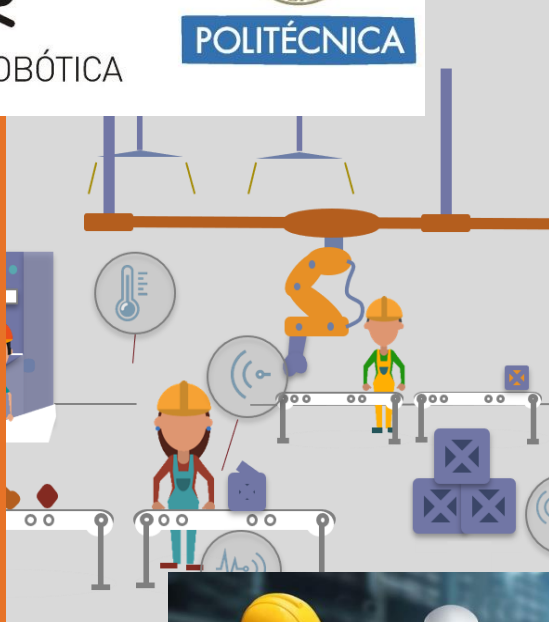platform-enabled **KIT**s of ar**T**ificial intelligence **FOR** an easy uptake by **SME**s

Platform-enabled kits of Artificial Intelligence for an easy uptake by SMEs: Two Case Studies

Rodolfo Haber

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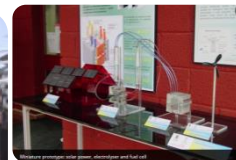**Email: rodolfo.haber@{csic.es, upm.es, car.upm-csic.es)**

Who we are

Center for Automation and Robotics
Joint research center of CSIC &
Universidad Politécnica de Madrid

GAMHE 5.0 pilot line
Manufacturing &
Energy industrial pilots.

MADRID

What and why

- To research and develop methods and techniques in the conjunction of Automation and Robotics driven by AI
- Intelligent hyper-automation of physical and cyber-physical/IoT systems towards Industry 5.0
- Main focus on production sytems/manufacturing processes
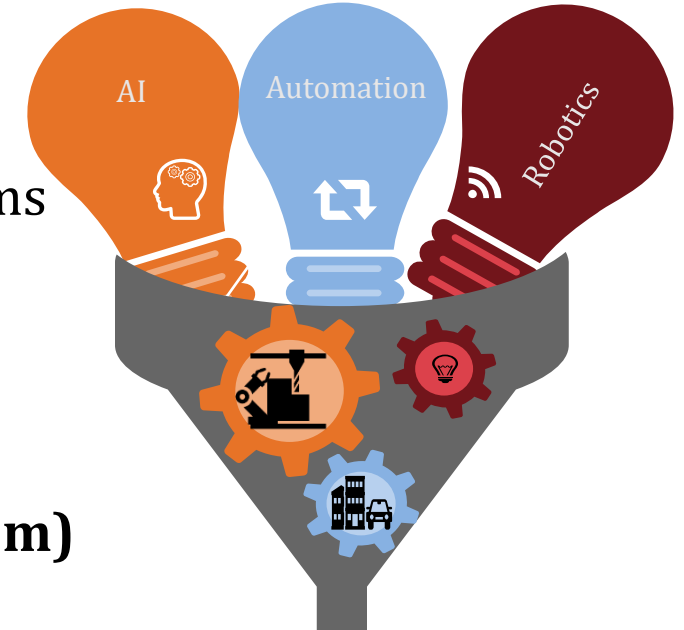
Xymbot spin-off CSIC&UPM and your SME partner (xymbot.com)
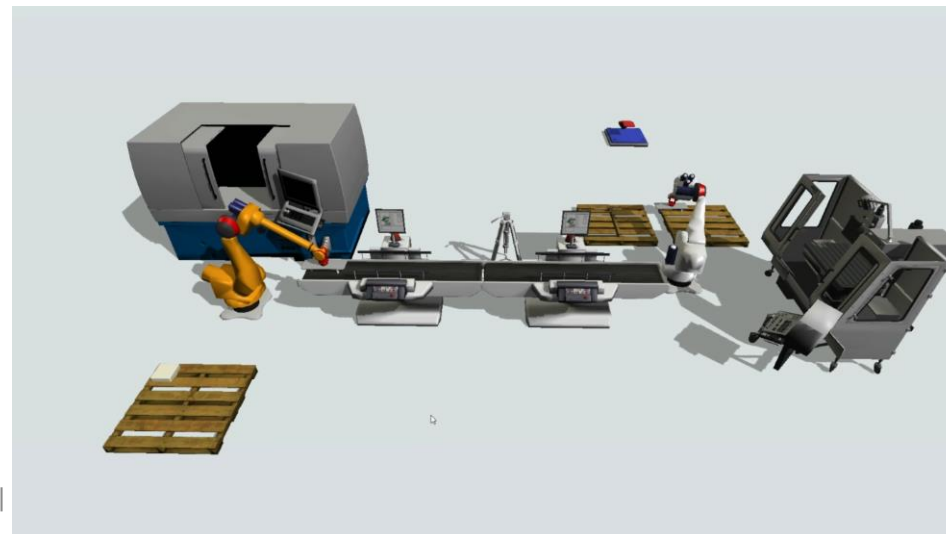
Modeling

Control

Supervision

Optimization

Index

SCOPE

KITT4SME specifically targets European SMEs and mid-caps to provide them with scope-tailored and industry-ready hardware, software and organisational kits, delivered as modularly customisable digital platform, that seamlessly introduce artificial intelligence in their production systems.

Countries and participating institutions
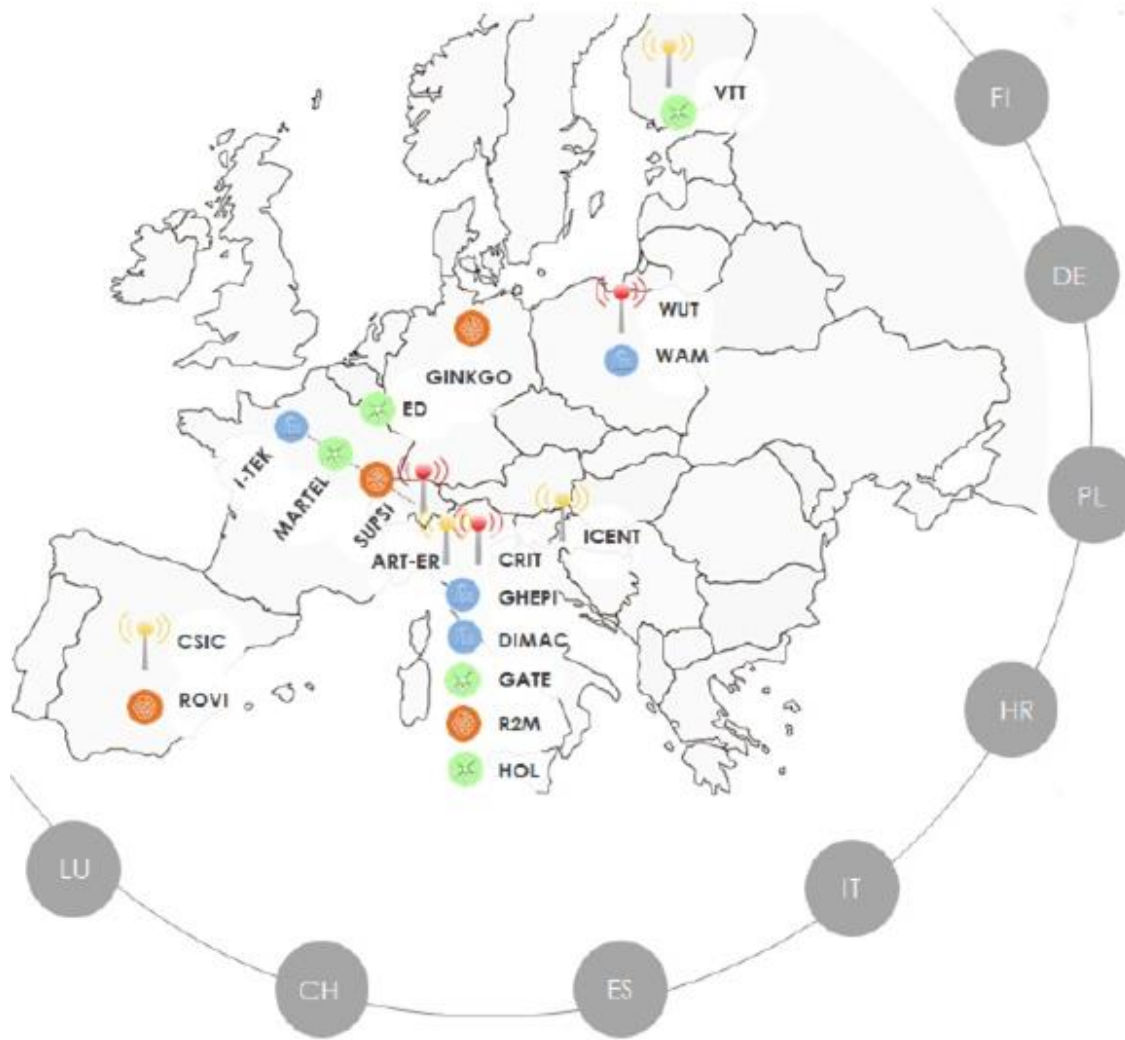
Current situation

- SMEs are unprepared and inadequately exposed to extremely complex and widely diverse digital solutions in the field of artificial intelligence.

- Current solutions are too broad in scope and relentless in dictating their own objectives instead of focusing on the issues a company really faces.

- Big companies have capitals and resources to research and build platforms internally.

- SMEs struggle in finding solutions to deploy AI-based solutions and kits that are fitting to their needs in smart manufacturing scenario.

- Current lag in the digitilisation race for SMEs is not a system by-product it is a designed feature.

Lacking of reliable, robust and efficient kits for deploying AI in Smart Manufacturing to face actual SMEs digitilization challenges.

Goals

- To make available to SMEs ready-to-use customised digital packages for embracing artificial intelligence opportunities at affordable prices and proper scale.

- To seamlessly fuse artificial intelligence and human problem-solving expertise into a single digital brain with unprecedented shop floor orchestration capabilities.

- To build a competence development centre that advances European workforce in line with digital skills trends and workers' aspirations.

- To extend the offer of local ecosystem so that players with different competencies can thrive while collaborating in the creation of customisable artificial intelligence kits.

- To support standardisation in the fields of sovereign data economy and characterisation of workers' skills and training experience.

SME journey: from Awareness to Evolve
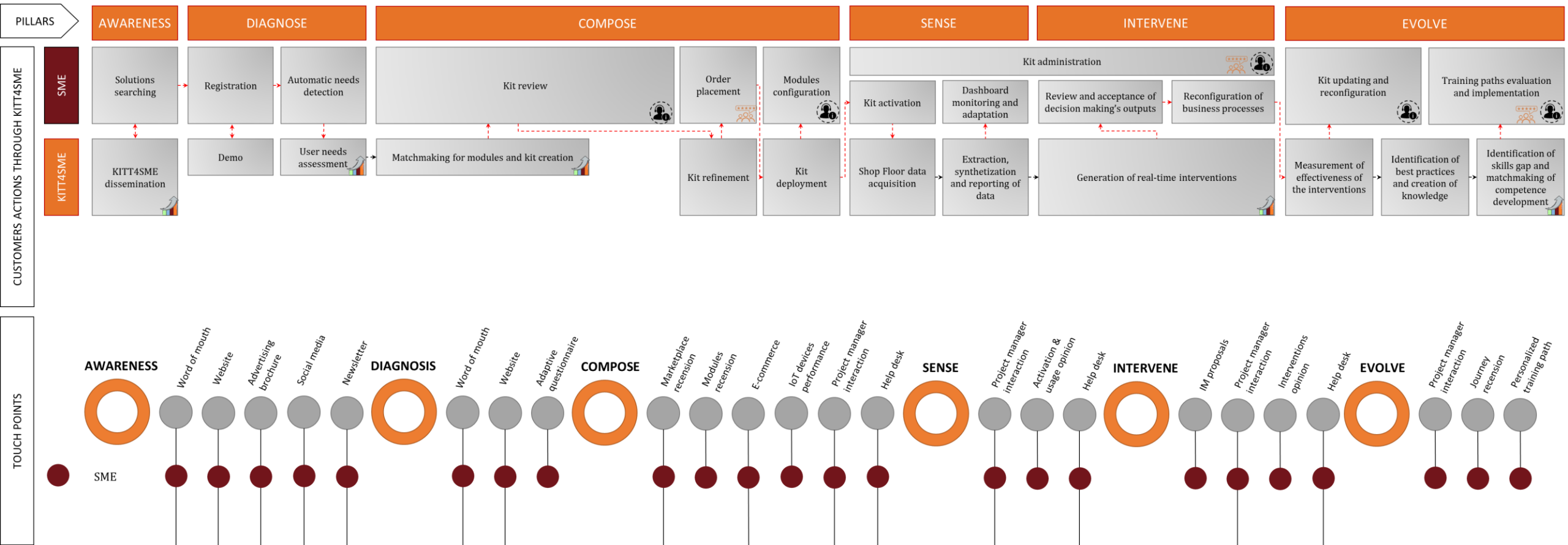
Pilots

- KITT4SME prepares, executes and evaluates the validation activities in four selected piloting environments: Injection moulding sector, quality system sector, high precision hand tools and instruments sector and electrical equipment sector

- The main objectives of the activities of these pilots are:

  1. To define a commonly agreed planning and methodology, that helps each pilot in preparing the human and physical resources to be engaged for the validation, in identifying and measuring KPIs, in executing the experiments and extracting valuable results.

  2. To execute early validation exercises, on preliminary prototypes of the solutions and evaluate usability.

  3. To execute the validation in 4 different pilots and for each one to elicit specific outcomes, feedback to improve the evaluated tools, identifying strength and weakness.

  4. To abstract the results into general ones and create lessons learnt that will be used to improve the platform offer.

Pilots

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Injection moulding   Quality systems   High-precision hand tools   Electrical Equipments

Open Calls

- KITT4SME open calls were oriented to benefit SMEs with most from the opportunities brought by artificial intelligence solutions

- SME-oriented open calls experiments, widespread adoption of modular kits developed by SMEs for SMEs.

Two rounds of open calls were organized, one per each type of activity:

- The first one addressed technology providers to enrich the platform offer
- The second one set up experiments combining technological providers and SMEs AI adopters.
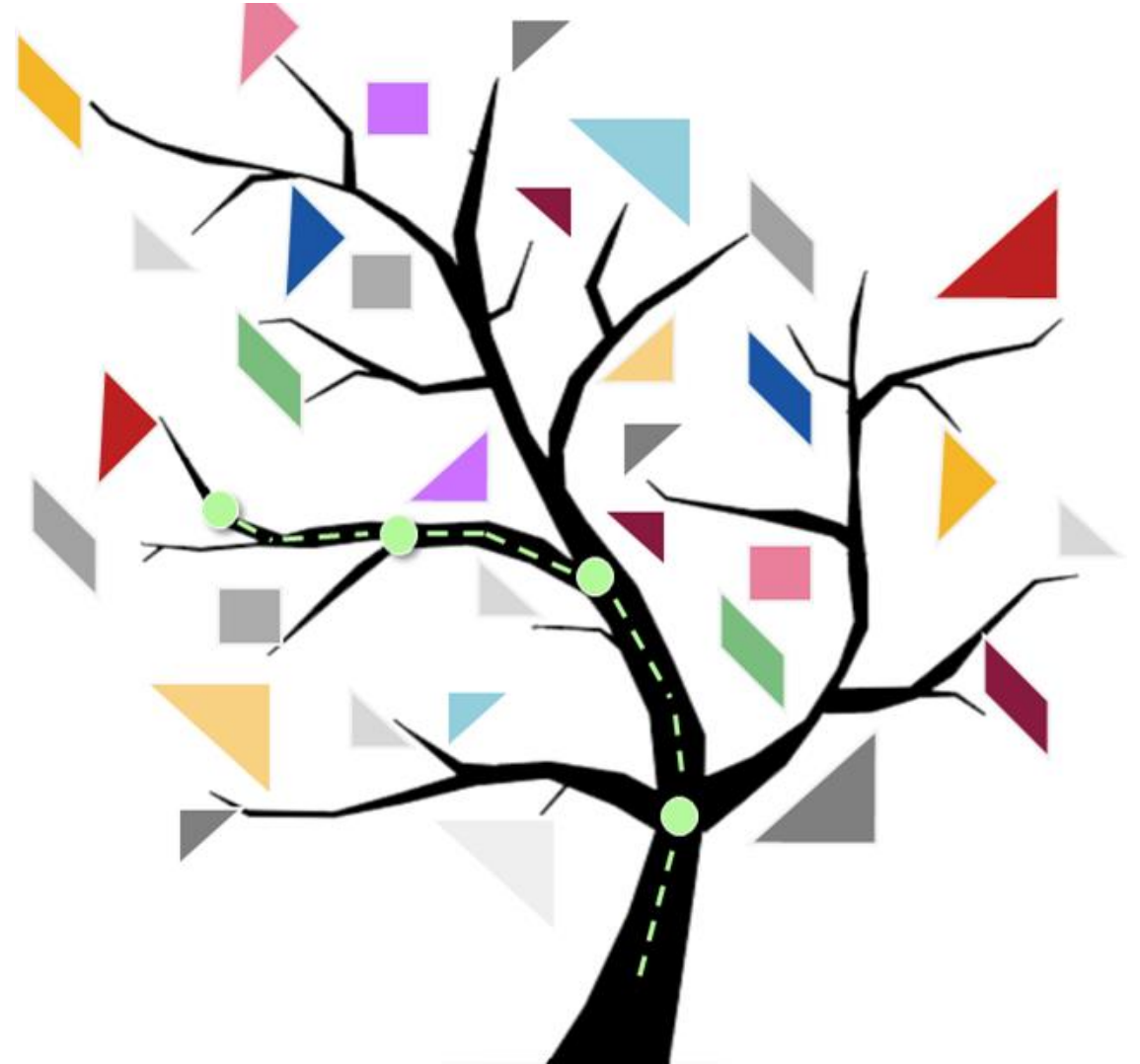
Why & How SMEs can benefits

- KITT4SME offers an open source platform for uptake of AI solutions in manufacturing for SMEs. The architecture is based on the currently best-in-class open source platform for IoT: **FIWARE**.

- FIWARE is a scalable open source component framework that can be composed to integrate, handle and manage context information from different data sources, distribute that KITT4SME data and stream it into involved external components for persistence as well as for AI-based processing aims.

- Computed results can then be integrated back enabling actuation and the enrichment of the current context
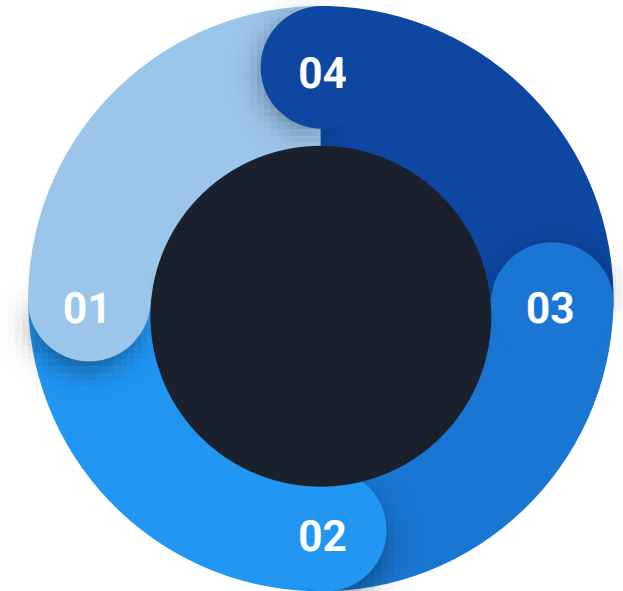
TWO CASE STUDIES

KITT4SME platform: FIWARE based solution
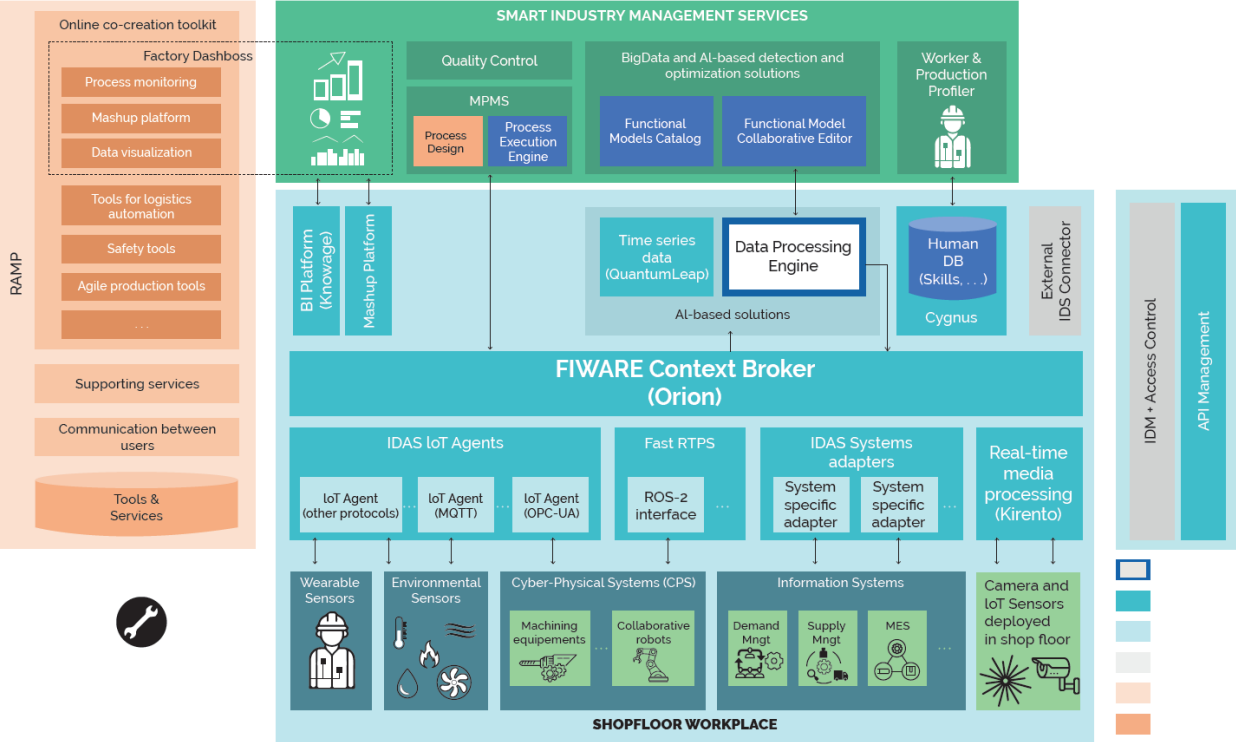
Kitt4sme.eu

Insight generation module

✓ IG module is designed for exploiting historical datasets of SMEs production systems, by extracting valuable information, and generating smart recommendations on the basis of user-defined KPIs.

✓ Three main functionalities: determine key features that most influence on each KPI defined by users, create models using already defined KPIs and the historical dataset, and recommend the optimal setting of the manufacturing system for improving the KPIs
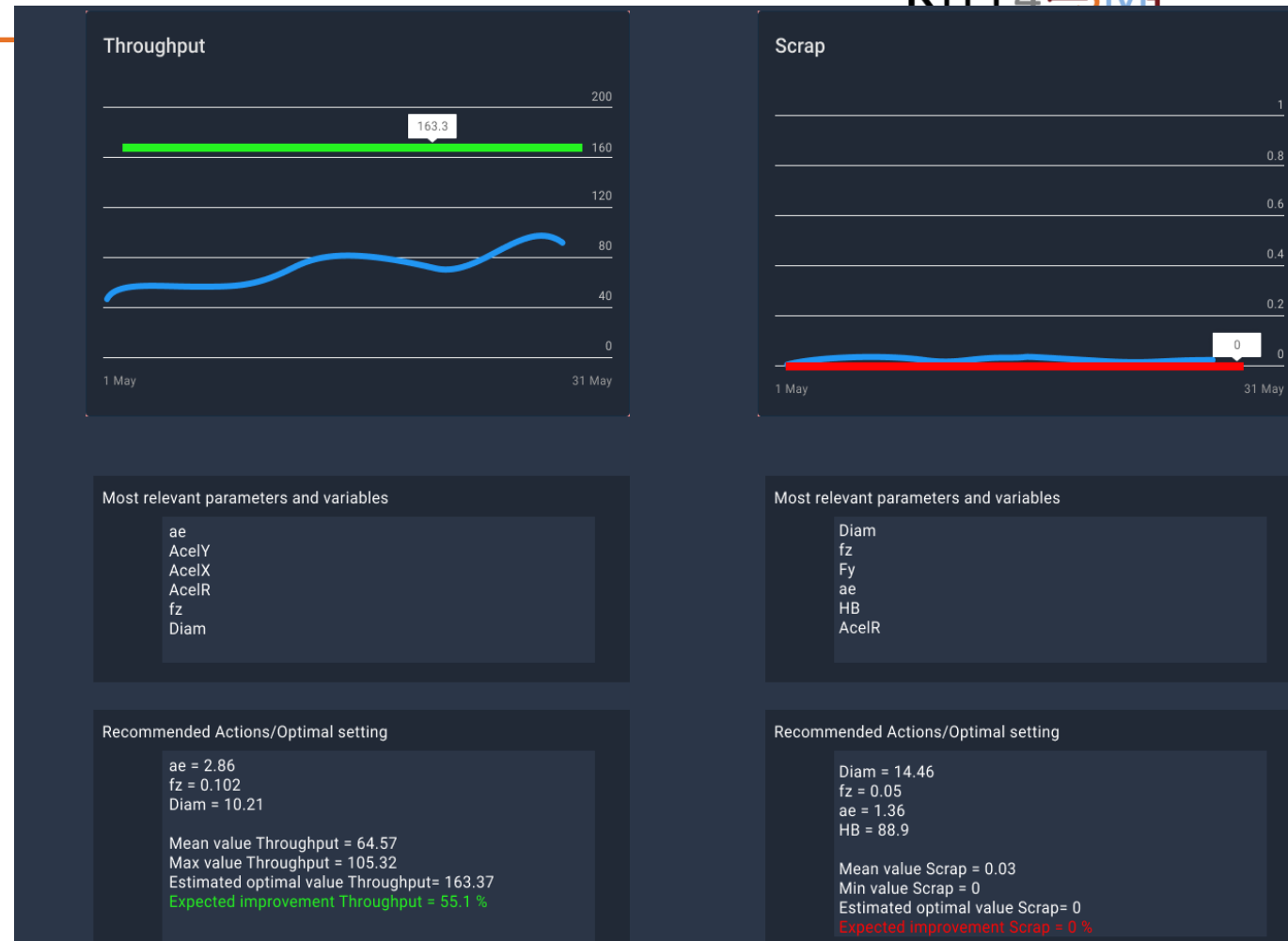
✓ **Two files: data and configuration.**
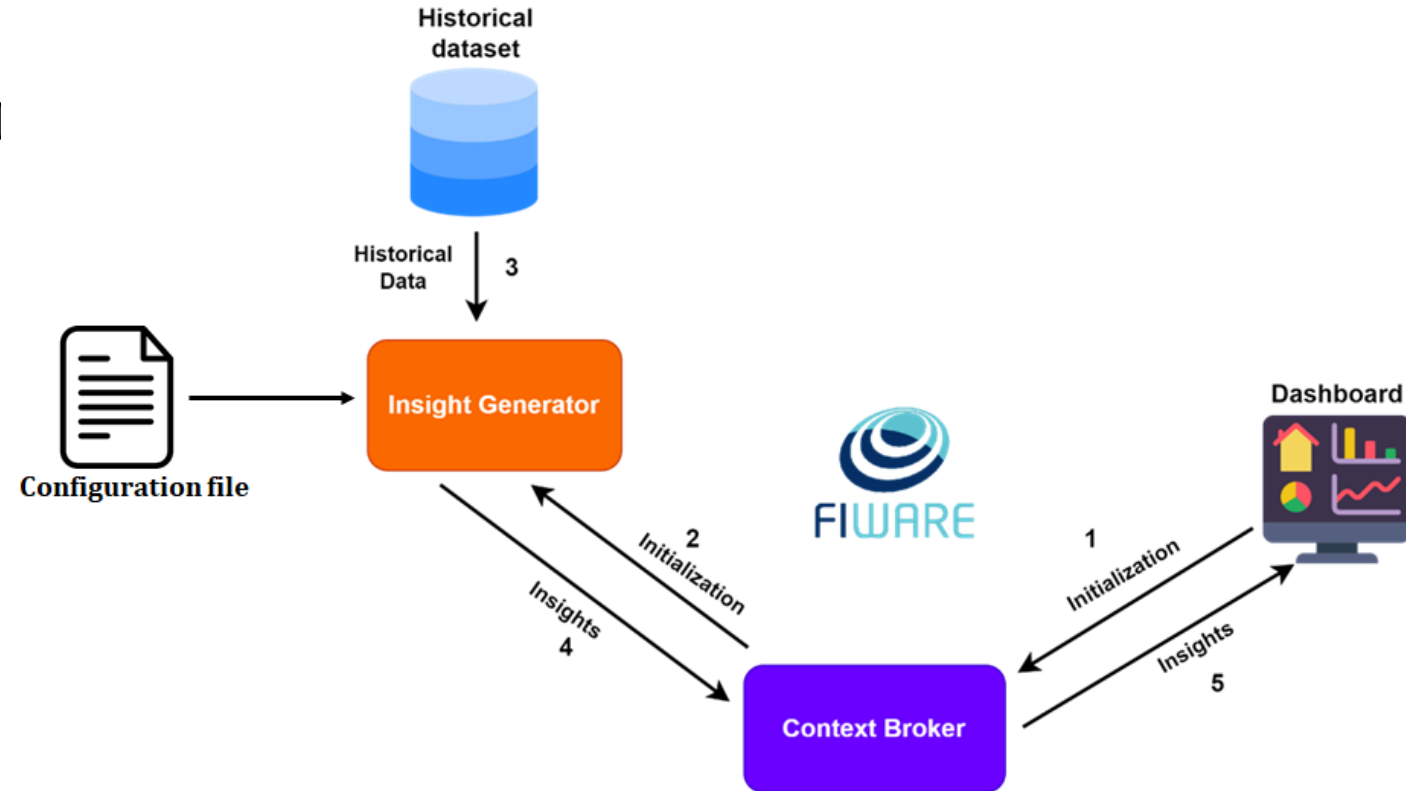
❑ **Four steps:** Analyze the data and determine the most influence parameters for each KPI, create models of the process, based on machine learning techniques, evaluate the models and determine the best model, and optimize the KPI in order to obtain the most impact actions.

IG case study

A manufacturing company is interested in improving the efficiency and the whole business by 1) better exploiting historical data already collected and stored including some linked KPIs using easy kit, 2) to know via useful insights if the process and machines are appropriately parametrized to achieve productivity and efficiency goals and 3) to know the recommended parameters required to guarantee the maximum efficiency and productivity of the manufacturing plant.

Data set: acceleration measurements (i.e., *AccelX*, *AccelY*, *AccelR*), force measurements (i.e., *Fx*, *Fy*, *Fr*), feed rate (*fz*), tool diameter (*Diam*), radial depth of cut (*ae*), Brinell hardness (*HB*) and operator fatigue (*FaMS*). In this case, the two outputs correspond to the following KPIs: throughput (number of components produced per hour) and scrap (ratio of defective components per hour).

Throughput

163.3

Most relevant parameters and variables
ae
AcelY
AcelX
AcelR
fz
Diam

Recommended Actions/Optimal setting
ae = 2.86
fz = 0.102
Diam = 10.21

Mean value Throughput = 64.57
Max value Throughput = 105.32
Estimated optimal value Throughput= 163.37
Expected improvement Throughput = 55.1 %

Scrap

0

Most relevant parameters and variables
Diam
fz
Fy
ae
HB
AcelR

Recommended Actions/Optimal setting
Diam = 14.46
fz = 0.05
ae = 1.36
HB = 88.9

Mean value Scrap = 0.03
Min value Scrap = 0
Estimated optimal value Scrap= 0
Expected improvement Scrap = 0 %

Concluding remarks

- ✓ Manufacturing SMEs have a very powerful set of kits to address at affordable price.

- ✓ The two case-studies: IG and RECO modules demonstrated the validity to face SMEs challenges.

- ✓ IG module yields smart recommendations and the final decision-making and application of recommended parameters rely on technologists and/or plant managers in manufacturing SMEs.

- ✓ The proposed RECO method overcomes limitations in terms of cost, technical requirements and performance. The suitability of RECO is demonstrated by improving efficiency and productivity on the basis of industrial KPIs.

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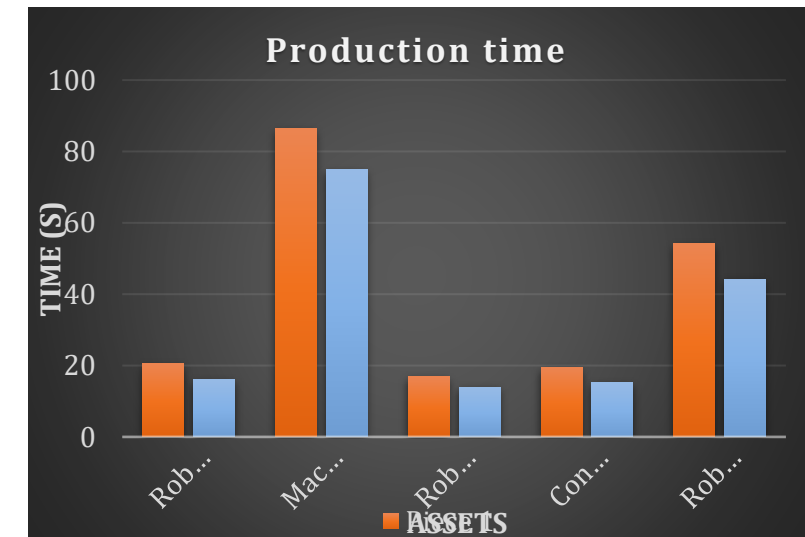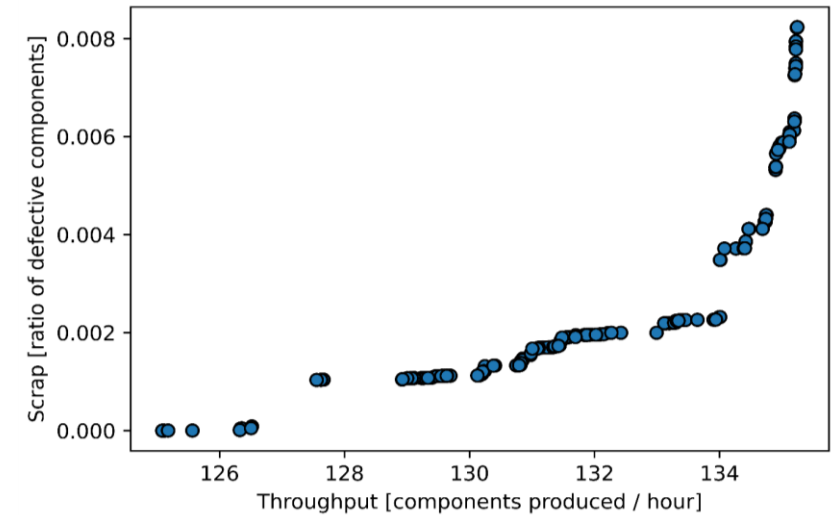
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Haber R.E., Castaño F., Villalonga A., Artificial Intelligence for Quality Control of manufacturing operations: Macro-mechanical milling in the Pilot Line GAMHE 5.0, **https://zenodo.org/record/5602977** , **27/10/2021 (250 downloads).**

Thank you for your attention

Presenter

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