



Scaling Predictive Equipment Health Using Vibration & Process Data

Indorama Ventures Quimica, Spain (CPET Segment)

By Rafael Limones Ayllon

Company snapshot



Presence in

32

countries

*update as of Apr 2025



114

manufacturing locations

*update as of Apr 2025



about

25,000

employees



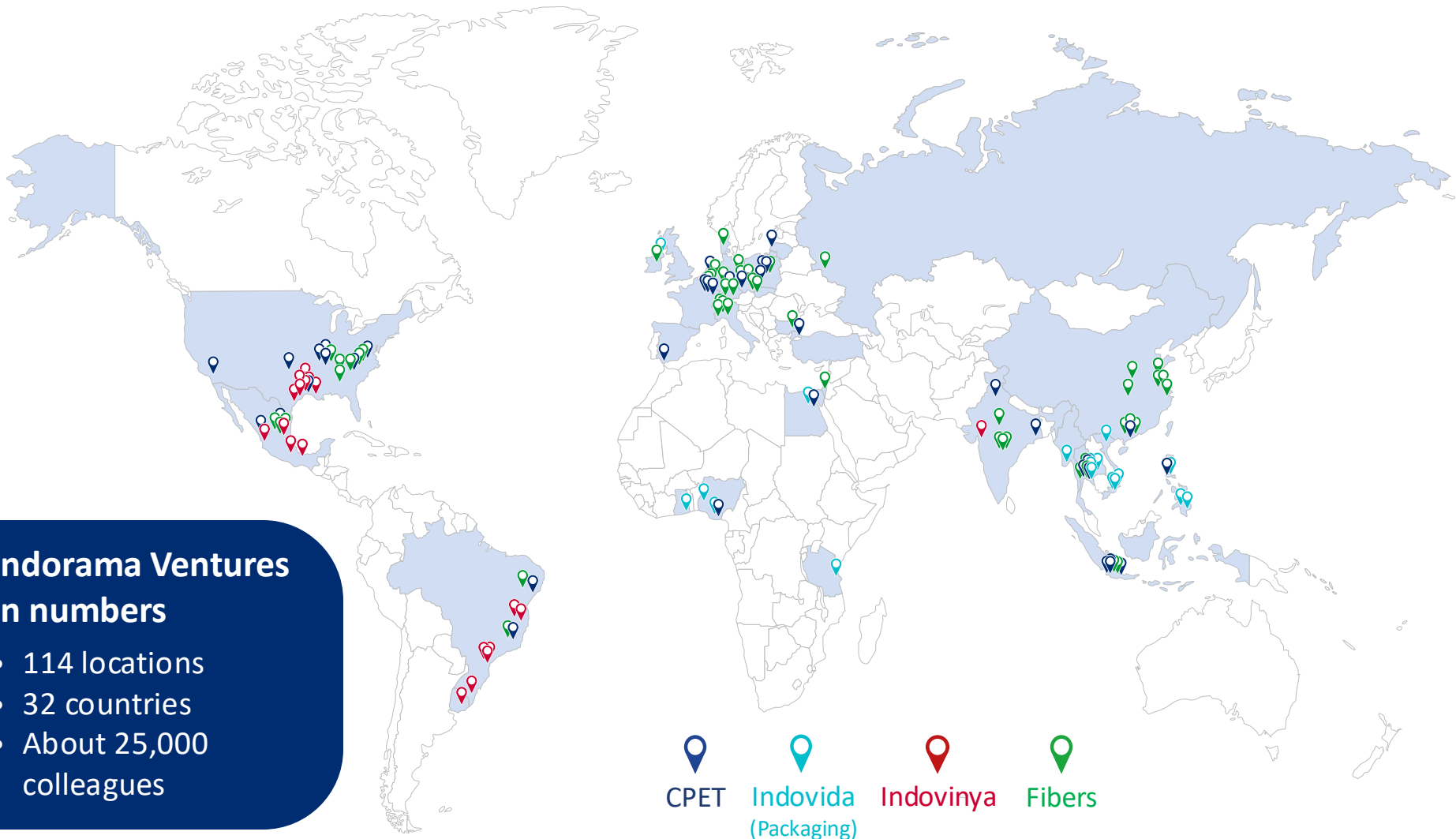
Consolidated revenues of

\$15.4B

(FY2024)



Our Global Manufacturing Footprint



Indorama Ventures in numbers

- 114 locations
- 32 countries
- About 25,000 colleagues

*update as of Apr 2025

Indispensable Chemistry



Americas

Brazil	Uruguay
Mexico	USA

EMEA

Bulgaria	Luxembourg
Czech Republic	Netherlands
Denmark	Nigeria
Egypt	Poland
France	Russia
Germany	Slovakia
Ghana	Spain
Ireland	Tanzania
Italy	Turkey
Israel	UK
Lithuania	

APAC

China	Philippines
India	Thailand
Indonesia	Vietnam
Myanmar	

Our customers help us grow as a market leader



#1

PET producer globally

#1

Recycled PET producer globally

The only shale-integrated player in the West



Indovida

#1

Market position in ASEAN

#2

Market position in Africa

Packaging leadership in emerging markets



Indovina

#1

Non-ionic surfactants Producer in Americas

#1

Americas' home care ingredients provider

#1

Crop solutions provider in Americas



Fibers

Lifestyle

#1

in PET staple fiber ASEAN

Hygiene

#2

in BiCo fiber

Mobility

#2

in airbag yarn

Mobility

#2

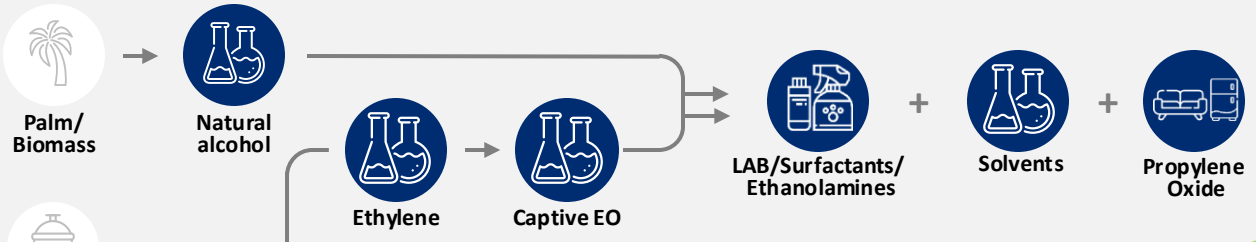
in tire cord fabric



Integrated value chain



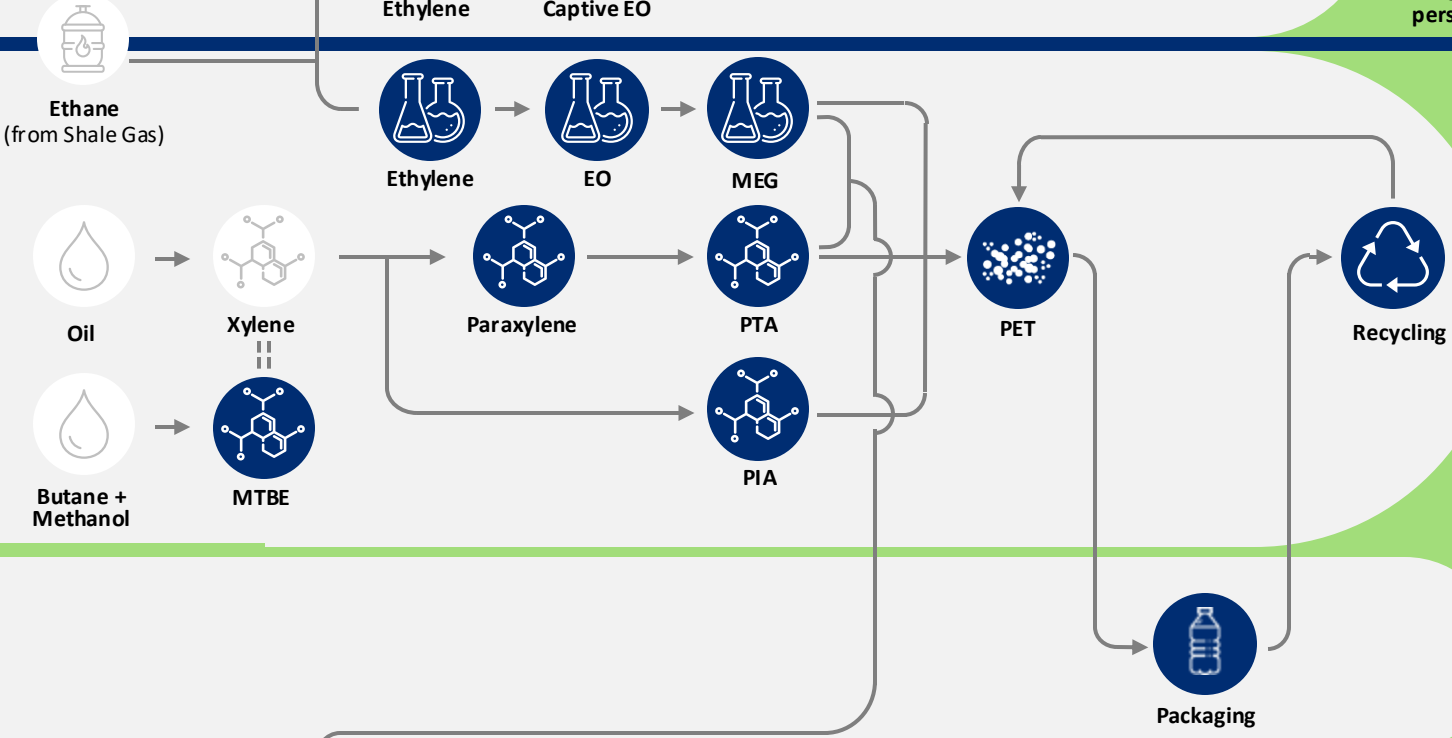
Indovina



Example end markets



CPET



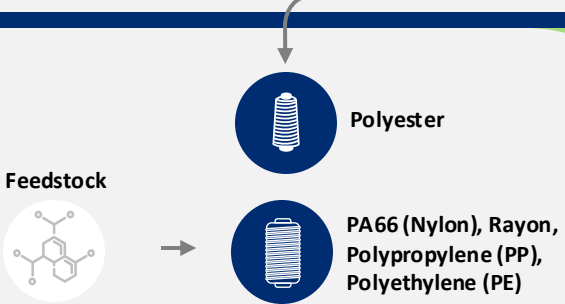
Example end markets



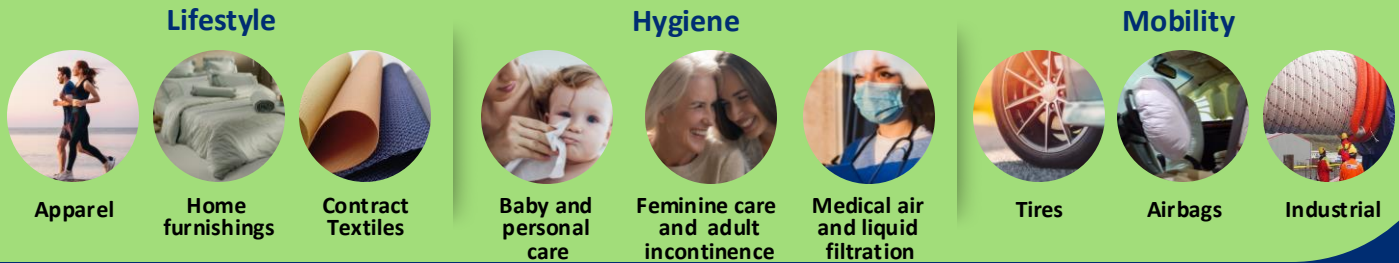
Indovida



Fibers



Example end markets



INDORAMA VENTURES - CPET

Química, Spain



The IVQ site is a core pillar of Indorama Ventures' Combined PET platform, featuring vertically integrated PTA, PIA and PET production at industrial scale. By transforming paraxylene into high-quality PET resin, the site anchors supply for packaging and polyester value chains across Europe. IVQ stands as a symbol of CPET's strength—integration, resilience, and world-class polymer manufacturing.

Digital x **IVEX** x Sustainability

**ADVANCED
INDUSTRIAL
ANALYTICS**

COMPETITION 2025

CPET's

Advanced Solution Showcase Submission by IVQ

From Indorama Ventures' Internal AIA (Seeq) Showcase – Dec. 2025

**Scaling Predictive Equipment Health
Using Vibration & Process Data**
Reliability Project



Rafael Limones Ayllón

Data Analyst - Digital & Process
IVQ (CPET Segment)

Category 3: Scaling Predictive Equipment Health Using Vibration & Process Data

Indorama Ventures Quimica, Spain

Define Turning **data overload** into monitoring clarity through scalable intelligence, enabling our teams to **reduce analysis time for early detection and reaction**

Goal: **Develop tools** and a way **to reduce analysis time** by leveraging all available information (documentation, manual vibration measurements, and process variables), in alignment with ISO 14224 practices.

Measure: Two Categories of Failures Monitored in This Project

Mechanical Failure Indications

ISO 14224 identifies **vibration measurement as a primary** Condition Monitoring Technique & a **key diagnostic indicator** for rotating equipment. Our focus on the project is for capturing, organizing, & summarizing manual vibration data to detect early signs of mechanical degradation.

Process Failure Indications

Process variables often show **earlier symptoms of abnormal conditions** before a breakdown occurs. Unsupervised machine learning models enable continuous monitoring & early detection of process-driven failure modes.

Currently focused was the agitators 27 equipment, as objective we want to get this for 409 equipment with manual vibration data

Saving as avoid cost: unexpected shutdown
(this saving was done on February 2025 to oxidation Reactor A)

Note – ISO 14224 is the global standard for Reliability & Maintenance data collection for equipment in petroleum, natural gas, petrochemical, & heavy process industries.

The Challenge We All Face with Vibration Spectrum Data

Indorama Ventures Quimica, Spain

Last 18 days

Without Analytics

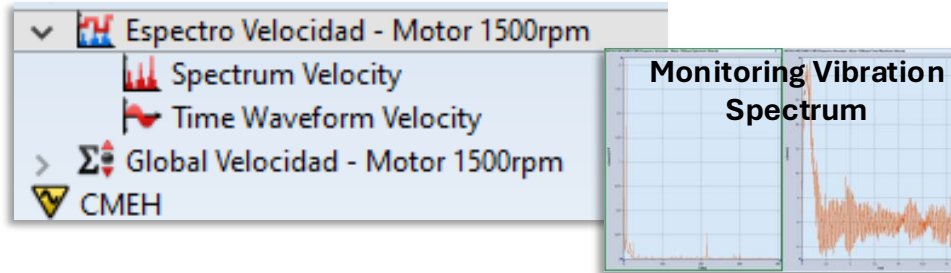
- 18 Agitator assets × 30 spect.indic × 2 min each = **18 Man-Hours** of manual review (*Just Agitators*)
Or All IVQ Equipment @
- 409 assets × 30 spect.indic × 2 min each = **409 man-hours** of manual review

Results:

High likelihood of **missed failures**, delayed insights, and inconsistent reviews,

- Data collected but **not converted into decisions**

1 Equipment → Avg 30 Different Signal per Equipment



1 Agitator — 2 Sub-equip — 9 diff. point of measure — Approx 4 bounds



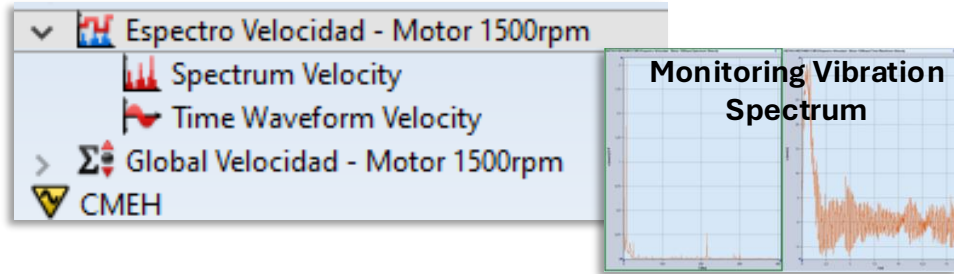
The reality we live in:

We either **don't analyze all the data** we collect,
or
we **don't collect it at all** — because we don't have the time...

The Challenge We All Face with Vibration Spectrum Data

Indorama Ventures Quimica, Spain

1 Equipment → Avg 30 Different Signal per Equipment



1 Agitator → 2 Sub-equip → 9 diff. point of measure → Approx 4 bounds

All spectra indicators

- 18 Agitator assets × 30 signals each = 18 Man-Hours of manual review (Just Agitator)
- Or All IVQ Equipment @ 409 assets × 30 signals each = 409 man-hours of manual review



- Results:
- High likelihood of missed failures, delayed insights, and inconsistent reviews,
 - Data collected but not converted into decisions

1 actionable Indicator (capsule)

What if,

All spectra indicators → automatically processed → 1 actionable indicator

ORG
EFFECT

With Analytics

Now, with SeeQ® &  =

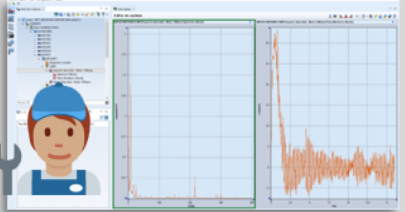
Focusing on Time to Act, instead of Time to Analyze then react

Thousands of data points compressed into a single insight:
“Which asset needs attention today?”

Project Overview: Turning Manual Efforts to insightful Knowledge for the long-term

Vibrations spectrum of critical machines

Step 1: Pruftechnik data



Python to **transform data & categorize**

Manual vibration data

Data downloaded manually



Vibration data by **frequency band**

Data on SQL server

14,940 thousand different tags of vibration

409 different equipment

Step 3: SEEQ anomaly detection & Man Vib. Now with Process Data

Seeq

Easy connection

Anomaly detection models

Scale Via Asset tree

Use categorize to create asset tree of all equipment with manual vibrations



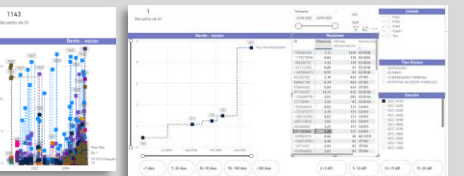
Equipment in asset tree are monitored using manual vibration and operational data

New Add-on which identifies lead contributing variable causing the anomaly

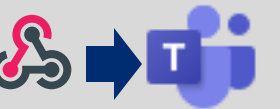


Step 2: Create PowerBI

Power Bi: Vibration trends by **frequency band**



Step 4: Notification by teams



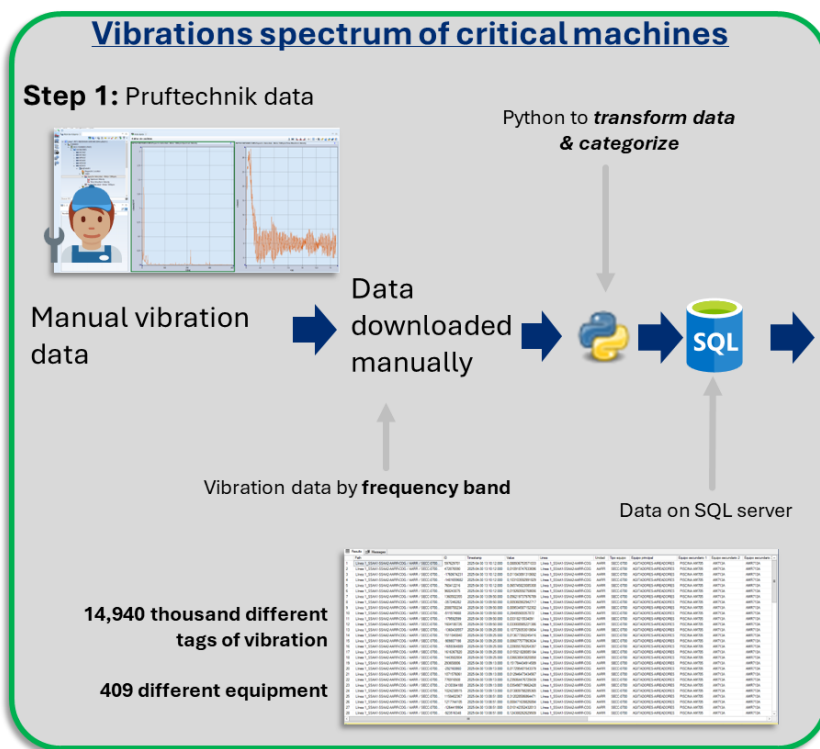
Notify on teams daily using Webhook

Step 5: Ai to quickly Investigation



Find quickly equip specs, recent failure, all documented on SharePoint

Data preparation and preliminary configuration

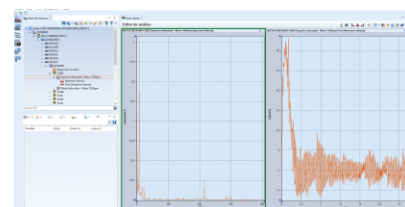


Step 1: Make the Invisible Visible

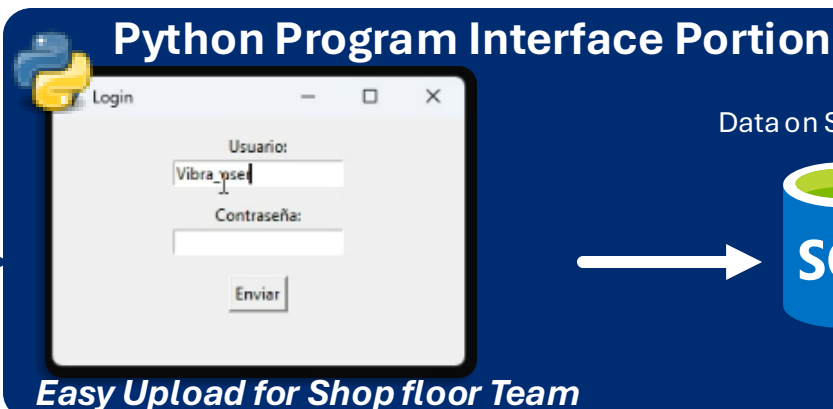
New Program Developed for Operator Ease

Step 1 — Capture & Organize

Collect raw vibration and process data, then structure and transform it using best-practice methods.



Manual Vibration Data



Data on SQL server



14,940 thousand different tags of vibration

409 different equipment



Python Program

Purpose: Extract value from Manual Rounds turning it into Organized & Structured Data

- Formats and uploads manual vibration data into SQL.
- Logs actions and tracks last insertion.
- Used by supervisors to manage Omnitred exports and SQL uploads.
- Resume of data input on excel

Over 14,000 vibration and process data points from 409 assets

Now structured and analytics-ready for rapid value generation!

Step 1 to 2-3 Prep: Configuration & Vibration & Process Tag Dictionary

Transform data & Categorize

Data & Equip Dictionary
for vibration tags

Linea	Unidad	Equipo principal	Equipo secundaria	Seeq Name	Tag/vibraciones
Linea_1_PET	FUNDOO	SECC-FUNDOO	BOMBAS	NO2_vibrec_BOMBAS_145386075	NO2_vibrec_BOMBAS
Linea_2_PET	FUNDOO	SECC-FUNDOO	BOMBAS	NO2_vibrec_BOMBAS_207679995	NO2_vibrec_BOMBAS
Linea_3_PET	FUNDOO	SECC-FUNDOO	BOMBAS	NO2_vibrec_BOMBAS_410840141	NO2_vibrec_BOMBAS
Linea_1_PET	FUNDOO	SECC-FUNDOO	BOMBAS	NO2_vibrec_BOMBAS_122101790	NO2_vibrec_BOMBAS
Linea_1_PET	FUNDOO	SECC-FUNDOO	BOMBAS	NO2_vibrec_BOMBAS_145045111	NO2_vibrec_BOMBAS
Linea_1_PET	FUNDOO	SECC-FUNDOO	BOMBAS	NO2_vibrec_BOMBAS_101995986	NO2_vibrec_BOMBAS
Linea_1_PET	FUNDOO	SECC-FUNDOO	BOMBAS	NO2_vibrec_BOMBAS_101868380	NO2_vibrec_BOMBAS
Linea_1_PET	FUNDOO	SECC-FUNDOO	BOMBAS	NO2_vibrec_BOMBAS_101868380	NO2_vibrec_BOMBAS
Linea_1_PET	FUNDOO	SECC-FUNDOO	BOMBAS	NO2_vibrec_BOMBAS_101868380	NO2_vibrec_BOMBAS

Asset Equipment Organization w/ Process Data

Attributes used to develop Isolation Forest in
Seeq then Scale easily

**Important Step: Ensures easily adapted to new tools or
technologies like Seeq with little or no rework.*

Seeq DATA LAB Organize Data Continued

```
from seeq import spy
import pandas as pd
import numpy as np
from datetime import datetime, timedelta

matrizbase = pd.read_excel('Asset-tree.xlsx', sheet_name='asset_tree_global')
```

**Asset Tree Creation for Analytics use,
@ SCALE**

Asset Tree Results: Organize Data Continued

Build separate asset trees for **Vibration calculations** &
Process calculations (Isolation forest=Process prediction).

Vibration Asset Tree

» Vibracion » Línea 2_TA2-PTA2-PTA3 » PTA3
» SECC-0300 » AGITADORES » TA301

- ☐ Seleccionar todo
- ☐ Any_vibration_capsule_active
- ☒ Process
- ☒ Vibration
- ☒ Vibration Capsule

Vibration asset tree includes about
30 tags per equipment.

Process asset tree, will depend on
the equipment availability of
historian tags

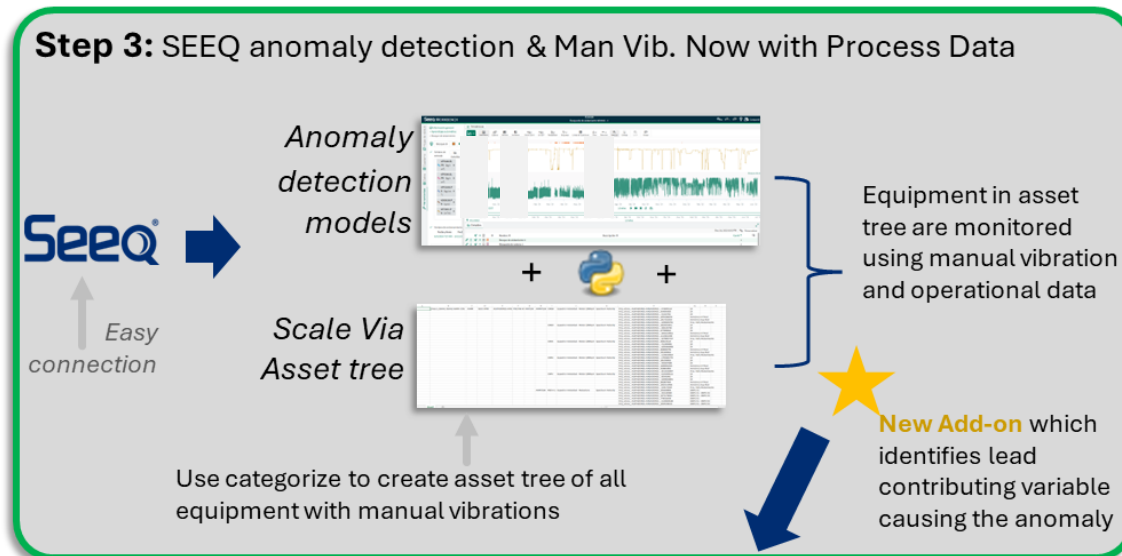
Process Asset Tree

» Fiabilidad » Línea 3_TA3-PTA4 » TA3 » SECC-0300
» AGITADORES » 3A301B (6P)

- ☐ Seleccionar todo
- ☐ Alert 1 - AE
- ☐ Alert 2 - AE
- ☒ Prediction Loss - AE
- ☒ Process
- ☐ Process_prediction
- ☐ Restrict_condition
- ☐ Risk score - AE
- ☐ Risk score thres 1 - AE
- ☐ Risk score thres 2 - AE
- ☐ Train_condition
- ☒ Vibration

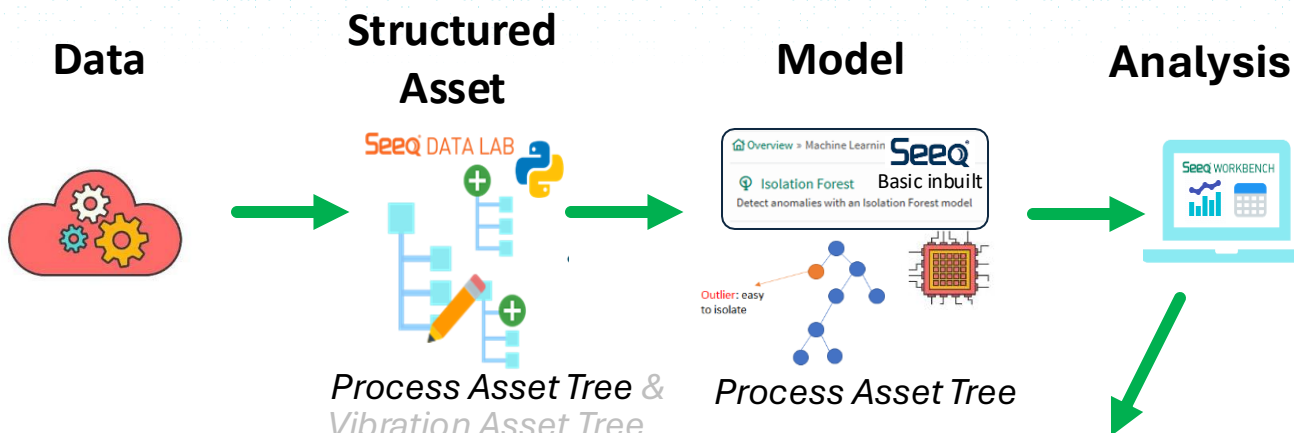
Add the necessary calculations in each asset tree

Additional information required for Machine learning models



Step 3: SEEQ anomaly detection / Man Vib. Now with Process Data

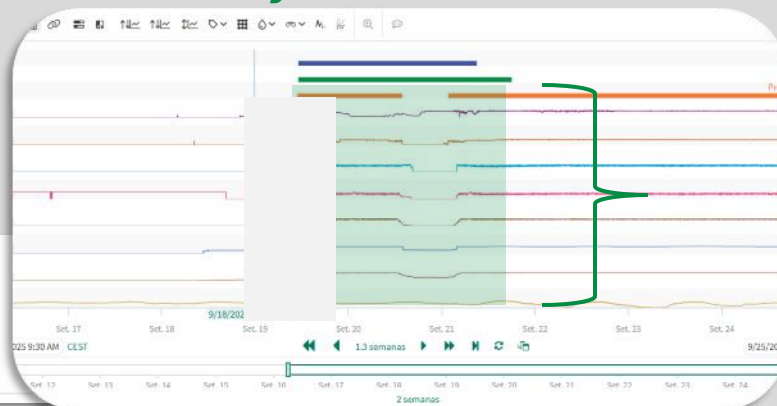
Thank you, CPET's MTC Team for helping us Quickly knock out this feature for my project!



Anomaly detection deviation for each variable used in forecasting.

Anomaly Event Condition

Overview > Machine Learning
Isolation Forest
Basic inbuilt
Detect anomalies with an Isolation Forest model



Scaling Machine Learning – currently to 27 Agitators

Leading Contributor for Anomaly? – Solved!



New Add-on that identifies the leading contributing variable behind the detected anomaly

Indorama Built Add-on

Anomaly Detection - Autoencoder
Build an Autoencoder model to detect anomalies.



Data Scientist Support

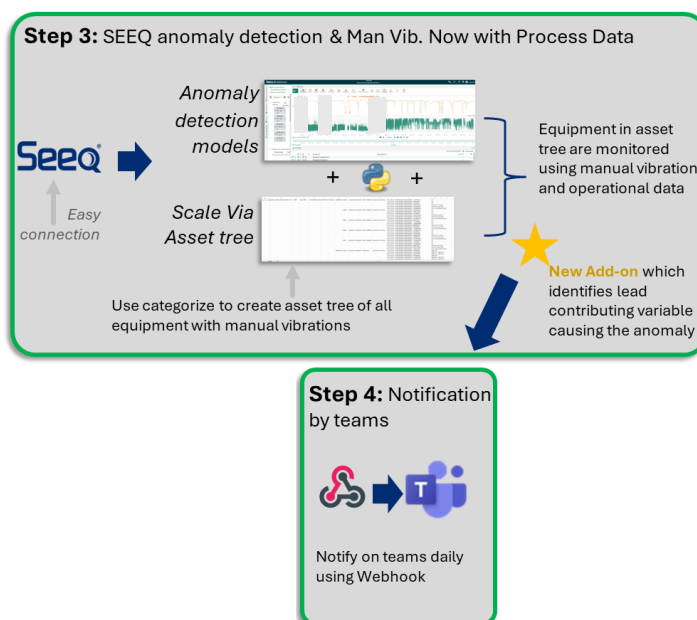
Then Sort by highest average contribution of anomaly for that specific Capsule - Event

Tags name	Avg.	Max.
Nombre	Promedio	Máximo
7PI5002.PV_std pred loss - AE - 0000000172	5.8188	7.1067
8U119.PV pred loss - AE - 0000000172	4.8801	7.8801
7LC302.PV pred loss - AE - 0000000172	3.0977	9.1326
7PI5002.PV pred loss - AE - 0000000172	3.011	4.3958
7IIA302.PV pred loss - AE - 0000000172	2.5043	7.2849
7FC201.PV pred loss - AE - 0000000172	1.7348	2.8679
7LC302.PV_std pred loss - AE - 0000000172	1.671	4.5889
7IIA302.PV_std pred loss - AE - 0000000172	1.2209	2.5658
7PC302A.PV_std pred loss - AE - 0000000172	1.0358	3.2336

Used to: Localize process variables more deviated vs trained period

Analysis and Results

Process Data



Step 3-4: Seeq Analysis | Confirmed Savings early this Year

Example of Process & Seeq

Before

Inspect **1 Equip.**
at a **time**



Analysis



Glycerin System Pressure

Before shutdown



After shutdown

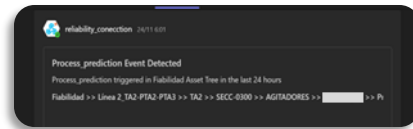


Anomaly need to analyzed by engineer using all variables used to modelized

Let Your Data Find You — the Moment Something Goes Wrong

Improved

Insights come to us automatically — no more chasing tags or digging through models.

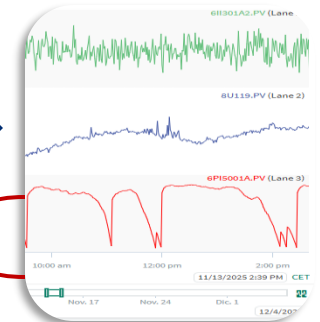


Monitor 27 equipment

Deviations of the variables using autoencoder output
(sort by high average)

Tags name Nombre	Avg. Promedio	Max. Máximo
6I1301A2.PV pred loss - AE - 0000000178	10.89	19.053
6PI310A.PV_std pred loss - AE - 0000000178	9.9268	22.413
6PI5001B.PV_std pred loss - AE - 0000000178	8.8362	15.896
6PI5001A.PV_std pred loss - AE - 0000000178	8.7821	15.795
6SI301A.PV pred loss - AE - 0000000178	7.594	12.64
6LC301A.PV pred loss - AE - 0000000178	7.3031	14.169

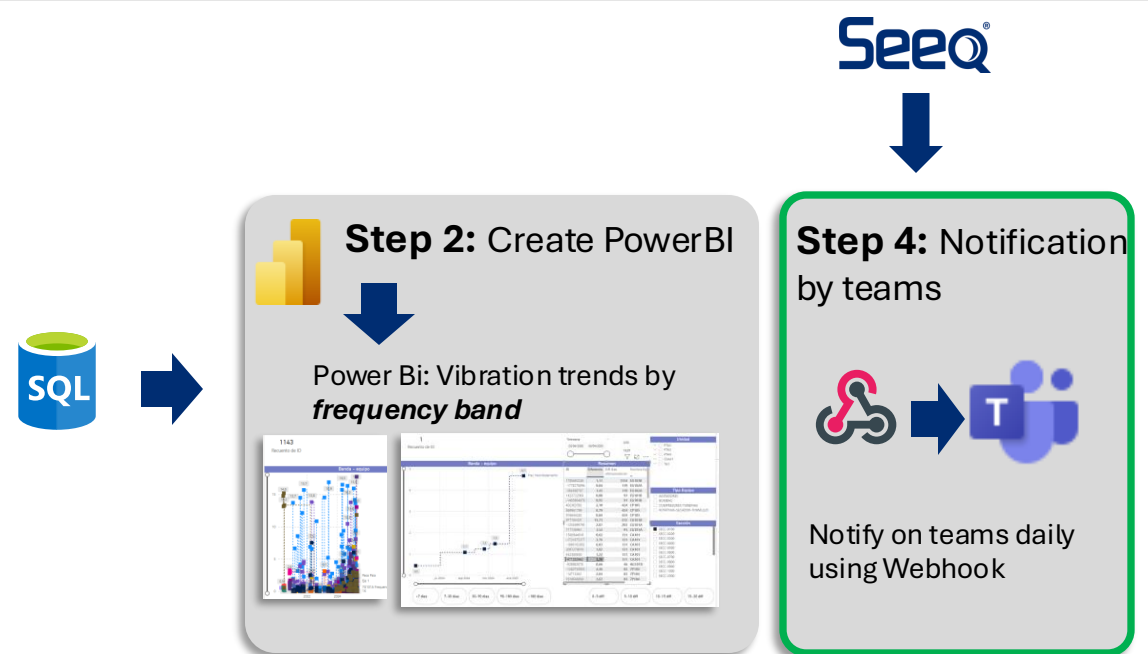
Glycerin system Pressure (STD)
focus on important variables



Trend of 19 h

Reporting Views

Vibration Data

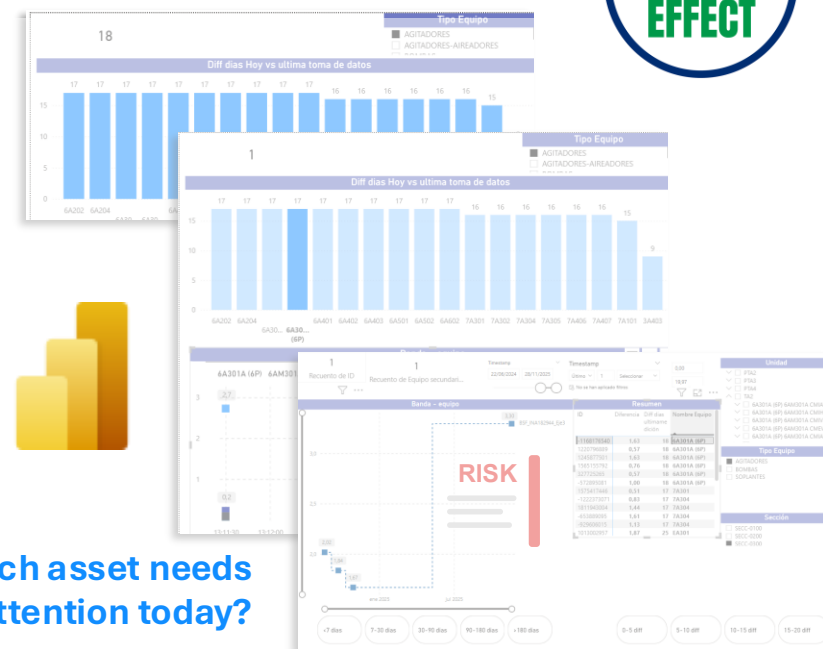
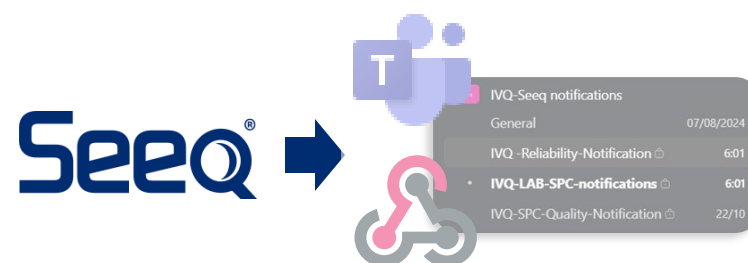


Step 2-4: Vibration analysis (Power BI-Seeq)

The vibration assets have so much conditions to monitor, with the objective to **minimize the time used** with the power of **asset tree group on Seeq** and the **agile check with Power BI** on detail after this **must continue** the review on Omnitrend (**Vibration software**)

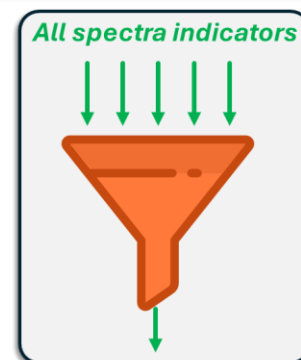
Example:

Focusing on Time to Act, instead of Time to Analyze.... then react



Thousands of data points compressed into a single insight:

This is a **support function** for the reliability engineer; it does **not replace** their judgment or professional expertise, but **Greatly** speeds up where to focus attention.



1 actionable Indicator (capsule)

Which asset needs attention today?

4 active capsule of 18 equipment with any capsule active on the last 18days

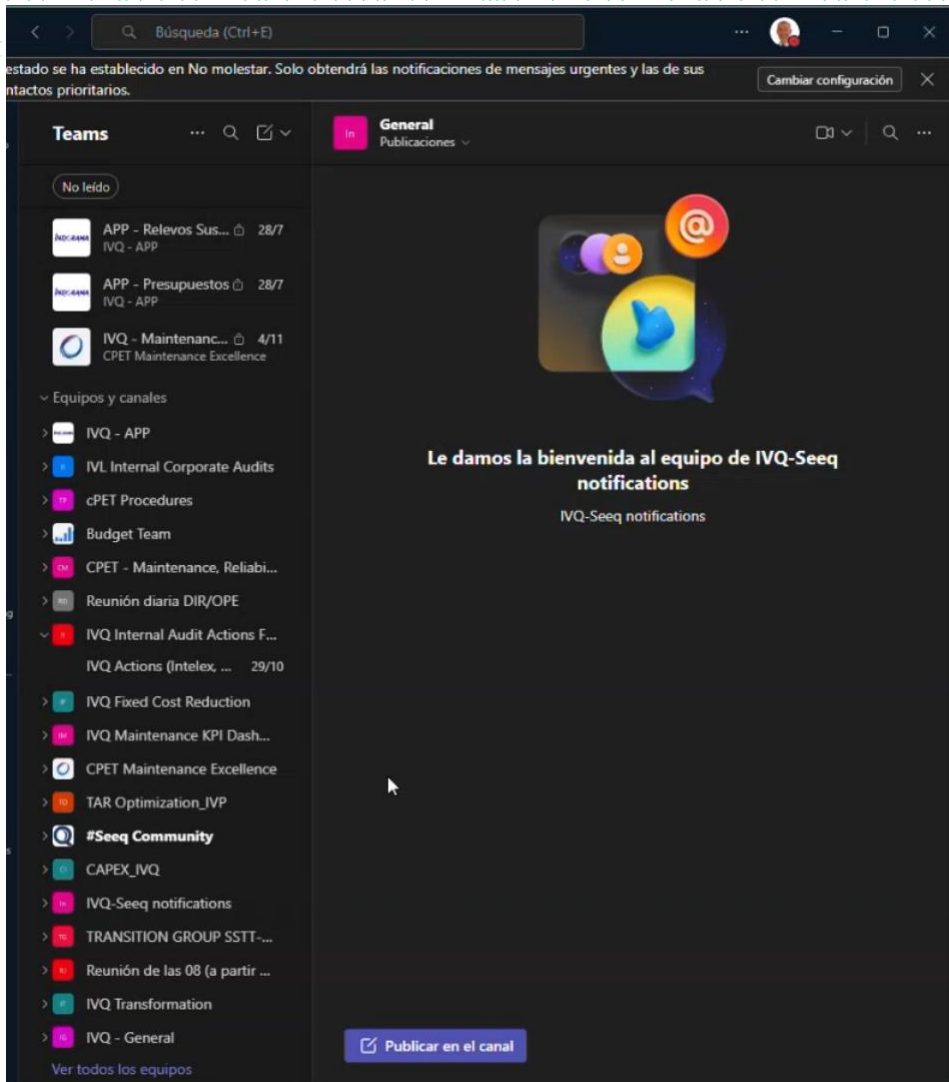


Unlocking the Next Level of Organizational Efficiency

This small-scale pilot is only the beginning...

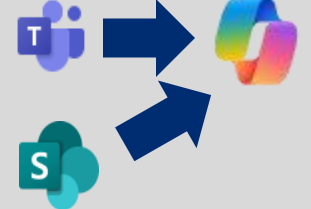


Step 5: : Ai to quickly Investigation




**Team's Webhook
notification of concern period**

**Step 5: Ai to
quickly
Investigation**



Find quickly equip specs,
recent failure, all
documented on 

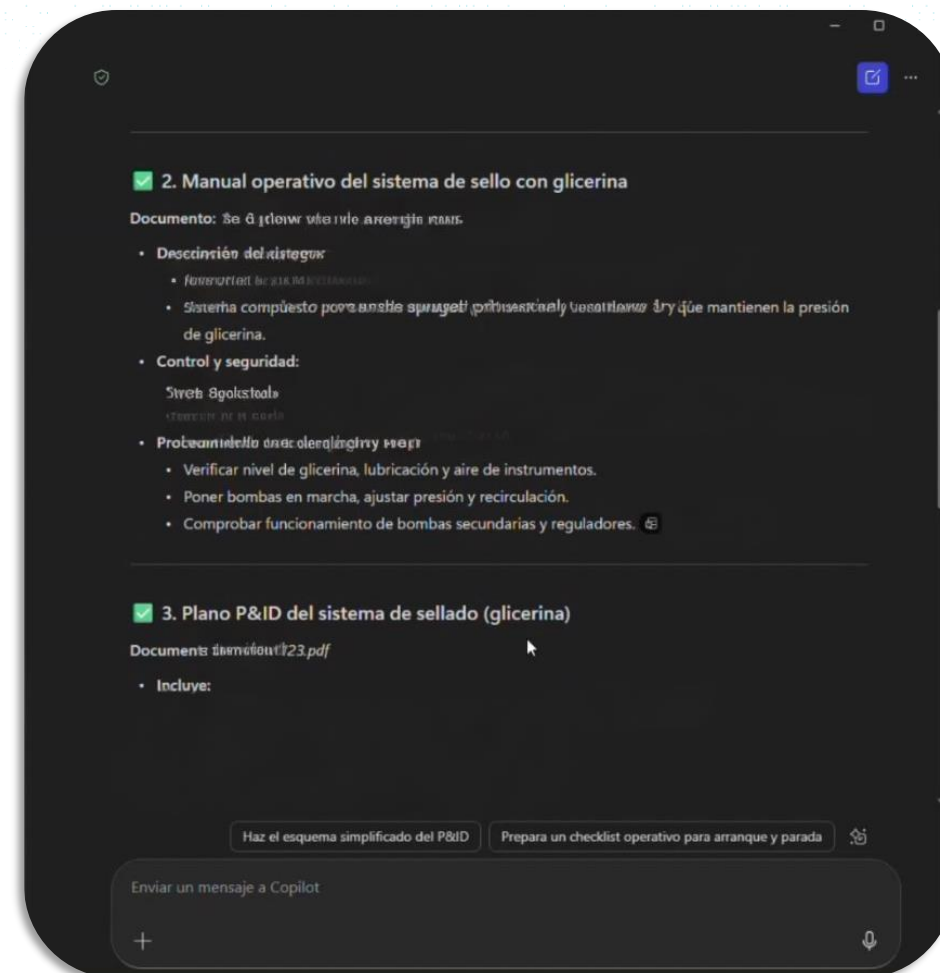
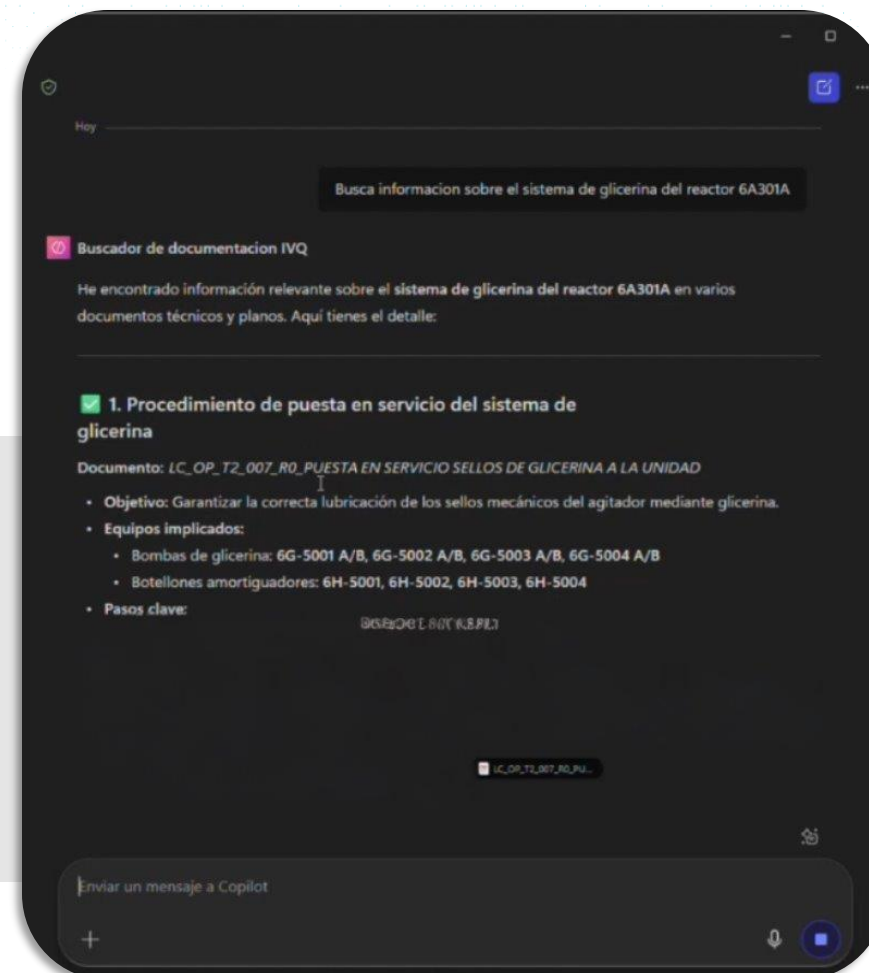
Unlocking the Next Level of Efficiency

 Copilot + SharePoint for unified & efficient information access

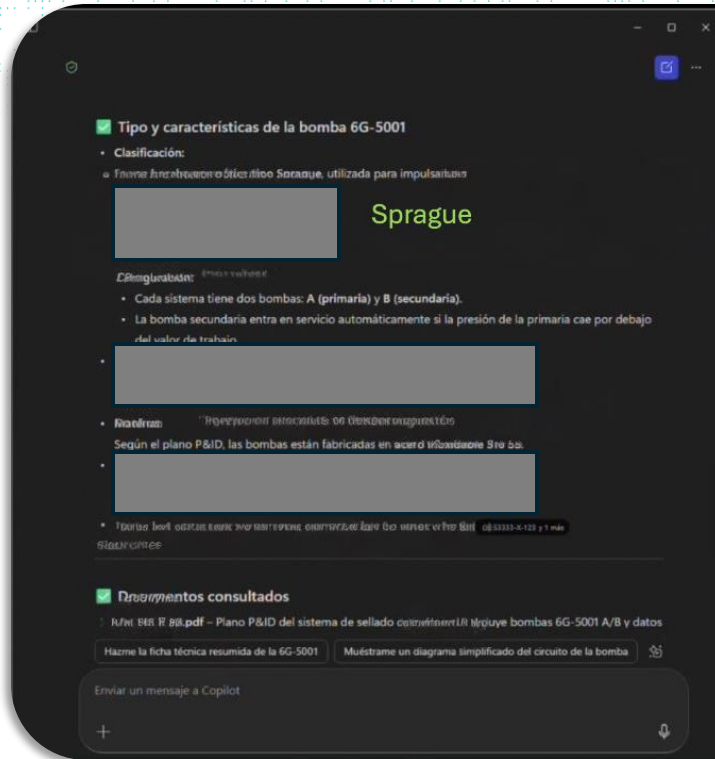
Prompt:

Search for information about the glycerin system of reactor 6A301A

Quickly finding
Procedures,
Manuals,
P&ID's



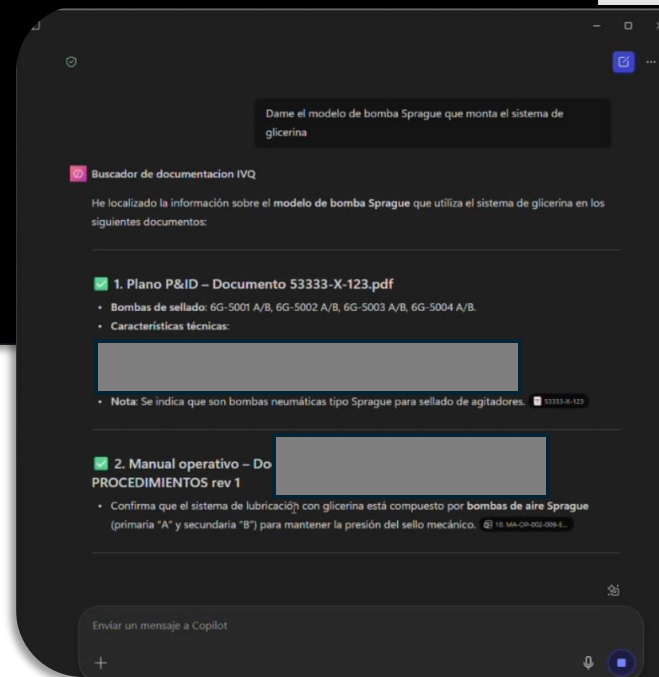
Unlocking the Next Level of Efficiency



 **Copilot + SharePoint for unified & efficient information access**

Prompt:
"What type of pump is 6G5001?"

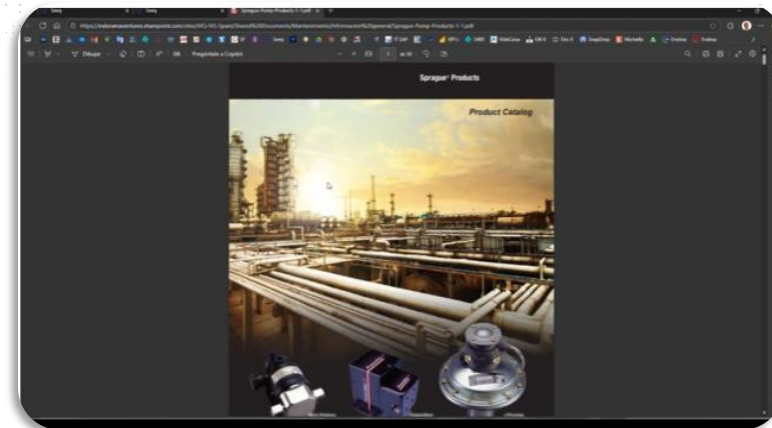
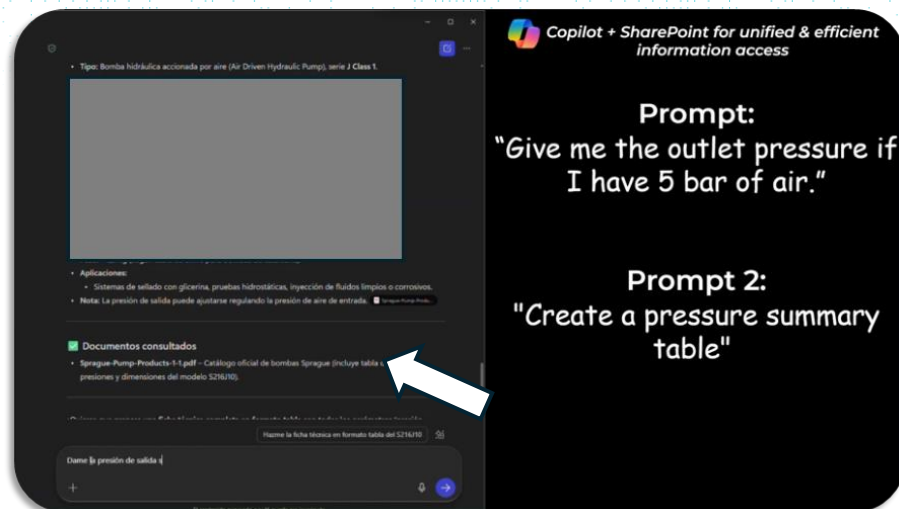
Quickly finding
Pump Specifications



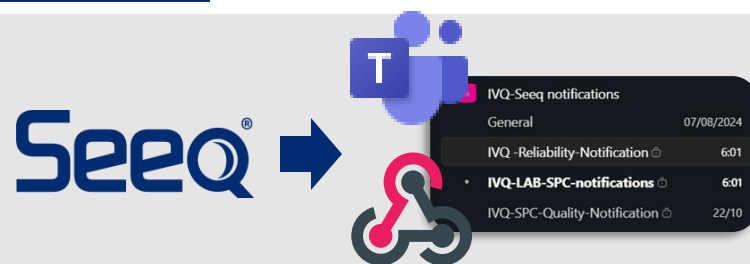
 **Copilot + SharePoint for unified & efficient information access**

Prompt:
"Give me the Sprague pump model installed in the glycerin system."

Unlocking the Next Level of Efficiency

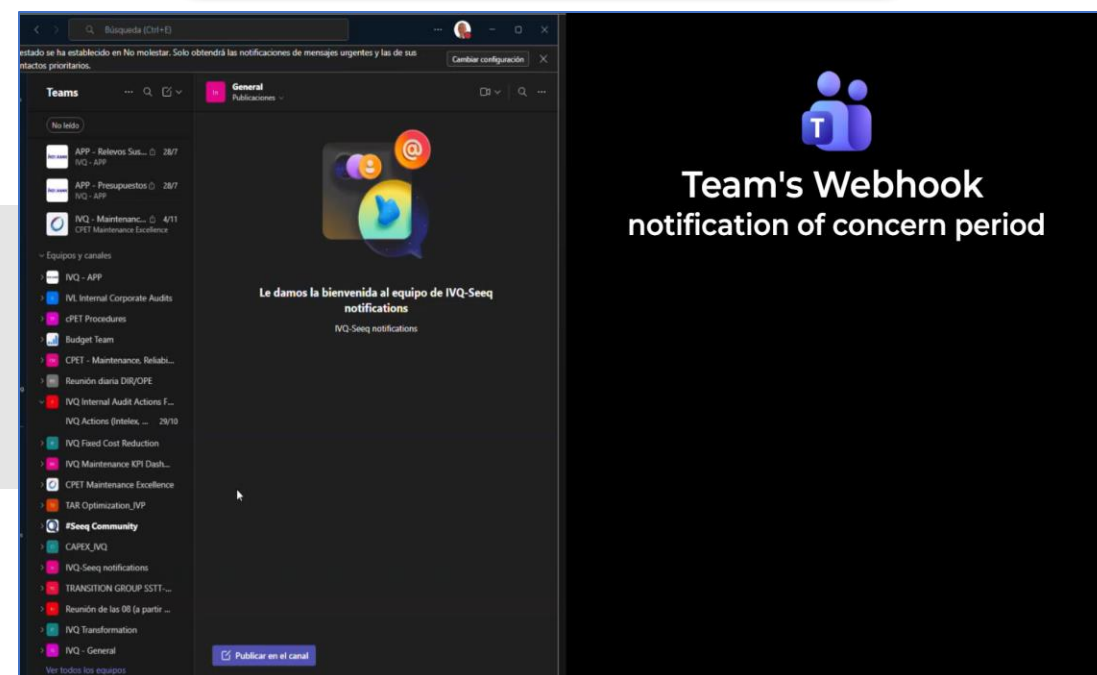


Reminder:



... **Started from**
Anomaly Information
coming to your
workspace

Information being brought to you
When you need it most



1 Page Project Summary:

Scaling Predictive Equipment Health Using Vibration & Process Data

Indorama Ventures Quimica, Spain

Define: Turning data overload into monitoring clarity through scalable intelligence, enabling our teams to reduce analysis time for early detection and reaction

Value:

- Early detection from anomalies.
- Time analyze reduced
- Standardize formats to ML
- Improve vibration data analysis

Measure:

- Time required to do a manual vibration analysis.
- Actions required to do mechanical or process analysis.

Analyze:

- Time available to analysis.
- Manual Analysis.
- Overload data to specialist engineers

Conclusion: The focus was on reducing the time required for each analysis and preventing overload

Improve:

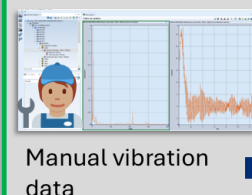
- Extract & structure vibration manual data.
- Implement tools with calculations.
- Create notifications with resume of equipment to analyze.
- Include isolation forest (unsupervised model) to monitor process conditions.
- Migrate technical documentation at accessible repository (not done yet)

Control:

- Keep and supervise what manual data is update on SQL database
- Keep and supervise the isolation forest with reliability and process engineers

Vibrations spectrum of critical machines

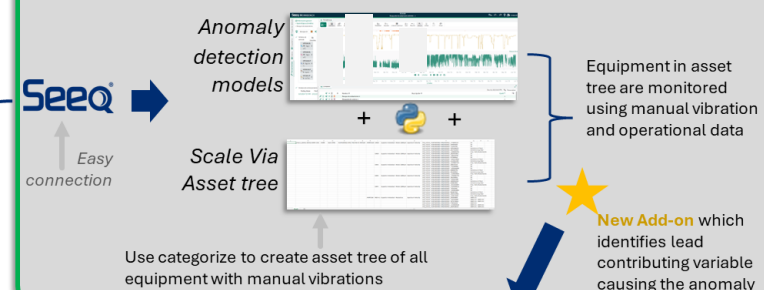
Step 1: Pruftechnik data



Python to transform data & categorize

14,940 thousand different tags of vibration
409 different equipment

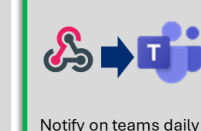
Step 3: SEEQ anomaly detection & Man Vib. Now with Process Data



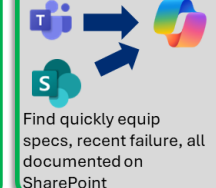
Step 2: Create PowerBI

Power Bi: Vibration trends by frequency band

Step 4: Notification by teams



Step 5: Ai to quickly Investigation



Analytics in Every Hand. Impact at Every Level.

Thank You to the Leaders & Team Supporting!

*The Entire Maintenance
& Reliability team*

Digital x IVEX x Sustainability

**ADVANCED
INDUSTRIAL
ANALYTICS**

#All_IN Analytics in Every Hand.
Impact at Every Level. **2026**