Manufacturing is widely recognized as the industry with the most to gain from the Industrial Internet of Things (IIoT). Industrial organizations globally are turning to IIoT, both to drastically improve operational efficiencies through more automation, and generate additional revenue streams with new business models.

However, there are many significant challenges facing the development and implementation of IIoT solutions:

- **Limited internal knowledge** of how IIoT works and its specific business value to operations/new revenue streams.
- **Large heavy aging machinery** with 30-60 year lifespans that is expensive to replace. Furthermore, unplanned outages are unavoidable with in-house solutions involving this machinery. Loss of productivity through this unplanned downtime is a deal breaker.
- Legacy industrial assets are hard to upgrade to match the functionality and communication standard of new IIoT-enabled assets, resulting in inconsistent data; a challenge when trying to measure **Overall Equipment Effectiveness (OEE)** at a factory level.
- Distrust towards new technologies that come from outside the traditional **Supervisory Control and Data Acquisition (SCADA)** field - also known as Industry 3.0. 44% of manufacturers have no knowledge on how to use IIoT to improve on current SCADA systems.

Although new machinery comes with built-in sensors and IIoT capabilities, manufacturers acquiring these machines are faced with the dilemma of either retrofitting their legacy machinery or replacing it with new IIoT-enabled models.

In this solution brief, we show that retrofitting is the most cost-effective option to solve these challenges. By retrofitting existing equipment, manufacturers can lower costs, increase OEE throughout all stages of manufacturing, and potentially open new revenue streams through the use of the data generated by the existing equipment setup.

### Some of the additional benefits provided by retrofitting:

- The interaction between human operators and machinery becomes much more effective.
- **Predictive maintenance**: models can be derived from the data streams, enabling better servicing of the machinery improving efficiencies in both capital and labor.
- **Reduce maintenance costs** by an average of 30%, and improve predictions of machine-specific failures by 70%.
- **Increase equipment efficiency** of existing machinery by up to 10%
- **Simplified Interoperability** between modern IIoT-enabled machinery and legacy machinery, enables the plant to be modeled as a whole and allows for smarter operations decisions.

### Factory Optimization Eliminates Data Silos

A typical Factory Optimization solution based on Dell Technology and the relayr Platform enables you to connect to the silos of data in both legacy and modern machinery on the factory floor, then collect, analyze and visualize performance and equipment health data from both existing digital interfaces and retrofit sensors.
As an operator of manufacturing machinery, you have a vested interest in extending its useful lifespan, avoiding outages, and streamlining operations. To achieve these objectives, data needs to be collected from each machine. For legacy machinery, this is only possible through retrofitting.

The first step is to understand the desired business outcomes of the retrofitting process. What outcomes you are trying to achieve? What are the most important data points to collect from your machinery to achieve them? The overall objectives above are universal, but the data needed to achieve them varies based on your specific product lines and pain points.

For example, the goal of one major bottle manufacturer was to increase the output of a bottling facility by at least 1.2 M bottles per year, representing a 6% increase for the facility. Other outcome goals could be to eliminate the need for manual data readings which would reduce man hours and data entry errors, or increase uptime by a target percentage which cuts costs associate with unplanned production outages.

Gain a clear understanding of the business use cases for retrofitting

1. Define data collection needs from both retrofitted and existing sensors

Before implementing an IIoT solution, you must identify which metrics are key to assessing its effectiveness. What key metrics are the most important to you? For example, do you care most about units produced per day, quality of units produced, or internal temperature of a machine? Once these metrics have been established, you will need to determine whether or not this machinery data is natively available through traditional SCADA sources or if retrofitting is needed to augment the currently available data. Most legacy machinery will need to be retrofitted.

At this stage, you will probably need to contact the machinery manufacturer to learn which parameters to measure in each machine to calculate the desired metric, how much of that information is natively available, and how much will only be available through retrofitting.

Most industrial processes operate at very high speeds and thus generate extremely large amounts of data when retrofitted/instrumented through an IIoT solution. To send such an immense volume of data to a central cloud running in a data center would be economically infeasible. This means that local analysis is required, i.e., the data must be analyzed on the edge, close to the machinery, using computational resources that reside inside the plant facility: the network edge.

Data stream processing is needed to make intelligent control decisions running in a closed or open loop that runs next to the machine being controlled. This imposes stringent requirements on the computational resource at the edge; in our case, this is implemented through an IIoT gateway.

3. Understand analytics & intelligent control on the edge vs. on the cloud
Data aggregation, abstraction, and storage/accumulation

As discussed in Step 3, due to the volume of data being generated by the machinery, it is neither advisable nor reasonable to send unprocessed data to a central cloud. Bandwidth and storage costs would grow exponentially, and 100% reliability of communication and cloud availability cannot be assumed. In addition, exposing so many data sources to the Internet increases the security risk to a dangerously unacceptable level.

Once the data is processed locally, only the data that needs to be sent is transmitted securely to the cloud and only when it needs to be sent. Meanwhile, the remaining data is compressed and stored locally on the gateway. This raw data can either be securely transferred in bulk to the cloud at regularly scheduled intervals for further processing, or it can be further analyzed locally for business relevant information that is then transferred to the cloud.

Aggregating, abstracting, and storing data at the edge not only reduces bandwidth and storage requirements, but also minimizes the risk of data loss through lack of availability or security breach.

Develop compelling & relevant visualizations

Understanding which information to display and how to visualize it in a meaningful way plays a key role in determining how to analyze the data generated by the machinery. This is dependent on the type of machinery, the type of data (identified in Step 3), and operational parameters.

These visualizations should be geared not only towards plant operators, but also toward non-technical business decision makers. It should provide management with direct insight into the impact of the IIoT retrofitting, enabling them to make more informed decisions. In addition to displaying OEE metrics, parameters from external systems (such as ERP or CRM systems) can also be computed and visualized.

Although it is beyond the scope of this brief to elaborate on information visualization techniques and dashboarding in general, it is important to consider the size and type of screen where the visualization will be displayed. Factors such as where the user interacts with the data (display on the machine, mobile device, computer screen in a control center, etc.) should be considered.

Focus on continuous machine learning

Machine Learning (ML) provides computers with the ability to learn and adjust their behavior when exposed to new data, without requiring reprogramming. It is comparable to the way a smart thermostat is able to analyze the data created from manual adjustments to a building’s temperature, based on time of day, day of the week, and even time of year, and begin to predict and automate temperature adjustments.

Using ML in IIoT to implement autonomous adaptive control systems is now a possibility. When applied to both the new data streams provided by IIoT retrofitting and the existing data streams from integration with Programmable Logic Controllers (PLCs), ML can drive continuous improvements of control procedures, anomalous behavior detection, and bottleneck and outage prediction, resulting in improved efficiency of operations on the factory floor.
Real deployment example:

By following the steps outlined in this document, with relayr and Dell Technologies, a major bottle manufacturer was able to retrofit a full manufacturing plant with an IoT solution that resulted in significant business benefits that include a 20% increase in machine uptime, 11% increase of overall plant performance, 2% increase in operating profit margin, and a 22% increase in customer satisfaction.

The plant machinery was retrofitted with industrial grade intelligent sensor kits to gather all relevant data and send that data to the Dell Edge Gateway 5000 for initial processing. Once initial processing was completed on the gateway, the important data was sent to the cloud for additional analysis and visualization.

Through this deployment, the manufacturer was able to achieve real time monitoring and reporting of the plant’s OEE, identify that only 3 of their machines were responsible for 90% of the plant’s total down time, and learn to predict a labeling malfunction up to 3 weeks before failure.

Plant deployment architecture:

Along with our IoT Solutions Partners, we provide technology you can trust to help you get started quickly and efficiently.

Dell takes a pragmatic approach to the Internet of Things (IoT) by building on the equipment and data you already have, and leveraging your current technology investments, to quickly and securely enable analytics-driven action.

The Dell IoT Solutions Partner Program is a multi-tiered partner ecosystem of technology providers and domain experts to complement Dell’s broad portfolio of IoT-enabling technologies.

To learn more visit us online at: www.delliotpartners.com

Contact Dell Sales to learn more about the Dell Edge Gateway 5000, our ecosystem of qualified partners, and to deploy this flexible factory optimization solution today.

References