

Vibration-based Condition Monitoring : Future Trend

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Few Facts about the University of Manchester, UK

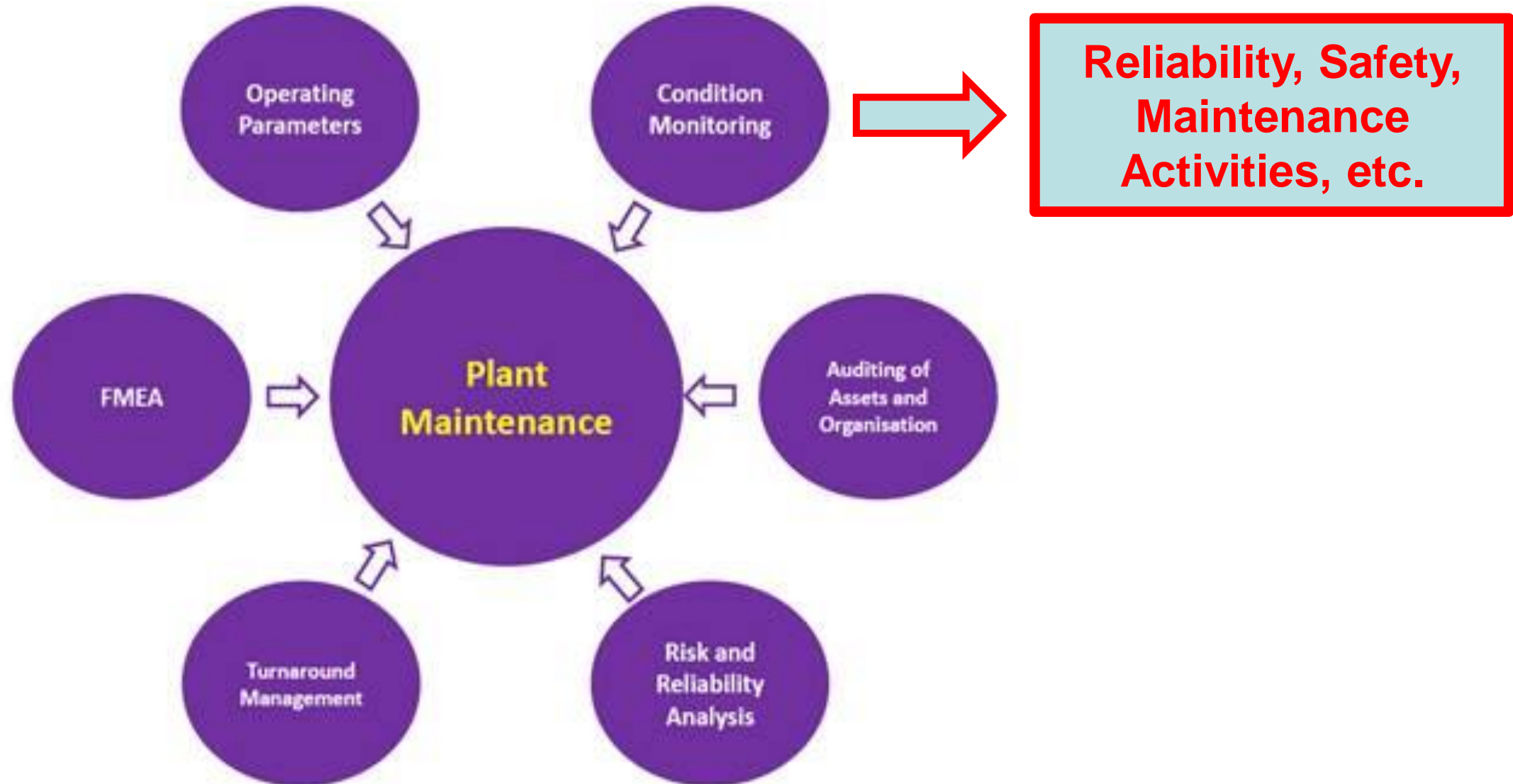
- Largest single-site university in the United Kingdom
 - Over 40,000 students from more than 150 countries.
 - Over 10,000 staff.
- Research Income >1000millions of the UK Pound per year.
- 25 Nobel laureates have worked or studied here.

• University Ranking

Year	World ranking	European ranking	UK ranking
2022	27	8	6
2017	38	8	6
2010	44	9	5
2004	78	24	9



Maintenance Model: A Generic Approach



Condition-based Maintenance objectives

- ***Identify fault(s)/defect(s) in machines and structures at early stage to reduce unplanned shutdown.***
- ***Carry out the required remedial work during planned Outage.***
- ***Reduce the downtime and maintenance overhead.***
- ***Maintain the plant safety as well.***
- ***Enhance Production***

Condition Monitoring (CM) Techniques

Vibration Monitoring

Monitoring of process and machine parameters

Temperature monitoring, Infrared analysis

Lubricant analysis

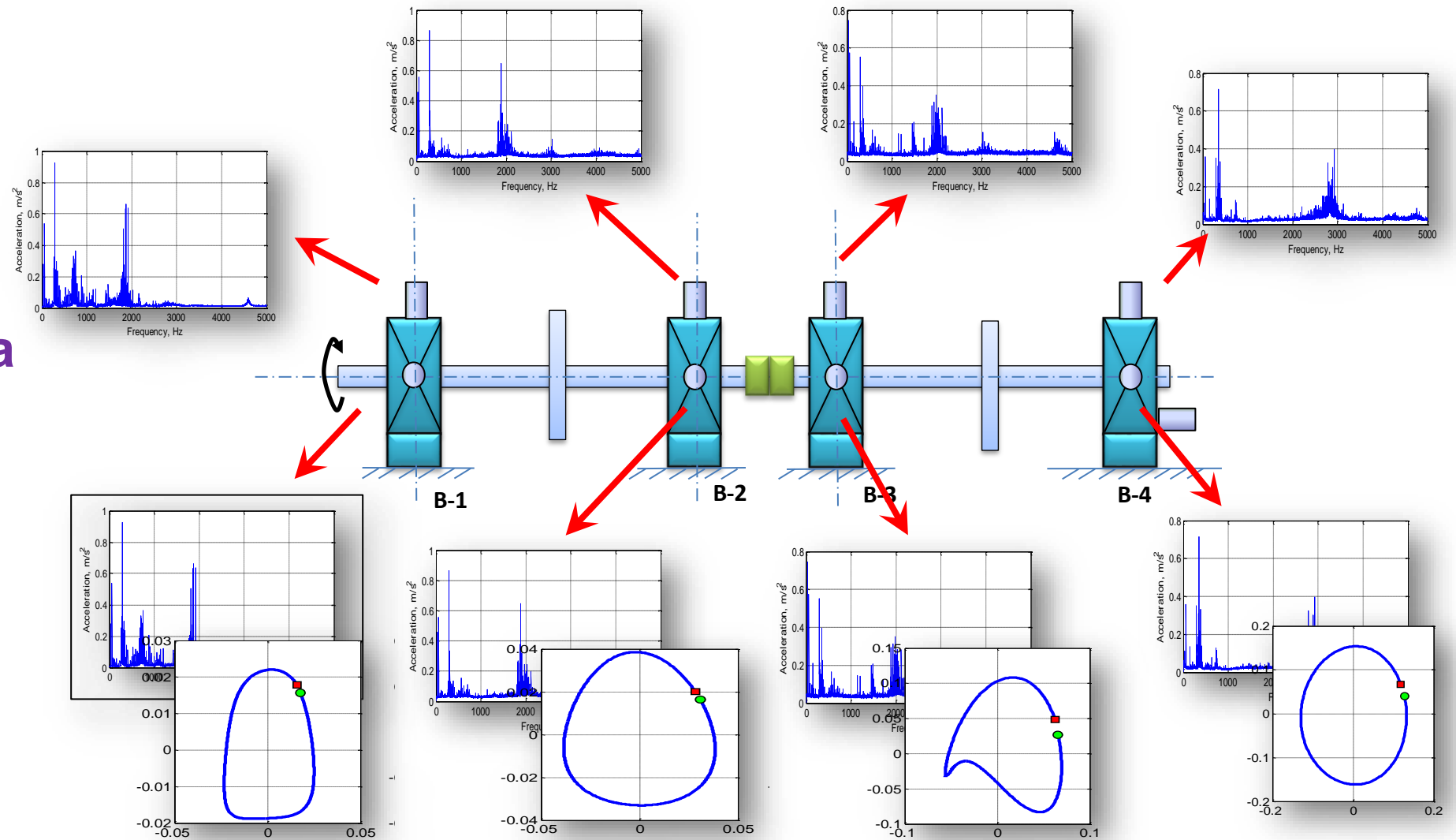
NDT Techniques

etc. etc.

Vibration-based CM

Challenges

More Measurements in a Machine: Data intensive and complex...



Limitations

Presence of faults can be detected, but

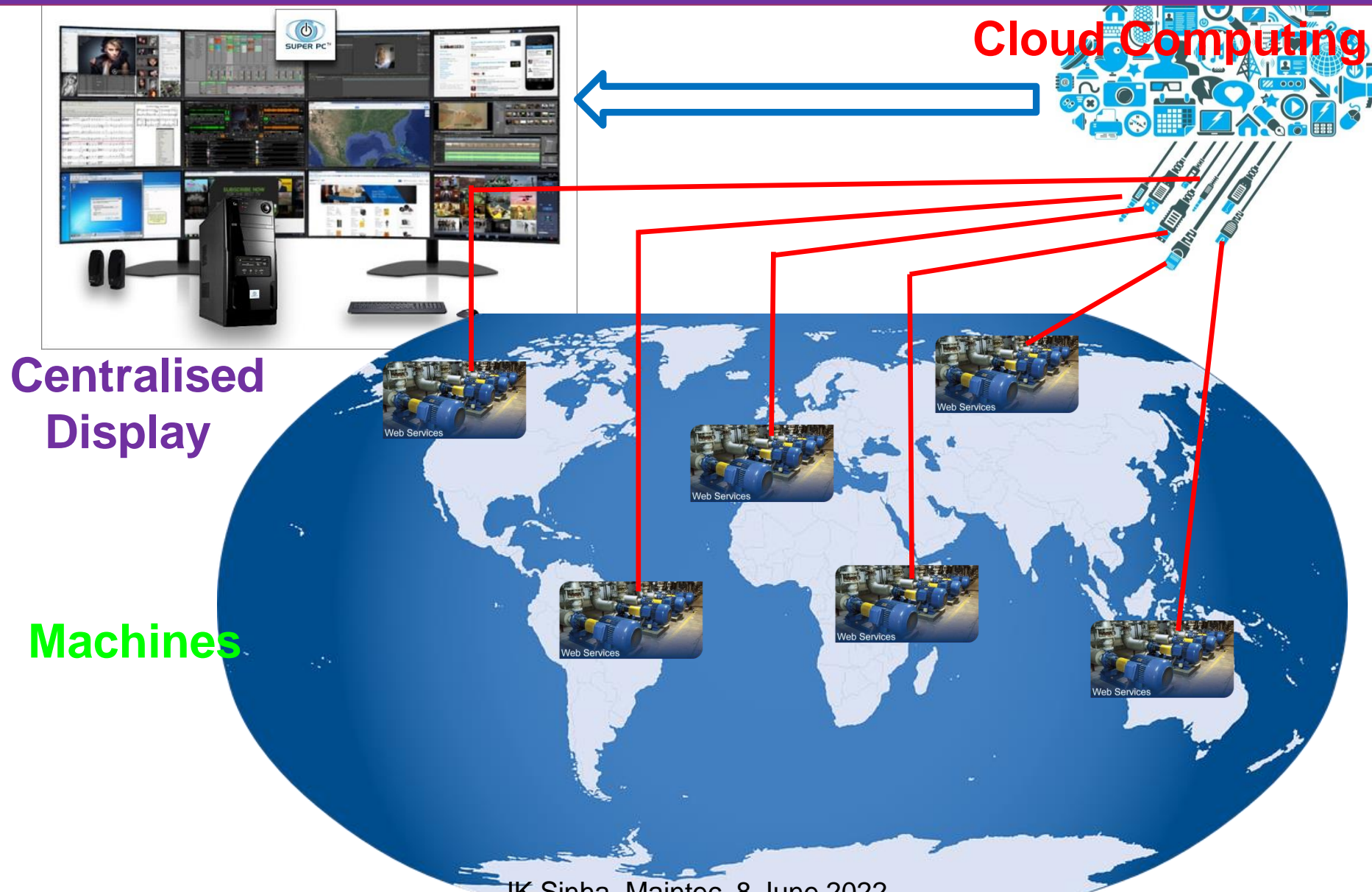
- *Detection process is subjective.*
- *Requires Experience & Engineering Judgement.*

Current Trend

- **Industry 4.0**
 - **Industrial Internet Things (IIoT)**
 - **Artificial Intelligence, ML, Digital Twins**
 - **BiG Data Analysis**
 - **Remaining Useful Life (RuL) Estimation**
 - **Feedback Control**
- Trying to Achieve “Digital to Digital” Approach-----

MAGIC BLACK BOX

Industry 4.0 Centralised CM System



Tools available for AI modelling.

Several studies available in Literature.

Generally requires BiG Historical Data and Training!!

Lack of Optimisation and Standardisation of the monitoring parameters based on machine dynamics.

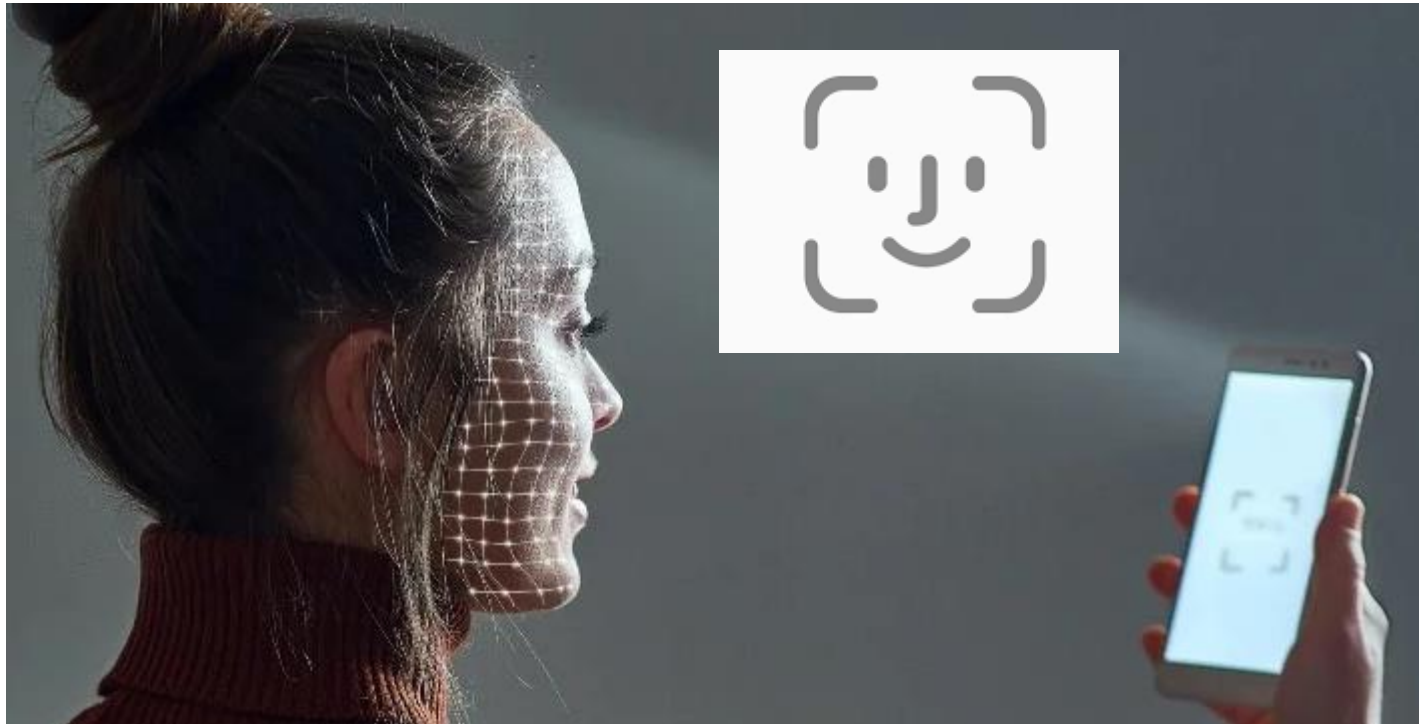
Industrial applications!

Face IDs

Mobile phone screen unlock

Login to Computers

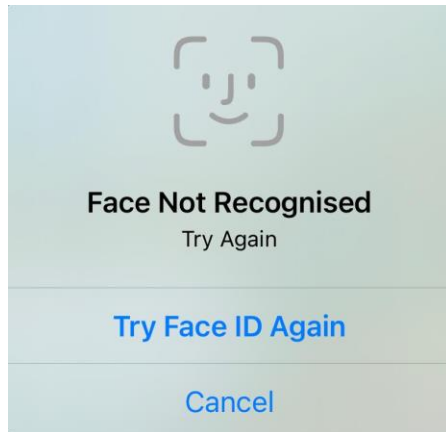
Other applications – Banking, many other Apps!



JK Sinha, Maintec, 8 June 2022

Source: Google Images

Self-learning Smart AI-based Face ID Model



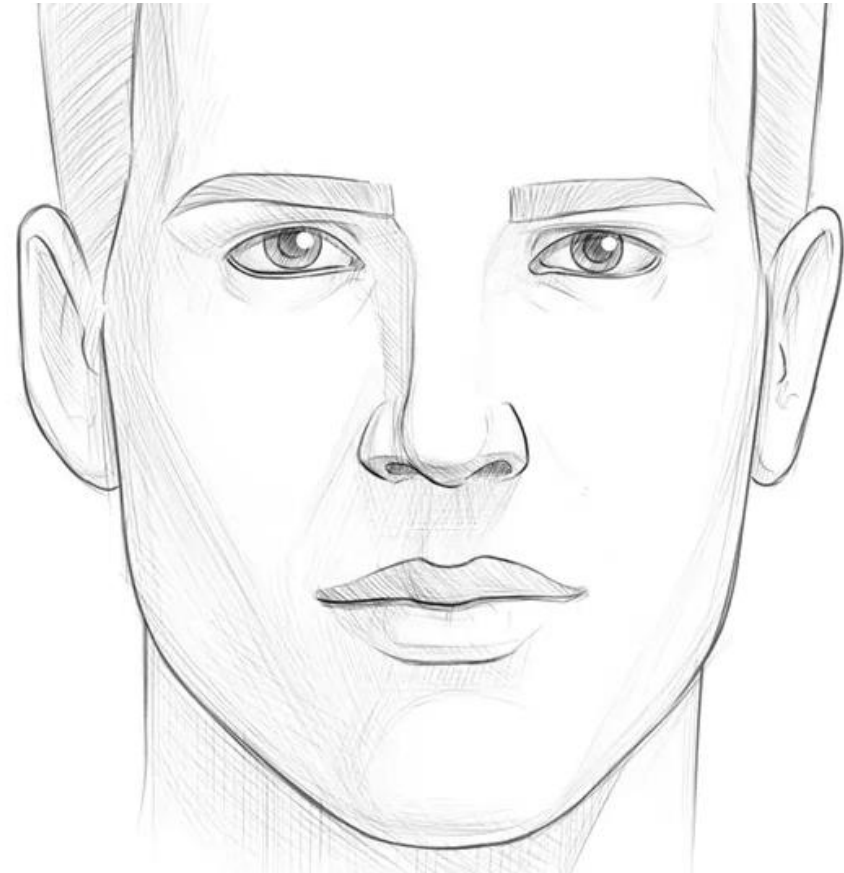
Eyes

Ears

Nose

Lips

Chin



Features!

Standardization of Vibration Features



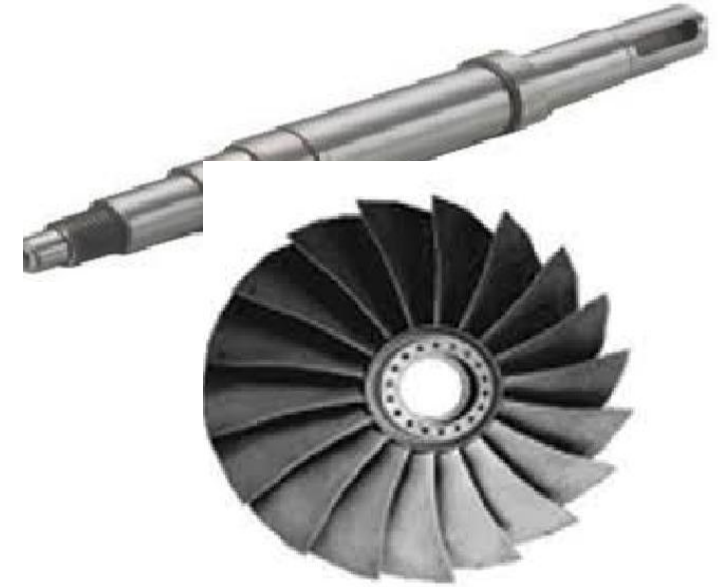
Motors



Gearboxes



Bearings



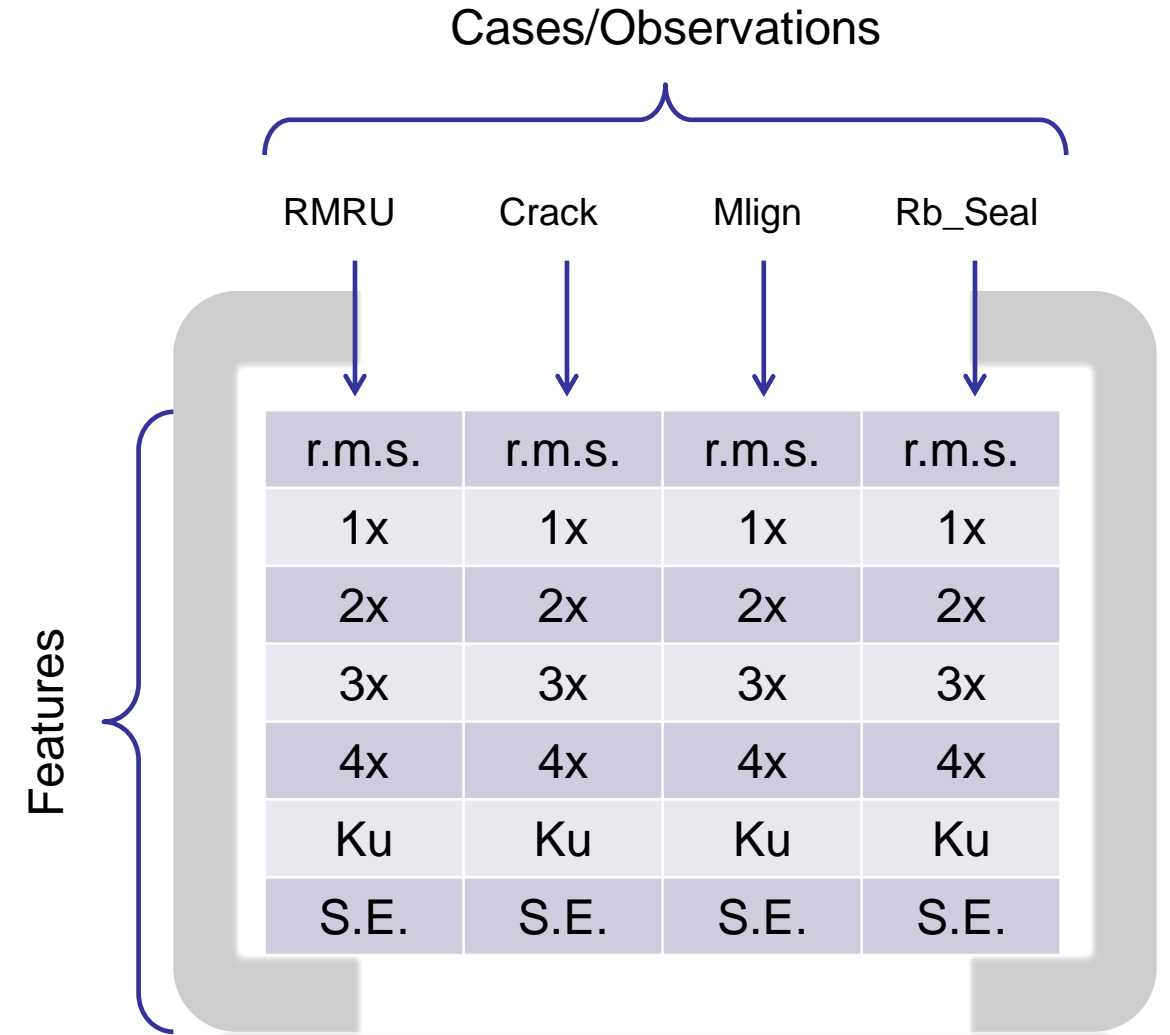
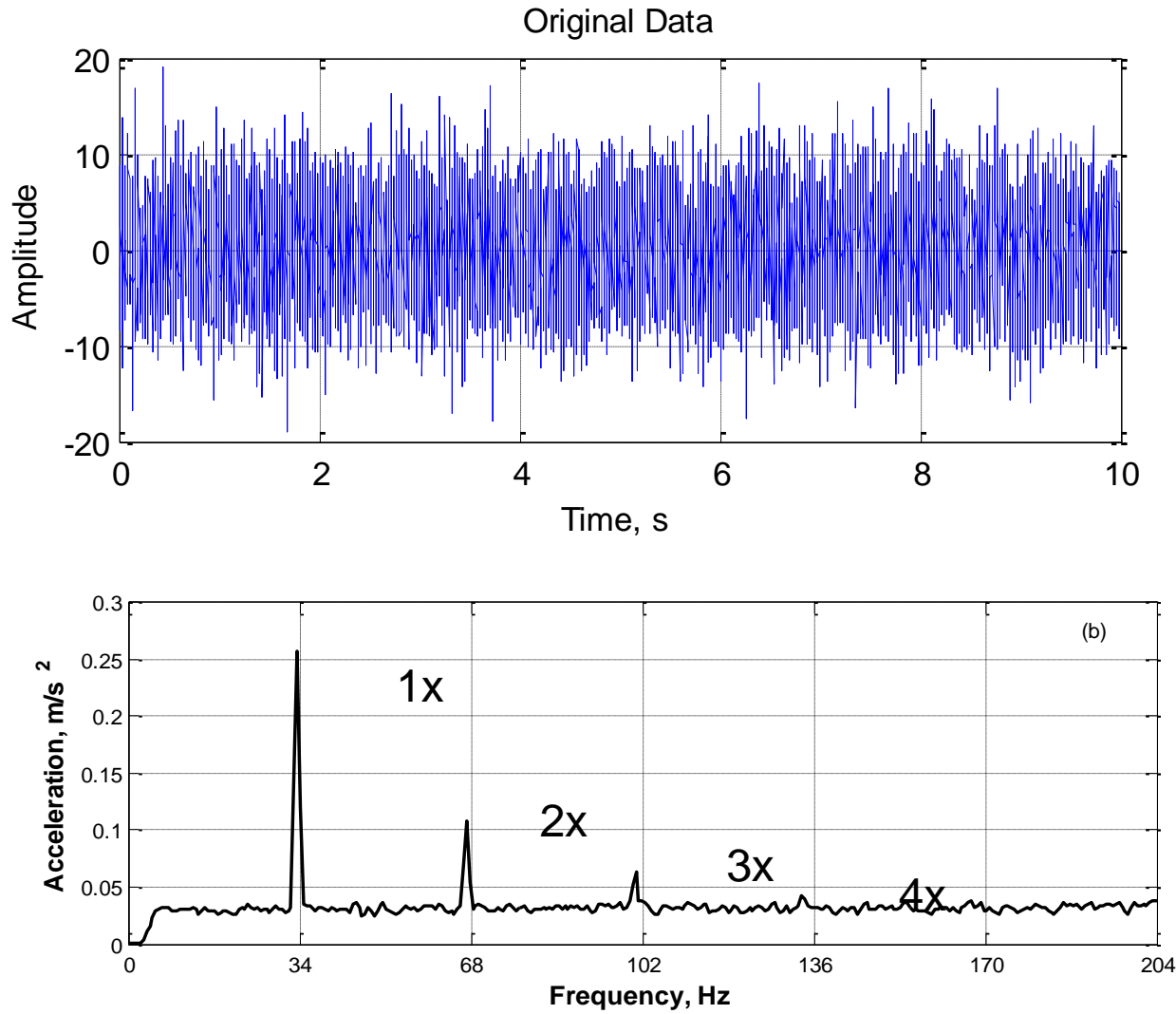
Rotor/Shaft

Optimise Vibration Features

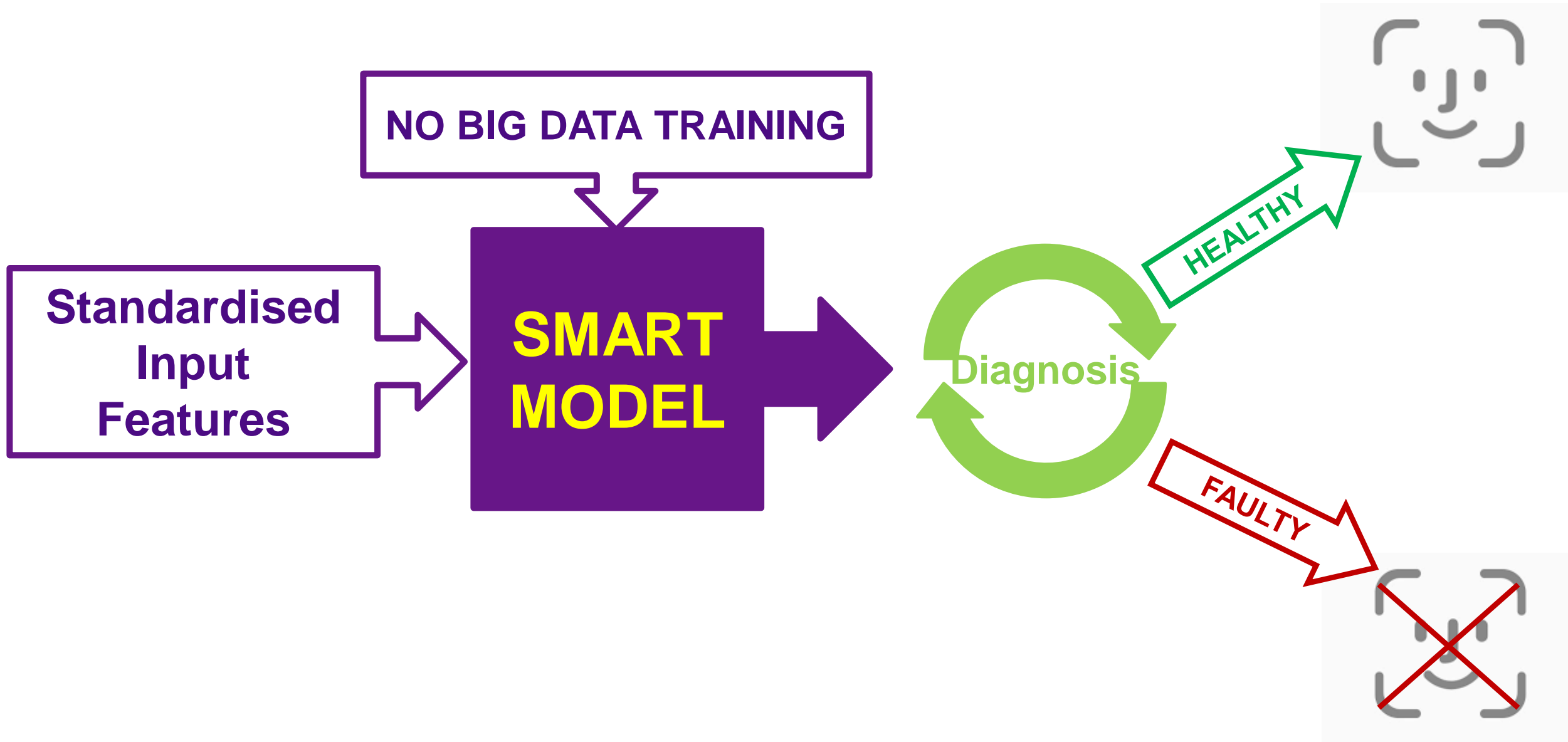
- *Time Domain Features –RMS, Statistical parameters*
- *Frequency domain Features – spectrum, envelope spectrum, etc.*
- *Any other parameters - operating conditions*
- *Features from other CM techniques*

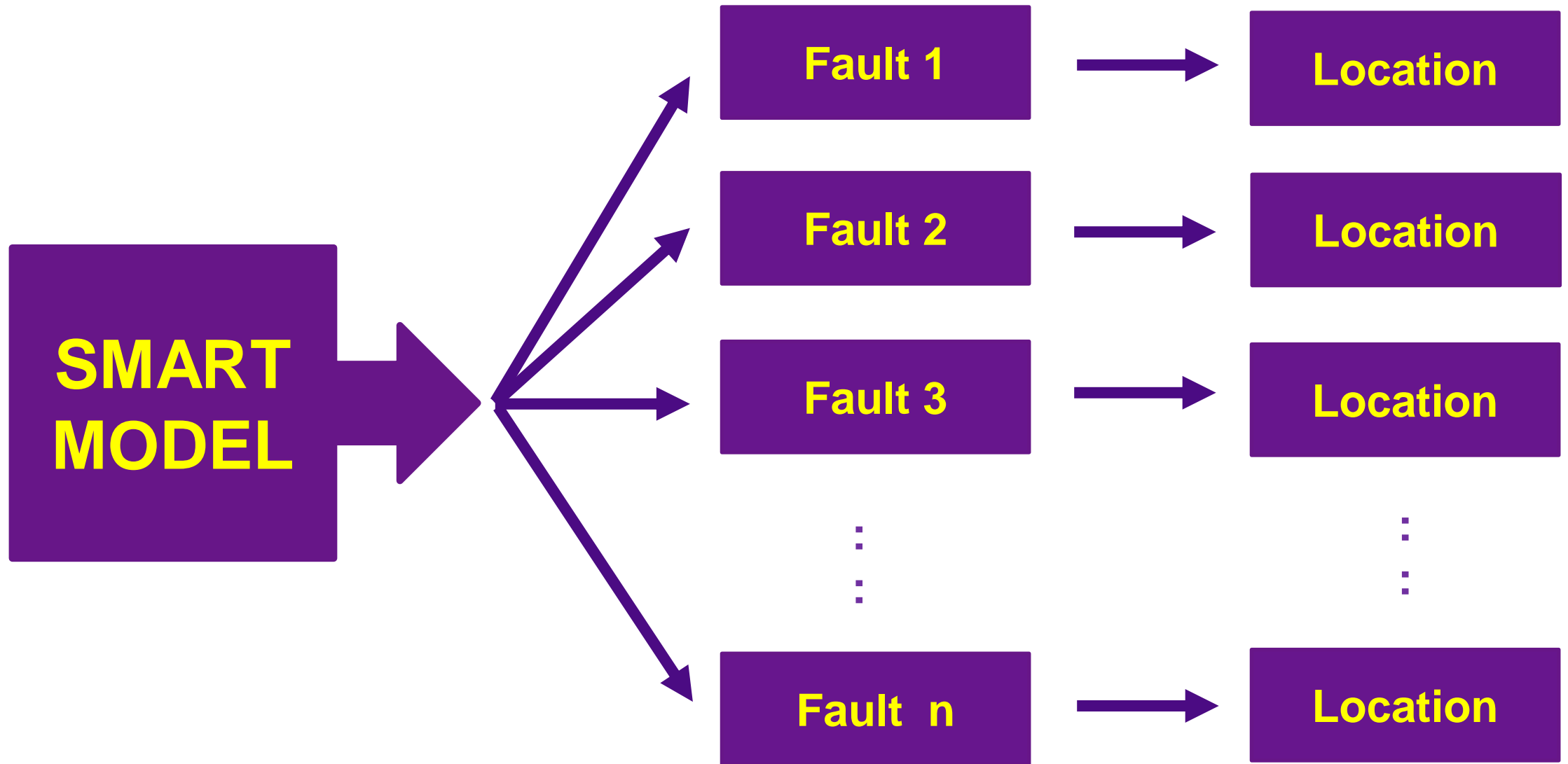
Generic Approach Needed!

Standardization of Vibration Features



Self-learning Smart AI-based Fault Diagnostic Model





- **Lack of integrated effort!**
- **Optimisation of the parameters based on machine dynamics needed.**
- **A Generic Standardised Model is needed for the Self-learning Smart AI-based fault Diagnosis Model.**
- **Blind application and the accurate prediction by the model is essential for reliability, lowering maintenance cost and overall safety.**

The UoM UK continues this research to develop such a Generic Approach!

Thank you!!

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