AUTOMATION

Unleash the **Power of Performance**

2501 S. Moorland Road | Box 510767
New Berlin, WI 53151-0767 | USA
262.782.2340

How to Implement IoT at your Pet Food Processing Plant to Improve Operational Excellence

WEM Automation

Peter Ensch

History of Industry 4.0

Industry 4.0 is a term that is becoming very common place, but what the term actually means, and what potential benefits it can bring to the pet food industry are still to be discovered.

Manufacturing has been evolving over the past several centuries and its' history is marked by several significant milestones. The various stages were all driven by the idea of using technology of the day to make industrial processes more productive and efficient.

> **Industry 1.0**: Modern manufacturing started in the 1770's with the use of water and steam power converted to mechanized processes such as grinding of wheat or the cotton gin.
>
> **Industry 2.0**: In the 1890's the introduction of the assembly line and utilizing electric power and motors, was used to increase industrial throughput by a factor of ten.
>
> **Industry 3.0**: In the 1960's making use of automation and the first industrial computers to control various processes was introduced and brought improved quality and repeatability. The first Programmable Process Controller, or PLC was introduced in 1969.
>
> **Industry 4.0**: The fourth and current stage, "Industry 4.0" was originally named by the German government as part of a national strategy to promote the computerization of manufacturing. The initiative was to use inexpensive computers and data storage, combined with advancements in networking to capture real-time data in Cyber-physical systems; and then use the same computers to perform analysis to automate decision making on the fly. It also included preventative and predictive maintenance; the concept of fixing things before they break down and cause unplanned downtime.

Definition of Industry 4.0

IoT, or the Internet of Things, is the combination of several cyber-physical systems communicating with each other autonomously, thus generating an increased amount of data, and then using that data to improve operational excellence, usually measured with improvements to safety, productivity, efficiency, and cost. Industry 4.0 is not only a vision it is a reality. There is a difference between developing big data and automatically processing big data. Industry 4.0 is utilizing various technologies at all levels of the plant and

integrating the systems into a production plant control, thereby creating a Smart Factory, which seamlessly interconnects mechanical sensors, electronics, software, and humans.

Catch phrases however do not create value. Big data is a well-known problem in pet food production facilities today, where the absence of valuable information is negatively impacting efficiency and productivity. What is important about big data, is having the ability to monitor and analyze it real-time, and then be able to alert the organization of deviations. In order to use big data for gaining and maintaining control of the process you have to be able to alert the right people, at the right time, and in the right context. Industry 4.0 is about making pertinent data available across the facility. Information is only one part of the story; it must drive action, actions that directly impact productivity, efficiency, and profitability. Whether your function is in operations, quality, warehouse, accounting, or supply chain management having the right types of information immediately available to drive educated decisions is key. To be practical and drive real improvements the information must impact both automated and manual processes.

It is also important to understand that there is a difference between the global internet or world wide web and the Internet of Things or IoT. The internet of things is about creating an internet within your factory to connect everything. The vision is that you take an internet down to the lowest level, in other words, every sensor and every actuator is a participant in the Internet of Things. Each device needs to have its own IP address so it can communicate on the network within the plant. Security is paramount to managing the internet within your plant. An important part of deploying the vision is having an isolated network on the manufacturing floor that can only be accessed by systems and people who have permissions.

So, what is a cyber-physical system? The physical system is what is happening on the plant floor. It is the material handling systems, the grinders, the scales, mixers, extruders, coolers, and packaging equipment. Essentially all the electro-mechanical equipment that converts raw material to finished product. When we attach sensors to monitor the equipment, physical conditions like temperature, pressure, moisture, for example; then bring the signals back to a centralized computer control system a cyber-physical system is created.

Unique Challenges of the Pet Food Industry

As with most industries, pet food shares many of the same demands around productivity and quality, however there are a few unique challenges with pet food. When it comes to ingredients pet food deals with an ever-increasing number of materials that have different density, consistency, and flow rates.

Take Protein raw ingredients for example, because of their fibrous nature, they can vary significantly within the same lot. Over the past several years consumer demand has increased the number of formulas exponentially to address both health, age, breed, and humanization of pet food. Controlling moisture is critical, finding and maintaining the proper balance for each formulation is key to controlling durability, palatability texture, and shelf-life. The proliferation of different packaging materials, designs, and sizes has added another level of complexity to the industry that requires day to day flexibility. Finally, consumers want to know where their pets' food comes from. Traceability and lot code tracking require a higher level of connectivity between process steps than previously used in the past. IoT can effectively address each of these challenges.

The Solution

RECEIVING

The pet food process begins with Receiving. Modern control systems can have highly automated receiving, including interfaces to ERP or MRP systems. These interfaces can automatically download purchase orders to the receiving system eliminating the waste of having to manually reenter information and any human error that could result. RFID technology can also be used to recognize trucks enabling access to the facility, direct traffic, enable tracking, and automatic unattended receiving of material. It is important to point out that receiving is also the start of the traceability process, capturing lot codes as material enters the facility is key. Materials can be automatically routed on material handling systems to proper destinations with automatic receipts of inventory transactions tied back to the ERP system. Sensors placed on conveyors and in bins can prevent overflows and jammed material. Program logic can prevent co-mingling of products or even lots of material. IoT can help manage and track the variety of materials like non-GMO, organic, and supplements.

GRINDING

Grinding is often considered a pretty simple process but critical to maintaining a consistent product and quality. Monitoring amps of the motor draws can be an effective way to monitor consistency of grind. With time, system parameters can be setup to monitor and know when a screen is wearing out. Alerting to the need to replace the screen before quality becomes an issue.

BLENDING & MIXING

Years ago, many pet food plants only produced a handful of formulations. Now today the never-ending changes to product lines to keep pace with consumer demand have increased the complexity of the Blending & Mixing processes. Again, interfacing your ERP and any third-party formulation software can save

time and prevent costly errors. With the use of micro-ingredient systems, that use VFD controlled feeders and inline scales, hand-adds can be eliminated and improve both the accuracy and speed of blending operations. The capability for full traceability is available, and inventory can be tracked real-time to understand and support purchasing decisions, or support more advanced automatic reorders through your MRP functionality.

EXTRUDING

The heart of any pet food facility is extruding. Automated extrusion control, tied to formulation, with automatic ramp up can reduce change-over times and improve overall efficiency. Huge improvements in throughput and quality are possible by simply moving from manual to automated controls. Many pet food producers continue to use manual controls for extrusion and startup times, and scrapped/reworked product reflects this. Automated extrusion controls can use multiple sensors across each zone to measure temperature, pressure, steam quality, and motor amps. These measurements are then used as inputs to PID loops that can automatically adjust for both process and raw material variations. The end result being improved throughput and quality.

DRYING

One new advancement in Drying automation control for pet food and treat processors is monitoring inlet and outlet moistures at the dryer; with the ability to make changes of the dryer zone temperatures, bed speeds, or both to achieve optimal discharge moistures. Using real-time moisture data and PID's enables dryer controls to maintain quality, control energy cost and is a great example of how you can use IoT to take things to the next level.

PACKAGING

For years, most packaging lines were largely stand-alone systems. IoT enables pet food producers to finally communicate with their packaging lines to automatically send packaging orders along with lot code information to carry the traceability to the packaged product. Bar code technology can be used to track the product down to the pallet or even bag level and further be used to track inventory in the finished goods warehouse. Immediate tracking of the amount of product produced can be compared to quantities packaged automatically with electronic records, eliminating labor intensive paper trails.

One of the big changes to the pet food market in the past several years is consumers wanting transparency of where their pets' food comes from. By utilizing IoT to connect each part of the process with handshakes of data at every step; a single system can track the entire production process. From automated receiving to out the backdoor shipping, and even to the distribution center or final delivery. The ability to run audits to support internal quality procedures, hold or conduct internal recall of product is simplified and less time consuming.

IN CONCLUSION

Preventative and predictive maintenance can be more easily configured and monitored using the Internet of Things. Temperature sensors in bearings and motors can be used to monitor condition and alarm, or even shutdown equipment, to prevent any catastrophic failure. Vibration sensors can be used on a variety of equipment to create known steady-state signatures, that again, can be used to monitor green, yellow, and red conditions. Die life can be tracked by number of tons extruded, and the list goes on. By utilizing IoT, sensors, and even transactional data a comprehensive preventative maintenance program can be tailored for your facility, monitored daily, producing the required triggers to maintain your plant to prevent costly unscheduled downtime.

In the end it is all about using IoT, sensors at the floor level, industrial networks and controls to collect data to a common central location for the entire plant. The trick is to do the complete integration of the multiple cyber-physical systems throughout your facility. To do this, you have to have a logical plan for implementing IoT, and the basic steps can be broken down into the following.

6 Step Process for Implementing Industry 4.0

1. **Develop a Plan**: All great plans start with understanding the goal and scope. Be sure the entire organization understands what problem you are solving or what need you are addressing.
2. **Pick the Right Team**: Select multidisciplined team members from across the business that include process experts, IT, quality, and finance. Use a project manager who has a track record of introducing new technology and managing change.
3. **Be Honest About the People Side of Change**: Change management is equally important and often more challenging than understanding the technology itself.
4. **Select the Best Technologies That Fit Your Business**: Remember you don't have to do everything at once, select the technology that fits your business, can be more easily installed on top of your existing technology and data. Look for future scalability.
5. **Deploy and Implement**: Make sure the initial scope is realistic in size and timing. Implementing a solution and proving to the team and management that it can be done builds confidence and a setting where you can then use continuous improvement techniques to build on the success.
6. **Follow-up, Follow-up, and more Follow-Up**: As with implementing any new process change or new technology it is good to follow up to make sure any technology or people problems are addressed. It takes weeks to create good habits and to fully understand the data being generated from the new system. Build time and hard scheduled follow up points in your action plan to verify the new process and systems are working.