Things to Think About & Do 2016

Innovation in Reliability and Asset Management Edition

BIG thoughts
and small actions
make a difference.

Here's what we're
working on
and **thinking about.**

What about you?

FEEL FREE TO SHARE THIS... PASS IT ALONG.
THINGS TO THINK ABOUT AND DO THIS YEAR.

Things To Think About & Do

Jeff Shiver
Joel Levitt
George Simonoff
Danielle Humphrey
Gail Peterson
BRIAN BAIRD
Allan Rienstra
Paula Hollywood
John Murphy
Mario Montag
ALBERTO LANDEUX
Burt Hurlock
Jagannath Rao
Terrence O'Hanlon
Jack R. Nicholas, Jr.
Michael Salvato
Pete Karns
Greg Bentley
ROSS DENTTEN
Derek Burley
George Williams

Predictions Are Difficult Especially When They Are About the Future!

Terrence O'Hanlon, CEO/Publisher
Reliabilityweb.com and Uptime® Magazine

The team at Reliabilityweb.com and Uptime Magazine has a mission to discover and deliver information that makes you safer and more successful. We hope the work done through the magazine, website, e-mail, events and Uptime Elements Reliability Framework serve that purpose.

This project is designed to prepare you for the future, the one that is knocking on your door at this very moment.

We asked some of our respected friends whom we consider to be thought leaders to look into the future, share their vision and guide us to take advantage of it to be safer and more successful.

Predictions are difficult, especially when they are about the future, so we hope you appreciate the tough position we put these contributors in.

Hopefully, none of them missed the mark as badly as the Decca Records executive who declined signing a new English band as he declared, "The Beatles have no future in show business."

Some may even be more accurate than one of my heroes, Nikola Tesla, who in 1926 predicted:

"When wireless is perfectly applied, the whole earth will be converted into a huge brain, which in fact it is, all things being particles of a real and rhythmic whole. We shall be able to communicate with one another instantly, irrespective of distance. Not only this, but through television and telephony, we shall see and hear one another as perfectly as though we were face-to-face, despite intervening distances of thousands of miles; and the instruments through which we shall be able to do this will be amazingly simple compared with our present telephone. A man will be able to carry one in his vest pocket."

The best way to predict the future is to invent it yourself, so please take these ideas and begin to apply them today.

The ***Evolution*** and ***Convergence*** of Technology

Imagine if you can, your entire "as-operating" asset population available as a naturally occurring and immersive interactive 3D digital engineering environment where "right time" information is always available during operations and maintenance leveraging technology that automatically index location with "geo-coordination."

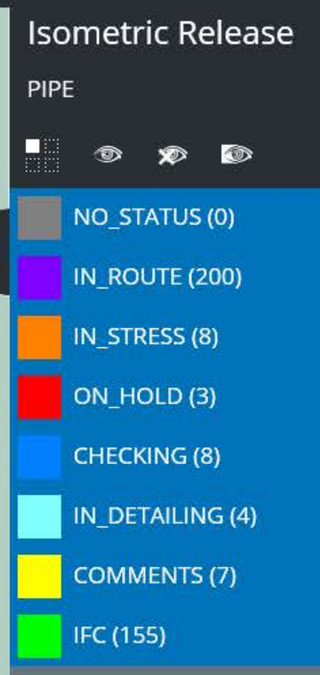
In fact, the key to unlocking the potential of the industrial Internet of Things is the realization that both virtuality and reality share the same fundamental 3D form factor. The breakthrough to enable their juxta-position is "continuous surveying"-- through which ordinary digital photography from position-aware drones and UAV's, smart phones, and video is routinely processed by "reality modeling" software into compu-tationally tractable 3D geometry at any desired level of precision.

The Industrial Internet of Things as currently envisioned appears to potentially overwhelm the response capacity of operations and maintenance professionals. To take sufficient advantage of continuous monitoring, the burgeoning real-time Big Data streaming from the sensors and environmental inputs of Operation Technology (OT) needs to be continuously and combinatorial analyzed against the historical Big Data in Information Technologies (IT) librarians, tabular databases, and transactions, to detect an actionable occurrence—but: then what?

Predictive analytics and machine learning can certainly begin "from scratch" to discern patterns and eventually algorithms to prescribe operational reactions.

What is missing? Leverage of the design engineers' intentions and optioneering—captured through their engineering technology (ET). This information will contribute indispensable insights for much more direct and effective decision support.

The challenge to this ultimate convergence has been that the design engineers work in a digital engineering environment, using digital engineering tools to produce the digital engineering models (in 3D and referencing schematics) which comprise the as-designed baseline "digital DNA" of the operating facility. To date, it has not been feasible for assets' digital engineering models to serve as the natural frame of reference for their operational observation—because the physical environment has not been comparably digitally capturable.
The rapid evolution of and convergence of technologies are now available to move this vision from imagination to reality for those early adopters who act to advance the future and deliver tremendous benefit in terms of performance, safety, environmental and social contribution. The next 3-5 years will reveal many case studies that today may seem like science fiction but are fully possible for those with the drive and vision to act.



Greg Bentley
CEO
Bentley Systems

"Continuous surveying will be the catalyst for the convergence of IT, OT and ET to advance from asset performance management to asset performance modeling."

Reliability and Asset Performance in a WORLD OF NEW TECHNOLOGIES

Imagine a world where the motor on the shop floor can talk to us and tell us, "I don't feel good today, my windings hurt, I may have a fever!" or a pump system that says, "I don't think I am operating at my most efficient operating point."

The manufacturing world will be a radically different place five years from now. All machines and systems will be connected, the Internet of Things (IoT) revolution will be the gateway to communicating with assets, with intelligence built into the assets to make them self-diagnosing and optimizing. The world of machine learning will learn and train models that will tell us about the future of our machines on a real-time basis.

The basis for a lot of this to happen is building a culture of collecting data from all our assets in a proactive manner. Furthermore, it involves making sure that assets are "connectivity ready" and data analytics become a way of life in production planning and maintenance and process optimization.

Companies that build these elements into their vision, drive it with a tone from the top and develop a workforce with the right skill set to tap into this revolution will be the ones who survive. This will be the basis for reliable operations, high yield assets and reduced operational costs.

How does one get there? With data and more data.

Jagannath Rao
President, Customer Services Business Unit,
Digital Factory Division, Siemens

3 MEGATRENDS

Revolutionizing Asset Management

"The future is already here – it's just not very evenly distributed" – William Gibson

Michael Salvato
Director and Program Executive
New York Metropolitan Transportation Authority

WHAT CAN WE DO as maintenance, reliability and asset management leaders to realize the benefit of innovation happening all around us? Today, three megatrends are converging to revolutionize asset management.

1 First is the adoption of asset management practices and standards as a common framework. This is enabling the rapid diffusion of innovation across sectors, driving a step change in expected costs, quality and risks outcomes. This situation is similar to the introduction of reliability-centered maintenance, which was pioneered in the aerospace industry, but is being embraced by the rail industry to improve safety and service at lower lifecycle costs.

2 Second is the integration of information and communication technologies into all aspects of our lives and social, mechanical and environmental systems. This new, information-rich layer of intelligence is fundamentally changing our relationship to our things, services and environment, as well as to each other. For instance, the adoption of remote condition monitoring, data analytics and visualization is helping us predict and prevent failures of critical systems.

3 Third, at the United Nations Climate Change Conference in Paris, France, we were all given a mandate from nearly 200 national governments, countless civil institutions and prominent religious leaders to quickly move from a carbon-dependent, industrial model to a life-sustaining, clean energy economy. Henceforth, the value of our assets will be measured by their impact to earth's natural systems. People all over our fragile planet are embracing sustainable development, applying information and communications technologies, and improving how they manage asset.

As leaders, we must embrace innovation, drive change and help transition our organizations to create a better world.

A Focus on Automated Processes and a Cognitive IoT

It's hard to imagine a time in history when the pace of innovation was faster than today and more valuable. As we look around the corner into the future, we can learn from what we see starting to happen today. Certainly, new tools will be more widely available and in use. Drones and advanced robotics are two great examples and technologies, such as blockchain, provide great promise. But two areas of innovation to focus on are the next generation of automated processes to drive optimization and a cognitive Internet of Things (IoT).

The first involves taking automated processes to the next level across enterprises and supply chains, and using new sources of data, many of which are unstructured, such as video.

With regards to a cognitive IoT, we'll look back at 2015 as the year it became clear that a new approach is required for making use of the plethora of unstructured IoT data. The cognitive IoT is such an approach. It's a way of deciphering IoT data to effectively handle increasingly large inputs while generating meaningful output.

To bring ambitious IoT applications into being, we need powerful, sophisticated ways of processing an increasingly large and varied flow of IoT data.

Pete Karns
Vice President, Product Management & Design, Internet of Things
IBM

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A "Tsunami" of Data

With the Internet of Things (IoT) already starting to deliver big data to the asset management field, there remains another challenge that potentially cures one of the common issues faced by many organizations today – bad, flawed, or missing data. A major opportunity on the horizon in the next three to five years is associated with the transition from relatively scarce and often inaccurate data to a “tsunami” of data that will be accurate, real-time, and cheap. However, big data by itself is not enough to tackle all asset management and reliability issues.

Although there will be no significant changes to the logic that drives techniques, such as reliability-centered maintenance (RCM), there will be a move toward those techniques becoming much more computer-driven. One of the only reasons why RCM multi-disciplinary teams currently exist is a lack of data or information. Actual RCM process times will fall dramatically once opportunities exist to process failure modes. This is achieved by looking for relevant data and cross-referencing extensive files that will be available and include the ability to discern P-F intervals, as well as equipment age-driven data. Not completely void of human intervention but close!

Walmart currently processes over one million customer transactions every hour. This data is imported into databases that are estimated to contain more than 2.5 petabytes (2560 terabytes) of data or the equivalent of 167 times the information contained in all the books in the U.S. Library of Congress. Data storage technologies will continue to improve and prices will continue to fall. This is important because the amount of data being harvested is going to exponentially increase. Dedicated cloud-based storage will be the main repository and be available anywhere, any time.

These are the opportunities and the challenges in the next few years. Exciting times!

Derek Burley
Founder & CEO
Blue Sky Reliability Consulting LLC

Predicting the **Future** of IoT

History of Business Harvard Professor, Richard Tedlow, is fond of saying, "We walk into the future facing backwards." By this he means we look to the past for guidance on how the future might look. He illustrates the point with an early concept rendering of a railroad, which is a line of stagecoaches hitched to an engine with a barrel stave boiler. Cast iron boilers and railcars were still in the future, but stagecoaches were well-established people movers, so that's how the artist imagined a railroad.

> We walk into the future facing backwards.
>
> - Business Harvard Professor Richard Tedlow

The hyperbole swirling around the Internet of Things (IoT) may be in similarly dangerous territory by envisioning a future based too strictly on the past. IoT designers and builders are rightly excited about the potential of prescriptive data that industrial assets will generate in reams. Few of them have worked in a plant or managed an industrial workforce. Many of them expect adoption cycles similar to retail and banking – in the range of three to five years – driven by *young, technically savvy, demanding consumers*. Is that consistent with what we already know about today's target IoT user?

IoT will face challenges in the industrial executive suite as well. To be sure, IoT is a big idea with far-reaching implications, but its economic impact is at the margin, both in terms of investment and return. Industrial change agents and visionary leaders concern themselves with big budget, game changing decisions. IoT is not a game changer, it is a game optimizer. IoT squeezes cents from dollars. The industrial executive suite pushes decisions like that to the user.

IoT will come, but only to organizations squarely focused on optimization now. Their cost and reliability advantages in three to five years will leave competitors depending on game changing strategies to survive.

Burt Hurlock, CEO, Azima DLI

IIoT Will Disrupt Automation

Call it what you will – the Industrial Internet of Things (IIoT), Industrie 4.0, or digital transformation – *it's here.*

The needed technologies are available – mobile, intelligent devices, wired and wireless networks, cloud computing, big data, analytics and visualization tools - no substantial technological breakthroughs are required. Reference architectures have been created and compelling use cases are being developed. Forward-thinking companies are already leveraging IoT platforms and associated technologies to grow revenues and cut costs.

Just as Amazon disrupted the retail industry and Netflix disrupted the entertainment business, IIoT is about to disrupt the automation industry. Case in point, ExxonMobil Research and Engineering Company recently announced it awarded a contract to Lockheed Martin to serve as the systems integrator in the early stage development of a next generation open and secure automation system for the process industries. The intention is to structure the program similar to recent avionics programs, with Lockheed Martin assuming the role of systems integrator. Yet to be determined is the supporting role automation and other suppliers will play. This approach represents a complete departure from the historical, long-term customer/distributed control system supplier relationship involving prolific engineering services. If successful, ExxonMobil believes this program will actually grow the process automation market by making it more productive and shortening the long system refresh cycle.

No less disruptive to our industry is the migration from selling products to selling the value of the product, or product-as-a-service. With the product-as-a-service business model, the original equipment manufacturer retains ownership of the asset itself, providing all required maintenance, service and repair. Remote device connectivity, coupled with device-level service apps, enhances predictive maintenance capabilities, continuous uptime, rapid service response and the opportunity to offer incremental, revenue-producing products and services. GE, for example, has been very public about reporting the benefits of connected products, including the company's ability to remotely resolve 53 percent of service issues in its power and water business.

Paula Hollywood
Senior Analyst
ARC Advisory Group

Own the Data

Not the Data Collector

In an increasingly competitive manufacturing landscape, maintenance reliability will seek unconventional partnerships to extract more value from asset condition management programs.

Smart organizations understand that the tangible value of an asset is measured by its output. A motor's real value is the horsepower it delivers. Pumps and conveyors are valued by the amount of product they move and boilers by the amount of steam they produce. Rather than investing capital to own these assets through conventional business to business (B2B) transactions, smart organizations form business for business (B4B) partnerships with original equipment manufacturers (OEMs) to deliver throughput financed by operations.

A singular function of reliability can be defined as "ensuring assets are capable of delivering their tangible value when it's needed most." To accomplish this, organizations invest capital in technology assets that glean conditional data about the health of plant assets. Ultrasound and vibration data collectors, thermographic cameras, and alignment and balancing instruments are just some of the information gathering assets upon which maintenance depends.

For this group of assets, value is also measured by their output data. The data they provide to the reliability program is what defines their relevance. However, most organizations choose ownership of these technology assets through the same antiquated B2B model. It's a recipe rife with faults, most prevalent of which is the onus for success is the customer's alone.

In the future, smart organizations will reject B2B box shifters. Instead, they will opt to align themselves with B4B solutions providers. These companies share a common mission that delivers the true value of their technology. Organizations will dedicate operational funds to receive quality data, successful implementation and ongoing mentorship and leadership. This may well be the only sure path to world-class asset management and reliability.

Allan Rienstra
President
SDT Ultrasound Solutions

How the Growth of Technology Will Support Maintenance

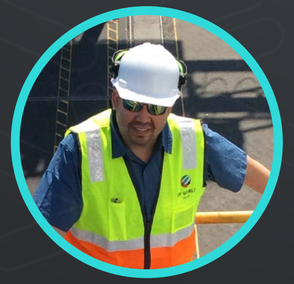
1 Technology, both hardware and software, is dramatically transforming our capacity to understand the condition of equipment and provide productivity enhancing tools for maintenance teams. Companies will incorporate technology at an amazing pace to support maintenance. This speed of adaptation will allow:

- Maintenance departments to have real-time dashboards to see the elements of the maintenance value chain.
- Sensors and wireless instruments to monitor equipment condition are moving from niche markets to mass consumption products; any equipment in any industry will be monitored in real time.
- Maintenance planning information will become available for everyone to see, including statuses of work orders, approvals, backlog data, requested maintenance, closeouts, etc.
- Maintenance execution will be seen in real time, electronic captures to start and stop a job will provide the location of maintenance crews, productivity and online request of spare parts, tools and support.
- Smaller condition monitoring instruments that will include analysis capabilities. Defects will be sent wirelessly to the computerized maintenance management system (CMMS) once the reading is finished and validated by the technician.
- Condition monitoring instruments manufacturers to have a unique platform for data transfer and analysis; the software interface with the CMMS will not represent a challenge anymore, nor the communication between technologies.
- Paper to disappear from maintenance departments. Tablets and smartphones will manage information more effectively and efficiently.

2 Precision and condition-based maintenance will no longer be a target to achieve; they will be the day-to-day way to work. Time-based maintenance will be reduced to a minimum.

3 Technology and data management will give the maintenance function a position as a business process, moving away from the expenditure paradigm that shadows its value.

4 Maintenance will move from the preventive/corrective ratios to financial efficiency indicators. Equipment maintenance plans will be directly linked with equipment performance and reliability indicators.



Alberto Landeux
Global Asset Management Specialist
DP World

SOOTHSAYING

Among many trends forthcoming are these five most prominent ones, primarily in the field of asset condition monitoring (ACM) or predictive maintenance (PdM):

1

Increased use of wireless and the Internet of Things (IoT) for communications, big data management and the application of advanced analytics for those too difficult to conduct locally. These include, but are not limited to:

- Data mining;
- Visual and clustering analysis (e.g., for patterns);
- Statistical analysis;
- Time-based analysis.

2

Merging of supervisory control and data acquisition (SCADA) with ACM or PdM. The reason for this is the shift from labor intensive tag-based SCADA systems to object-oriented systems. Object-based SCADA won't replace ACM/PdM, but will bring those responsible for both into a closer collaborative relationship.

3

New business models for the application of ACM/PdM and related specialty skills, such as:

- All-inclusive lubrication contractor services, including:
  - ✓ Selection, stocking and provision of required products;
  - ✓ Application of lubricants;
  - ✓ Lubricant condition and wear particle analysis;
  - ✓ Participation in root cause analysis teams.
- Backup ACM/PdM contractor services, including but not limited to:
  - ✓ Mentoring, training and certification of new in-house ACM/PdM team personnel;
  - ✓ Temporary replacements because of extended absence of certified team members;
  - ✓ Support on-demand for hard to solve machinery problem situations.

4

Shift from personal computers and laptops or specialty ACM/PdM hardware to commercial tablets and multiple plug and play ACM/PdM and laser alignment sensor suites connected by wireless and the Internet to central analysis centers for data storage, correlation and added support when needed.

5

Every maintenance technician involved in some way with ACM/PdM through the addition of low-cost, limited capability ACM/PdM tools, including but not limited to:

- Vibration analysis;
- Ultrasonic analysis;
- Infrared thermography;
- Laser alignment.

Jack R. Nicholas, Jr.
P.E., CMRP, CRL, IAMC

Note: Excerpt from the upcoming book titled, "Asset Condition Monitoring Management" by Jack R. Nicholas, Jr.

Smart Infrastructure

Getting More from Strategic Assets

Over the next five years, digitally enhanced or smart infrastructure will revolutionize how the infrastructure sector is run and developed. Traditional roles, business models and measures of value are all set to change and the infrastructure sector needs to recalibrate itself to meet that change.

Other industries, such as finance, retail, health, education and the media, have all been disrupted by the rise of abundant digital communications and information and had to adjust in the face of new technologies that allow new ways of working. In manufacturing, humans stand side by side with robots in the workplace, while lawyers and doctors are seeing more of their work conducted by machines.

Infrastructure has so far been relatively unaffected, but is on the brink of its own transformation. Smart infrastructure is one aspect of the new digital world in the infrastructure sector. Smart infrastructure is the result of combining physical infrastructure with digital infrastructure, providing improved information to enable better decision-making, faster and cheaper, and help infrastructure businesses realize value from their assets.

Infrastructure owners across all sectors need to embrace smart infrastructure because:

✓ Smart infrastructure will allow owners and operators to get more out of what they already have, thus increasing capacity, efficiency, reliability and resilience.

✓ Getting more from existing assets will enable owners and operators to enhance service delivery despite constrained finances, growing resource scarcity and, in mature economies and densely populated areas, a short supply of green field space.

Physical infrastructure examples include transport, energy, water, telecommunications, waste, etc.

Digital infrastructure examples include building information modeling (BIM), asset information management and related enabling requirements, processes, data models, master data management and technologies, including a geographic information system (GIS); mobility to aid and control human behaviors; sensor data; virtual tools; visualization tools; open file formats; supply chain cloud-based solutions; drones; asset tracking; big data; Internet of Things; networks; machine learning, etc.

Scale of the Smart Infrastructure Opportunity

For people and businesses working in the infrastructure sector, smart infrastructure will become a huge new industry, requiring new skills and replacing old ones. An estimate of the digital requirement of $400 billion of planned smart cities puts the elements of digital infrastructure between five percent and 12 percent of the total cost. Extrapolated out to include the $57 trillion of mature infrastructure, as reported in January 2013 by McKinsey Global Institute, it can be said that retrofitting the digital infrastructure to create smart infrastructure is a potential challenge and opportunity in the infrastructure sector worth $2.8 to 6.8 trillion.

Three Pressing Infrastructure Industry Issues

1 ***Set out the business case for digital investment in infrastructure:*** At the moment, it is a hard fight to get backing to switch cash from capital projects to invest in digital resources for an existing infrastructure. Shared case studies backed by strong financial data setting out the benefits of a whole life approach in terms of longer lifespan and greater utilization of existing infrastructure are required.

2 ***Develop common language for asset classification and definitions so information can be shared:*** Underlying the value of smart infrastructure is that data collected can be shared throughout each sector and across sectors. A common glossary of terms and processes needs to be agreed upon and used so data can be shared to fast track the benefits of smart infrastructure.

3 ***Establish quality data and asset information:*** To maximize the benefits of smart infrastructure, asset owners need to standardize their asset information and share the templates. Educational institutions need to adapt to include an understanding of smart infrastructure in the courses they offer.

Ross Dentten
Asset Information & Configuration Lead, Crossrail Ltd

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Adopt and Adapt NEW and EXISTING Technologies

Most of the buzz centered on emerging technology seems to be based on the Internet of Things (IoT) concept. But if we change that label to "Things We Communicate With" (TWCW), it becomes clear that we've been working in this space for a long time. What's changed is how effectively we can interact with the data to both make decisions and automate the decision processes.

Rather than processing data on smaller systems independently, we can now visualize and aggregate the data streams into larger systems. Why should we be making decisions about a hydraulic pump skid based on data local to its system when we can also look at the surrounding systems impacting it? Instead of basing a decision on motor current as a single channel, we can now include data from other systems, such as weather, enterprise resource planning (ERP), product mix and utility power factor, into the decision matrix.

The ability to store and process multiple, large data streams is bringing this functionality to the masses. Until recently, accessing and processing these data streams required spreadsheets, custom programming, or math. However, true analytic engines are now being deployed at almost the desktop level. We can now begin to determine what "normal" looks like, allowing us to more easily define "not normal" and incorporate these correlations into our processes and decisions.

IoT is nothing new. How we process the data and how we use the resulting insights are how we are going to take the next steps in managing our systems, rather than letting them manage us.

Where We Are, When We're There

A primary consideration in developing and deploying solutions for the workforce is keeping them "where they are." If they work on a desktop, provide the tools on the desktop; if they're mobile, provide the tools on the device. More and more, the workforce and management are becoming dependent on mobile solutions.

Technological advances not only provide the tools to mobilize asset management functions, they create the expectation that these functions be mobilized. Users are beginning to expect and organizations will need to provide:

- 100% connectivity
- Augmented reality
  - Users must be able to visualize beyond the visible.
- Machine, data and workforce integration.

One of the bigger challenges is balancing workforce anonymization and efficiency. If leadership uses or is tempted to use device data as Big Brother, workforce adoption will be difficult.

Brian Baird
Application and BI
Development/Support
North Star BlueScope Steel LLC

IoT is nothing new...
It's how we process the data and how we use the results.

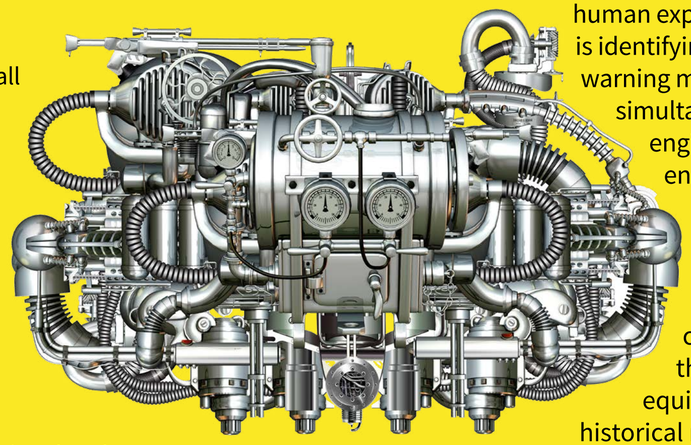
The Power of the Machine

The Future of Predictive Maintenance

Industry depends on the availability of the machines that power it. Predictive maintenance is undergoing a massive shift due to a number of factors:

1. New, smart equipment that emits data about its operating parameters, providing greater insight into operating profiles and conditions.
2. Increasing ubiquity of wireless transmission bandwidth, enabling all of this data to be more quickly and reliably transmitted.
3. Advances in computing technology that enable companies to efficiently mine the mountains of data that have accumulated over the years, which can yield new insights into factors heralding equipment performance deterioration or outright failure.
4. New software technology which is enabling the transition from traditional tools (e.g., infrared, vibration, oil analysis, etc.) used by maintenance professionals to capture abnormal conditions in equipment, to large centralized, automated big data systems leveraging information from multiple, disparate sources to tap into the power of machine learning and artificial intelligence.

In short, we're headed to a time when our equipment will be advising us when to service it.



For decades, expertise from humans was critical to assure asset reliability. This included knowledge from the engineers who designed and built the equipment, to the operators responsible for its use, to the maintenance professionals entrusted with ensuring its reliable performance. Advanced computing technologies, like predictive analytics and artificial intelligence, are enabling a disruptive shift from human expertise to where computer software is identifying reliability risks and automatically warning maintenance professionals while simultaneously alerting the supplier's design engineers. These alerts allow design engineers to research the problem and potentially develop enhancements to reduce or eliminate it.

Advanced software and analytics capabilities create a "digital twin" of the equipment based on data from equipment sensors, operators, maintainers, historical maintenance records, usage conditions and external factors like weather. System-generated warnings are triggered by dozens of seemingly separate events. For example: Locomotive 123 has a warning for a turbo component failure within a two-week window. This locomotive is flagged due to sensor readings plus these factors: at least 5,565 miles; its last maintenance event performed at Depot ABC; hauled at least 3,000 tons per trip; average track complexity score of 8.2; at least 30-inches of rain since the last maintenance event; and average ambient temperature was below 40 degrees.

These changes will enable:

- Original equipment manufacturers to more reliably shift their business models to servitization, where they will accelerate the shift from selling an asset to the service (i.e., power by the hour).
- Reactive maintenance to be significantly reduced; Fleet management and maintenance will be better aligned since computer software will automatically optimize the time and place for condition-based maintenance based on part availability, maintenance skill set, shop utilization and customers' service-level agreements. Using insights gained from technologies like predictive analytics, asset managers and operations personnel can acquire a much better planning horizon to identify at-risk assets and schedule the needed maintenance when it is less disruptive.
- Tapping into new insights in operational and equipment data so suppliers can benchmark their equipment's performance and incorporate the information contained in the data to build better, more reliable products.
- Maintenance professionals to focus more on optimizing scheduled maintenance based on data and analytics and less on, "this is how we have always done it."

Mario Montag
CEO & Founder
Predikto, Inc

New Innovations Turning *Business Models Upside Down*

Technology innovations in the Internet of Things (IoT), the Cloud, big data and analytics are invoking dramatic business changes in asset intensive industries. Serious mathematics is finally getting into the analytics game and information technology (IT) and operational technology (OT) platforms are converging.

These innovations open the door for opportunities that are driving industry changing results. Business models are turning upside down as roles, responsibilities and skills change.

> *"Business models are turning upside down as roles, responsibilities and skills change."*

Equipment vendors are moving from selling their products to offering services. Their reward is based on the performance, reliability, uptime and upgrade of their equipment. In return, they deliver significant business outcomes, such as equipment running consistently and according to specifications, reduced costs, increased reliability and controlled inventory.

Chief information officer (CIO) leadership becomes increasingly important to the business as industrial organizations embrace these innovations. Skills in IT and OT will cross over as CIOs oversee the converging and standardization of these platforms.

A welcome by-product of these innovations is a solution to the worrisome problem of a retiring knowledgeable workforce. A new age workforce that is comfortable with technology will work collaboratively using a different set of skills and, perhaps, from remote locations. Roles in maintenance reliability outfitted with new skills will shift focus from reactive to managing proactive and predictive practices.

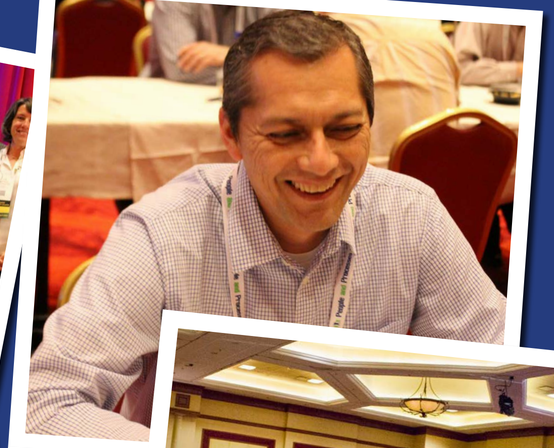
Meanwhile, ISO55000 continues to create executive suite awareness about the value that assets generate.

It's an exciting time to be in asset management!

Gail Peterson
Founder & CEO
Fortig Inc.





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From Safety to Templates: The Future of Maintenance Reliability

As we automate more and more, the standard of maintenance becomes more critical to ensure safety and environmental compliance. Historically, many corporate executives have been educated to focus on shareholder value and profit. Within three to five years, expect a greater shift in the C-suite toward understanding the human costs of not having asset reliability. Sadly, this will be driven by the legal system, with executives personally facing criminal prosecution for corporate manslaughter and environmental breaches.

As a way to limit liability and focus on core business aspects, anticipate that more organizations will turn to outsourcing specific functions, such as maintenance, storerooms and even production, where possible. Another driver for outsourcing will be the continued exodus of the baby boomers retiring and the skills gap for their replacements. To address these, organizations will be forced to spend more on skill and knowledge development for their internal resources. This problem will be compounded with the generation of millennials, where employment relationships will be increasingly short-term, transactional and variable.

As a maintenance manager or reliability engineer, look for an even bigger push from a systems perspective to enable the concepts of big data, interconnected systems creating large data sets that enable computer modeling and trending. More connected devices with the Internet of Things (IoT) will be adding more data to the mix. The struggle for most organizations will be in creating actionable information from the data as many are literally drowning in data today. Many organizations will be spending significant resources writing the rules (e.g., if this, then that) with manufacturing systems to make big data useful.

From a materials management perspective, anticipate licensing the ability to manufacture parts by downloading specific templates from the manufacturer and creating them on-site using additive manufacturing processes (i.e., 3D printing). This will help drive inventory values down, reduce costs and enable just-in-time (JIT) manufacturing.

Jeff Shiver
Managing Principal
People and Processes, Inc

Overcoming Future Hurdles to STAY SUCCESSFUL

The confluence of the Internet of Things (IoT), asset management software and emerging technologies will generate significant opportunities for non-financial heavy asset companies to leverage their investments toward greatly increased reliability and production. Asset leaders progressively have the opportunity to leverage big data capabilities using machine learning technology, sensors data, drone images, smart camera intelligence, just-in-time (JIT), 3D printing, expanded self-diagnostics, advanced mobile technologies and real-time health monitoring alerts. Gone are the days of little or bad data, replaced by massive quantities of real-time intelligence making deliberate and thoughtful information integration our biggest challenge of this coming decade.

With that challenge comes several hurdles, namely investment, cultural adoption and newer emerging technologies. The investment hurdle, simply stated, is that most firms prefer to invest their capital funds into traditional hard infrastructure versus software, monitoring equipment, predictive analytics and smart camera capabilities. Overcoming this requires the asset leader to optimize a combination of project management, project piloting and financial analysis to assure a successful, fact-based result which, over time when repeated successfully, lowers the beta risk for future investment.

> “With that challenge comes several hurdles, namely investment, cultural adoption and newer emerging technologies.”

With continued success, cultural organizational adoption also improves, but an emerging facet of the IoT confluence is new requisite managerial skills for success. Tomorrow’s asset manager must be a skilled leader adept in the ways of these new technologies and the IoT. The individual must be part IT, facility manager, production manager, finance manager, project manager and salesperson.

Lastly, the speed of technology innovation brings more than a little chaos as the next new “thing” may distract or change an organization’s focus. Hence, the asset manager now needs to stay abreast of these emerging technologies unlike any time in the past and sell staying the course unless a truly good fit is found.

The confluences of IoT, asset management software and emerging technologies have become competitive advantage weapons to improve a firm’s profit and loss statement and improve customer service. The real trial is whether the asset leader adapts to take a leadership role in making these results a reality.

John Murphy
Chief Mech Officer
Engineering & Strategy
CSX Transportation

Bright Future for the Spares Business

Joel Levitt
President
Springfield Resources

Internet-based parts sourcing and 3D printing are two macro factors that will make the parts business more rational. These two factors will also cause the next macro trend, which will be centered on the financial suffering of the original equipment manufacturers (OEMs).

With regards to the economics of OEM manufacturing, most profits come from the parts and service businesses. If the parts situation gets fixed and the fix is not profitable to the OEMs, a big source of profit will go away, namely the parts business.

Ironically, both trends are related to the technologies that created this mess in the first place. Actually, it is more a creative destruction/creation cycle, but it sure feels like a mess. This parts situation will get worse before it gets better.

Internet-Based Sourcing

The single biggest marketplace for parts is or will be eBay. It is possible other marketplaces will develop for parts within heavy fields, such as mining.

Sourcing and disposal of spare parts on eBay will become easier and more efficient as more people in your industry use it. Easier because there will be a better chance the parts you need will be on, it, and more efficient because the larger the marketplace is, the more "real" the prices become.

Real prices are the prices that emerge when both buyers and sellers have good information and the marketplace itself, in this case the eBay platform, is honest. It also benefits from the concept of reputation. eBay maintains the reputation score of all its sellers and buyers. In every transaction, both the buyer and the seller can rate the quality, timeliness, description, condition of product, or payment problems.

Sellers also can have stores where buyers interested in specialized offerings can shop. As this business spreads, more and more parts will become available and it might become the first place to check, which has already happened in some industries. Traditional parts dealers will either get on this bandwagon or fall by the wayside.

Reputation Is Essential for an Efficient Marketplace

The CAT 793 is a popular haul truck used in mines worldwide. A quick search of eBay shows many parts on sale. But if we drill down, we find a seller who has been rated on over 1,100 transactions and has a 100 percent positive feedback score. If we look up the seller, we see this seller has been a member of the eBay community since 2004 and is located in the United States. The seller information box also mentions a store. If we were buyers, we might subscribe to the store's mailings or bookmark the store for future use.

If this seller offered counterfeit parts, some would complain and others would be warier, or eBay would shut the store down. The seller could start over, but the reputation, good or bad, would not go with the seller.

Anyone who personally uses eBay knows to check the reputation of sellers and maybe even read through the feedback.

Internet-Based Disposal

When you visit any maintenance warehouse, you will find obsolete inventory. These items were purchased for a specific asset, but the asset was likely retired before they were needed.

In one warehouse, $3 million worth of obsolete inventory was found. In salvage auctions, sellers expect less than $.10 on the dollar or way less in some instances. The buyers are typically other users and dealers who later sell the parts on eBay-type sites.

When you offer up your obsolete spares yourself, you increase the value of the whole network for everyone. You also recover five or more times the value and find opportunities where you can trade your obsolete spares for spares you need. Of course, you need to invest the labor and space to do this. It could be a fun job in the future for flea market and auction junkies retiring from active maintenance.

3D Printing

The second major disruption is 3D printing, which can be likened to the popular Star Trek series and its various incarnations. Within that future, is a gadget called the replicator. This device started as a food maker, making everything from tea for the captain to full meals and eventually producing items, from small metal objects to authentic looking artifacts or souvenirs.

The technology is also used for producing spare parts, which makes it possible to repair most ship damage without having to return to a starbase. Even the largest replicators could not make something as complex as a shuttle craft, rather the technology is used to make large parts that are assembled into various crafts.

To make a replicator work in today's organizations, a library of detailed building specs for a wide variety of materials and items is needed. That's because the technology disassembles molecules to elements on an atomic level and reassembles them to suit the specs. Literally, the replicator can turn lead into gold.

3D printing is not there yet! But like cell phones, body imagers and laser cannons, Star Trek thinking leads the way. People are already making prototypes, small parts, toys, weapons and even a seven-piece car. The capabilities of printers are constantly expanding in their repertoire of materials, shapes and sizes.

Powdered metals can be formed prior to sintering to make metal items. How soon will it be before scores of popular parts will be reversed engineered and available for a price?

Airbus is now using 3D printed parts in its aircraft. How long before this becomes mainstream?

Finally, according to a July 13, 2015 article on the 3D printer and 3D printing news website (www.3ders.org), the U.S. Navy installed a compact 3D printer on the amphibious assault ship, the USS Essex (LHD 2), for testing. The Navy aims to train sailors on this technology so if a part is needed and it doesn't exist in inventory, they can design and print the part on demand within hours or days, allowing for a more rapid response to the ship's needs.

Note: Excerpt from the upcoming book called "Surviving the Spare Parts Crisis" by Joel Levitt

70% of reliability improvement efforts will FAIL

What is happening in the 30% of reliability initiatives that succeed?

The answer can be summed up in a single word:

Leadership

World-class organizations recognize that success is achieved through **leadership**; however, they also realize that results are only delivered through **engagement** and **empowerment** of everyone in the workforce. Leadership does not come from one person, it comes from everyone.

This is especially true for reliability.

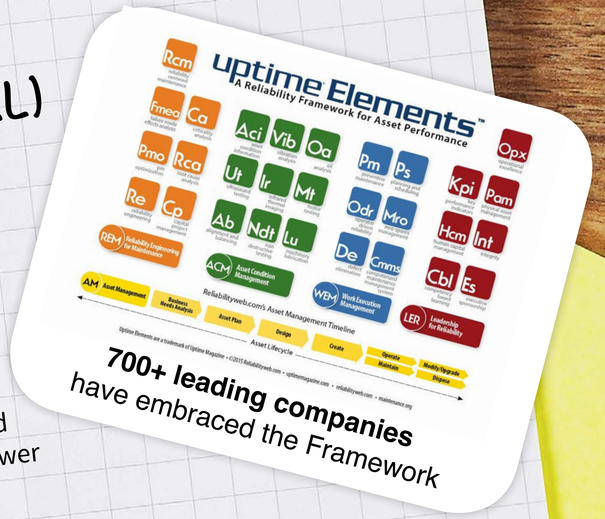
Uptime Elements Certified Reliability Leader (CRL)

WHAT:

Provide assessment and certify individuals who demonstrate an awareness of the integrated and interrelated reliability system, Uptime Elements.

OUTCOME:

Promote **confidence** and **knowledge** around reliability leadership to align, engage, empower and energize asset performance.



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Embracing Generation Z

Collaboration, Contribution and Connection

At the heart of **Generation Z** is a desire to collaborate, contribute and connect. This has undoubtedly been fostered by technology – a landscape of social platforms and ready access to information – but also through a need to bypass the economic and ideological constraints of today's market-driven society.

In a world of market monopolies, the surveillance state, biased mainstream media, and the notion of owning property no longer even a dream, **Generation Z** is seeking alternative collaborative ways to contribute to society and connect with others, such as crowdfunding, carpooling, cooperatives, couch surfing, etc.

Generation Z individuals are growing up in a world of options, uncertainty, access to big data and analytics, and with a growing recognition that current ways of working are unsustainable for the economy, society and the environment. But don't uncertainty, data, analysis, sustainability and collaboration sound like many of the ingredients for successful asset management?

Today, infrastructure organizations are battling with the asset management challenges of delivering against long-term objectives while achieving short-term returns and managing risk. They are grappling with how to marry big data and technology with their day-to-day challenges. A common result: silos, cost cutting and unmanageable levels of retained risk.

As today's CEOs are replaced by those from **Generation Z**, they will bring with them an organizational culture better suited to asset management. They will replace futile short-term cost cutting with long-term thinking, dismantle silos by aligning objectives, solve problems through collaboration with their vast virtual networks, and harness with ease the technology that is so inherent to their paradigm.

This may still be 15 years off, but why can't we learn from the next generation now? Those organizations willing to embrace the desires to collaborate, contribute and connect, or better still, engage the next generation directly, will be one (virtual) step ahead of the game.

Danielle Humphrey
Consultant
eAsset Management

"Infrastructure organizations are battling with the asset management challenges of delivering against long-term objectives while achieving short-term returns and managing risk."

A Look Ahead

George Williams
Director, Asset Management
B. Braun Medical, Inc

Industrial Internet of Things (IIoT)

Smart devices improve safety as they ensure proper personal protective equipment (PPE). Sensors will know if proper PPE is being utilized as signals are sent from areas, machines and tools in combination with PPE, such as hard hats, arc flash suits, safety glasses and safety shoes, to ensure alarms when lack of PPE exists.

Machine setup will be ensured as signatures related to product quality are stored and immediate alarms indicate when setup does not align with expectations, dramatically reducing waste, ensuring product quality and warrantee assurance.

Preventive Maintenance (PM) and Repairs

Computerized maintenance management system solutions will contain YouTube style videos for PM and repair work instructions and job plans.

Going a step further, cameras and sensors in your smartphone will ensure proper installation. As an example, when installing belts, the camera/phone combination can ensure alignment via camera and also tension through audible frequency detection.

Inventory Management

Drones begin to deliver parts to landing pads across the site. Weekly schedules are created and each day the storeroom delivers the materials and tools for the following day to localized landing pads where technicians can eliminate wasted travel times by picking up their materials closer to or directly at the job site. These landing pads can be permanently affixed or mobile. For emergencies, techs can have mobile landing pads, order materials from wireless devices and have the materials delivered rapidly without the need to clean up a job site, travel to and from the storeroom, and set back up again.

Building Information Modeling (BIM)

BIM will include reliability expectations, as well as those achieved. This enables engineering to know precisely how changes to systems impact reliability and what designs are necessary to achieve expected reliability.

Smart devices *lead to a* **smart future**

Wanted: A Capable Workforce

One of the largest challenges ahead is workforce capability. As automation and technology increase, and less people are required on the shop floor, identifying talent and grooming that talent becomes even more critical. In a culture where there are fewer exposures to these necessary skills for both operators and maintainers outside the workplace, the approach of hiring based on aptitude and having a system to educate and promote from within starts looking like the only solution.

This new generation, in particular, is very attuned to technology and they readily use it for communications, finding an answer, or learning how to do something. If you've used YouTube to look up how to change the cracked screen on your iPhone, then you're familiar with the way the new generation uses technology.

Leveraging technologies to evaluate aptitude, such as the use of simulators or demonstrating how to perform a sheave alignment on YouTube, are just two examples of tools we'll need to use for evaluating and educating our workforce.

George Simonoff
Director of Reliability
The Wonderful Company

Reliability Realized

Asset-intensive companies are typically processing some kind of commodity (e.g., mining the same minerals as a competitor or producing the same electrical power as a competing power generation utility), so the only way to distinguish its financial results is to show how well its assets perform in terms of productivity and cost.

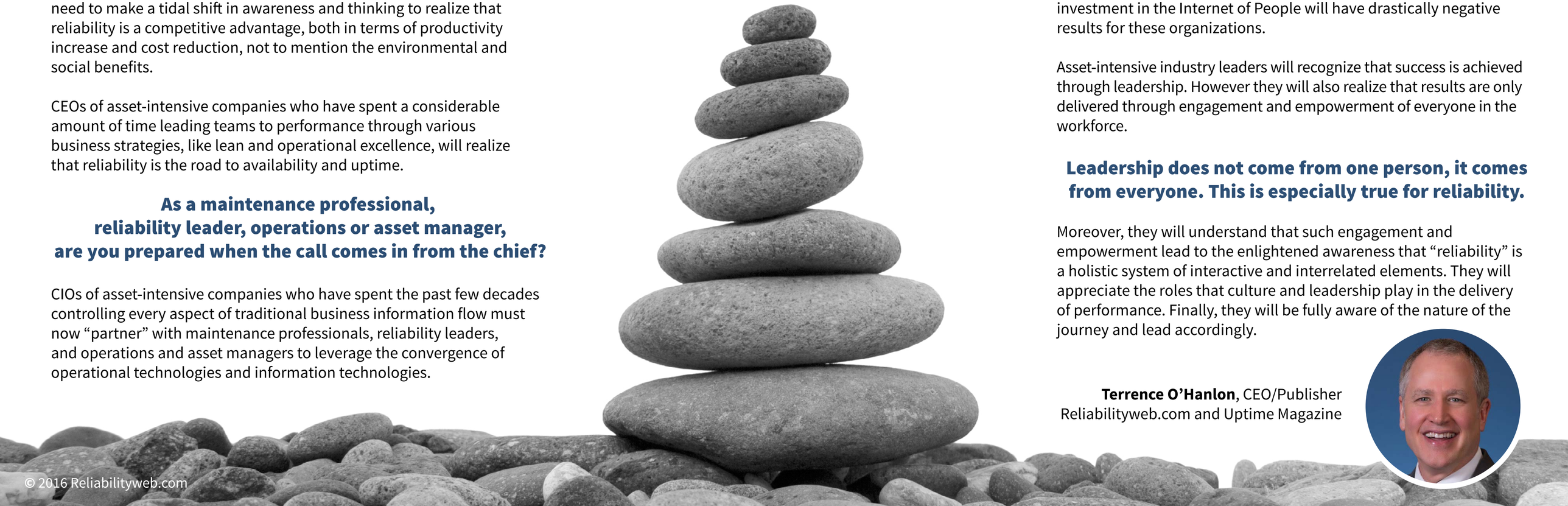
In order to survive and thrive, asset-intensive company leaders will need to make a tidal shift in awareness and thinking to realize that reliability is a competitive advantage, both in terms of productivity increase and cost reduction, not to mention the environmental and social benefits.

CEOs of asset-intensive companies who have spent a considerable amount of time leading teams to performance through various business strategies, like lean and operational excellence, will realize that reliability is the road to availability and uptime.

As a maintenance professional, reliability leader, operations or asset manager, are you prepared when the call comes in from the chief?

CIOs of asset-intensive companies who have spent the past few decades controlling every aspect of traditional business information flow must now "partner" with maintenance professionals, reliability leaders, and operations and asset managers to leverage the convergence of operational technologies and information technologies.

Retiring Cisco Systems CEO, John Chambers, delivers dire prediction: 40% of companies will be dead in 10 years.



Asset-intensive industry leaders will create permanently staffed operational readiness teams to partner with capital project teams to drive the highest asset performance for the total asset lifecycle. It will be tempting for these asset-intensive industry leaders to enthusiastically embrace the Industrial Internet of Things, drones or unmanned aerial vehicles, cognitive computing, predictive analytics and asset information mobility; however, overlooking equivalent investment in the Internet of People will have drastically negative results for these organizations.

Asset-intensive industry leaders will recognize that success is achieved through leadership. However they will also realize that results are only delivered through engagement and empowerment of everyone in the workforce.

Leadership does not come from one person, it comes from everyone. This is especially true for reliability.

Moreover, they will understand that such engagement and empowerment lead to the enlightened awareness that "reliability" is a holistic system of interactive and interrelated elements. They will appreciate the roles that culture and leadership play in the delivery of performance. Finally, they will be fully aware of the nature of the journey and lead accordingly.

Terrence O'Hanlon, CEO/Publisher
Reliabilityweb.com and Uptime Magazine

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