TankScan

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White Paper

7 Elements of IoT for Tank Level Monitoring

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Learn the steps to take to get consistent value from tank level monitoring maintenance programs.

Much like a chain on a bicycle or a chain used to pull a lodged vehicle out of a ditch, the value chain of the internet of things (IoT) is only as strong as its weakest link. Often the results or lack of results are due to breakdowns in the people and process link of the value chain.

For example, with manual monitoring, the end user or operator goes to each tank, connects the sensor (sometimes a stick), and collects the data. Then they go back to their office, considers their expected use and if a delivery is required, writes up a delivery order. In many cases the delivery order is completed and a run out and other related consequences of lost production are avoided.

However, it is also common in industry for the delivery order to be delayed by end user due to distractions or more urgent tasks. In cases when the order is delayed, it is typically due to an unplanned or unexpected event. The end user usage may increase or the supplier may have a tuck in for repair. In these cases, the measurement is taken, but the future circumstance is unclear, how much, what product and when is the drop-dead delivery date.

All too often, people are busy, the delivery is not prioritized, the delivery is not completed, the tank runa out, an emergency delivery is required and the value of measuring the tank level is not realized. The breakdown in this value chain is in the people and process link. The sensor was connected, the data was collected, the analysis was completed, yet the process of prioritizing and completing the delivery failed.

How Can the 7 Elements of IoT Help?
First, here are the seven elements of IoT:

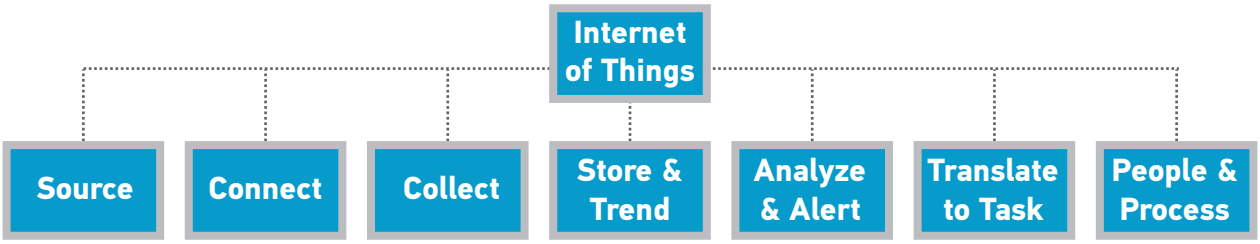


Image 1. The seven elements of IoT (Images courtesy of ATEK Companies)

Based on decades of experience in tank level monitoring, the first way the seven elements of IoT help is by defining the necessary elements or links to get all the way to value or delivery completion. In past years with or without IoT, the common failure point in creating value from measuring the tank level has been in the people and process link. Many manual or wired tank level monitoring deployments had entirely left out this element. With luck, value may have been delivered initially when there was a lot of attention to the effort. Yet, over time the value was lost, perhaps because of personnel turnover or possibly due to a lack of a well-defined or understood value chain.

In starting a new or reviving tank level monitoring programs, one of the first questions to ask is, **When is value realized?** A typical answer is, **When the measurement data or report is delivered, or when the alert is sent.** However, the value is realized if and only if the recommended delivery gets done.

In the seven elements of IoT, the work gets done in element No. 7 by the people and the process. The challenge to ensuring a successful tank level monitoring solution—whether it is IoT or a manual measurement—is to work successfully, consistently and expediently through the seven elements to get to value creation.

The Broken Value Chain
Common pitfalls in today's rush to use IoT, artificial intelligence and machine learning often involve overlooking one of these seven elements, resulting in a broken value chain. For example, many fleet optimization companies are working to bring value and the benefits of machine learning and artificial intelligence to the dispatch optimization and tank level monitoring industry, yet are unfamiliar with basic failure modes and the effects of fleet systems.

In many cases, the systems generate too many alerts and unproductive tasks for the operator to check on tanks where no attention is required. In other cases, the alerts are not setup and the value of an early warning prior to run out is not realized. The new technology and program takes an immediate hit, scoring one for the unpredictable tank and the old way is good enough.

Here is how to translate the seven elements of IoT to industry:

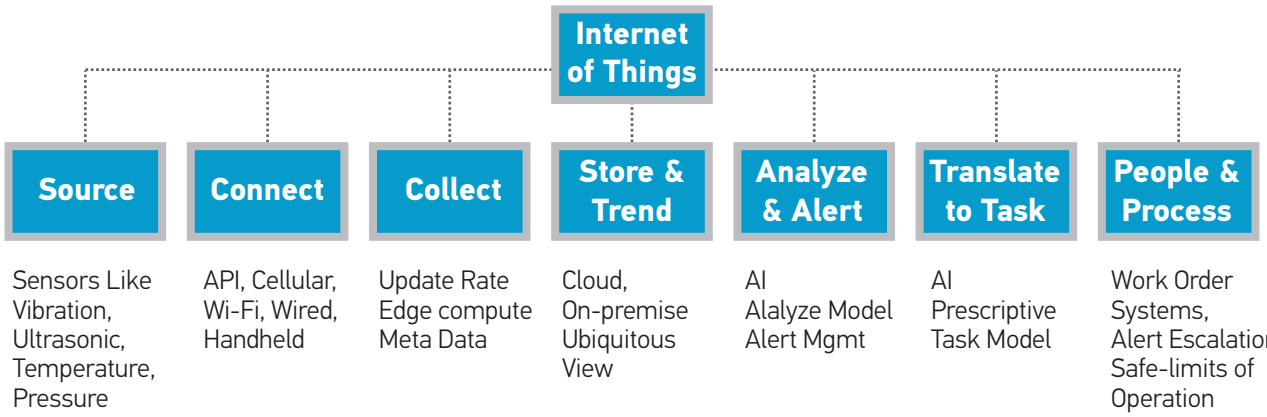


Image 2. Examples of equipment and processes in each of the seven elements

Source: To establish a strong link for the source element (tank), users need to know what conditions or failures are most valuable to detect. The most common failure mode for tanks is run out. To detect and mitigate this early requires understanding the root cause. The likely root cause of a run out is unexpected or increased use.

Using a leading indicator or measurement is key to building a strong link for the source element. A best practice for monitoring a leading indicator for run out is to use gallons or days-to-empty monitoring, percent level is not enough.

Connect: A strong link for the connect element means flexibility for wired, Wi-Fi, cellular and application program interface (API) connectivity for a wide range of tanks in-plant, utility room, roof-top, tank farm and off-site tanks. A connecting device that can edge compute the level, average use, and days-to-empty, as well as, the health of the measuring device is a benefit. Onboard memory to timestamp, store and forward data in the event a wireless connection is down is another feature to boost system reliability. Lastly, power flexibility for battery or line power make for a strong connect link.

Collect: Flexible update rates, adding metadata, and cloud and on-premise storage options make for a strong collect element. For example, when resolving intermittent issues like transition between seasons, a faster update rate is often a benefit. For continuous monitoring of tanks, an option to line power the sensors will further improve the strength and capability of this link in the value chain. Capability to add or include metadata will be necessary for success further along the value chain.

For example, a fleet management system (FMS) ID for the monitored tank will be required to tie out a sensor alert to an automated and intelligent delivery order in link No. 7, the people and process link. Another example is having meta data on the tank location can help create a more descriptive and detailed delivery order.

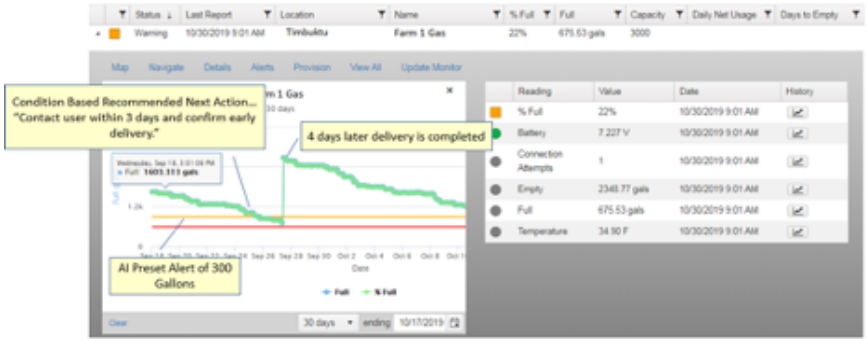
Store & Trend: Having responsive and ubiquitous access to historic data, display trends, overlay trends, zoom tools and export tools to other programs like Excel or other API-compatible applications makes for a strong link. Using a cloud application and avoiding software or app installs and maintenance, while having unlimited and tiered users, is another aspect that makes for a strong link. Lastly, having device diagnostic trends for battery voltage, signal strength and connection attempts further strengthens this link.

Analyze & Alert: Having industry expertise and artificial intelligence models based on decades of data to pre-set alerts without baselining makes for a very strong link. On the other hand, baselining without domain or fleet management expertise is the single biggest cause for missing existing optimization opportunities. While automated baselining techniques used with anomaly detection are the single biggest cause for nuisance alerts and results in unproductive use of the operator or driver's time. Using an artificial intelligence model to pre-set alerts is essential for a strong link here.

Translate to Task: The most common question asked when a new alert is received is, Now what? Having an artificial intelligence model or rules-based model to translate the alert to a prescriptive task is critical to connect to link No. 7—people and process. With this link and strong previous links we can take a real alert on a leading indicator and transcribe an English or textual-based task that needs to be completed in response to the alert. A popular example is a minor or first-level alert that is translated to contact user and confirm change in use rate, then schedule order and delivery accordingly.

People & Process: The people and process link are where the value is realized. With the strength of the previous links, the right delivery can be completed by the right person, with the right material, at the right time. If any of the previous links are weak, a less desirable and less valuable outcome is achieved.

Case Study Showing IoT Value Chain for Tank Level Monitoring



On September 23rd, tank level sensors were deployed to monitor fuel levels for end users of a Midwest fuel distributor. The sensors were battery powered and easily and quickly connected to the tank using a top entry ultrasonic sensor. With cellular embedded in the sensor, and using existing cellular and smartphone infrastructure, the hardware and system was all in place.

Using alert thresholds that were pre-set, and the artificial intelligence or rules-based model for translating an alert to a prescriptive task, the settings were all in place.

Upon connecting the sensor to the tank, a minor alert was issued, and an intelligent delivery order was emailed stating, **Contact user within 3 days and confirm early delivery.** Four days later during a planned and scheduled delivery, the order was completed and the alert condition was resolved. This completed the value chain for tank level monitoring by avoiding the larger failure of tank run out, and avoiding an emergency delivery.

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