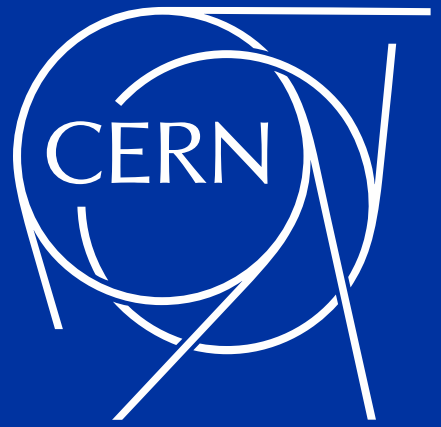


CERN-ABB motorSENSE Project

R&D collaboration for sustainable science & future

Nauman Latif (CERN-EN-CV)

CIPEA Innovation Day (27th June 2022)

CERN’s commitment for a better planet

CONSERVE ENERGY TODAY

FOR

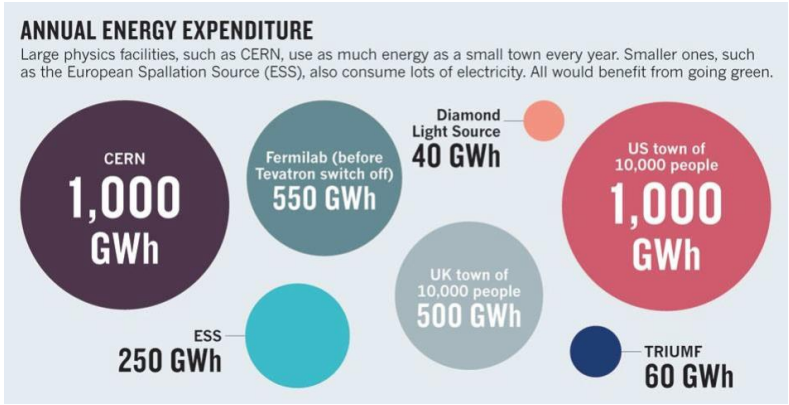
CLEAN AND GREEN TOMORROW

CERN to partner with ABB firm on innovation

- To minimise environmental impact of large-scale facilities
- To develope technologies that can help society towards a better planet

Challenge

Total Energy Consumption of CERN equals 1.3 TWh per year



Electric motors consume over 45% of the world's electricity.

By 2040 the number of motors will double.

Adoption of high efficiency motor systems would cut global electricity consumption by up to 10%.

Changing just one motor can make a difference.

- To make operation of large-scale research facilities more sustainable, energy consumption to be reduced by using efficient, reliable and environmentally friendly equipment and processes

Project Scope

“Analysing and improving the energy efficiency and reliability of the cooling and ventilation infrastructure of large-scale research facilities through a case study of CERN’s cooling and ventilation infrastructure”

R&D Collaboration

- **CERN**
  - EN-CV (Cooling & ventilation)
  - EN-IM (Information management)
- **ABB** firm

Project Goals & Deliverables

Goal 1

- Creating a roadmap with the aim of achieving a 10-15% of overall energy reduction in the cooling and ventilation infrastructure at CERN

Goal 2

- Create and validate a system digital twin of the cooling and ventilation infrastructure (electrical motors, drives, pumps, fans, etc.) by enabling online diagnostics and maintenance

Goal 3

- Public dissemination of results to share the learnings, best practices to inspire industries and large-scale research facilities around the World to become more sustainable and reliable

Technical Challenge & Approach

- Assess the existing installation by analysing the fleet aggregated data, operation history, maintenance history and real time operation data collected by the measuring equipment
- Develop an asset and system digital twin to be used for energy efficiency and reliability assessment based on physics model, statistical models, machine learning and AI
- Based on collected data and conducted assessment run the various scenarios

"A **digital twin (DT)** is a virtual representation of behaviour of the actual, physical asset in operation"

The DT reflects the current asset condition. This involves :

- relevant historical data about the asset
- direct acquisition of asset data into tuning algorithms (models, simulations,…)

A DT can be a twin of a component, a system of components, or a system of systems

Project Phases

Phase 1 Jan'22- Jun'22	• Assessment of the current infrastructure and the future development needs
Phase 2a Feb'22- Apr'22	• Identification of current installations and classification of criticality (critical process , semi-critical process , auxiliary processes), development of sensors installation requirements
Phase 2b Apr'22- Aug'22	• Assessment of the current spare part storage and conducting the redundancy analysis
Phase 3a May'22- Aug'22	• Installation of the measurement equipment on physical devises (sensors, gateways, drives controller surveillance) and defining the data acquisition framework
Phase 3b Apr'22- Apr'23	• Development of the system digital twin of the infrastructure with focus on energy efficiency improvement and condition monitoring
Phase 4 Oct'22- Jun'23	• Application of the digital twin by creating various energy saving scenarios
Phase 5a Jun'23- Dec'23	• Definition of the roadmap for achieving the project goal
Phase 5b Jun'23- Dec'23	• Dissemination of results and best practices in the scientific sources

Timeline 2022-2023

2022												2023											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Phase 1: Assessment of current installations with respect to energy efficiency																							
			Phase 2a: Identification of current installations and classification of criticality																				
				Phase 2b: Assessment of the spare part storage																			
				Phase 3a: Installation of measurement equipment																			
			Phase 3b: Development of the system digital twin of the infrastructure with focus on energy efficiency improvement and condition monitoring																				
									Phase 4: Application of the digital twin by creating various scenarios with respect to defined KPIs														
																	Phase 5a: Definition of the roadmap for achieving the project goal						
																	Phase 5b: Dissemination of results and best practices in the scientific sources						

motorSENSE: WP1, WP2a & WP2b

Assessment of the current infrastructure and future development needs, assessment of criticality

- The cooling and ventilation infrastructure at CERN consists of around 3,000 motors and 600+ converters driving pumps and fans
- Motors are of different power ratings, from different suppliers and produced in different years
- Motors are driven by different methods, e.g., Variable Speed Drives, Soft-starters or Direct-On-Line
- Due to high requirements for availability, many motors/converters/pumps are fully redundant
- Some motors/pumps are equipped with additional sensors, e.g., temperature sensors , vibration sensors
- To make an initial assessment about energy saving potential, a list of 900 motors have been shared
- Based on shared data, an initial Life Cycle Assessment and energy appraisal will be performed to establish the baseline for the project
- To start the initial energy efficiency assessment
- Conduct the criticality assessment by getting access to drawing for the infrastructure under investigation
- Running interviews with maintenance engineers to develop and initial baseline

motorSENSE: WP2

Development of sensors installation requirements

motorSENSE: WP3a

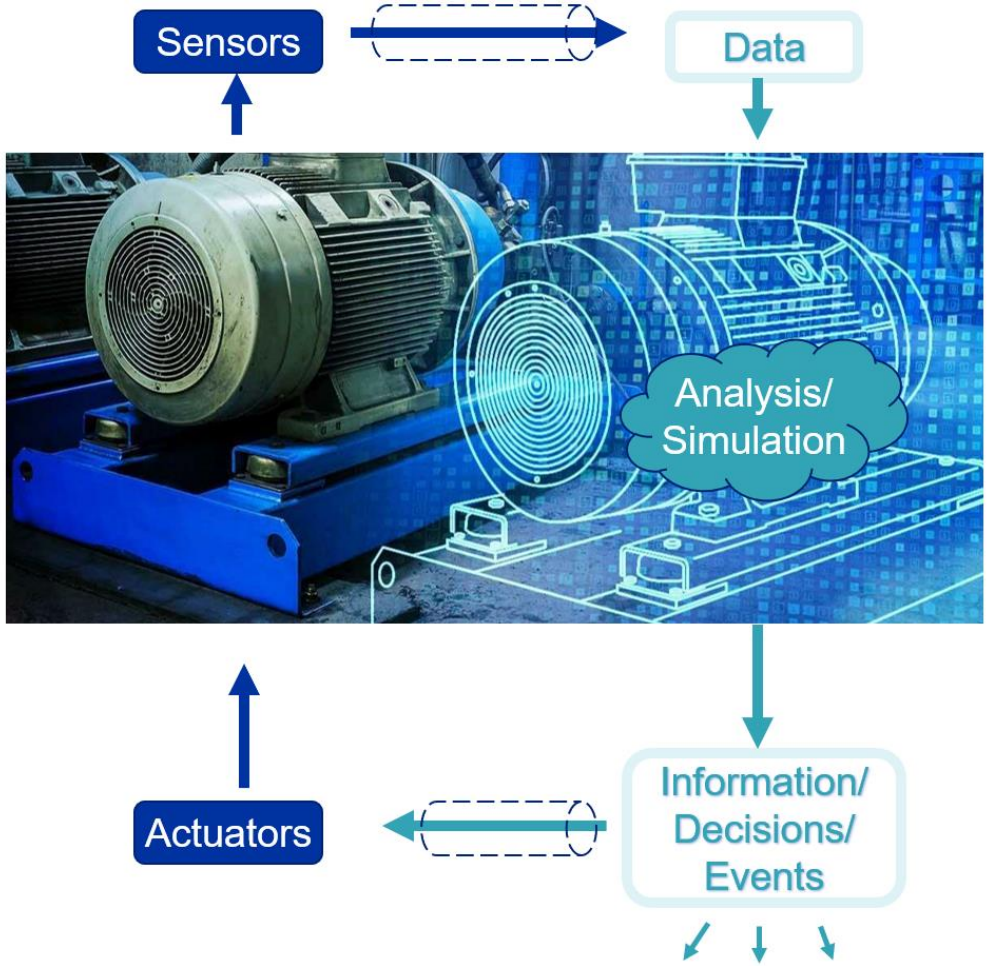
Installation and development of the data acquisition framework

ABB Ability™ Smart Sensor to be used for LV motors driving pumps and fans

NETA-21 A remote monitoring tool that provides access to drives via the Internet or local Ethernet networks

- Converts traditional motors, pumps and bearings into smart, wirelessly connected devices
- Picks up data on vibration, temperature, power and other parameters
- Attached to the component's frame without any wiring
- Battery operated
- Communication via Bluetooth

Data acquisition Network



motorSENSE: WP3a

Development of data acquisition framework

June 29: Necessary arrangements for installation of the Smart Sensors in cooling room of CERN data centre

Identify additional potential location for pilot installation of sensors

June 30: Installation of sensors, development of data acquisition framework

July 01: Synchronizing the data collected by sensors with the data from CERN SCADA system

Making further assessment of available historical and operational data

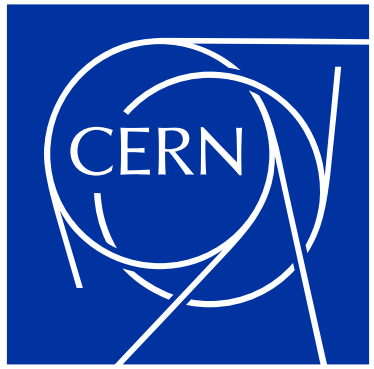
Next phases to follow as per defined timeline…..

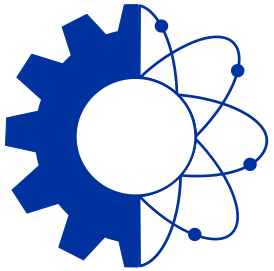
Energy efficient motors

- Improve performance of machinery
- Lower energy costs
- Positive effects on the enviornment
- Cut the global electricity consumption by up to 10%

Unique Project

“Opportunity to inspire industries and large-scale research facilities around the world to become more efficient and sustainable”





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