


Feed the Machine: Five Ways to Queue Up Automated Transformer Management

by Wesley Suplit
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Just a short decade ago, the notion of using machine learning to solve everyday problems felt like the stuff of science fiction films. However, technology develops at far faster speeds than we can necessarily anticipate. This is why, only a heartbeat after IMB's 1997 introduction of a machine that could beat the world chess champion, we find ourselves interfacing with machine learning every day. Netflix recommendations. Email spam filters. Alexa.

The rate of adoption moves at similarly warped speeds. It took 75 years for 50 million people globally to have access to the telephone, but only 19 days to achieve 50 million downloads of the mobile app, Pokémon Go [1]. That speed is striking; the potential for change, immense.

Electric power reliability has been forced to evolve to meet the demands of this digitally transforming world, now characterized by an increasing connectedness between humans and machines. In terms of transformer

management, a core aim is reaching the point where we can let the machines make the maintenance and reliability decisions for us — data-driven asset management powered by machine learning.

If You Build It, They Will Come

Of course, the term “digital transformation” implies a change, shifting your facility from one operating reality to another. The technology available to our industry isn't sophisticated enough to completely remove the human element. Yet. However, by definition, machine learning improves the more you use it. Accruing a rich knowledge base of verified condition data, whether or not you currently have predictive analytics in place, will help refine machine-led transformer reliability. In other words, start building now, and automated transformer management will come.

So, how should you attack this dataset issue? Honestly, the best and most basic thing you can do is to keep gathering transformer data — visual inspections, DGA analysis, moisture testing, infrared scans, all of it — even if you're not sure exactly how or when you'll use it. Additionally, here are five areas of the transformer maintenance and reliability process where digitalization efforts can help move the needle toward automated transformer management.



Wesley Suplit is a senior product manager at SDMyers, a transformer testing and maintenance company with 55+ years in the electric power reliability space. He is responsible for transforming ideas into extraordinary products, services, and customer experiences related to improving the reliability of electrical equipment and decreasing failure modes.

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1. Digitize Transformer Data Collection

Here's a wake-up call: research shows that 44 percent of facilities still rely on paper records [2]. This represents an enormous loss of accessible data. Machine learning algorithms can't analyze data sitting in file cabinets or in the back of a technician's van. Implementing digital inspection and monitoring tools is critical. There is a range of tablet-based inspection apps that aid in digital data collection during routine transformer inspection and sampling. These tools go beyond simply digitizing your condition data. They add value by improving the accuracy and quality of that data with step-by-step workflows, barcode scanning, data verification steps that flag erroneous data (e.g. data fields that won't accept four digits as a temperature), and image uploading to improve visual checks and aid in corrective action plans. Most inspection apps also include built-in safety features, such as PPE requirements and SOP checks. The most advanced inspection software allows embedded remote tech support via video chat, voice recognition, efficiency improvements based on history, and augmented reality to assist with specifying and quoting repairs.

Remote monitoring is another lynchpin in ensuring that you collect the level of data needed to properly utilize predictive analytics. By attaching an online monitor to your transformer, you can collect condition data around the clock, enabling real-time fault detection. Monitoring devices can detect and measure the presence of up to nine gases for a full DGA report. In addition to the real-time oil data, remote monitoring also collects electrical or thermal parameters for a comprehensive look at a transformer's health.

2. Automate the Liquid Testing and Analysis Process

Collecting data is just the first step. Your routine transformer fluid samples and remote monitoring reports are sent to a dielectric fluid testing laboratory for expert analysis. However, note that not all dielectric liquid analysis labs are created equal. It's important to select a testing lab that utilizes best-in-class digital solutions in order to not only capture the wealth of data contained in your sample containers—but also to ensure accuracy and visibility.

Laboratories that employ a digital-first strategy rely on a robust laboratory information management system (LIMS) that interfaces directly

with samples (via bar-code tracking, Figure 1), instruments (automatic direct data transfer), and a customer portal for real-time sample tracking and reporting throughout the entire analytical process. These platforms allow for computer-assigned diagnostics with an expert final review, utilizing the best of both humans and machines.

3. Incorporate Data Visualization

When selecting a fluid testing laboratory, or when adopting an in-house asset management platform, consider placing data visualization at the top of your features/functionality priority list. Why? For starters, the human brain processes images 60,000 times faster than words with four times the recall. With that in mind, the ability to receive and review data in a visual format as opposed to rows of information in Excel sheets seems almost like a superpower.

With specific regard to transformer management, data visualization is key to exercising fast and efficient data-driven decision-making. Viewing data in color-coded, clickable charts and graphs allows you to quickly digest asset health information with the ability to drill deep into a single asset or view

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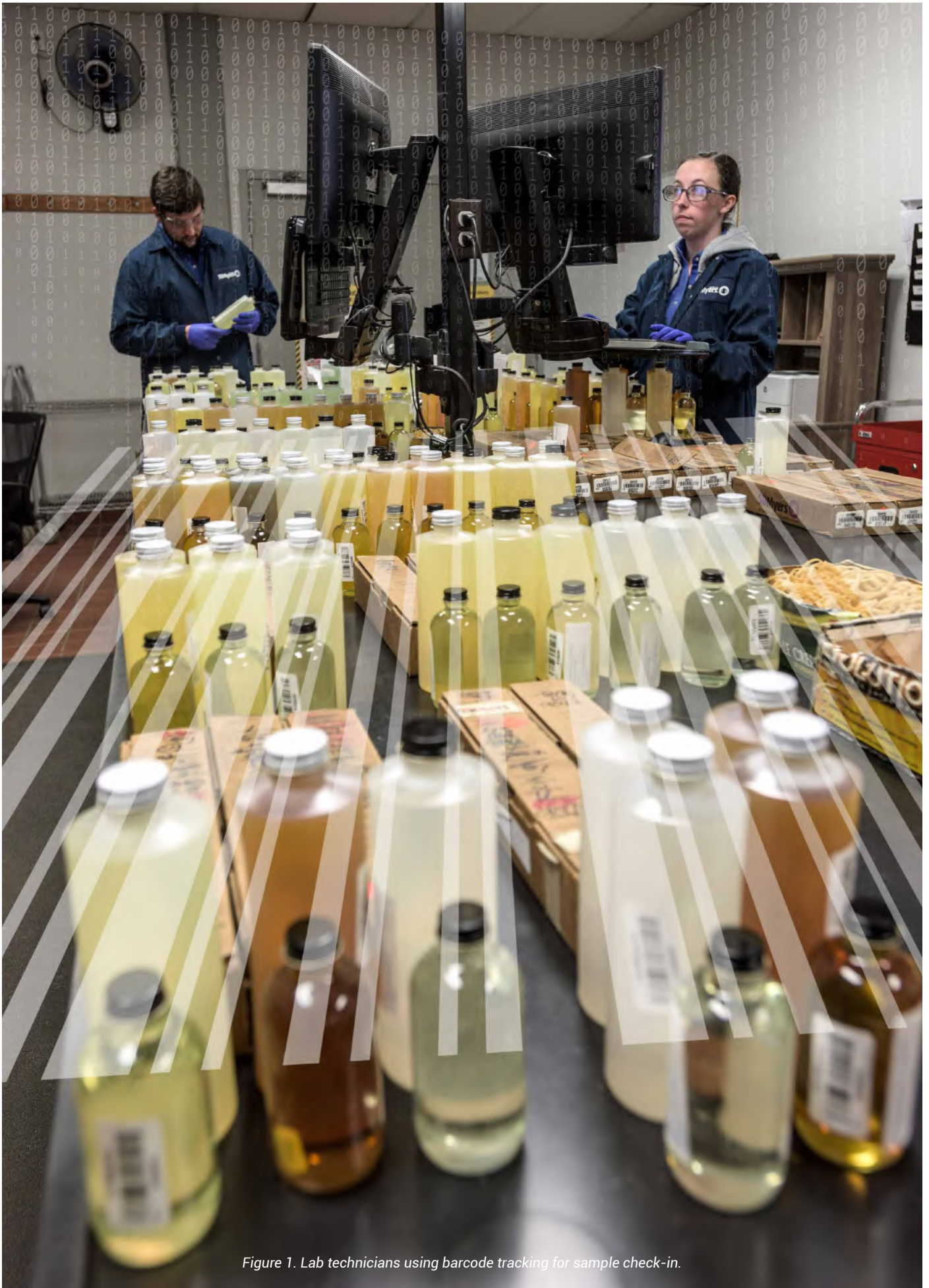


Figure 1. Lab technicians using barcode tracking for sample check-in.

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fleet-level information with GPS mapping capability (Figure 2).

This level of insight empowers you to:

- Audit the specific level of risk for any of the transformers in your fleet
- Prioritize your maintenance allocations with greater judgment
- Ensure your most critical transformers are receiving the attention they deserve
- Economize on the amount of time that is associated with interpreting your data

The power of data visualization comes to life when you consider health indexing (Figure 3). A visual data dashboard can assign your transformer a health score based on whatever parameters you set. The more data you accrue, the more confidence you can have in that score. In this example, the score is a four-level rating system that

informs reliability engineers of the transformer's overall condition, enabling better resource allocation and action toward reliability.

The condition score aids the recipient in decision-making and greatly simplifies the review of each diagnostic test with four basic categories:

- Satisfactory – Requires normal monitoring
- Watch – Needs more frequent testing and continued observation
- Service – Needs service or further evaluation
- At Risk – Requires immediate attention

4. Define Your Alarm Management Philosophy

Modern automated control systems are very effective at improving the

efficiency of industrial processes. However, these systems make it very simple to set up alarms and notifications—sometimes too simple. This results in unnecessary alarms, confusing alarms, and alarm flooding conditions – annoying conditions that lack insight.

Whether you're looking at transformer liquid sampling data or remote monitoring reports, I'm going to assume that you don't want to be pinged by "at risk" health scores or similar alarms when the issues don't necessarily mean that catastrophe is nigh. Defining a clear and strategic alarm management philosophy ensures that your alarms are meaningful to your unique operation (Figure 3).

When developing an alarm management philosophy, it's best to consider:

- Any known assumptions regarding equipment and processes

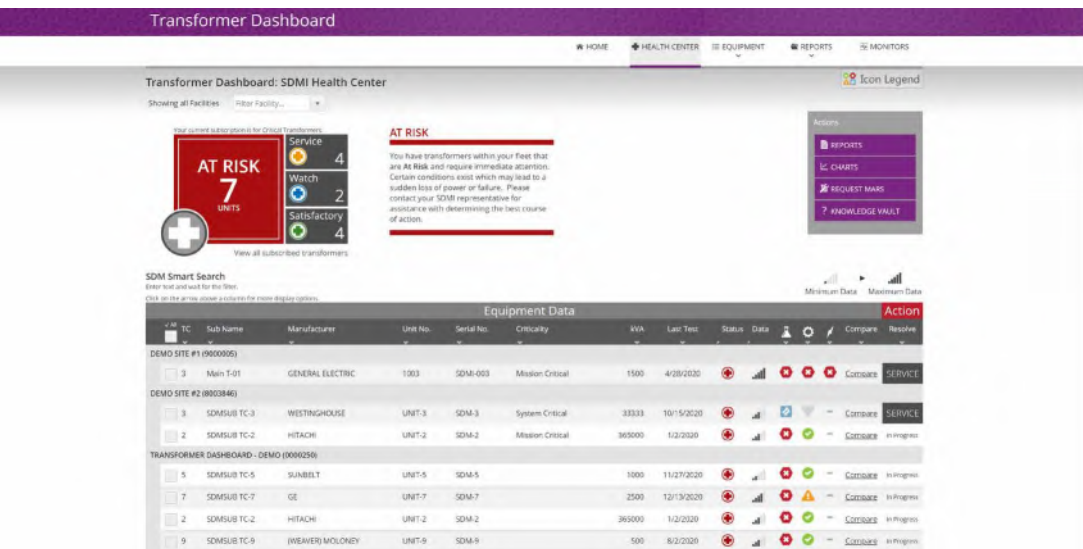


Figure 2. Data presentation dashboard (demo only) showing health indexing.

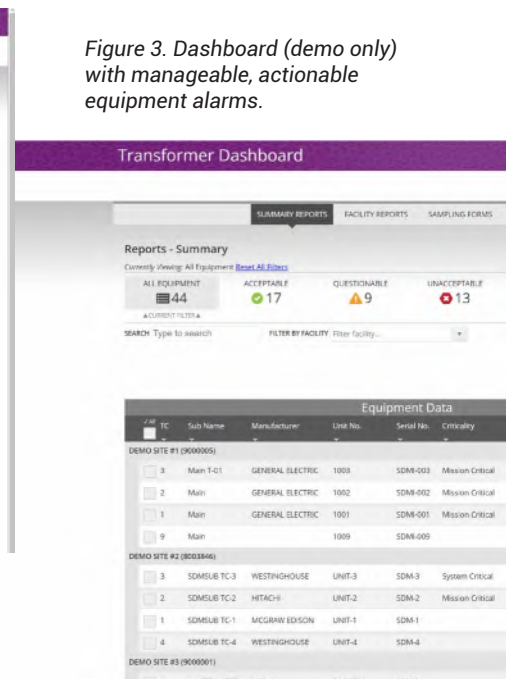


Figure 3. Dashboard (demo only) with manageable, actionable equipment alarms.

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- Regulatory standards such as ANSI/ISA 18.2-2016, OSHA requirements, etc.
- Condition triggers, such as IEEE standards, provider limits, or machine learning-based parameters
- Alarm design and prioritization rules
- Alarm lifecycle and reassessment

Who receives alarms and what do they do with that information? These are internal workflows you should also clearly define before you're ready to take the full plunge into machine-led transformer management.

5. Leverage Business Intelligence Tools

Clearly, a rising theme in this article is that reliability engineers and asset

managers have access to more data at a higher quality than ever before. This is a good thing, yes. However, it's only a great thing if you have a system set up for maximizing the value of your historical and trending data. Based on a sample of customers, 91 percent say they use comparative data to make equipment decisions. Because we have 55+ years of transformer condition data, we're in a unique position of making that data available for comparative analysis (Figure 5) with a benchmarking tool that allows customer to compare the condition of their asset with all of the like assets we have in our system.

This is just one example. With the software capabilities in existence today, you have an arsenal of analysis options that can take your historical data out of retirement and put it to work with machine learning.

The Fast Track Forward

When you're in the midst of building a digitally focused reliability strategy, it can feel like you're behind and your progress is slow. The bad news is that you very well may be behind in terms of machine learning and its wealth of capabilities. But, the good news is that progress in this arena tends to happen very quickly once the right puzzle pieces are all in place. Just ask Alexa.

References

[1] "Aarogya Setu becomes world's fastest app to reach 50 million downloads: Niti Aayog CEO," *The New Indian Express*, April 16, 2020

[2] A. Pelliccione, Plant Engineering 2018 Maintenance Study, 7 Key Findings on Facility Maintenance, *Plant Engineering*, March 1, 2018

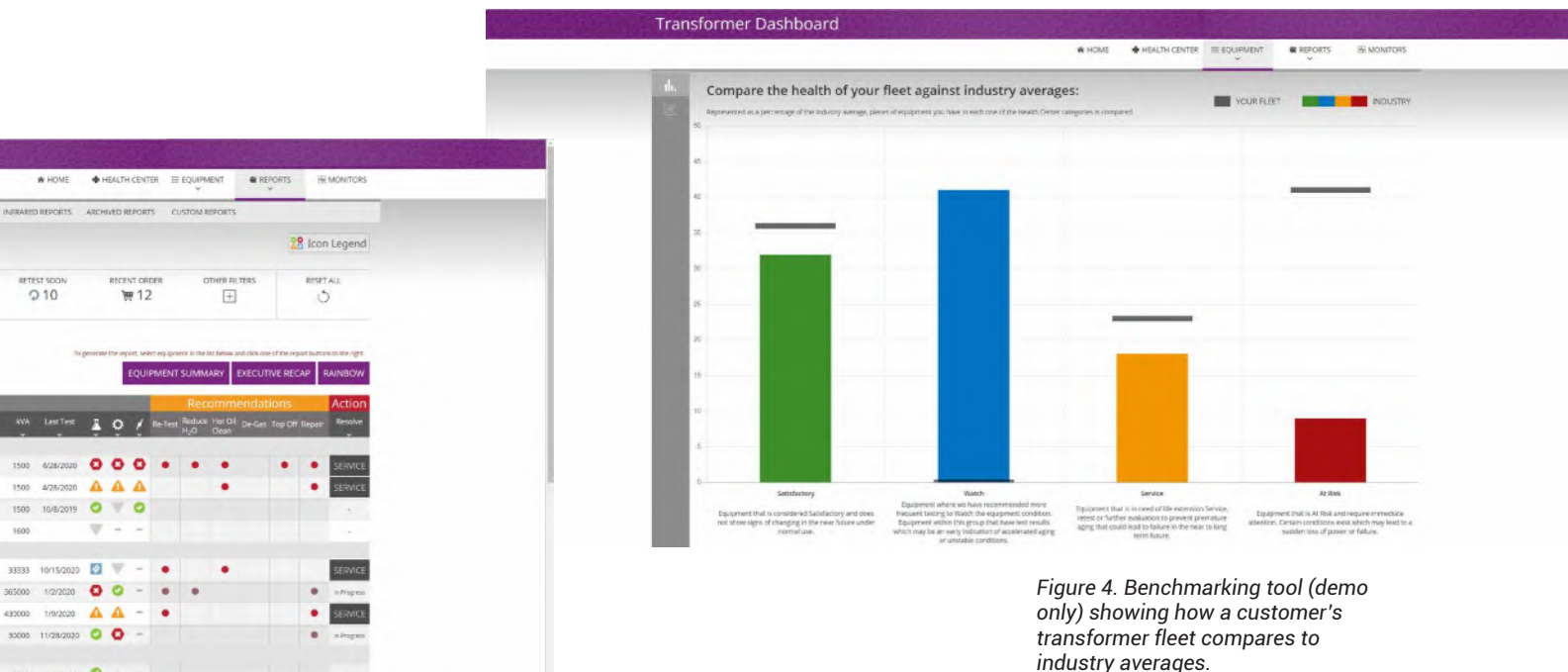


Figure 4. Benchmarking tool (demo only) showing how a customer's transformer fleet compares to industry averages.