

Remote and Continuous Data Analysis

For critical assets

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Introduction

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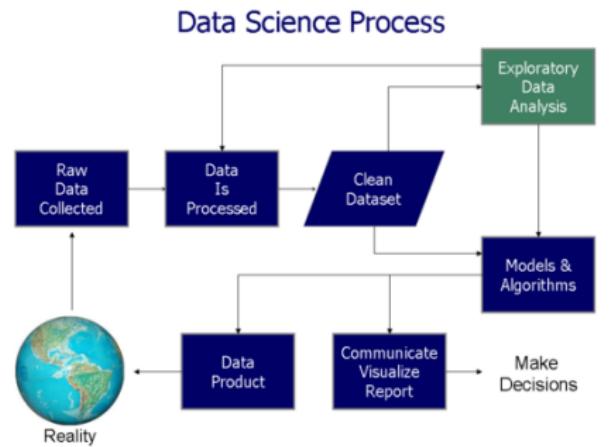
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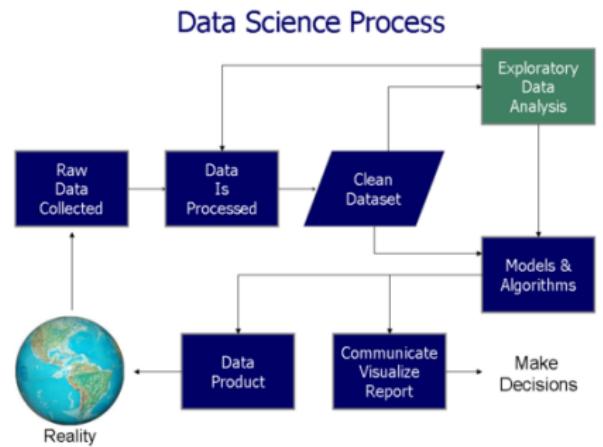
Data analysis

- Process of breaking down a whole into its constituent parts for closer evaluation.



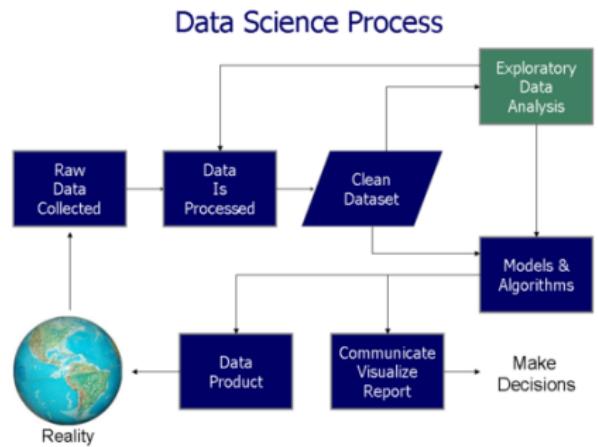
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- **Connection to the scientific method**



Operational environment: Maintenance

In the numerous areas in which data analysis shines, we focus on **Maintenance**, where the priority is ensuring system reliability and safety during life cycles. The basic types include:

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 - 3 Condition-based maintenance: *maintenance when it is needed*



Host: Zensor

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Zensor

Quick Overview

Based in Brussels, [Belgium](#). Main focus is IoT and Industry 4.0.

Provide a full, integrated, and intelligent monitoring solutions for:

- Industrial Production (Food, Glass, Metal)
- Infrastructure (Rail, Tram, Bridges)
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Four aspect are involved:



Figure 1: Project building blocks



Core Service

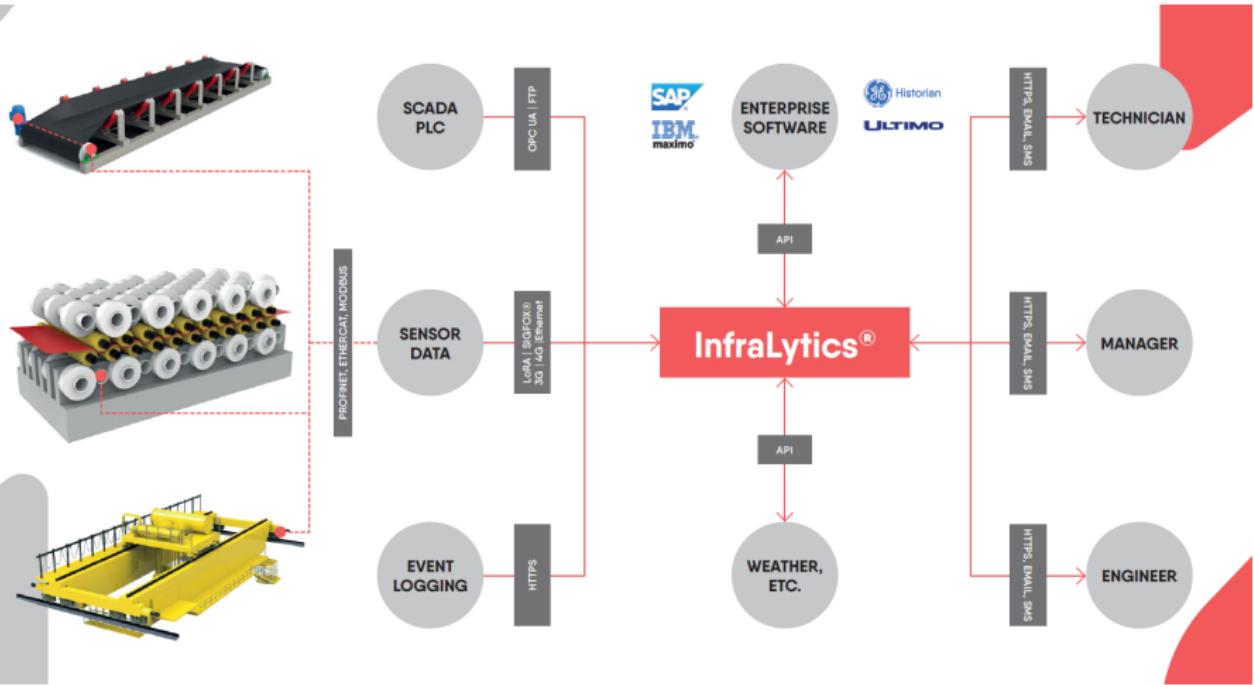


Figure 2: Infrastructure Analytics platform



Tools

Pandas

- Data processing & cleaning
- Python library, widely adopted
- *Split-Apply-Combine* approach

InfluxDB

- Data storage & warehouse
- Key-value – Time Series Database
- TS-data that represent how a system changes (over time)

Grafana

- Data exploration & visualization
- Web-based interactive app
- Dashboard development



Blade grinder vibration

Goals

Improve blade-cutting machine line; has a high number of standstills and not ideal quality of the cut.



General goals:

- Increase production quality
- Avoid unplanned standstill & extend machines's life
- Identify the impact of the grindstones turning
- Find the root-cause of strong vibration



Context

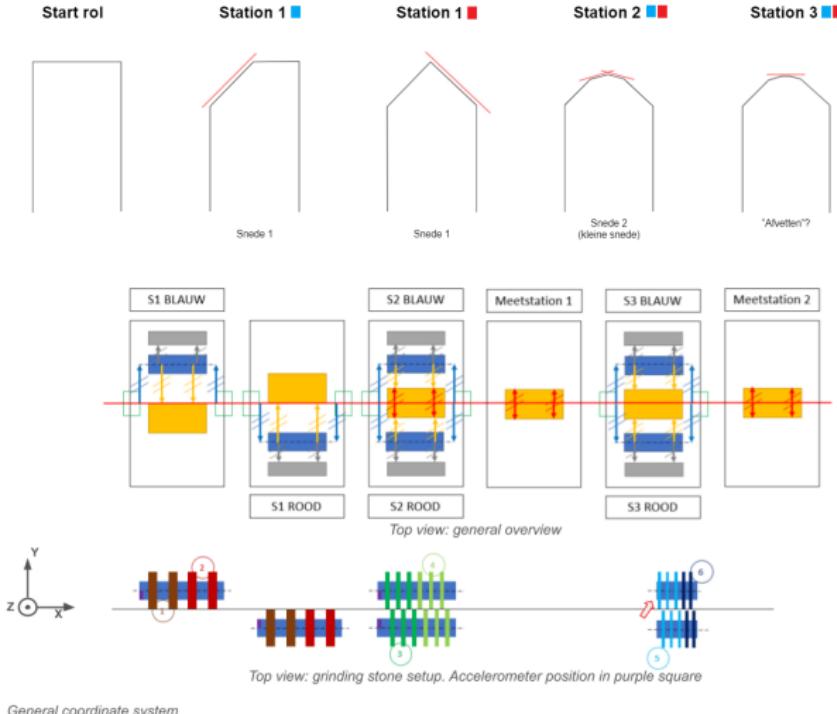


Figure 3: Blade evolution & line top view; engineering schematics



4 Phases – I

Hardware & Data sources

- 3-dimension accelerometer
- Mobile cabinet
- Log file (operational data)



(a) Installation photo



(b) CAD render



4 Phases – II

Installation

- red and blue sides
- Local (x, y, z) for each sensor placement
- Global (X, Y, Z) for the entire production line
- Sensor orientation and installation angle

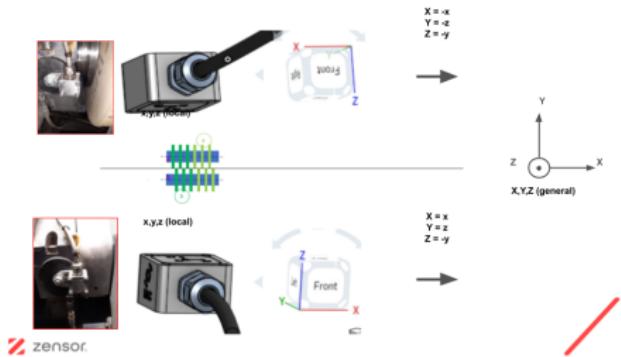


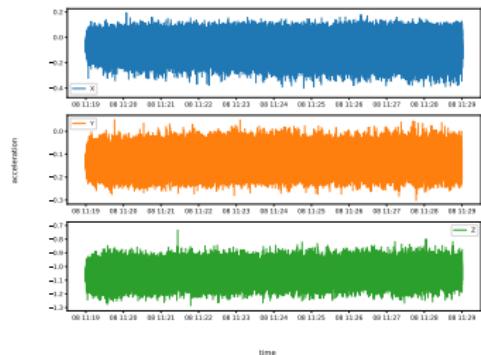
Figure 5: From local to general coordinate system



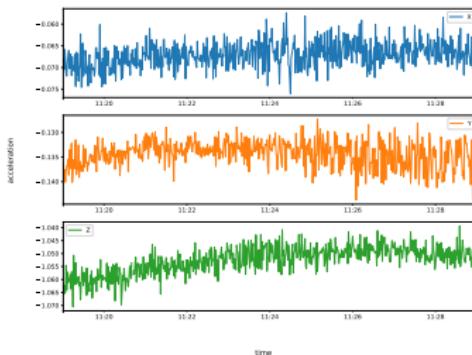
4 Phases – III

Data Management

- Single data stream
- $ACC_{x,y,z} \longrightarrow DB$
- 60Hz to 1Hz /w Lambda



(a) 60Hz raw vibration



(b) 1Hz raw vibration



4 Phases – IV

Analysis

- 1 Exploratory data analysis
- 2 Isolate relevant blocks
- 3 Retrieve ACC Data
- 4 Vector calculus:
 $x, y, z \rightarrow X, Y, Z$
- 5 Root mean square (RMS)

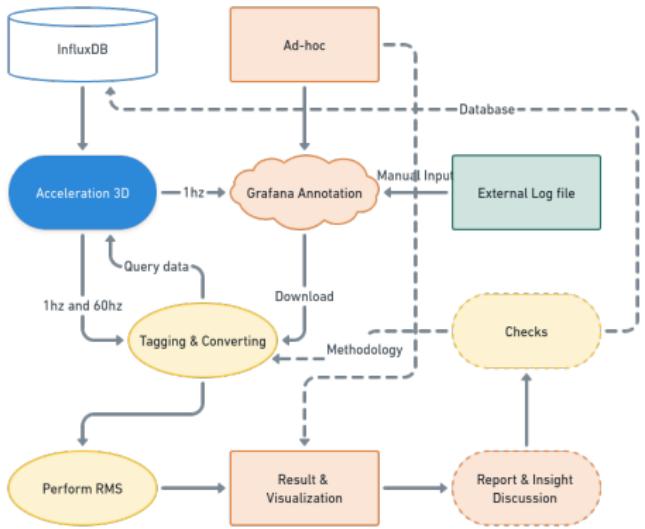
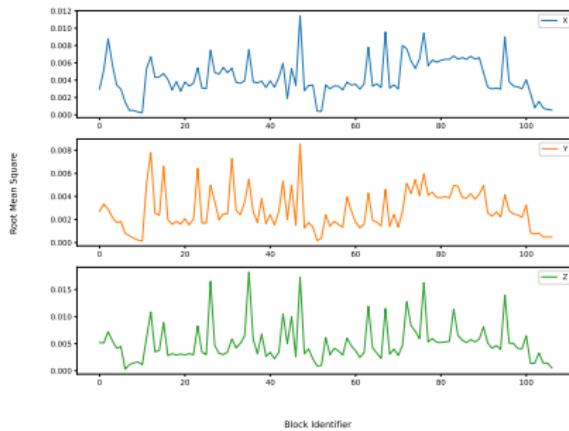


Figure 7: Steps involved during and after the analysis phase

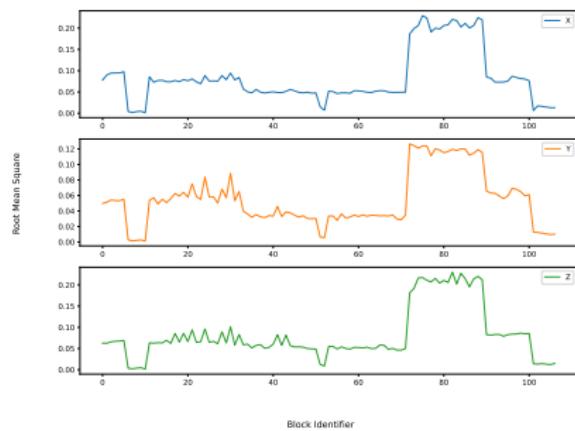


Results

These plots were then discussed with a more experienced colleague, who had more domain knowledge. He also continued with the analysis.



(a) 1Hz RMS values



(b) 60Hz RMS values

Figure 8: RMS amplitude comparison
between low and high frequency data



Findings

The *ad-hoc* analysis showed some insightful findings:

- 1 station one, blue side, has higher vibration than expected
- 2 station two is the main source of vibration as we hoped it would be
- 3 the cooling fluid, while drying, cause higher vibrations.

Counter-intuitive result

Vibration amplitudes (RMS_X), along the blade going through the grinding stone stations, seemed more prominent than in Y direction, perpendicular to the blade direction.

The stones turning would intuitively cause more vibrations perpendicular (Y, Z) to their rotating axe, not along (X).

After successfully double-checking the whole stack we can confirm that, indeed, X and Y are not switched.



**Monitor electricity
consumption**

Goals

Track the energy usage of a large campus, the Brussels Health Campus, in Jette, using existing data collected over several years. We focus on the academic hospital, that has its own distribution network, in closed-ring shape for increased reliability.

General goals:

- Having a global view on the data, centralized and well accessible for multiple user
- Minimizing the energy losses and overall consumption
- Identify where the exact sources of energy cost are
- Improve sustainability reducing energy need and peak request



Context

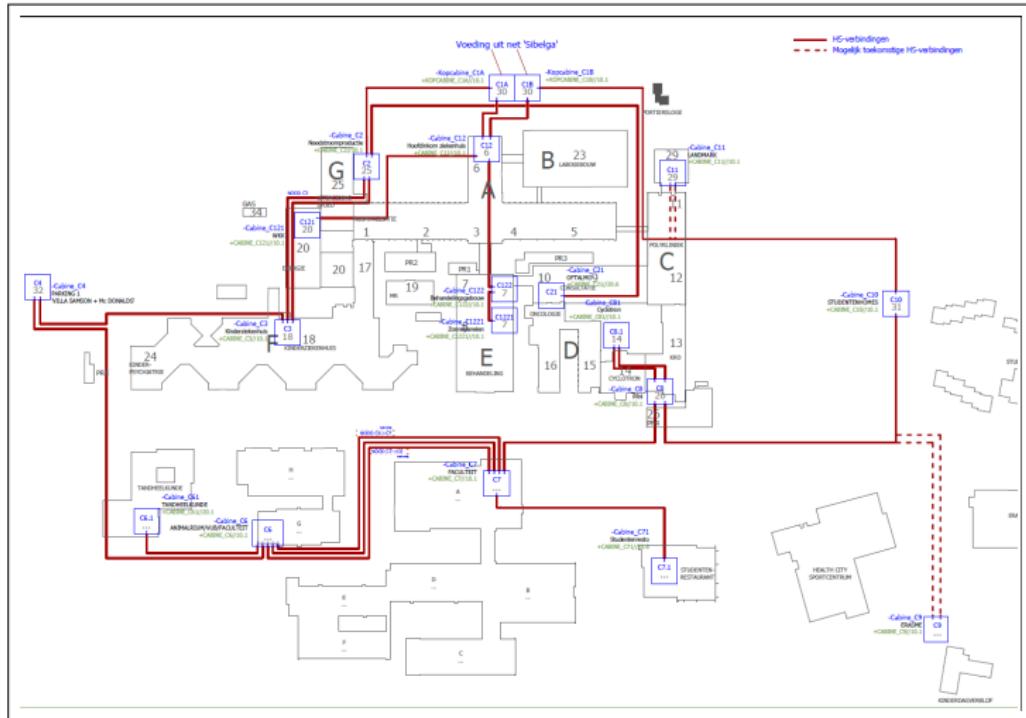


Figure 9: UZB electricity distribution network layout



4 Phases – I

Data sources

- Tries to reflect reality
- Limited dataset
- 15-minute “electricity” data
- Also metedata source

Example:

root/NodeC3/Transformer
0302/ConsumerEnergy/
Bord_Radiologie.csv

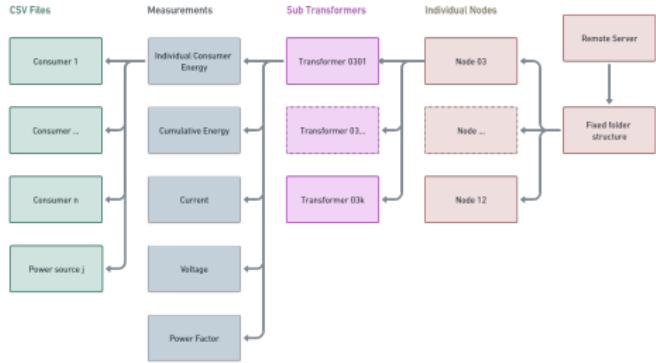


Figure 10: VUB's folder tree structure



4 Phases – II & III

Commissioning

- SSH File Transfer Protocol
- automate remote access
- automate ingestion

Data Management

- Multi processing script
- Parsing, cleaning and tagging
- Writing DB “measurement”



Figure 11: VUB's data ingestion flowchart



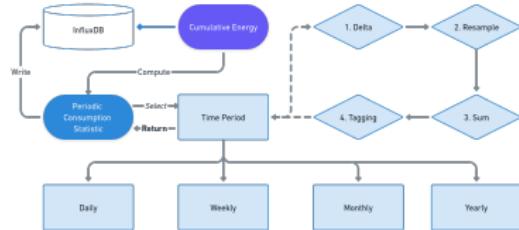
4 Phases – IV

Analysis

- Lorem
- Ipsum
- Sed
- Dolore



(a) Transformer-302 raw data dashboard



(b) VUB's analytics chart



Grazie per l'attenzione