

NOVEMBER 2021

THE PDM PAPER

The Newsletter of Symphony Industrial AI



Note from the Editor

Carolyn Bordini

I am continuously impressed by the innovation and dedication from our awesome team of employees here at SIAI. We've made huge strides this past year, from innovating our already top of the line vibration analysis software, to developing the most advanced and accurate wireless sensor on the market. I'd also like to welcome Savigent to the family, which is now our Digital Manufacturing

division. Our two teams are already working closely together in all facets - I can't wait to see where we go from here!

Website: <https://SymphonyIndustrial.AI> Questions?: Sales@SymphonyIndustrial.AI

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AI based vibration analysis

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Letter From the CEO: Digital Manufacturing

I am delighted to give you an update on all the things that have happened since our spring newsletter. Even more exciting are all the things that we have coming that I know will have a positive impact on our users:

Since our last newsletter:

- **Digital Manufacturing** - We acquired Minneapolis based Savigent, which has become the foundation for our Digital Manufacturing Division. Founded nearly 25 years ago, Savigent provides deep and broad IOT integration and workflow orchestration for some of the largest chemical, food & beverage, medical and electronics manufacturers in the world. Our Digital Manufacturing Division is already taking advantage of our Eureka AI platform to provide AI based optimizers to their users.
- **Wireless** - Customers told us they wanted low cost/high resolution wireless and we delivered. Watchman AIR™ wireless vibration solution transforms companies from monthly manual data



collection, which is expensive, unreliable because of personnel challenges and machine unavailability, as well as sometimes dangerous, to safe and effortless daily monitoring of assets.

Going forward:

- **Sustainability** – There is hardly a company on the planet that is not concerned about reducing energy consumption and pollutants. Greenhouse gas concentrations are at their highest levels in 3 million years and continue to rise. Our Performance 360 is being enhanced to provide our users with diagnostics, recommendations, and dashboards that will drive sustainability into processes. In our recent user survey, 53% of respondents said that sustainability is a top corporate initiative but they are just getting started. 75%+ have not even started to employ AI to help in the journey, mostly because of lack of human resources. Coal, gas & petrochemical plants, refineries, steel mills, aluminum smelters, and foundries can all benefit with the technologies that we are bringing to market.
- **On the road** – Thanks to the tremendous interest in the solutions we have brought to market, I have been invited to speak at seven 2nd half of 2021 conferences in the US, Europe and the Middle East. We hope to see you at one!
- **User meeting** – As we did this year, expect our annual PdM Conference in early 2022. It is a wonderful opportunity to hear from other users. Many of our users have made more progress in advancing their reliability programs in the past year than at least the previous five.

Wishing you a safe and prosperous 2021! -Dominic Gallello-

INTRODUCTION TO SYMPHONY INDUSTRIAL DIGITAL MANUFACTURING



By Prashant Jagarlapudi

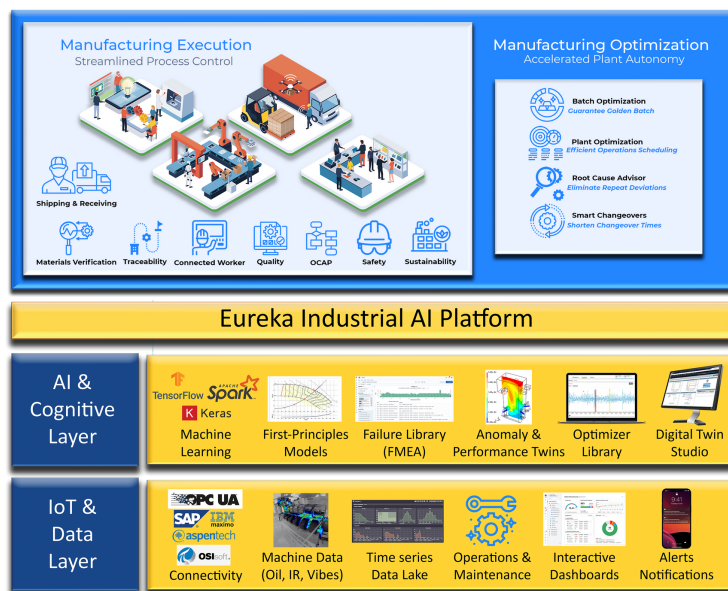


Earlier this year, Minneapolis based Savigent solution became part of Symphony Industrial AI as its Digital Manufacturing (SIAI-DM) division. This acquisition brings to Symphony's customers 25 years of digital manufacturing experience and a robust software platform to enable various AI driven, IIoT enabled manufacturing operations management for digital plant. The acquisition also marks one of the steps toward the journey to realize the bold vision of "Enabling autonomy for every plant in the world."

The current product footprint brings key capabilities to Symphony's customers that are ideal for a Manufacturing setting. An overview of the capabilities are listed below.

- **Connectivity** – A deep and broad connectivity framework with configurable plug-ins into numerous Level 1 data sources such as Modbus, OPC-UA, EtherNet/IP, as well into Level 4 data sources such as SAP, Oracle and other applications.
- **Historian** – ability to historize any and all data that flows through the platform.
- **Steam Analytics** – Configurable stream analytics for notification and alerting mechanism
- **Workflow Orchestration** – strong Workflow Orchestration between asset signals, human interaction, Level 4 system (ERP, MES etc.) reconciliation
- **Low code application development** – easy configuration of workflows and Human Machine Interface (HMI)

Symphony's Digital Manufacturing platform is deployed at many large (like Seagate) and small (like Cambria) manufacturing in multiple manufacturing sectors and manufacturing process models. As we look forward, we are looking to integrate the Savigent Platform with Symphony's EurekaAI which is a leading purpose-built AI platform focused on Industrial customers.



These capabilities are key for driving the autonomy in the factory floor and the investments are already demonstrating value. One of our large global high-tech customers is driving high quality Golden Batch by understanding root cause of failures, with the combined Eureka and Digital Manufacturing platform. To learn more about our current capabilities as well our upcoming roadmap, [please reach out to us](#).

-Prashant Jagarlapudi-

AI BASED VIBRATION ANALYSIS



By Joe Van Dyke



We are seizing the opportunity of what data science and the world's largest data lake can bring, by busily creating new AI methods to automate vibration analytics. Some interesting examples of our efforts are described below.

The "Average Data Lake"

Methods for automated machinery diagnostics rely heavily on what we call averages, or baselines. Our diagnostic algorithms compare all newly measured vibration readings from an asset to these baselines to determine which features are out of bounds, then analyze patterns of those features across all test locations on an asset or machine.

Setting baselines by creating average data has always been the job of an analyst and it takes knowledge, thought, time and effort. Analysts need to use a data viewer in ExpertALERT to look at the first several sets of readings on an asset (or identical assets under surveillance) and make sure there are no major faults already indicated in the data, make sure the readings are good quality and that there is nothing missing from all the test locations. If any set of readings is deemed average-able, they add the readings to the average file by clicking a single shortcut button. Simple enough, but time consuming because the standard for an average file is to get at least 6 sample tests added to ensure decent statistical variation. Because of this, building the baselines can take a lot of calendar time especially when readings are taken only monthly or quarterly.

To make this less manual and time consuming, we patented the baseline synthesizer algorithm, which kicks in if there are no averages for an asset. It works great but synthesized data is not as good as real data. So, to get the advantage of good manually created averages, but with minimized effort, we created an average "data lake." It's like a "best of" compilation of all the manually built average data sets for unique asset types from our history of vibration programs over the years.



WHEN WE ADD A NEW CUSTOMER,
WE USE THE LAKE TO QUICKLY
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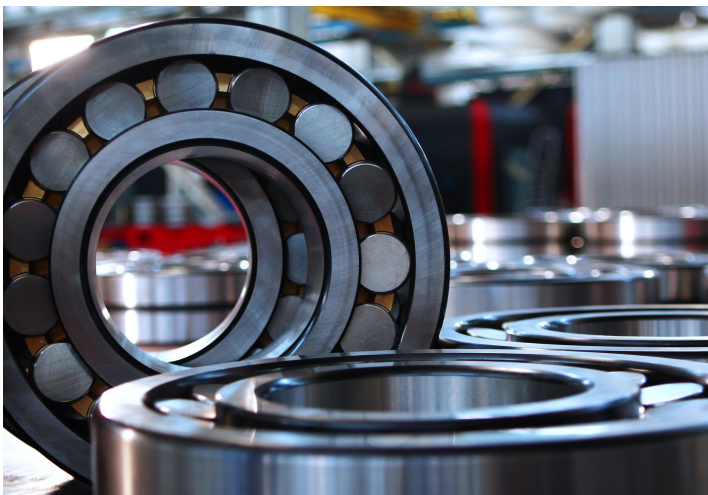
Hidden Vibration Source Recognition

Another significant driver of accuracy is the identification of machinery vibration sources inside a machine. These include things like belt ratio, number of pump vanes, gear teeth, motor rotor bars, etc. We want to add these items to the asset definitions, but these mechanical aspects are rarely known to the customer or our analyst ahead of time. Analysts need to determine them by looking at the vibration "spectra" patterns in accumulated readings and this process always takes analyst time, effort, and specialized knowledge. To address this, we created automated processes to find these standard vibration sources, starting with the easier ones: Pump vanes and motor bars.

This is done with "cognitive tools" that examine the readings taken for a machine and look for patterns. When found, with sufficient confidence, the tool automatically enters the asset model codes that identify these features. **The expert system then uses these codes for enhanced fault detection.**

Future efforts

Automatically determining running speeds on machines with multiple shafts, especially where there is a belt-drive, or a variable-slip magnetic drive is an example of a more difficult problem that we will be attempting to solve in the near future. Automatically figuring out the number of teeth on gears inside a multi-stage gearbox based purely on vibration patterns is another problem on the list. We are very excited to solve these challenges that will bring great benefit for our users. -Joe Van Dyke-



AI FOR A SUSTAINABLE FUTURE



By Sudeep Gowrishankar

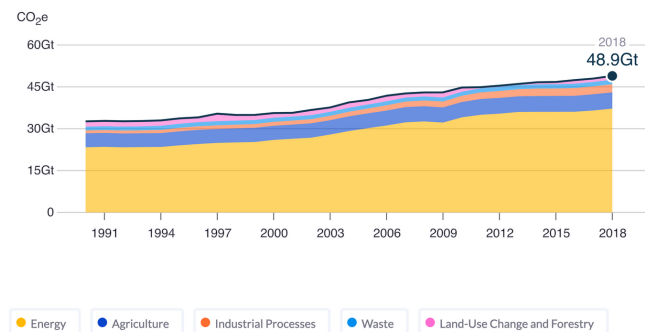
The earth's environment is in a code red status and new digital solutions are required to meet the challenge.

United Nations body for assessing the science related to climate change issued results of the 6th Working Group Report in August of 2021. The key highlights were:

- Greenhouse gas concentrations are at their highest levels in 3 million years and continue to rise. As a result, the earth is now 1.2°C warmer than it was in the late 1800s. The last decade was the warmest on record.
- The current path of carbon dioxide emissions will increase global temperatures by 3-5°C by the end of the century.
- Over 90% of people breathe unhealthy levels of air pollution, largely resulting from and continue to rise.
- The consequences of climate change now include, among others, intense droughts, water scarcity, severe fires, rising sea levels, flooding, melting polar ice, catastrophic storms, and declining biodiversity.
- The 10 largest emitter countries contribute 68% of all emissions.
- While a growing coalition of countries is committing to net zero emissions by 2050, about half of emissions cuts must be in place by 2030 to keep warming below 1.5°C. Fossil fuel production must decline by roughly 6% per year between 2020 and 2030.

Historical GHG emissions

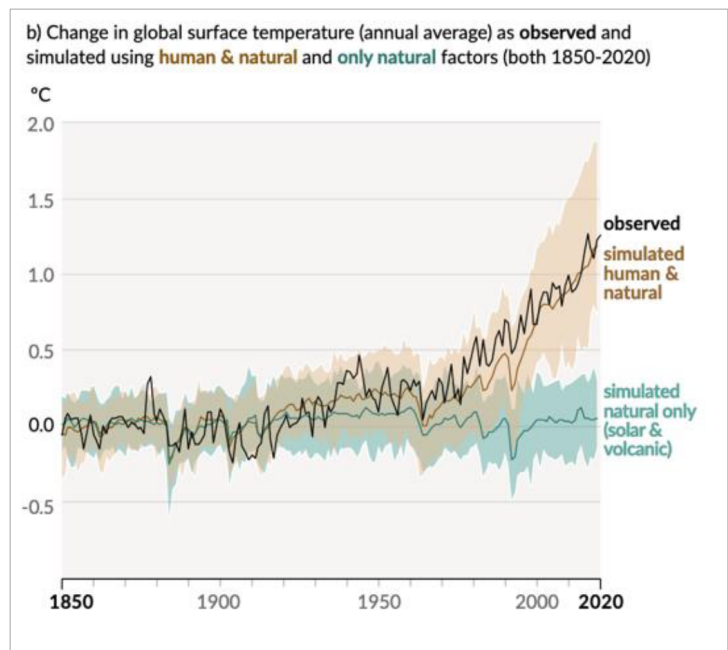
Data source: CAIT; Countries/Regions: World; Sectors/Subsectors: Total including LUCF; Gases: All GHG; Calculation: Total; Show data by Sectors.



Energy and Industrial Processes are key contributors to the total human Greenhouse Gas (GHG) emissions of the planet.

Source: World Resources Institute. (2020, December 10). Historical GHG emissions [Graph]. <https://www.wri.org/insights/interactive-chart-shows-changes-worlds-top-10-emitters>

To meet the challenge, the world eventually needs to move towards more sustainable sources of energy (energy is the major contributor of human greenhouse gas emissions). But until non-polluting sources and technologies of energy production mature and become widespread, the need to produce and utilize energy more efficiently is also extremely important.



Human contribution to global temperature change has been dramatic over the last half-century.

Source: IPCC, 2021: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press. In Press.

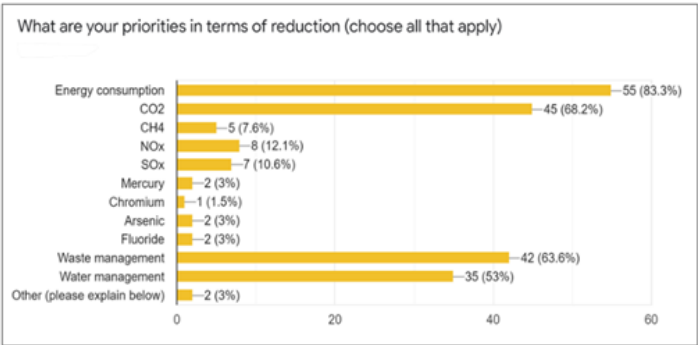
In fact, our customers are also very aware of these goals. In a recent survey that Symphony Industrial AI conducted with its customers, there was an enormous recognition that sustainable operation is not a futuristic goal anymore; it is a need that must be addressed right now.



The responses suggest that over 95% of the respondents' companies have either made sustainability a top company priority or have been actively discussing it. Out of these, over half of the respondents are just getting started with the initiative. Many of them are using manual data analysis to keep track of their sustainability goals, metrics, and compliance while others are still figuring out what and how to track sustainability.

There is also widespread recognition that the main ways to drive sustainability is through better energy and water usage, reduction of waste, and reduction of emissions.

Therefore, we are now building in features into Performance360 that help calculate, monitor, and optimize sustainability KPIs. These features are a natural extension to the AI-based process optimization that makes up the core of Performance360. With the new sustainability features, you will now be able to create metrics and dashboards that track sustainability of a process or across all your plants, and plan operations with sustainability as a core objective of your industrial processes.



Survey respondents recognize energy consumption, water management, waste reduction and management, and emissions reduction as their main priorities in their sustainability initiatives.

The role of AI in sustainable operations is much the same as the role of AI in driving optimal process/plant performance. AI can process incoming sensor data in real-time using models that are also built using large amounts of data. Data-based model building allows for very complex systems to be modeled in a tractable fashion with high-fidelity. Once these models are running, they can adapt to changing conditions and continuously optimize for operational KPIs as well as sustainability KPIs. Performance360 comes in-built with AI-based anomaly detection, AI-based process forecasting, and AI-based control optimization. All these AI tools work seamlessly with domain-informed machine reasoning engines that ensure that known domain constraints are not violated, and users are presented with useful inferences using domain knowledge rather than disparate pieces of information that they must assemble manually to ultimately be useful and drive outcomes. -Sudeep Gowrishankar-



A sample dashboard on Performance360 to track metrics and KPIs related to sustainability.





MANAGING WIRELESS VIBRATION DATA VOLUMES



By Michael DeMaria



The extent of technology and volumes of data generated in a plant can feel quite overwhelming. This is especially true when considering a permanently installed vibration program for plant assets. With wireless sensors now at the

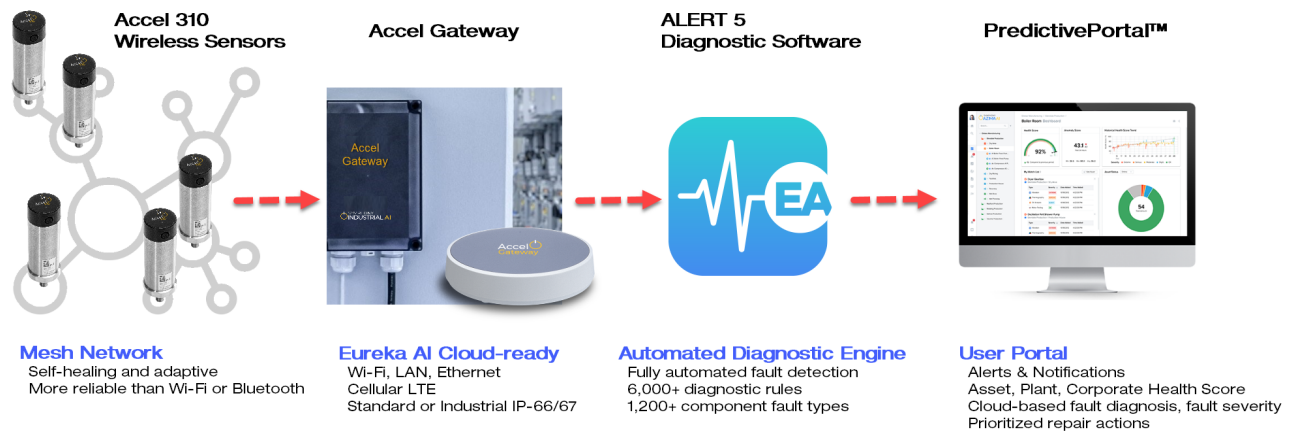
inflection point of affordability, it is easy to include all machines traditionally collected with monthly, portable system, as well as new machines rarely monitored, to a daily, wireless vibration program. Going from monthly data to daily can be challenging to manage without proper tools.

When discussing wireless vibration programs with people who have explored various offerings, it became clear that two obstacles must be solved to make the program successful: automated screening and accurate visibility.

Symphony Industrial AI's ExpertALERT™ software provides such an application. With more than 6,000 diagnostic rules and over 1,200 unique fault conditions trained from millions of datasets, this expert automated diagnostic engine can screen through tons of data and produce prioritized repair recommendations.

Just screening the data, however, is not good enough. Diagnostic results must be accurate and specifically present the actions necessary to correct the asset fault. Keep in mind, the desire to have wireless vibration is to have less labor involved in the vibration program and daily understanding of the health of a plant. Adding wireless sensors certainly adds the data, but those that have tried it without automated diagnostic software describe it like the boy who cried wolf, constantly receiving false recommendations.

Watchman AIR™



Automated screening is the ability of the application to analyze the vibration data for quality and completeness, and then decipher that data to generate diagnostic results for the next steps. If using low resolution vibration sensors or mere overall vibration, this task is somewhat straight-forward. But the result is lacking the complete understanding of component level faults for a machine. For a replacement to the portable system, wireless sensors must be able to collect higher frequency, higher resolution data such as with Watchman AIR's, Accel 310™ sensors.

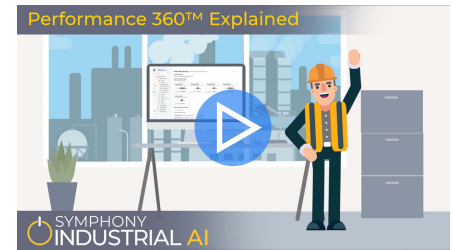
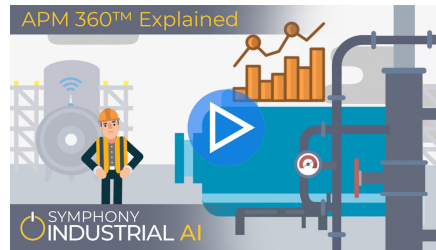
With higher resolution data the challenge those users would face is the ability to consume such volumes of data on a daily basis. Analysis of vibration data is complicated, and the interpretation of vibration at volume requires an advanced, trained rulebase and intelligence to decipher its meaning.

When multiple decision makers in a plant are interested in the health of assets, and updated on a daily basis, inaccurate results create lots of confusion and distrust in the program. With Watchman AIR™, a massive data lake is leveraged to bring a new asset into a program rapidly and to validate the data for accurate diagnostics. Symphony Industrial AI also offers expert analysis services to certify the automated diagnostic criteria to take full advantage of the automated system and deliver both automated and as necessary, reviewed results through the web interface, PredictivePortal™, quickly and accurately.

When considering the move from monthly vibration data to daily wireless sensors, it is essential to have advanced automated diagnostic software capable of screening the data and delivering accurate results with the right call, to the right people, at the right time. -Michael DeMaria-

CHECK OUT THESE NEW PRODUCT VIDEOS

Learn more about Symphony Industrial AI offerings by watching these explainer videos



Join us for informative talks every week!

- **November 17th:** Centralizing your CBM
- **November 24th:** Using AI to reduce energy usage in Smelters
- **December 1st:** Accelerating Glass Furnace Performance with AI
- **December 8th:** Reducing machine faults by as much as 90%
- **December 15th:** AI For Optimal Plant Sustainability
- **January 5th:** Process Anomaly Prediction with AI & Domain Knowledge
- **January 12th:** Best Practices for Automated Vibration Analysis
- **January 19th:** Digital Twin Builder – Self Service

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Symphony IndustrialAI is an innovator in industrial insight, accelerating autonomous plant operations. The industry-leading EurekaAI/IoT platform and industrial optimization solutions connect tens of thousands of assets and workflows in manufacturing plants globally and process billions of data points daily, pushing new plateaus in operational intelligence. Symphony IndustrialAI digital manufacturing solutions connect devices, processes, people, and systems enabling harmonizing plant automation and control. Symphony IndustrialAI plant performance applications span asset predictive maintenance and process health and optimization, maintaining high availability of equipment, extending the life of capital assets, and reducing process variability. Symphony IndustrialAI solutions provide high value to its users by driving variability out of processes and optimizing operations for throughput, yield, energy efficiency, and sustainability.

