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AWARDS

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2020 BEST PRACTICES AWARD

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2020 GLOBAL INDUSTRIAL IOT
PLATFORM FOR POWER GENERATION
PRODUCT LEADERSHIP AWARD

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Background and Company Performance

Industry Challenges

The fourth industrial revolution, also known as Industry 4.0, delivered the Industrial Internet of Things (IIoT), which leverages the internet and computing infrastructure to connect machines, processes, and people. According to Frost & Sullivan's estimates, as of 2019, the potential revenue opportunity for IIoT in power generation was \$1.97 billion. The revenue opportunity will accelerate in the first half of the next decade, growing at a compound annual growth rate of 17.4%, owing to a combination of factors, including the need for flexible assets, recovering investment costs, and saving unwanted maintenance costs.¹ Thus, Frost & Sullivan's research analysts expect potential revenue opportunity to rise to \$2.87 billion by 2025 due to an increase in adoption rates.² The IIoT adoption proliferation will improve asset performance drastically by unlocking value from siloed information, leading to better outcomes and reduced downtime for power plant operators.

The power generation industry is one of the more mature industries facing extreme challenges to its traditional business process due to several factors, including new developments in smart technology, changing customer preferences, a shift to renewable sources and distributed generation, and the increasing need to deliver energy-efficiency solutions as part of a wider decarbonization agenda for the industry. For a sector that has been traditionally well-protected, and therefore, slow-moving, these challenges present two key threats to the long-term viability of many power utilities. The amount of operating hours is increasingly being influenced by market signals dictated by variable supply and shifting consumption patterns, consequently impacting monetary flow back to the operators. Moreover, a shift in traditional business models to distributed, innovative business models in the industry is making power generation markets increasingly competitive. In addition, prevailing issues regarding sizable data volumes and the widening knowledge gap continues to plague the industry. According to Frost & Sullivan's estimates, by 2030, 30% of the power workforce is eligible for retirement, placing the onus on utilities to reskill and reinvent to face future challenges. Therefore, the increasing adoption of IIoT will play a vital role in asset upgrades and management, and seamless portfolio integration with efficient data management, aiding in managing the workforce efficiently.

Product Family Attributes and Business Impact of Uniper Energy

Based in Düsseldorf, Germany, Uniper SE (Uniper) is an international energy company that combines technologically advanced, large-scale assets with best-in-class technical and commercial expertise that is more than a hundred years old. Being an owner and operator of power generation assets, and independent of equipment and component suppliers, enables the company to deliver flexible, bespoke, competitively priced energy

¹ *Utility 4.0—Impact of Industrial Internet of Things (IIoT) on the Global Power Industry, 2019.* (Frost & Sullivan May 2019)

² *Utility 4.0—Impact of Industrial Internet of Things (IIoT) on the Global Power Industry, 2019.* (Frost & Sullivan May 2019)

³ *Global Mega Trends To 2030.* (Frost & Sullivan September 2019)

products and services with agility, precision, and speed. The company operates in Germany, Sweden, the United Kingdom (UK), the Netherlands, Belgium, and Hungary. Outside of the European Union, it operates in Russia and has offices in the United States, Azerbaijan, Singapore, and the United Arab Emirates.

A Holistic View

Uniper addresses two critical challenges through its best-in-class IIoT-based platform. Power plants struggle with inherent data volumes as they produce too much data that they do not use. This issue stems from generally declining competence or onsite staffing levels, meaning sites do not have the resources or capabilities to review all data. Uniper identifies maximizing available data without generating more, turning it into information and creating actionable insights as a critical challenge and pain point. Moreover, compared to power, other industries attract more skilled engineers while tenured workers approach retirement. As a result, a significant knowledge gap prevails in the power industry. Knowledge retention and expert advice are critical to maintaining and optimizing safe operation. Uniper rises to meet these challenges through its provocative platform, Enerlytics, which addresses both issues with demonstrable results that differentiate its clients from their respective competition.

The Enerlytics platform delivers a holistic view of power plant assets, capturing data from multiple sources, and performing streaming and batch analytics. The platform achieves this through its five core clusters: asset maintenance and reliability management, asset performance management, asset risk management, asset market optimization, and asset planning, and valuation. These five clusters enable better access to data, data manipulation, and data sharing with a broader audience within one ecosystem. This important data is backed by unparalleled engineering expertise to deliver actionable insight to clients. Even though Uniper's competitors are thorough with their data handling techniques, they fall behind when it comes to engineering and knowledge expertise.

Best Practices Example: Uniper's remote condition monitoring services originated in vibration monitoring for its equipment; however, in 2009, the company developed an advanced multi-dimensional anomaly detection algorithm that can model the whole power station, not just the main shaft line. Operators train models on "good" data and subsequently create alert limits around them. When an alert occurs, Uniper reviews and sends it to the site with a full diagnosis and suggested course of action. This process, utilized within the Predictive Maintenance Hub (PMH) application, enables Uniper to break down a complex system into its constituent components to model and monitor while displaying results on the Enerlytics platform.

The PMH application and service received assessment during a competitive trial with market-leading solutions in 2011. The software and service combination proved to be the most cost-effective solution and was rolled-out across Uniper's gas turbine fleet and the UK's coal fleet. During this roll-out process, the pay-back time of the investment in the service proved to be roughly six months, with over €6 million saved during the first three years of the operation of the service. Recently, Uniper's PMH solution maintained its

competitive advantage by earning an installation at a large UK coal and biomass power station. This addition added four gigawatts (GW) to its already impressive portfolio. Uniper currently monitors 30 GW globally with a further three GW expected before the end of the financial year. In its experience, Uniper finds 35% of unplanned unavailability events are avoidable through timely intervention in line with the recommendations found in its PMH application.

Staying Connected

Uniper maintains continuous contact with its customers, refusing to sell software solely and leave the client to implement and configure it themselves. The company maintains active involvement in not only successful software implementations, but also in making sure the client gains the most value from it. Furthermore, Uniper ensures its extensive engineering knowledge integrates at implementation. Moreover, the company offers consultancy services to clients should they encounter any issues in their power plant. Uniper's engineering knowledge stems from being an owner and operator, positioning it as an ideal partner for such matters. During implementation, constant knowledge transfer from its experts to the client's experts is present as the company remains involved throughout the whole process.

Uniper delivers a thermodynamic modeling suite (TMS) for a customer's whole plant and subsystems, which can be used both online and offline for what-if analysis and root cause analysis. These models offer insight for expected performance (based on design data), actual performance (based on live data), target performance (based on design data incorporated known degradation), and the delta between the above levels, at different loads and states. This ultimately delivers tools to understand plant performance compared to design, and it then identifies the root cause of any issues together with Uniper's experts.

The Enerlytics TMS is powered by PROATES, a fully featured thermodynamic modeling package from Uniper. Initially developed by the Central Electricity Generating Board in the 1970s, it has been updated continually to provide an exceptionally detailed basis for thermodynamic calculations used in plants to this day. PROATES possesses a rich history of providing in-depth analysis for a wide variety of "what-if" scenario studies for a full breadth of customers within the industry.

Best Practices Example: Uniper partnered with a coal plant that experienced erratic boiler temperatures, which resulted in excessive fouling. Without the Enerlytics platform, the site decided that regular soot blowing was the answer—this did not solve the client's problem. By leveraging the TMS, alongside Uniper's implementation team, the site identified the issue stemmed from two particular mills not biasing fuel correctly. The client expected 60% to the bottom and 40% to the top; however, they were dumping all the fuel at the top of the boiler. This caused a fireball to move, and the majority of the combustion occurred at the top of the boiler, causing excess fouling. At the same time, the coal site implemented the predictive maintenance hub, which alerted to one of the mills having a faulty close valve, as it registered the same temperature closed as it was open. This

revelation resulted in better issue understanding, and having visibility of the problem, the client was able to schedule maintenance to the mills and investigate the fuel biasing issue.

The Value is in the Details

Uniper delivers best-in-class value through its comprehensive testing. All Uniper solutions are tested and proven on their assets first. Once it understands and obtains value from these assets, Uniper moves forward with client implementations. This process provides a competitive edge as it means Uniper ensures proven benefit, and the company offers a price that will result in a one-year payback. Additionally, Uniper's experience with multiple business cases positions it as the ideal support for clients currently building their business case, including uncertainty factors and scenario planning. Each business case is built upon real examples from on-site (if they have done a trial period), historical incidents which Uniper proves it can catch, as well as case studies the company has from other assets.

The company builds on its price/performance value through its Plant Performance Tracker (PPT) application, which empowers users to interpret the outputs from the TMS and other applications on the platform. At its core, PPT has a calculation engine that creates complex visualization to demonstrate trends and correlations, to understand the data put into the system. Units at varying sites in the plant are tracked against one another, enabling quick identification of best-performing units to improve the performance of other assets on the plant or in the fleet. Moreover, the PPT allows users to carry out non-step checks and comparisons of plant start-ups and shutdowns, analyzing the data to locate discrepancies and flag abnormalities before they become critical issues. If necessary, the PPT also records processes and determines which assets are performing well and which require optimization. Once created, a report can be reviewed for any period that the data is available for, near real time. Continuing Uniper's drive to solve the knowledge decline, a user can comment on visuals, which are then visible to all the other users where a major problem occurs. An alert can then be created and tracked until completion or closure of that fault is resolved.

Also, the PPT application is highly customizable, and it can be tailored to a customer's site-specific needs. As part of the implementation process, Uniper's coal, gas, biomass, hydro, solar or wind operations and maintenance (O&M) expert and project manager works closely with clients to identify the key areas where significant improvements are necessary, and then produce reports to track and monitor top issues to ensure improved performance.

Best Practices Example: Historically starting only a handful of times per year, a coal site's fuel oil required for startup was a negligible cost; however, a more flexible start with over 100 starts per unit per year, resulted in prohibitive costs. The company leveraged Uniper's PPT to track the fuel oil needed at startup (usually warm starts) and optimize where this was required across the boiler. Over time, the site reduced the fuel oil needed per startup, reaching savings of roughly €25,000 per startup, which translates to over €3 million in savings per year, and further ensuring the site remains viable.

Further investigation of the situation above leads the coal plant to recognize historic operator activity meant the plant came on 3.5 hours before the synchronization, resulting in a need for additional fuel oil. The PPT's visualization identified the most efficient and convenient start time (2.5 hours before synchronization), empowering the site to build reports to support the changing of the culture on-site, to embed the changes. For a year, the site leveraged these reports at the start of shift meetings and by pitting shifts against each other, along with sharing best practices between shifts. As a result, the site further increased the fuel oil savings and improved the efficiency of the shift performance overall.

A Solid Reputation

Acting as the digital delivery engine for Uniper's engineering/trading and O&M service businesses, Enerlytics is very important for Uniper's delivery of its unique selling points: owner and operator with 100 years of engineering experience with absolute original equipment manufacturer (OEM) autonomy. As such, the company places great emphasis on building a brand capable of successful competition. This strategy is critical, mainly since the company is not an OEM provider and thus aspires to be an alternative for those who require more than digitalized processes but do not want an OEM as a software provider. To that end, Uniper designated Enerlytics as one of its strategic initiatives, with the whole organization focused on creating a strong brand that resonates with potential clients. Finally, since Uniper, as a whole, aims to become one of the main drivers of the energy transition; Enerlytics is seen as one of the most critical tools toward delivering the energy transition.

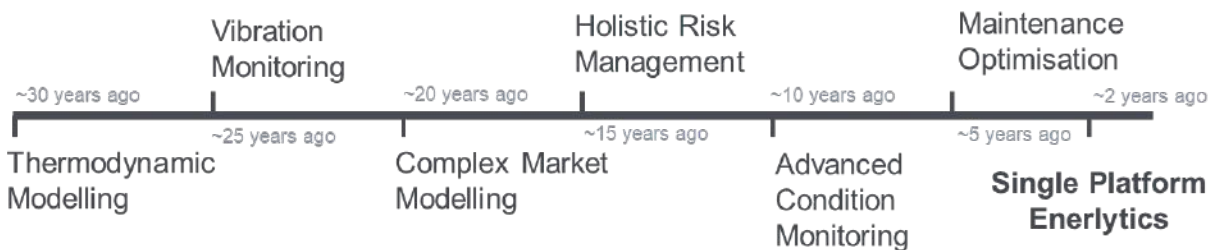
Efficient Through-and-through

Given Uniper's experience as an owner and operator of its power plants, the company is influenced continuously by outside forces, whether economic or political, in its daily operations. As such, Uniper strives to achieve operational efficiency in its plants through its internal operational excellence programs. Uniper's goal is to optimize and become efficient wherever possible within its plants. The company's operational efficiency focus is used and passed on to its internal and external clients, as well. The fact that Uniper operates its plants is a value-add when dealing with customers with similar plants, and the company strives to pass its knowledge onto them. Thus, Uniper's services and technologies that it offers through Enerlytics are the same it has already implemented in its out-plant fleet, thus achieving benefits such as a six-month return on investment and a 56% internal rate of return.

Non-stop Innovation

Current market offerings in the IIoT for the power generation industry mostly focus on delivering a product in predictive maintenance and performance management. However, additional industry voids include products in risk management, maintenance strategy, and market solutions. As an integrated company with a comprehensive knowledge and experience base, Uniper elected to include risk management and trading within the platform, which provides it a competitive advantage as the rest of its competitors, being

OEM providers, are unable to offer. Moreover, Uniper's continuous development ensures its continued differentiation.



Moreover, Uniper's history provides it with the experience and pedigree to create a unique selling point and differentiate from the competition. While this has not been proven, it was initially a hypothesis, and through customer interviews and internal stakeholder sessions, Uniper validated it and embarked on a comprehensive approach to investment:

- Strategic decision: In 2017, a 12-week sprint to integrate base applications and win clients.
- Financial decision: In mid-2017, full investment case with staged funds releasing based on client success
- Each quarter: Progress reviews with board members for budget release

Uniper aims to continue delivering the business on target, a testament to the company's new culture. The level of faith and accountability provided to the Enerlytics team is exceptional and allows the team to flourish and grow to four times the size in two years.

Conclusion

Due to the plethora of technologies provided by the Industrial Internet of Things (IIoT), technology participants must look to form partnerships with energy original equipment manufacturing or utilities for alleviating technology-related issues or streamlining processes. However, prevailing challenges, such as a growing knowledge gap and considerable data volumes, continue to restrain adoption.

Uniper Energy leverages its century old expertise to deliver its IIoT-based platform: Enerlytics. The platform delivers a holistic, real time view of asset performance, delivering actionable insights to operators, enabling them to act quickly when faced with a potential issue. Furthermore, Uniper retains close relationships with its customers, maintaining an active presence should its customers need any assistance in the future. Moreover, the company builds value into its solution with features such as the Plant Performance Tracker and thermodynamic modeling suite.

For its iron-clad value proposition, holistic platform with best-in-class features, its close relationships with its customers and the market, and a strong overall position, Uniper Energy wins Frost & Sullivan's 2020 Global Product Leadership Award in the IIoT platform for the power generation market.

Significance of Product Leadership

Ultimately, growth in any organization depends on customers purchasing from a company and then making the decision to return time and again. A comprehensive product line filled with high-quality, value-driven options are the key to building an engaged customer base. To achieve and maintain product excellence, an organization must strive to be best in class in three key areas: understanding demand, nurturing the brand, and differentiating from the competition.



Understanding Product Leadership

Demand forecasting, branding, and differentiating all play critical roles in finding growth opportunities for your product line. This three-fold focus, however, must be complemented by an equally rigorous focus on pursuing those opportunities to a best-in-class standard. Customer communication, customer feedback, pricing, and competitor actions must all be managed and monitored for ongoing success. If an organization can successfully parlay product excellence into positive business impact, market share will inevitably increase.

Key Benchmarking Criteria

For the Product Leadership Award, Frost & Sullivan analysts independently evaluated two key factors—Product Family Attributes and Business Impact—according to the criteria identified below.

Product Family Attributes

- Criterion 1: Match to Needs
- Criterion 2: Reliability and Quality
- Criterion 3: Product/Service Value
- Criterion 4: Positioning
- Criterion 5: Design

Business Impact

- Criterion 1: Financial Performance
- Criterion 2: Customer Acquisition
- Criterion 3: Operational Efficiency
- Criterion 4: Growth Potential
- Criterion 5: Human Capital

Best Practices Recognition: 10 Steps to Researching, Identifying, and Recognizing Best Practices

Frost & Sullivan analysts follow a 10-step process to evaluate award candidates and assess their fit with select best practices criteria. The reputation and integrity of the awards are based on close adherence to this process.

STEP	OBJECTIVE	KEY ACTIVITIES	OUTPUT
1 Monitor, target, and screen	Identify award recipient candidates from around the world	<ul style="list-style-type: none"> • Conduct in-depth industry research • Identify emerging industries • Scan multiple regions 	Pipeline of candidates that potentially meet all best-practice criteria
2 Perform 360-degree research	Perform comprehensive, 360-degree research on all candidates in the pipeline	<ul style="list-style-type: none"> • Interview thought leaders and industry practitioners • Assess candidates' fit with best practices criteria • Rank all candidates 	Matrix positioning of all candidates' performance relative to one another
3 Invite thought leadership in best practices	Perform in-depth examination of all candidates	<ul style="list-style-type: none"> • Confirm best practices criteria • Examine eligibility of all candidates • Identify any information gaps 	Detailed profiles of all ranked candidates
4 Initiate research director review	Conduct an unbiased evaluation of all candidate profiles	<ul style="list-style-type: none"> • Brainstorm ranking options • Invite multiple perspectives on candidates' performance • Update candidate profiles 	Final prioritization of all eligible candidates and companion best practices positioning paper
5 Assemble panel of industry experts	Present findings to an expert panel of industry thought leaders	<ul style="list-style-type: none"> • Share findings • Strengthen cases for candidate eligibility • Prioritize candidates 	Refined list of prioritized award candidates
6 Conduct global industry review	Build consensus on award candidates' eligibility	<ul style="list-style-type: none"> • Hold global team meeting to review all candidates • Pressure-test fit with criteria • Confirm inclusion of all eligible candidates 	Final list of eligible award candidates, representing success stories worldwide
7 Perform quality check	Develop official award consideration materials	<ul style="list-style-type: none"> • Perform final performance benchmarking activities • Write nominations • Perform quality review 	High-quality, accurate, and creative presentation of nominees' successes
8 Reconnect with panel of industry experts	Finalize the selection of the best practices award recipient	<ul style="list-style-type: none"> • Review analysis with panel • Build consensus • Select recipient 	Decision on which company performs best against all best practices criteria
9 Communicate recognition	Inform award recipient of recognition	<ul style="list-style-type: none"> • Inspire the organization for continued success • Celebrate the recipient's performance 	Announcement of award and plan for how recipient can use the award to enhance the brand
10 Take strategic action	Upon licensing, company is able to share award news with stakeholders and customers	<ul style="list-style-type: none"> • Coordinate media outreach • Design a marketing plan • Assess award's role in strategic planning 	Widespread awareness of recipient's award status among investors, media personnel, and employees

The Intersection between 360-Degree Research and Best Practices Awards

Research Methodology

Frost & Sullivan's 360-degree research methodology represents the analytical rigor of our research process. It offers a 360-degree view of industry challenges, trends, and issues by integrating all 7 of Frost & Sullivan's research methodologies. Too often companies make important growth decisions based on a narrow understanding of their environment, resulting in errors of both omission and commission. Successful growth strategies are founded on a thorough understanding of market, technical, economic, financial, customer, best practices, and demographic analyses. The integration of these research disciplines into the 360-degree research methodology provides an evaluation platform for benchmarking industry participants and for identifying those performing at best-in-class levels.

360-DEGREE RESEARCH: SEEING ORDER IN THE CHAOS



About Frost & Sullivan

Frost & Sullivan, the Growth Partnership Company, helps clients accelerate growth and achieve best-in-class positions in growth, innovation and leadership. The company's Growth Partnership Service provides the CEO and the CEO's growth team with disciplined research and best practices models to drive the generation, evaluation, and implementation of powerful growth strategies. Frost & Sullivan leverages nearly 60 years of experience in partnering with Global 1000 companies, emerging businesses, and the investment community from 45 offices on 6 continents. To join Frost & Sullivan's Growth Partnership, visit <http://www.frost.com>.