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Monitoring & Diagnostics

How to Maximize Reliability

Interview with Michael Cunningham, COO at Camlin Group and Managing Director at Camlin Energy

Integrated Condition Monitoring: **Merging Data from Relays and Asset Monitors for a Fuller Evaluation**

Condition Monitoring Realities: Dealing with the Unexpected

Integrated Condition Monitoring: Merging Data from Relays and Asset Monitors for a Fuller Evaluation

by **Austin Byrne**

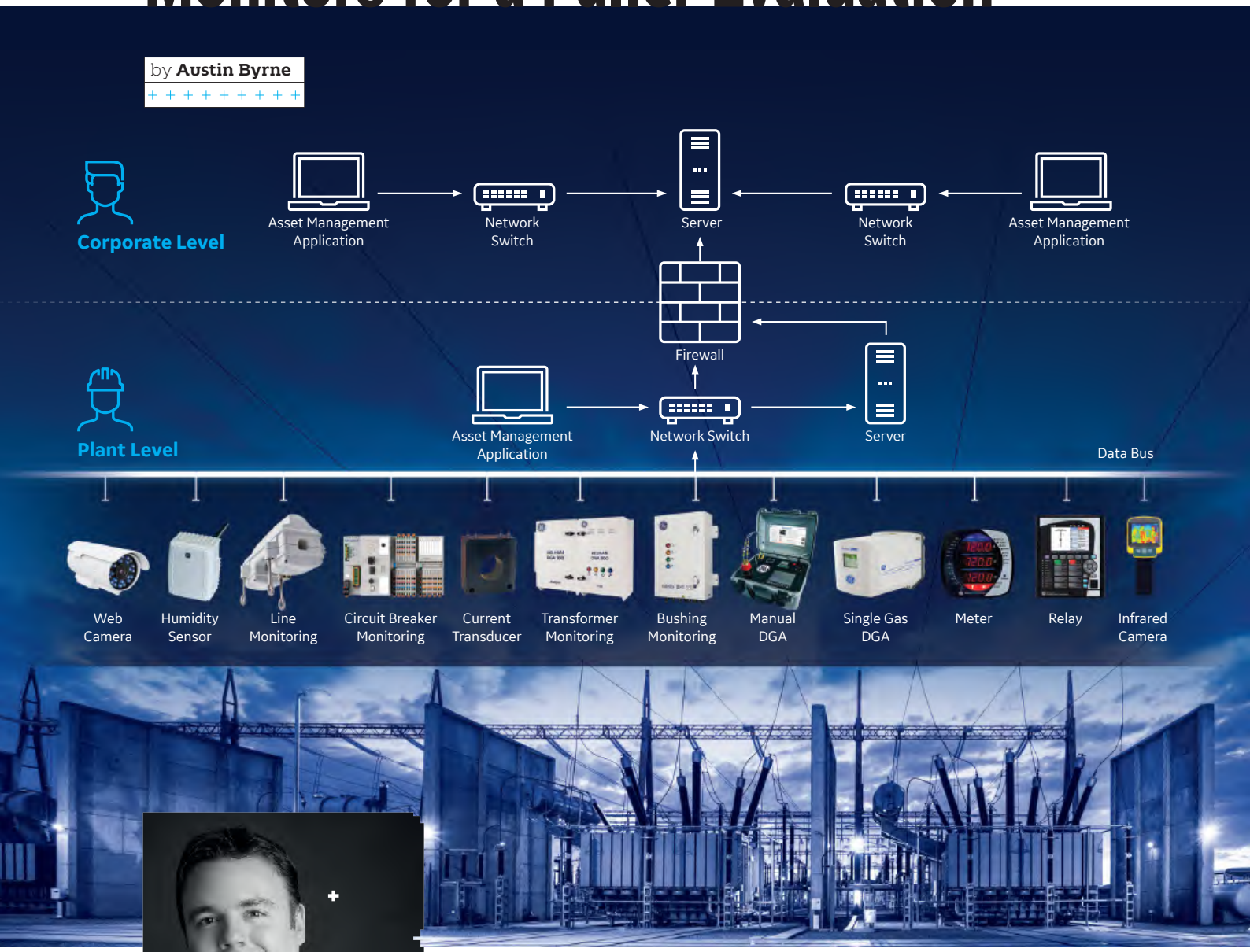

Figure 1. Example of ICM Topology

Austin Byrne leads the enhancement, promotion, development and delivery of GE's Monitoring & Diagnostics software solutions and applications. He is also responsible for operating transversely across Grid Automation product lines, focusing primarily on integrated condition monitoring within the electrical utility and industrial substations. He joined GE in July 2010 as the software quality manager for Monitoring & Diagnostics before moving into product management in 2013.

Introduction

All businesses share a common goal – implement operational efficiencies whilst maintaining a reliable service for their customers. Achieving this goal relies on information about the asset condition and in today's environment, this is increasingly challenging due to the abundance of aging assets across the globe and businesses focused heavily on reducing spend. Hence the common phrase: "do more with less".

Data drives the decisions businesses take to implement and achieve the expected efficiency and reliability results. Data derived from the critical components and assets is at the core of the service provided to their customers and is responsible for their operational process delivery. There has never been more data in the world than right now. It is estimated that 2.5 quintillion bytes of data is created each

Photo: GE

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day, with that pace accelerating due to connected devices and the Internet of Things [1].

However, this abundance of data must be derived and refined in to precise, strategic, and actionable information. Data is derived using communication networks and refinement comes in the form of its analysis and interpretation.

In this article, we will focus on the concept of integrated condition monitoring (ICM) which can play a key role in the capture, accurate analysis, and interpretation of data. ICM is the mechanism by which the data from multiple online and offline sources and assets is captured and analysed together to provide a holistic picture of an asset's condition at an individual and fleet level. ICM also focuses on situational information as part of the assessment to better understand the impact of operational fluctuations and external events. When deployed at a fleet level, ICM can provide a more accurate picture of the operational risk exposure of an organisation based on the potential of assets failing and the overall impact of the unexpected downtime as well as repair/ replacement costs. ICM can also help organisations develop a successful condition-based maintenance strategy.

ICM IS THE MECHANISM BY WHICH THE DATA FROM MULTIPLE ONLINE AND OFFLINE SOURCES AND ASSETS IS CAPTURED AND ANALYSED TOGETHER TO PROVIDE A HOLISTIC PICTURE OF AN ASSET'S CONDITION AT AN INDIVIDUAL AND FLEET LEVEL.

Data Analysis Challenge

Unfortunately, underutilisation of data continues to be an oversight in many organisations, hindering their ability to achieve their mission statements. There are a number of causes of this, with the most common and obvious cause coming from not connecting remote monitors to an IT (Information & Technology) infrastructure and being made available to applications where the data can be analysed in a timely manner by the right people.

When considering a new deployment of a remote online monitoring system, planning this connectivity will be an important step in that process. If the remote monitoring devices have already been deployed, fortunately, it is typically quite straightforward to retrospectively setup and establish communications with the remote monitoring devices.

However, in both instances, engagement between the organisation's IT suppliers, the end users of the data and the vendors is critical. Between the IT department and the end user, an architecture needs to be developed that shows where the data needs to travel from and reside at, and which zones or network substructures it must navigate to get to where it needs to be. Once that is understood, the IT department and the selected vendor or vendors can then develop a topology that can be used to provide the communication path as per Figure 1. This could be as simple as connecting an ethernet cable and opening specific network ports on an existing IT infrastructure. Or it could require a more comprehensive setup that requires deployment of dedicated wired/wireless communication devices and a network for transmitting the data along with application-to-application synchronisation servers.

Figure 1 exemplifies the several typical assets at an electrical substation and remote monitors and sensors that can be deployed. Some of the devices might be simple, like a weather station. However, an asset like a power transformer consists of various components: transformer tank with active part and oil-paper insulation, tap changer, bushings, cooling unit and conservator, to mention some. Advancements in sensing devices and analytics allow the implementation of solutions that go beyond the well-established Dissolved Gas Analysis (DGA) including on-load tap changer, cooling unit or bushing monitoring. An integrated monitor covering all components might help to simplify the data influx.

Another not so obvious cause of data underutilisation comes from a lack of awareness of the valuable data being generated by equipment classified as non-monitoring, such as relays and digital fault recorders along with other systems.

Types of Data

When it comes to ICM, there are different types of data being analysed, some of which are defined below:

- Symptomatic Data – This is data gathered on an asset which is a symptom of an issue rather than the result or cause of a problem.
- Fault Data – This is data captured when a fault occurs causing an event such as a trip; it can be the result or cause of a problem.
- Environmental Data – Data captured about the external environment in which the asset is operating, over which there is little or no control.
- Operational Data – This is data measured and captured on the operation of the asset such as load, energisation, tap changes, thermal, cooling control, etc.

Symptomatic and fault data can sometimes get confused. For example, when dissolved gases start to generate in an oil filled transformer, it is symptomatic of several issues, such as insulation breakdown, loose connections, overheating, damaged or worn components, etc. Whereas fault

data would be considered data, such as over voltage which can cause damage to the equipment if it is not prevented.

Symptomatic data can often be a precursor to a serious fault and hence be detected well before fault data is generated and captured. However, symptomatic data can also be caused by benign changes in the operation of the asset, environmental variation or it can even be the expected behaviour of an asset.

Here in lies the challenge: without downtime and invasive internal examinations, how can you identify if the symptoms recorded are an indication of an issue? If so, how serious is the issue, the damage being done, what is the root cause and is the asset in danger of failing unexpectedly?

THE SUCCESS OF ANY ASSET MANAGEMENT STRATEGY RELIES HEAVILY ON HOW THE INFLUX OF DATA IS MANAGED AND EFFICIENTLY EVALUATED.

Management of the Data

The good news is that by applying an ICM methodology and cross-corelating the multiple sets of data available, it is possible to better understand the asset condition.

Advancements in data science have enabled manufacturers to reuse existing parameters measured by a device to extract further information. Reapplication of existing sensors in equipment is becoming more and more prevalent as product vendors develop new techniques and firmware to extract and provide new data. The extra information that is extracted from the data generated by such equipment enables organisations to gain more insights into the connected critical assets.

The success of any asset management strategy relies heavily on how the influx of data is managed and efficiently evaluated. More and more organizations are looking

Photo: GE


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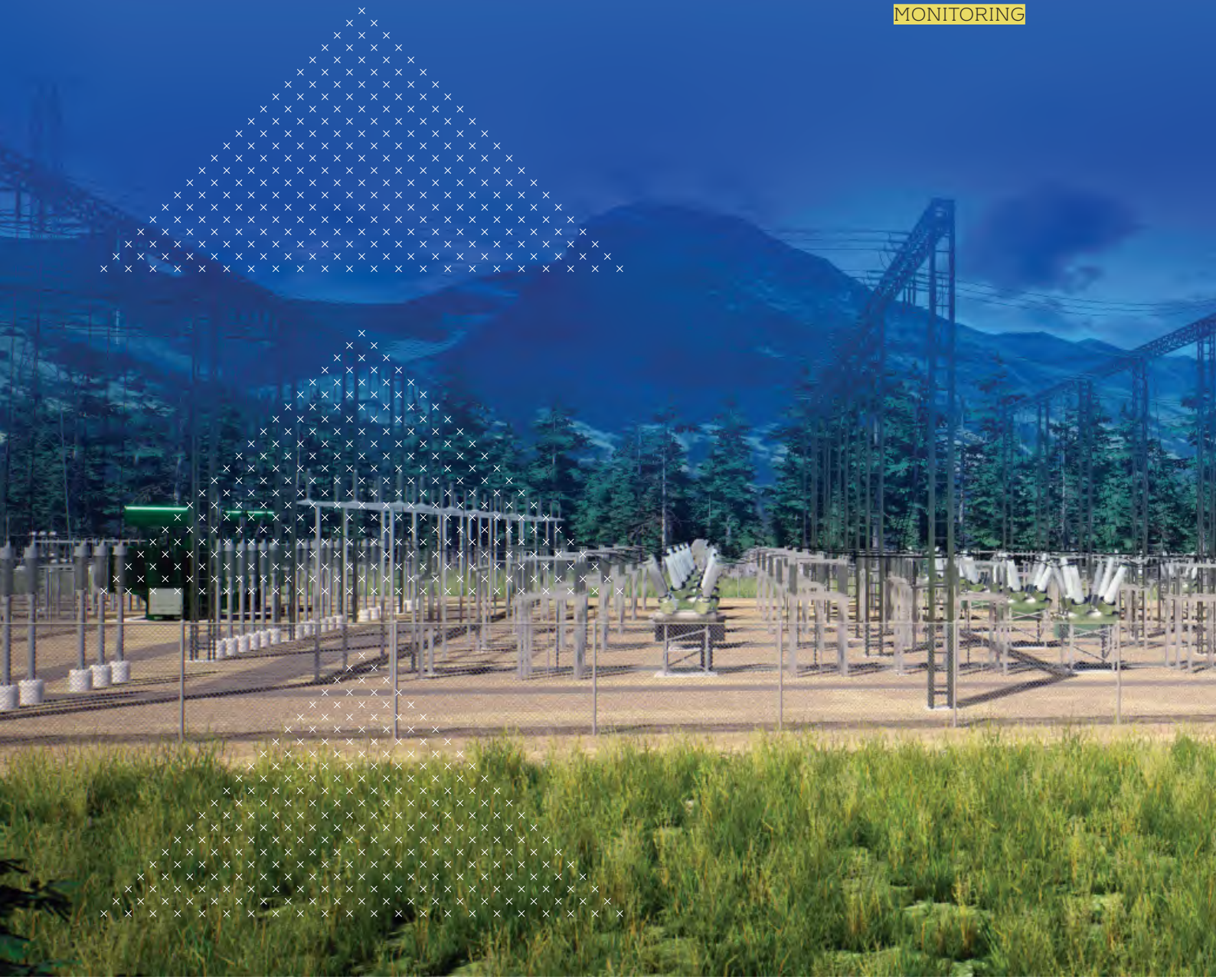
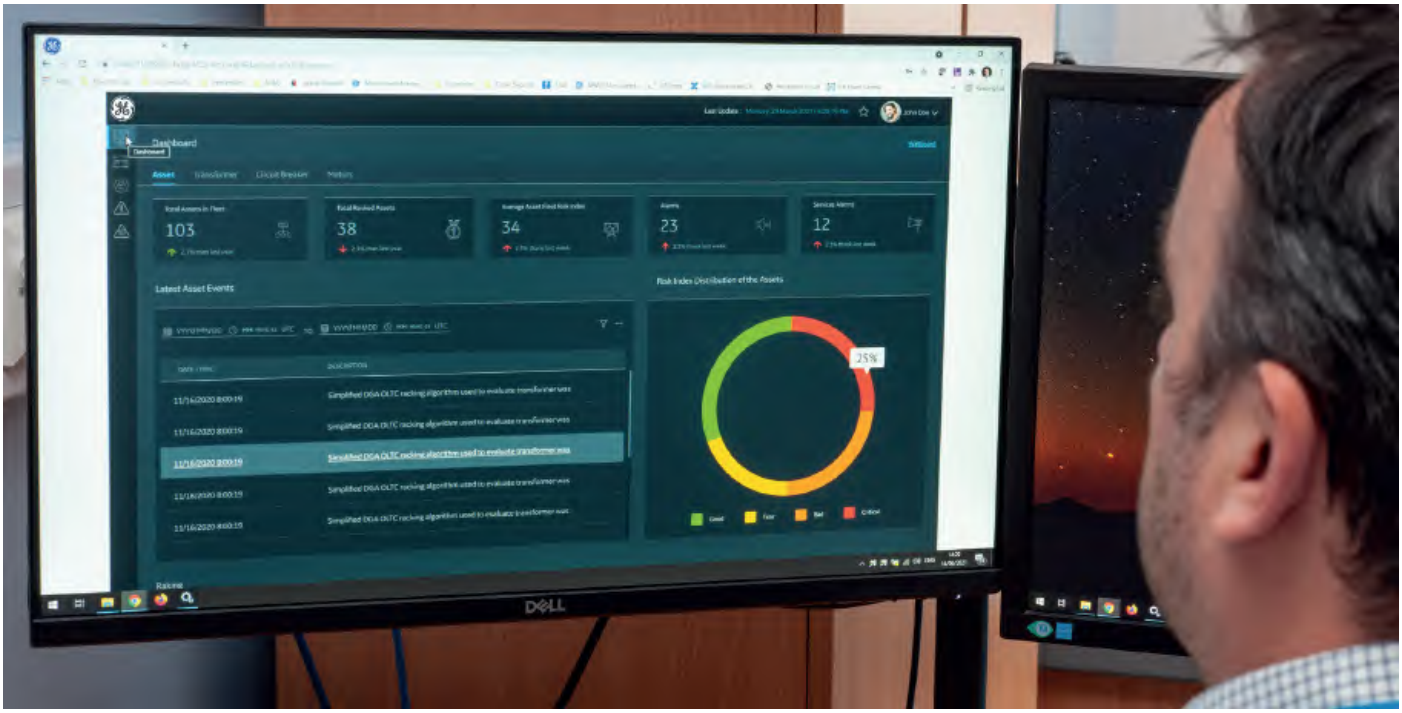


THE KEY PREMISE OF INTEGRATED CONDITION MONITORING (ICM) IS THE COMBINATION AND ADVANCED ANALYSIS OF ALL THE RELEVANT DATA GENERATED. BY COMBINING THE DATA FROM MONITORING AND NON-MONITORING EQUIPMENT ALONG WITH EXTERNAL DATA SOURCES, A MORE COMPLETE PICTURE OF THE ASSETS SITUATION PAST AND PRESENT CAN BE CREATED.

to software in the form of asset management applications, to enable business outcomes by managing the vast amounts of data and turning the valuable data into information and asset insights.

Understanding the differing types of data, how it is to be presented in an asset management application and how it will be analysed is critical. Using data analysis and diagnostics tools as detailed in standards such as IEEE C57.104 [2] helps with the interpretation of asset data. Asset management applications capable of performing automatic analysis of data to derive an assets health or risk of failure focus attention and streamline data analysis to assets in need.

Photo: GE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103
38
34
23
12
Latest Asset Events
25%
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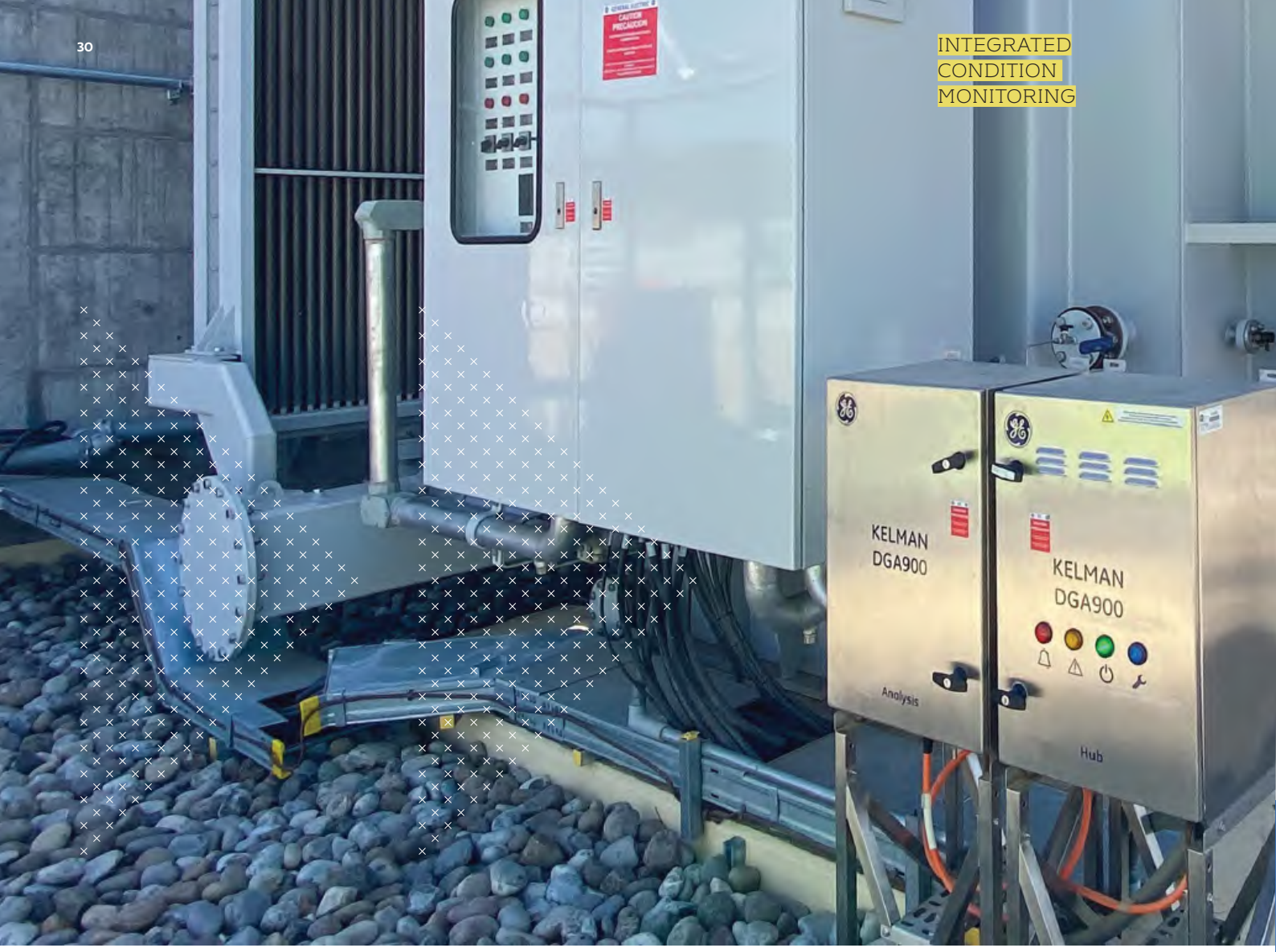

Summary

As shown in Figure 1, there is a vast amount of data and information gathered for assets, captured by an array of equipment connected to the asset as well as external sources. By analysing the data sets separately, the subject matter expert's ability and opportunity to accurately diagnose the asset is vastly hampered.

The key premise of integrated condition monitoring (ICM) is the combination and advanced analysis of all the relevant data generated. By combining the data from monitoring and non-monitoring equipment along with external data sources, a more complete picture of the assets situation past and present can be created.

Advancements in interoperable data analysis software, equipment and sensors help organisations adopt ICM as it greatly simplifies the integration process and information extraction. By utilising data science and algorithms, software applications can automatically detect correlations in the data and further streamline data analysis, subsequently allowing the experts to focus more of their attention on the information that truly matters, freeing up more time for strategic planning.

When applied across an entire fleet of critical assets responsible for operational process delivery, for example, the transformers, circuit breakers and motors used in the day-to-day operation of utilities and industrial organisations, the results and information about each asset analysed can be combined to create a more comprehensive fleet overview. This ready to use information pool provides important details on the condition and health of the entire fleet, thus allowing organizations to understand their asset risk exposure, providing them with the information to pre-empt, plan and reduce downtime as well as deploy a successful condition-based maintenance strategy reducing future risk.

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[2] IEEE C57.104-2019 – IEEE Guide for the Interpretation of Gases Generated in Mineral Oil-Immersed Transformers

Note:

The information from the article is based on the paper written and presented by Austin Byrne at the TechCon North America 2021: "Integrated Condition Monitoring, Merging Data from Relays and Asset Monitors for a Fuller Evaluation_Techcon_2021_Paper"

Photo: GE