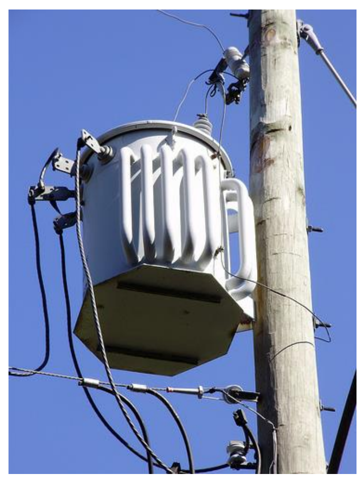
Using Health Indices for Strategic Asset Management

Aging infrastructure, changing focus of regulatory environment, introduction of the smart grid, increase in renewables flowing into the grid, and the arrival of home electric vehicle recharging and demand response capabilities are all driving the industry to find smarter ways to manage their asset investments. Without more strategic ways to manage assets, utilities will find themselves at a disadvantage both competitively and financially.

There are many reasons for this recent shift in the industry. The economic downturn has definitely had an impact on electrical power companies. Pressure has mounted out of a desire to minimize costs, both for maintenance and for system upgrades in order to maintain profit margins. Additionally, given the increased demand for higher efficiency, financial returns, and stability of supply from power companies, there has been an increased in scrutiny by investors.

As more and more utilities turn from a government-management model to a profit centered business, the need to treat infrastructure and maintenance as investments has become increasingly important. As companies pursue expansion and upgrades, they need ways to determine the best places for investment. By determining how to optimally invest in new capital projects, system overhauls, and better maintenance strategies, corporate heads are able to maximize funding for the highest value.



For the vast majority of electric utilities, this all points to the need to develop health indexing systems for reflecting the condition of the various links within their networks. In the end, there are several key advantages to engaging in strategic asset health measuring and management. Not only will it help to prevent unnecessary failures and enhance reliability, it can also enable operational excellence by ensuring a more accurate assessment of conditions. Reduced risk and more targeted investments are also obvious boons to this kind of analysis.

Best Practices for Health Indexing

First, it's important to understand how a health index works. In general, any health index process involves collecting data and then developing predictive models. It would be next to impossible to measure the performance of every individual asset as it would be impractical on an economic and functional level. Not only that, but because there are no set standards for evaluating the health of any given asset, you have to rely on the judgment of an engineer which is generally inconsistent across thousands of components that are geographically dispersed. As a result, health indexes are tools used to apply data gathered from a selection of components across the entire network in a hierarchical approach.

The other thing to keep in mind when understanding the nature of health indexes is that they ultimately measure asset degradation – the long-term life expectancy of an asset, not whether it currently has a defect or is suffering from unreliability. In other words, a health index will measure the failure processes and estimate the time it will take for an asset to degrade or fail.

With that understanding, let's look at the best practices for using a health index for predictive asset management. In general, any health index should encompass several steps, including factors that measure a link's performance and the relative importance of each factor; conducting performance measurement to grade a link's characteristics; and then finally estimating time to failure for a link. In most cases, a health index will provide the failure probability based on things such as design, age, load, and so on.

For instance, a health index will usually record the actual age of a link independent of the loading. It will also take into consideration outages caused by the link. Loading history is also measured based on good records of general loading patterns, overloads in the short term, and other operating conditions.

Typical system design issues are also considered. These include things such as sensitivities and common failures of various component types and linkages based on their particular design. These pieces of information are used to predict failures based on when the problems generally occur.

Other factors that are always considered include things such as maintenance history, testing, and current condition. Since system maintenance is so important to the proper functioning of a link, it also has a big impact on the overall life expectancy of components. The type, severity, and number of maintenance issues are examined from good records to help assess the health of an asset.

In addition to these physical equipment factors, secondary issues are assessed. For instance, this often includes any potential environmental impact the link may have on nearby water, soil, or ecosystem. Given that there are financial risks associated with accidents and spills, determining the potential for environmental damage is important when ascertaining the health of a given system.

Additionally, as regulations often evolve after the original installation of components, any new legislations that impact the overall performance of a link need to also be taken into consideration. Regulations for particular types of equipment or designs may increase long-term operating and maintenance costs and add reporting burden, necessitating the upgrade of various components to ensure compliance. Regulations that might come into play include those that protect workers and community members from undue toxic exposures; those that govern the environmental impact from the breakdown of components; and so on.

Finally, and perhaps most importantly, health indexes also look to take the financial impact of a failure into account. This can include anything from upgrade costs, maintenance costs, operating costs, regulatory compliance costs, and even company reputational costs.

Each of these factors is weighed and considered in terms of how they will affect maintenance procedures, replacement policies, and overall security of the system. Collecting the data for each of these factors may include a variety of testing methods, including field inspections, operating observations, lab tests, and so on. Accurately and painstaking done, a good health index will provide a complete picture of the condition of assets, the probability of failure, and any associated risks.

Case Studies in Asset Health Index Use

Health indices are being used around the globe in numerous industries, including on virtually every continent. One examples is The French Transmission System Operator – a utility that recently instituted the use of a tool to assess the condition of 225 kV oil pipe cables installed between 1957 and 1989. Using dissolved gas analyses as a performance indicator, they were able to track cable age, link load, link length, and the number of cable breakdowns on a link. By analyzing fault records, this information allows the French Transmission System Operator to determine which links are likely to experience failure in the near future.[i]

In another example from the same country, failure rates of various cables – wet-designed synthetic cables, mass impregnated paper cables, and oil-filled cables – were rated for failure through health indexing. These had all been installed in the early nineties, many of which had an increasing failure rate. Using a health index, they were able to measure the influence of technology on degradation rates, unreliable manufactured designs, and leakages due to global ageing to prioritize which to replace next. [ii]

Hydro-Québec TransÉnergie in Canada had an aging infrastructure as well, since most of it had been built between 1960 and 1980. Working with an IT firm that specialized in the electric utility environment, Hydro-Québec TransÉnergie reviewed maintenance standards with an eye to how to improve reliability and cost control. Using new software to document maintenance activities, archive test results, and analyze their data, the company led to the prioritization for rehabilitation or replacement of thousands of components.

Within their asset health management software, they were able to inventory equipment including dominant characteristics and grouping of diverse components by system. This allowed them to analyze relationships and dependencies to better plan for future upgrades and replacements.[iii]

Having the right software package has proved very strategic for this particular utility, but is a very important consideration for any company looking for a best-practice strategic asset management system. GE, for instance, offers their M&D Software PERCEPTION COMMANDER for the monitoring and diagnosis of transformers.[iv]

In addition to the right software analytics tools, companies are also utilizing other visual, spatial, and temporal tools. This can include grid sensors, weather feeds, and other three-dimensional tools for gathering operational data. Recently developed in the research arena are stick-on current sensors that require no clamping around the utility conductor for easier data collection in a variety of environments. Designed by researchers at the Georgia Institute of Technology, these sensors can be used to monitor many utility conductors without being impacted by other current carrying assets in proximity by discriminating far magnet fields from near field of interest.[v]

Conclusion

In the end, health indices for advanced asset management will result in smarter investment strategies and planning, lower ownership costs for grid assets, optimization of maintenance, reductions in risk, and greater service continuity with fewer failures. Perhaps the greatest advantage to this type of assessment system is providing the data necessary for electric utilities to balance the needs of capital investments, asset maintenance, and day to day operating costs in an intelligent, cost-competitive manner.

Images via Flickr: [mullica] & [PEO, Assembled Chemical Weapons Alternatives]

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Sources

[i] *Health Index*. (2007). Retrieved from Jicable: http://www.jicable.org/2007/Actes/Session_B4/JIC07_B41.pdf

[ii] *Health Index*. (2007). Retrieved from Jicable: http://www.jicable.org/2007/Actes/Session_B4/JIC07_B41.pdf

[iii] Smart Grid News. (2012). *Strategic Asset Management*. Retrieved from Utilicase: http://www.smartgridnews.com/artman/uploads/1/SAM_ebook_V4_1.pdf

[iv] *M&D Software*. (n.d.). Retrieved from GE: http://www.ge-energy.com/products_and_services/products/transformer_monitoring_and_diagnostics/software_and_services.jsp

[v] *A Novel Low-Cost Smart Current Sensor for Utility Conductors*. (2012, June). Retrieved from Smart Grid, IEEE: http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=6169976&url=http%3A%2F%2Fieeexplore.ieee.org%2Fxpls%2Fabs_all.jsp%3Farnumber%3D6169976