SKYSPECS

Holistic Condition Monitoring Using Multiple Data Streams

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Contents

- Introduction to i4SEE + SkySpecs
- Augmented Intelligence: a Domain Driven Approach
- Combining multiple analytics techniques
- Agile O&M Planning and Execution
- The Big Picture
- Conclusions

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SKYSPECS

Simplify Renewable Energy **Asset Management**
so less can do more for the planet

Trusted by leading wind farm owner/operators

.. And backed by industry insiders

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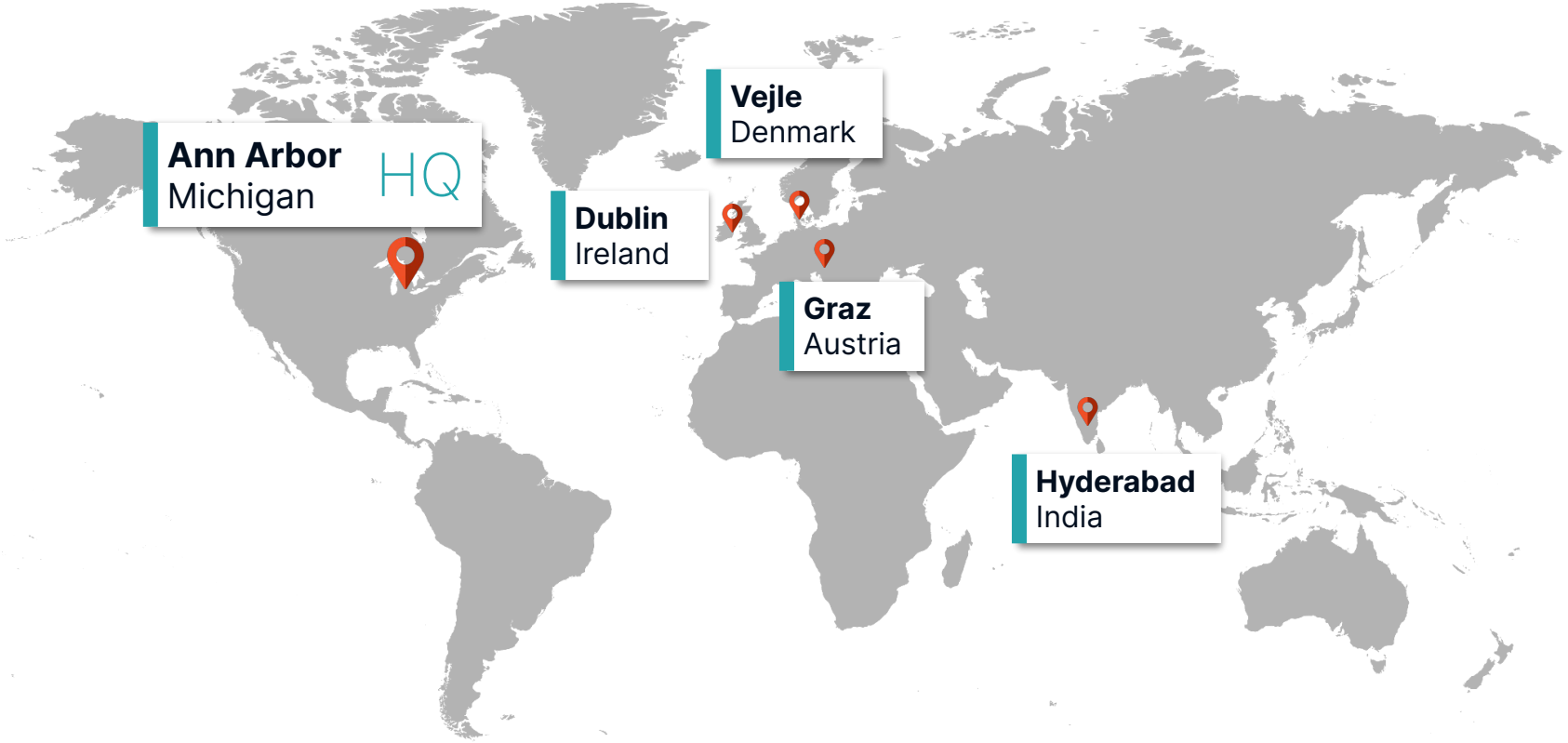
Global team of 300 - Office and remote

Operational and digital footprint across windfarms on 6 continents



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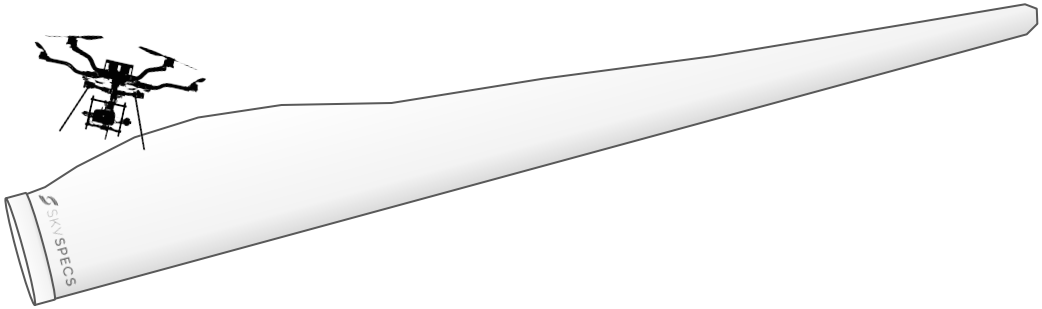
SKYSPECS BY THE **NUMBERS**



$42B

Assets under contract

130 GW

Gigawatts served

45%

Of North American blades monitored annually

190K

Unique turbines inspected to date

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A holistic, technology-driven approach to Asset Health and Performance

Complete Asset Health Management

SOLUTIONS

- SkySpecs Performance
- HORIZON CMS
- HORIZON BLADE MGT.
- HORIZON FINANCE

SkySpecs provides a range of solutions, allowing organizations to create the right combination for their specific needs. We will meet you wherever you are in your O&M journey.

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SkySpecs + i4SEE

Advanced Analytics and Predictive Maintenance Capabilities for the Global Wind Industry

Data-driven insights that lead to actual cost savings

Valuable information to help quantify and manage asset risk

Earlier and more accurate fault detection and reduce downtime.

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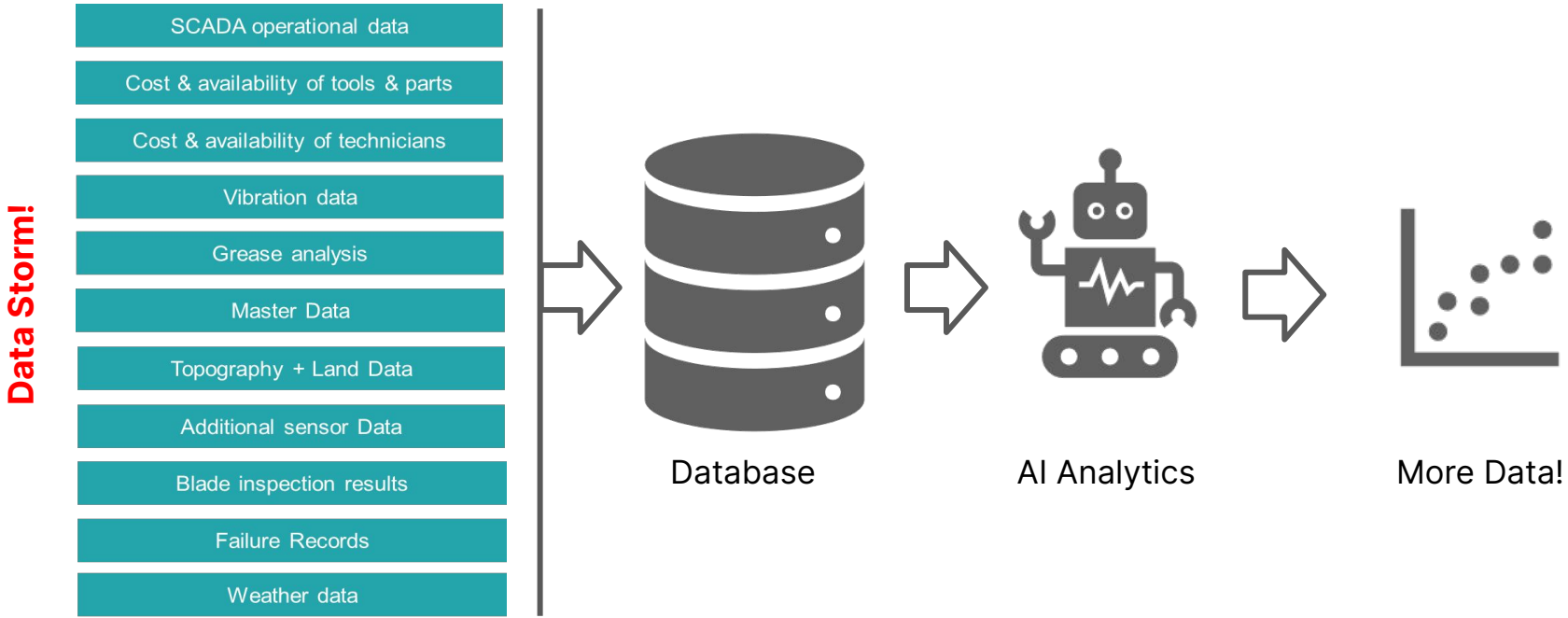
“Full A.I.” Approach

Black-box modelling to learn the relationship between all available data and turbine faults

Often results in high costs and output that does not create significant value



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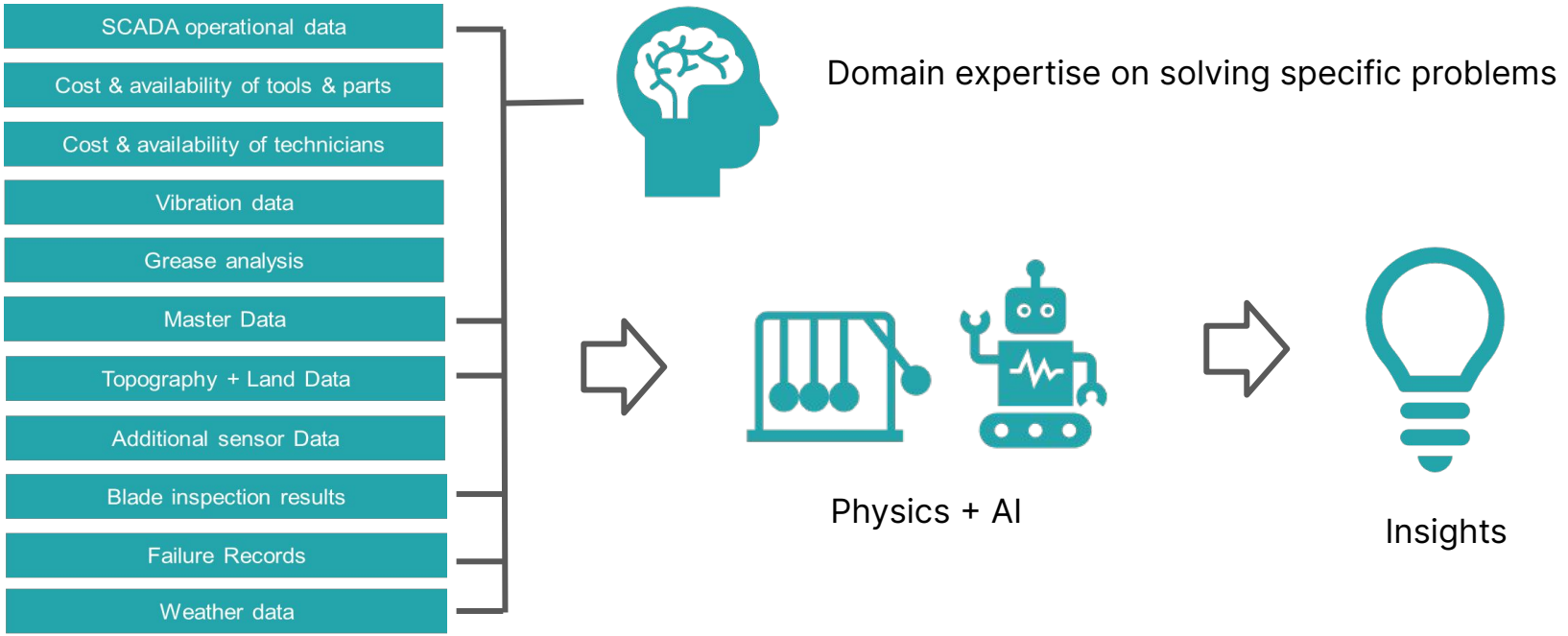
“Augmented Intelligence” Approach

Selective use of data to solve specific problems, domain expertise with machine learning in support

Lower cost and produces more transparent results ready to be fed into processes



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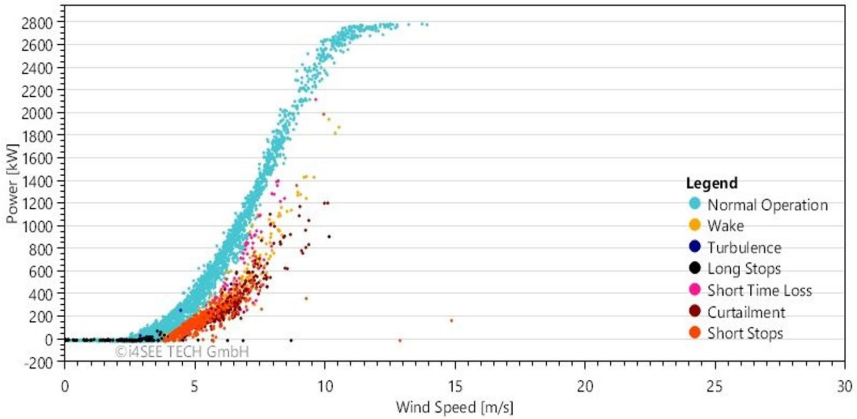
Performance Analysis: Turbine operational state

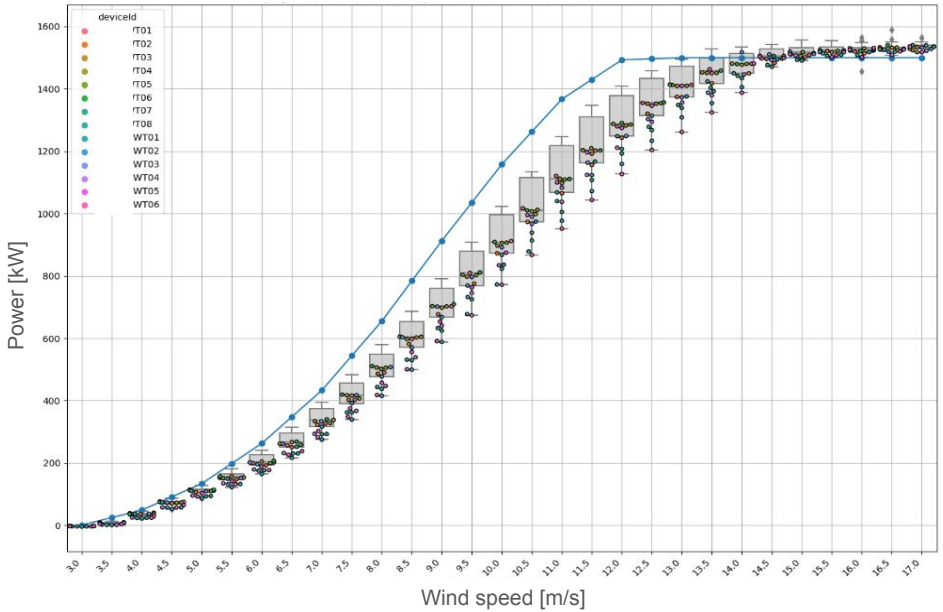
Understanding performance losses, wakes, icing, controller errors, curtailment, production losses.

Providing a high level overview of the turbine status, to increase efficiency in planning inspection and repair activities.

State classification



Performance benchmarking



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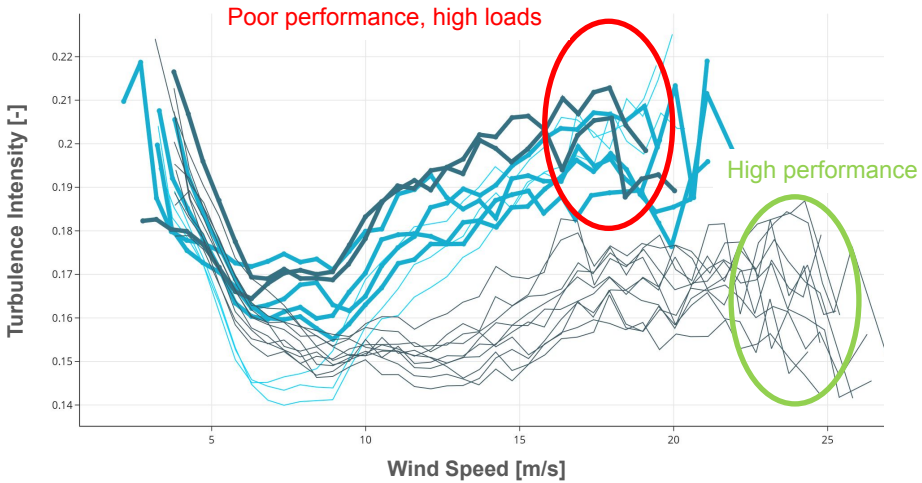
Pitch System and Rotor Monitoring

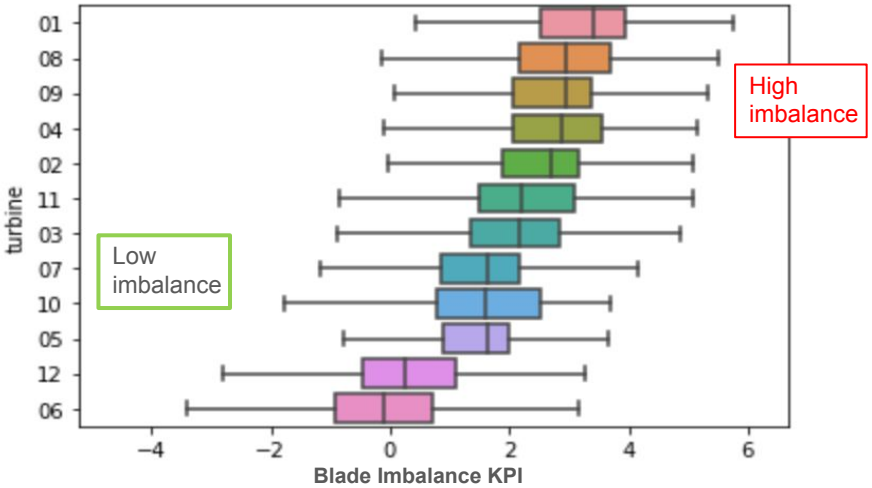
Turbine performance and blade loading strongly affected by site conditions.

Blade imbalance analysis proven effective for diagnosis of blade misalignment and icing.

Turbulence intensity conditions at two sites, several turbines at each site



Blade Imbalance Check (high frequency SCADA)



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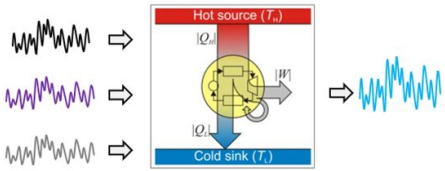
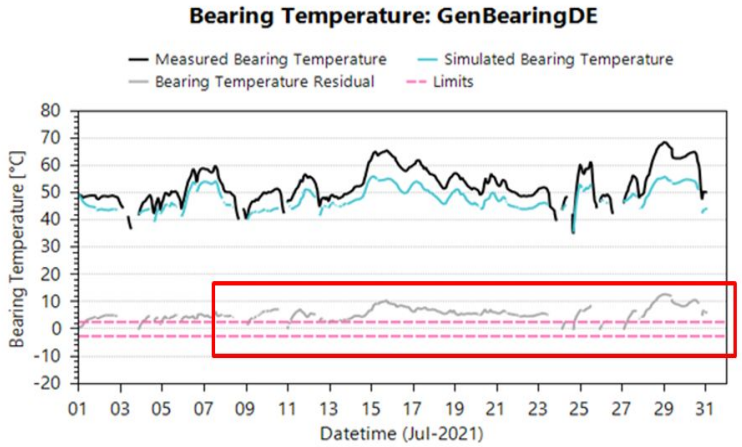
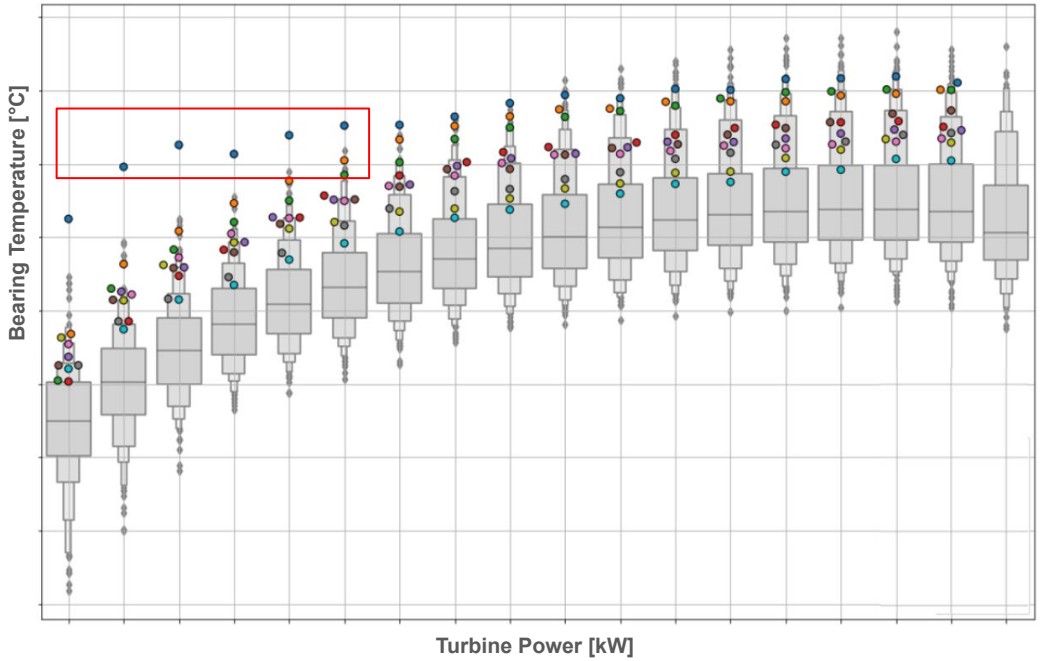
SCADA Temperature Analysis



Physics-based temperature model



Main Bearing Temperature Benchmarking



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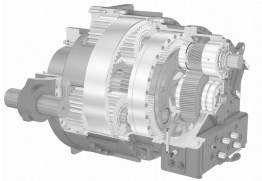
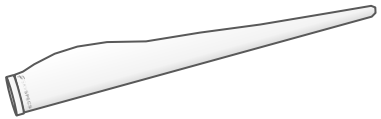
Synergies Across Multiple Monitoring Techniques

Drivetrain



- Temperatures
- Alarms
- CMS
- Particles

Blades



- Blade Damage
- Blade Imbalance
- Weather
- Performance

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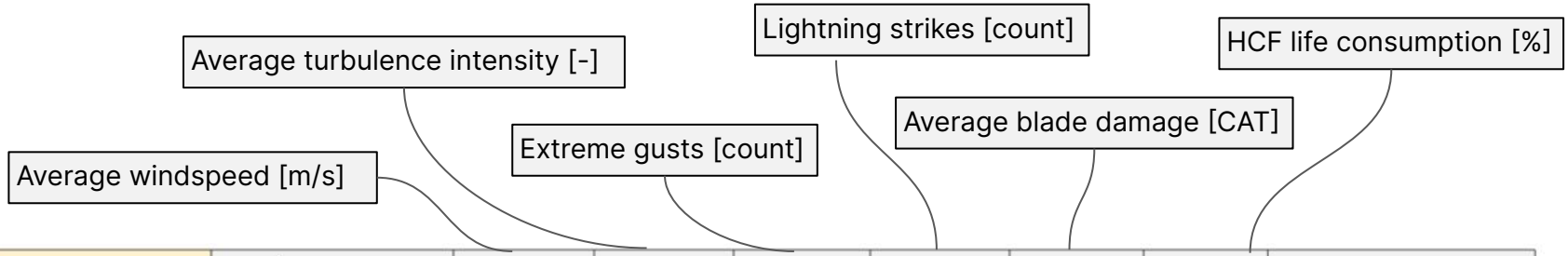
Benchmarking loads (example: blades)

Assessment of historical loading to identify highest risk turbines



Portfolio 1	Terrain	KPI#1	KPI#2	KPI#3	KPI#4	KPI#5	KPI#6	RISK
Site 1	simple	5.9	0.06	0.2	0.8	2.0	0.2	LOW
Site 2	moderate complex	6.0	0.12	0.3	0.4	1.9	0.2	MEDIUM
Site 3	simple	7.5	0.11	0.4	0.4	1.8	0.3	MEDIUM
Site 4	moderate complex	7.5	0.13	0.3	0.6	2.2	0.3	HIGH
Site 5	complex	7.5	0.15	0.3	0.7	1.9	0.4	MEDIUM
Site 6	simple	6.5	0.13	0.3	0.6	1.8	0.3	LOW
Global Fleet (320 samples)	*N/A*	*7.2*	*0.12*	*0.3*	*0.4*	*1.5*	*0.3*	*N/A*

Blade-related monthly KPI's, based on rolling average values during last 12 months

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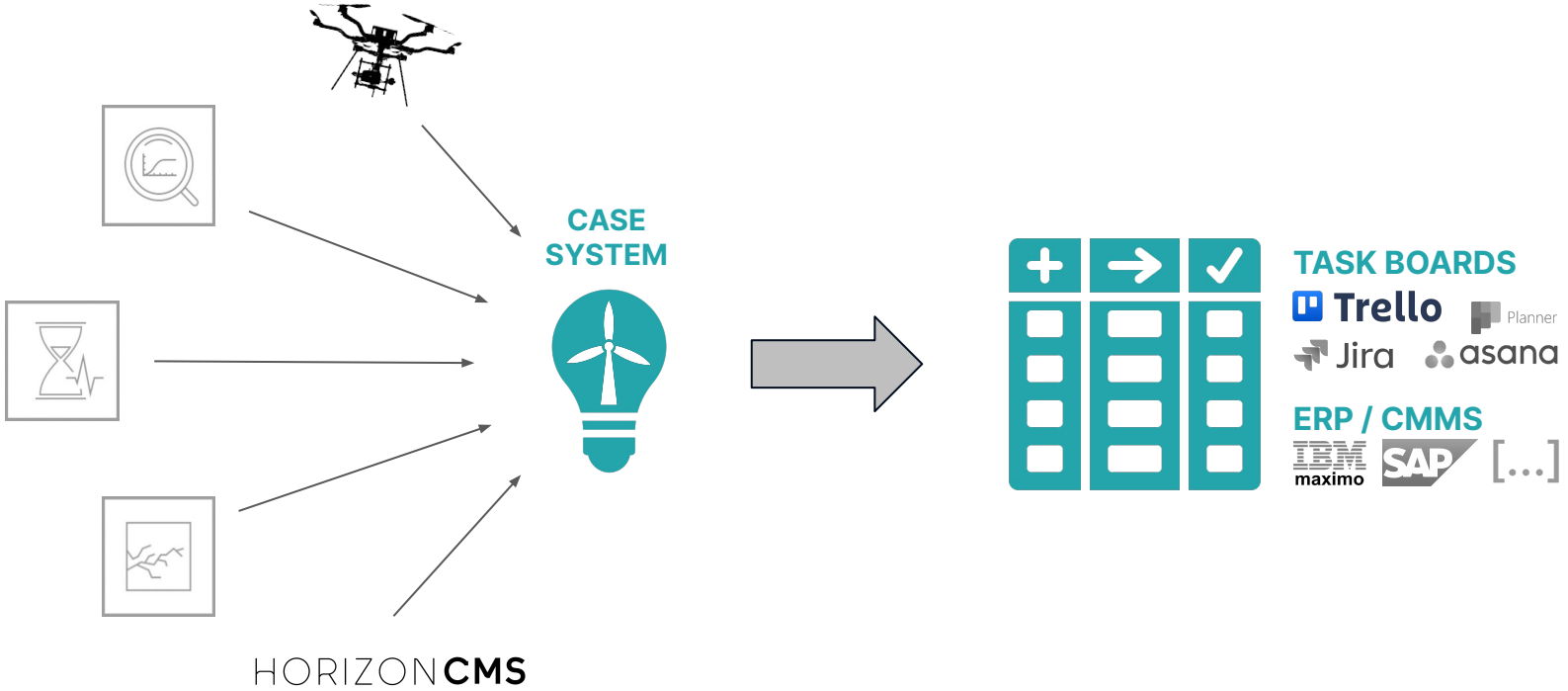
Combining Observations in a Case System

Enriching diagnostics using inputs from multiple tools



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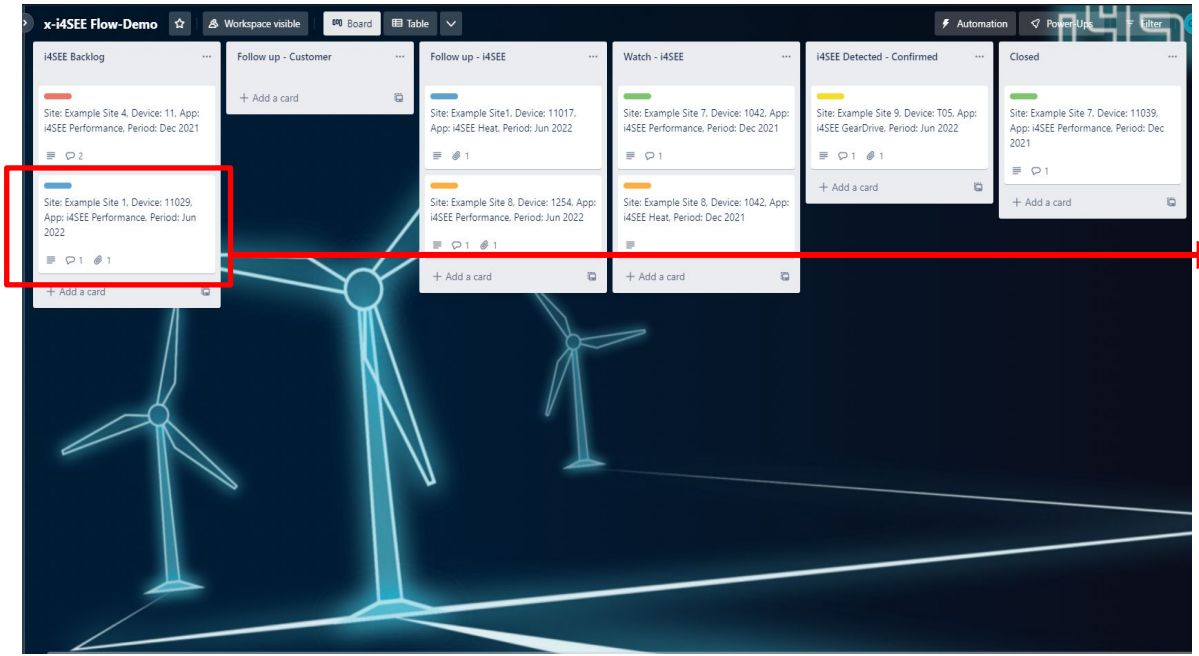
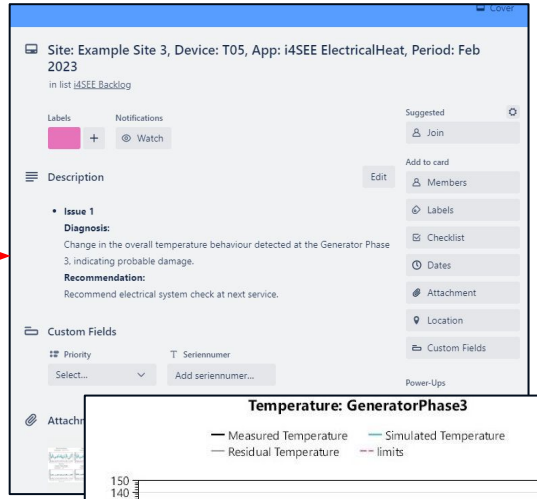
Agile Planning of Predictive Maintenance

Tasks enhanced with diagnostic information, “playbook” for follow-up process





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The Big Picture

Combining multiple data streams to solve a specific problem

Data Collection

- SCADA (10-min, high freq.)
- Weather Data
- Topography + Land Data
- Failure Data + Costs
- Additional sensor Data
- Master Data
- Blade Inspections
- Financials

Combining multiple data streams

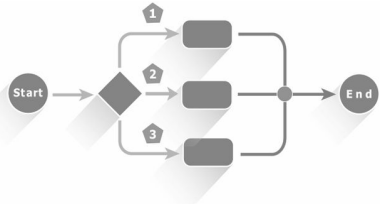
Advanced Analytics

Turbine performance & health

Loads benchmarking & prioritisation

Full transparency of failure risk

Delivery



Agile workflows and playbook

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Summary

- Data should be used selectively and combined with domain expertise.
- Multiple analysis techniques can contribute to the “bigger picture”.
- Delivery must be designed to meet different stakeholder needs.
- With this approach, we can weather the data storm and focus on solving problems!

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