Lean Thinking Comes to the Industrial Battery Room

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More than 20 years after it first entered the manufacturing lexicon, Lean thinking is finally taking hold in the warehouse and DC. Now, the last frontier for Lean implementation is the industrial battery room.

But is Lean thinking needed in the battery room? Is Lean implementation even possible? And if so, is it worth spending the time, money and resources to accomplish it?

This white paper will set out to answer each of these questions with the same response: yes.

The foundations of Lean

Lean's foundations are found in Henry Ford's mass assembly manufacturing system, developed in the early 20th century, and later the Toyota Production System (TPS), created by Toyota in the mid-20th century. In its simplest form, Lean manufacturing means producing goods with less; it applies fewer resources without affecting the quality or quantity of the goods produced. Toyota's purpose in developing its system was the elimination of waste, and TPS is focused on seven sources of waste:

1. **Overproduction** – manufacturing items before they are required
2. **Motion** – unnecessary motion caused by poor processes
3. **Waiting** – leaving goods in stasis before they are ready for the next process
4. **Transportation** – excessive movement and handling to get goods from one process to the next
5. **Over-processing** – effort that adds no value to the finished product
6. **Inventory** – excess material or equipment that ties up money that could be used for other things
7. **Defects** – allowing quality deficiencies that result in rework or scrap

Eventually, an eighth source of waste was identified: **People** – that is, not using the knowledge and ability of people within the business.

TPS is credited with turning Toyota into a global leader in the production of quality automobiles. Indeed, the company overtook long-time industry leader General Motors as the world's largest automaker in 2008. Eventually, interest in TPS and other Japanese business efficiency practices spread to other countries. Some U.S. manufacturers – notably Xerox and GE – made great strides in improving quality and efficiency using such practices. The term "Lean" was first introduced in a 1988 article, "Triumph of the Lean Production System" by John Krafcik, who had been a quality engineer in the Toyota-GM NUMMI joint venture.

One reason for the delayed implementation of Lean thinking in the warehouse setting is that the original concept of Lean was designed for mass production of identical or similar items. In the warehouse, volumes aren't huge and are not standardized, so the science of Lean can't be applied in exactly the same way.

But Lean practices can be implemented in the warehouse. In order to produce more with less – and with less waste – warehouse managers can design storage areas, cross-docking systems, pick systems and shipping areas to function faster, with less energy expended and fewer labor hours used just as easily as can be done in a manufacturing line.

> ***"Six of the eight types of waste can be found in the battery room."***

Finally – Lean thinking in the battery room

If Lean thinking is becoming, at long last, such a powerful management tool in the warehouse, why not in the battery room? Because battery room activities are seen as ancillary to the warehouse's main business of storing and distributing. The problems that can be found in the battery room are considered to be relatively insignificant. These beliefs are based upon a lack of clear understanding about the magnitude of waste in the typical battery room. In fact, a poorly run battery room actually creates additional waste throughout the entire warehouse.

A key tenet of Lean thinking is that you cannot change or improve what you have not measured. Feedback is required for continuous improvement, and the four basic steps of the Lean process are geared to achieving that improvement:

1. Identify waste and make a plan to reduce it
2. Implement plan
3. Measure actual performance
4. Evaluate actual performance compared to plan; make adjustments

When battery room activities are carefully studied, it becomes apparent that six of the eight types of waste can be found there.

1. **Transportation:** Unnecessary trips to the battery room to change batteries due to inadequate information on the charge state of the battery being used.
2. **Inventory:** More batteries and chargers in the fleet than are needed for the required work.
3. **Motion:** Battery changing and battery watering processes that require more movement than is necessary.
4. **People:** Too many people watering and charging batteries, some with skills that could be best put to use elsewhere in the warehouse.
5. **Waiting:** Operators queuing for battery changes due to poor charging practices; operators waiting during slow battery watering practices.
6. **Defects:** Operator selection of the wrong battery, which can shorten battery life, costing money; too much or too little water added during battery watering, which shortens the battery life and may cause a hazardous condition due to electrolyte boil overs.

Studies and anecdotal evidence have shown that waste in the battery room can cost large warehouses and DCs hundreds of thousands of dollars per year. Even small operations with as few as 10 to 20 forklift trucks can lose tens of thousands of dollars due to these wastes.

So, how does one tackle the task of eliminating waste in the battery room? The first step is understanding the nature of industrial batteries. Today's batteries are the best ever manufactured. With proper use and maintenance, these batteries will provide years of use. Nevertheless, all batteries degrade over time, even when not being used.

In order to maximize a battery's useful life, managers should understand six basic areas of battery maintenance and use:

1. **Charging:** Batteries should be fully charged to ensure the electrolyte is properly mixed. Never disconnect charger cables from the battery during the charge, as this may damage the connectors and create a possible explosion hazard. Allow batteries to cool down before using, as excessive heat shortens battery life. The typical industry recommendation is a minimum of eight hours of cool down time.
2. **Discharging:** Batteries should be fully discharged. Partial discharges increase the number of cycles, decreasing operator productivity. Over-discharging can result in permanent battery damage.
3. **Cycling**: Under-cycling batteries creates corrosion even when batteries are not being used, wasting cycles. Over-cycling, which gives batteries inadequate time to cool down, causes corrosion due to increased heat, shortening battery life and reducing the number of cycles.
4. **Watering:** Under-watering a battery exposes the lead plates to air, which causes the plates to sulfate and lose capacity. Over-watering batteries reduces their capacity. Three percent of capacity is lost with each electrolyte boil over. Watering with deionized or distilled water is important, too, as dissolved minerals found in most tap water can cause battery damage, reducing battery life.
5. **Cables and Connectors:** Repair broken cables. Short circuits are a fire and safety hazard. And repair broken connectors. Intermittent contact can damage chargers and create dangerous arcing.
6. **Washing:** Regular washing of batteries minimizes short circuits across the surface of the battery, reduces energy loss and minimizes tray corrosion.

Eliminating waste in the battery room

The forgoing background on battery operation and maintenance will help managers begin the process of attacking waste in the battery room. To achieve measurable and sustainable elimination of waste, managers need to focus on the three major impacts on battery room operation and maintenance: **Rotation, Rightsizing** and **Battery Watering**.

Rotation

The #1 cause of reduced battery run time, reduced battery life and waste in the battery room is improper battery rotation. This occurs when forklift operators make their own battery selections without proper direction as to the "correct" battery to take. Left to their own devices, operators will take the closest battery (in order to make the quickest change) or the newest battery (in hopes of getting the longest run-time). The "correct" battery – *the battery that has had the longest cool down time since charging* – may be in the back of the battery room. So, most operators will take the closer battery. Convenience trumps proper rotation.

The consequences of improper battery selection are costly. Site tests have shown that when battery selection is left to an operator, 30 percent of the batteries will be underutilized and 20 percent will be overused. The result: uneven battery usage, premature battery failure and lost productivity.

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The key to ensuring proper rotation – that is, selecting the battery that has had the longest cool down time since charging – is to make picking the right battery simple and to measure performance for accountability. When proper battery rotation practices are implemented the results are dramatic. In a study of one company's introduction of good battery rotation practices in which data was collected for the three months before and three months after proper battery rotation procedures were introduced, the average battery run time increased from 6 hours 30 minutes to 6 hours 57 minutes – nearly half an hour.

Battery management is the key to proper rotation

Battery organizing systems are the single most effective tool for ensuring proper battery rotation and, therefore, reducing waste in the battery room. For example, iBOS® (intelligent battery organizing system) from Philadelphia Scientific monitors all batteries in a pool and eliminates operator judgment in battery selection by determining which battery has had the longest cooling time since charging. Once charged, each battery is placed in queue. The system's simple-to-use "read and react" display then tells the operator which battery to take. An audible alarm alerts the operator when the wrong battery is taken.

With the iBOS Real-Time Monitor, a battery room manager can use an on-site computer to continuously monitor battery selection activities. It signals the manager when one of five alert conditions is triggered:

1. Low battery availability
2. Battery mispick
3. Short charge duration
4. Charger fail to start
5. Short cool down time

Rightsizing

Proper rotation of batteries can, on an ongoing basis, save significant money in the battery room through small, but consistent and continuous adjustments to operating and maintenance procedures. Rightsizing a battery room also offers significant potential cost savings by properly matching the size of the battery fleet to the operational needs of the forklift fleet. When a battery fleet contains too few batteries, battery assets are being overutlized, reducing battery run time and battery life. When there are too many batteries in a fleet, unused assets are being wasted.

Determining the proper size battery fleet can be a challenge because of the difficulty in obtaining objective, accurate information. Operators themselves, while using the batteries and accessing the battery room every day, may provide subjective feedback that can be misleading and unreliable. Industry "standard" ratios may provide some helpful guidance, but these ratios assume that all facilities operate the same way, and they do not account for changes in warehouse and battery room operations over time.

The Lean method for rightsizing a battery fleet requires ongoing operations feedback and measurement. Key areas to measure include battery availability at any given time, including when there are more batteries than needed and when the battery room is running out of available batteries; the length of cool down time; and battery cycles per week.

Rightsizing via the Internet

When combined with the power and accessibility of the Internet, battery organizing systems are an ideal tool for rightsizing battery fleets. For example, users of iBOS can subscribe to the iBOSWorld™ Web Service (**www.iBOSWorld.com**), which enables managers to optimize assets by analyzing battery performance and creating reports remotely on the Internet. Mispick Reports, Utilization Reports (including cool down time, a reporting feature unique to iBOS) and Availability Reports help analyze asset utilization and availability and proper battery rotation while identifying faulty chargers. Most importantly, the reports can verify that a battery fleet is rightsized for the facility. Data from the user's iBOS system controller is fed daily by phone line or Ethernet connection to Philadelphia Scientific's secure server, where it is backed up and stored for five years.

Battery watering – determining when to water batteries

Watering industrial batteries has been called "a simple job done poorly." There are two easy steps in the battery watering process:

1. Determining which batteries need watering
2. Watering the batteries

But each of these simple steps is fraught with potential pitfalls. In most warehouses, batteries are watered on a set schedule – typically every week. Not only can this be a complicated procedure, but also a time waster, as many of the batteries that are checked don't need watering – and many that are checked needed watering far earlier, and costly, permanent damage may already have been done to the battery.

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The original method of determining which batteries need watering – and still used in some warehouses – is checking every battery every week. This is an extremely time intensive activity, as personnel remove each vent cap and peer inside each cell to determine the electrolyte level.

Using technology to determine the battery watering schedule

The fastest way to determine when batteries need watering is with battery watering monitors, which attach to the top of each battery. Monitors, such as the Philadelphia Scientific Blinky™, allow watering on a labor-saving "as-needed" basis instead of a hit-or-miss schedule. The Blinky features a UL Classified electronic probe and patented circuit that prevents false indication due to leakage paths and tracking on a dirty or wet battery. Battery watering monitors not only save money and improve productivity, but enhance warehouse safety by reducing employees' exposure to acid.

Battery watering – watering batteries quickly and precisely

The precise watering of batteries is critical to the proper maintenance of batteries and to their long run time and long life. Over-watering a battery can cause boil overs, creating a hazardous condition. But it also decreases the battery's useful life because sulfates are washed out of the battery during a boil over, and sulfates are needed to maintain capacity. For every boil over, the battery loses approximately three percent of its capacity. Over time, boil overs can decrease the life of a battery by six months or more.

Under-watering can happen when batteries aren't watered on schedule or when they are manually watered and the operator accidentally skips a cell. When a cell is skipped in a typical watering regimen, it might not get the water it needs for another week. When parts of the battery's positive and negative plates get dry, battery capacity is decreased. And even when water is re-introduced to the dry cell – for example, at the next scheduled watering – it will not return to its previous performance. In the worst case, a damaged cell would need to be replaced entirely.

The most common factor contributing to over- and under-watering is the hand-watering of batteries. An estimated 70 percent of industrial batteries in North America are filled by hand, despite the fact that single-point battery watering systems have been available for years.

One type of single-point watering system, the Philadelphia Scientific Water Injector System™, features Water Injectors with precision level-sensing valves. The Injectors are installed into each cell on a battery, and rugged tubing runs through each Injector, forming a single, continuous flow path on top of the battery. The operator clicks on a water hose, opens a valve and waters a single battery in 15 seconds or less – a fraction of the time it takes to water a battery by hand and up to eight times faster than other single-point systems.

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The system saves money in two ways. First, it cuts labor costs, often paying for itself within its first year of operation. Second, it extends the life of each expensive battery it is installed on due to improved quality of watering. A survey of Water Injector System users revealed that in an average 100-battery fleet, a company can expect to save approximately $26,000 per year with an ROI of about 13 months. (Survey participants considered labor savings from the decreased time spent watering batteries, time saved due to less frequent battery changes and savings from less frequent battery purchases as batteries experienced longer lives with proper maintenance.)

The Water Injector System also improves safety and environmental cleanliness. There is no need to peer into cells to inspect levels as with manual filling, and Water Injectors automatically fill each cell to the correct level, so there is no overfilling and no electrolyte overflow during charge.

The Lean Battery Room: It's possible, it's beneficial – and it can be immediately implemented

The warehouse and DC battery room is the last frontier for the implementation of Lean practices. Yet the Lean Battery Room can be immediately implemented with existing technologies and proper maintenance and operating practices. And the potential benefits are enormous, representing tens of thousands of dollars in savings from reduced waste even in small- to mid-sized battery rooms.

For more information about the Lean Battery Room, contact Harold Vanasse, vice president of sales and marketing at Philadelphia Scientific, The Lean Battery Room Experts[SM], at HaroldVanasse@phlsci.com or +1 215-616-0393.

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