA Firmware customers depend on the company to craft the high-quality electronics, firmware, and software that make their products *smart*. USA Firmware customers also depend on the company's IoT and wireless expertise to make their products *connected*. USA Firmware—*smart* and *connected*.

About the RBB and USA Firmware Partnership

As IoT sophistication continues to grow, manufacturers and their partners must find new ways to include the software, hardware, and firmware that enable the IoT. RBB has found that clients are increasingly looking for PCBAs to support IoT final applications. The partnership with USA Firmware ensures assembly designs include specialized technical requirements to meet the escalating demand for the IoT. RBB now includes sensors in many of the short-run PCBAs the company assembles for clients—a win for RBB clients, end users, and, of course, a win for the RBB–USA Firmware partnership.