

Industrial Data Services for Quality Control in Smart Manufacturing



The i4Q project

The Manufacturing Partnership Day
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Ilias Gialampoukidis & Georgia Apostolou
Centre for Research and Technology Hellas – CERTH,
Thessaloniki, Greece



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CERTH
CENTRE FOR RESEARCH & TECHNOLOGY HELLAS



Consortium



The i4Q consortium is made up of 24 stakeholders covering all the areas of expertise and demonstration necessary for a correct execution of the project.

- Industrial partners: **WHIRPOOL** (White goods manufacturer), **BIESSE** (Wood industrial equipment), **FACTOR** (Metal machining), **RIASTONE** (Ceramic pressing), **FARPLAS** (Plastic injection), **FIDIA** (Metal industrial equipment)
- Implementers: **TIAG** (Industrial Communication Protocols and Standards), **CESI** (Machine tools, Advanced Materials, Micro-technology), **AIMPLAS** (Thermoplastic and thermosetting plastic materials)
- Technology providers: **IBM** (Information Technologies Company), **ENG** (Software and Services Company), **ITI** (Information Technologies Institute), **KBZ** (Information Systems Company), **EXOS** (Operations Consulting Company)
- Research & development: **IKERLAN** (Technological Centre), **BIBA** (Research Institute), **UPV** (Technical University), **TUB** (Technical University), **UNINOVA** (Research Institute), **CERTH** (Research Institute)
- Specialist Companies: **FBA** (Dissemination and Exploitation), **IVLAB** (Dissemination and Exploitation), **DIN** (Standardisation), **LIF** (Legal)

ID	Participant organisation name	Acronym	Logo	Country	Size	Role
1	ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS	CERTH		Greece	RO	R&D
2	ENGINEERING - INGEGNERIA INFORMATICA SPA	ENG		Italy	LARGE	TECH
3	IBM ISRAEL - SCIENCE AND TECHNOLOGY LTD	IBM		Israel	LARGE	TECH
4	INSTITUTO TECNOLÓGICO DE INFORMATICA	ITI		Spain	RO	TECH
5	KNOWLEDGEBIZ CONSULTING-SOCIEDADE DE CONSULTORIA EM GESTAO LDA	KBZ		Portugal	SME	TECH
6	EXOS SOLUTIONS SL	EXOS		Spain	SME	TECH
7	IKERLAN S. COOP	IKER		Spain	RO	R&D
8	BIBA - BREMER INSTITUT FUER PRODUKTION UND LOGISTIK GMBH	BIBA		Germany	HSEE	R&D
9	UNIVERSITAT POLITÈCNICA DE VALÈNCIA	UPV		Spain	HSEE	R&D
10	TECHNISCHE UNIVERSITÄT BERLIN	TUB		Germany	HSEE	R&D
11	UNINOVA-INSTITUTO DE DESENVOLVIMENTO DE NOVAS TECNOLOGIAS-ASSOCIACAO	UNI		Portugal	RO	R&D
12	TTTECH INDUSTRIAL AUTOMATION AG	TIAG		Austria	LARGE	IMP
13	CE.S.I. CENTRO STUDI INDUSTRIALI SRL	CESI		Italy	SME	IMP
14	AIMPLAS - ASOCIACION DE INVESTIGACION DE MATERIALES PLASTICOS Y CONEXAS	AIMP		Spain	RO	IMP
15	FUNDINGBOX RESEARCH APS	FBR		Denmark	SME	SPEC
16	LABORATOIRE VIRTUEL EUROPEEN DANS LE DOMAINE DE L'INTEROPERABILITE DESENTREPRISES	IVLAB		Belgium	OTHER	SPEC
17	DIN DEUTSCHES INSTITUT FUER NORMUNG E.V.	DIN		Germany	OTHER	SPEC
18	PRAVO I INTERNET FOUNDATION	LIF		Bulgaria	OTHER	SPEC
19	WHIRLPOOL EMEA S.p.A.	WHI		Italy	LARGE	USER
20	BIESSE GROUP	BIES		Italy	LARGE	USER
21	FACTOR INGENIERIA Y DECOLETAJE S.L.	FACT		Spain	SME	USER
22	RIA STONE FABRICA DE LOUCA DE MESAEM GRES SA	RIAS		Portugal	SME	USER
23	FARPLAS OTOMOTIV ANONIM SIRKETI	FARP		Turkey	LARGE	USER
24	FIDIA SPA	FIDIA		Italy	LARGE	USER

The Challenge



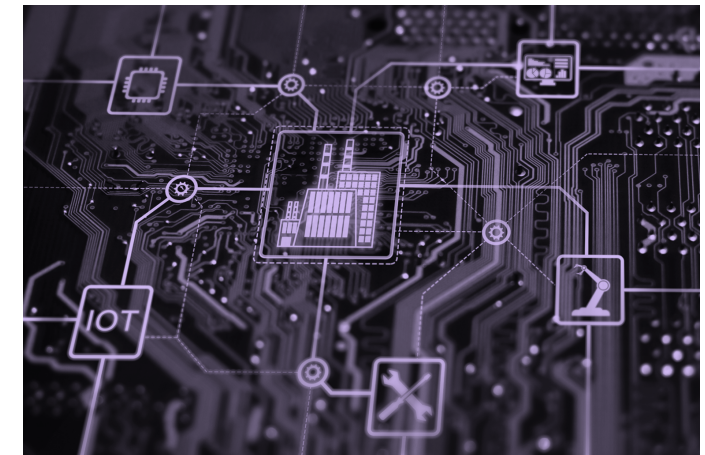
- Manufacturing companies are continuously facing the challenge of redesigning and adjusting their systems to produce goods adapted to specific requirements and produced under the minimum required production rate, guaranteeing high quality and limiting the use of resources.

The Goal

i4Q Project will provide a complete solution consisting of sustainable IoT-based Reliable Industrial Data Services (RIDS) able to manage the huge amount of industrial data coming from cost-effective, smart, and small size interconnected factory devices for supporting manufacturing online monitoring and control

Industrial Sectors and activities:

- White Goods (WHIRLPOOL)
- Wood Equipment (BIESSE)
- Metal Machining (FIDIA)
- Ceramics Pressing (RIASTONE)
- Plastic Injection (FARPLAS)
- Metal Equipment (FACTOR)

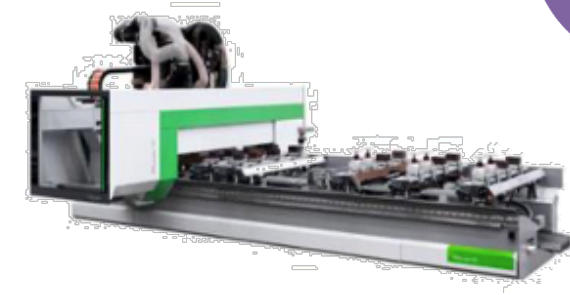


The Pilots



Wood Equipment (BIESSE)

Continuously monitor working conditions and process parameters. i4Q outputs will use readily available sensors, such as vibration or temperature, and will leverage the available PLCs, that are able to adapt the process to the recorded working conditions providing a way to correct process drifts



Metal Machining (FIDIA)

i4Q Solutions will combine advanced vibration monitoring methods, with AI-driven prediction of Quality indicators



White Goods (Whirlpool)

Reuse available data to continuously estimate the current product's quality, allowing the certification of product conformity at serial number level. Continuous process qualification, as compared to the earlier qualification based on statistical verification of early productions in external laboratories



The Pilots



Metal Equipment (FACTOR)

Factor will use the i4Q Digital Twin and the i4Q Data Repository for digitising its entire factory, through the use of sensors, cameras, and other data collection techniques, in order to be able to evaluate production decisions based upon data analytics and simulation, visualize products performing in their environments in real-time



Ceramics Pressing (RIASTONE)

Improve the Production Efficiency, through new and advanced processes that can measure the quality of the incoming Raw Matters inline, with a continuous and complete data driven incoming raw matter quality control



Plastic Injection (FARPLAS)

i4Q Solutions complements the plastic injection manufacturing process with an automatic advanced inspection phase based on AI, and collect data from all phases, perform the corresponding data analytics, and actuate over the different devices in order to optimize several processes





i4Q Reliable Industrial Data Services (RIDS)

- i4Q RIDS is a complete package consisting of 22 i4Q Solutions
 - 17 software tools
 - 5 guidelines

i4Q RIDS is an IoT-based Reliable Industrial Data Services toolset for assuring data quality, traceability and proper use, to achieve manufacturing lines' continuous process qualification, quality diagnosis, reconfiguration and certification.





Manufacturing Data Quality

- [i4QQE QualiExplore for Data Quality Factor Knowledge](#) ^[1]_[SEP]
- [i4QBC Blockchain Traceability of Data](#) ^[1]_[SEP]
- [i4QTN Trusted Networks with Wireless & Wired Industrial Interfaces](#) ^[1]_[SEP]
- [i4QSH IIoT Security Handler](#) ^[1]_[SEP]
- [i4QDR Data Repository](#)

Rapid Manufacturing Line Qualification and Reconfiguration:

- [i4QPQ Data-driven Continuous Process Qualification](#). ^[1]_[SEP]
- [i4QQD Rapid Quality Diagnosis](#). ^[1]_[SEP]
- [i4QPA Prescriptive Analysis Tools](#). ^[1]_[SEP]
- [i4QLRT Manufacturing Line Reconfiguration Toolkit](#).

Manufacturing Data Analytics for Manufacturing Quality Assurance

- [i4QDIT Data Integration and Transformation Services](#) ^[1]_[SEP]
- [i4QDA Services for Data Analytics](#) ^[1]_[SEP]
- [i4QBDA Big Data Analytics Suite](#) ^[1]_[SEP]
- [i4QAD Analytics Dashboard](#) ^[1]_[SEP]
- [i4QAI AI Models Distribution to the Edge](#) ^[1]_[SEP]
- [i4QEW Workloads Placement and Deployment](#) ^[1]_[SEP]
- [i4QIM Infrastructure Monitoring](#) ^[1]_[SEP]
- [i4QDT Digital Twin simulation services](#)

i4Q Guidelines





- [i4QDQG Data Quality Guidelines](#) ^[1]_[SEP]
- [i4QSG Cyber security Guidelines](#) ^[1]_[SEP]
- [i4QDRG Guidelines for building Data Repositories for Industry 4.0](#) ^[1]_[SEP]
- [i4QLCP Manufacturing Line Data Certification Procedure](#) ^[1]_[SEP]
- [i4QLRG Manufacturing Line Reconfiguration Guidelines](#)



WHAT?

The i4Q Infrastructure Monitoring solution is a software tool that allows for the **detection of impending manufacturing line problems** and **provide efficient alerts** to the users for potential failures.

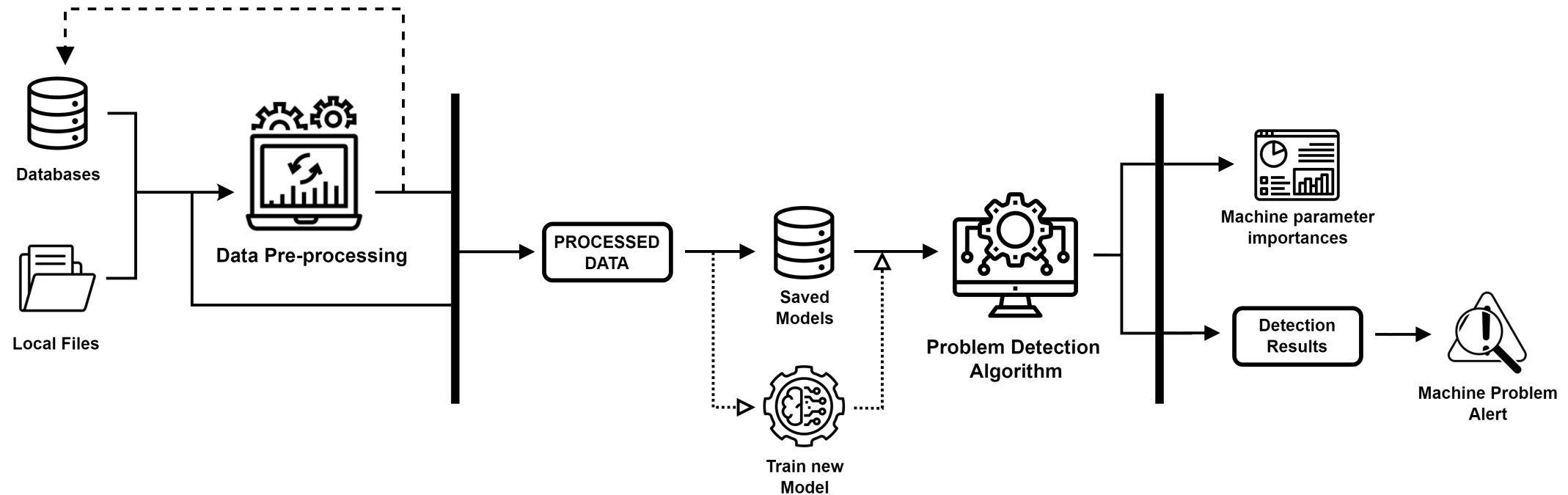
WHY?

<p>Increase production rate.</p> 	<p>Reduce frequent maintenance inspections.</p> 
<p>Lower production waste.</p> 	<p>Minimize repair costs.</p> 



HOW?

Through the exploitation of manufacturing data and the utilization of cutting-edge AI algorithms, insightful visualizations and warnings are provided upon the detection of machine problems.





EXAMPLE



USE CASE

A manufacturer wants ensure the optimal condition of a CNC milling machine in order to avoid production interruptions.

PROBLEM

- Maintenance engineers have to perform condition monitoring which is time consuming.
- Severe machine failures lead to prolonged production downtimes and high repair costs.

OBJECTIVE

- Accurately detect machine malfunctions and degraded components.
- Minimize the detection time of machine problems.
- Provide alerts to the machine operators to take corrective actions.



IM - Infrastructure Monitoring

Input data

	XPosition	YPosition	ZPosition	XMotorCurrent	YMotorCurrent	ZMotorCurrent	XP_median	YP_median	ZP_median	XM_med
0	-714.1451	-2.5243	-2.5243	20.5000	90.5000	237.4444	237.0000	237.0000	237.0000	237.0
1	-714.1452	-2.5243	-2.5243	20.5333	89.5000	236.5000	236.5000	236.5000	236.5000	236.5
2	-714.1452	-2.5243	-2.5243	20.5000	89.5000	237.0000	237.0000	237.0000	237.0000	237.0
3	-714.1452	0.0000	-2.5243	20.5000	89.4706	237.2500	237.0000	237.0000	237.0000	237.0
4	-714.1451	-2.5242	-2.5242	20.5263	89.5000	235.8333	236.0000	236.0000	236.0000	236.0
5	-714.1451	-2.5243	-2.5243	20.4667	89.5000	236.0769	236.0000	236.0000	236.0000	236.0
6	-714.1451	-2.5243	-2.5243	20.5000	89.4737	235.5000	235.5000	235.5000	235.5000	235.5
7	-714.1451	-2.5242	-2.5243	20.5500	89.4737	235.5000	235.5000	235.5000	235.5000	235.5
8	-714.1452	-2.5242	-2.5243	20.5000	89.5333	235.4667	235.0000	235.0000	235.0000	235.0
9	-714.1450	-2.5242	-2.5243	20.4706	89.5000	235.1667	235.0000	235.0000	235.0000	235.0

Data preparation

Select target variable

Degradation

Target variable

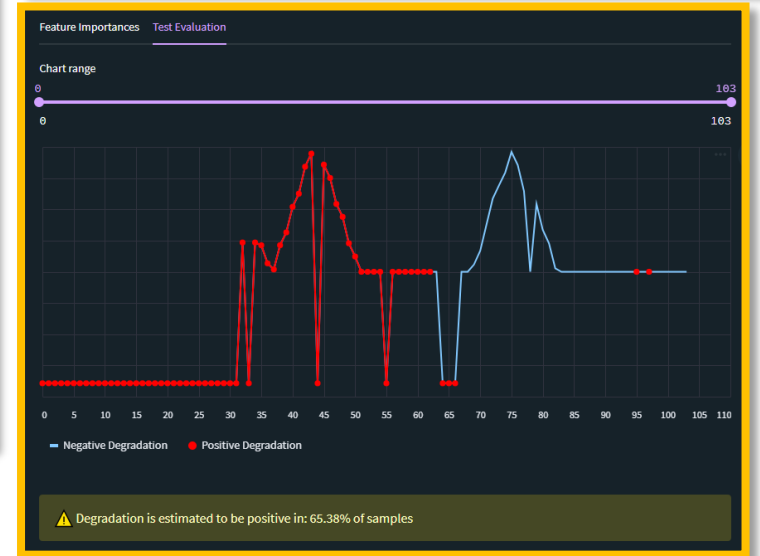
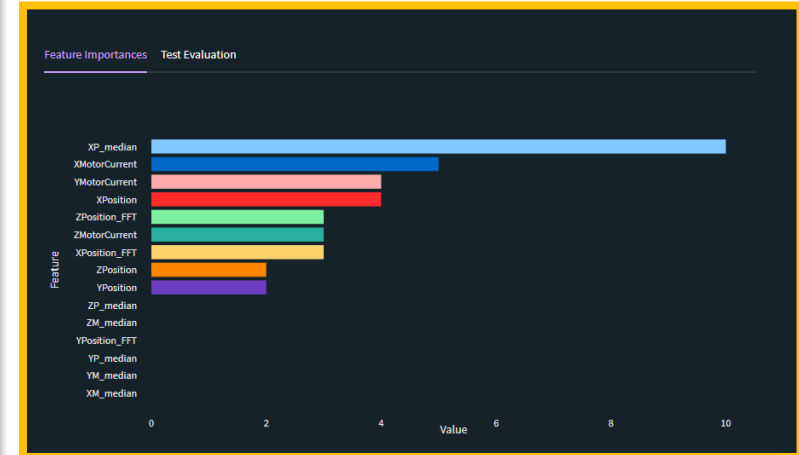
Select test-set portion

76%

16% 96%

Train set Test set

Stratified train-test-split





Key Performance Indicators Assessment: examples from pilots

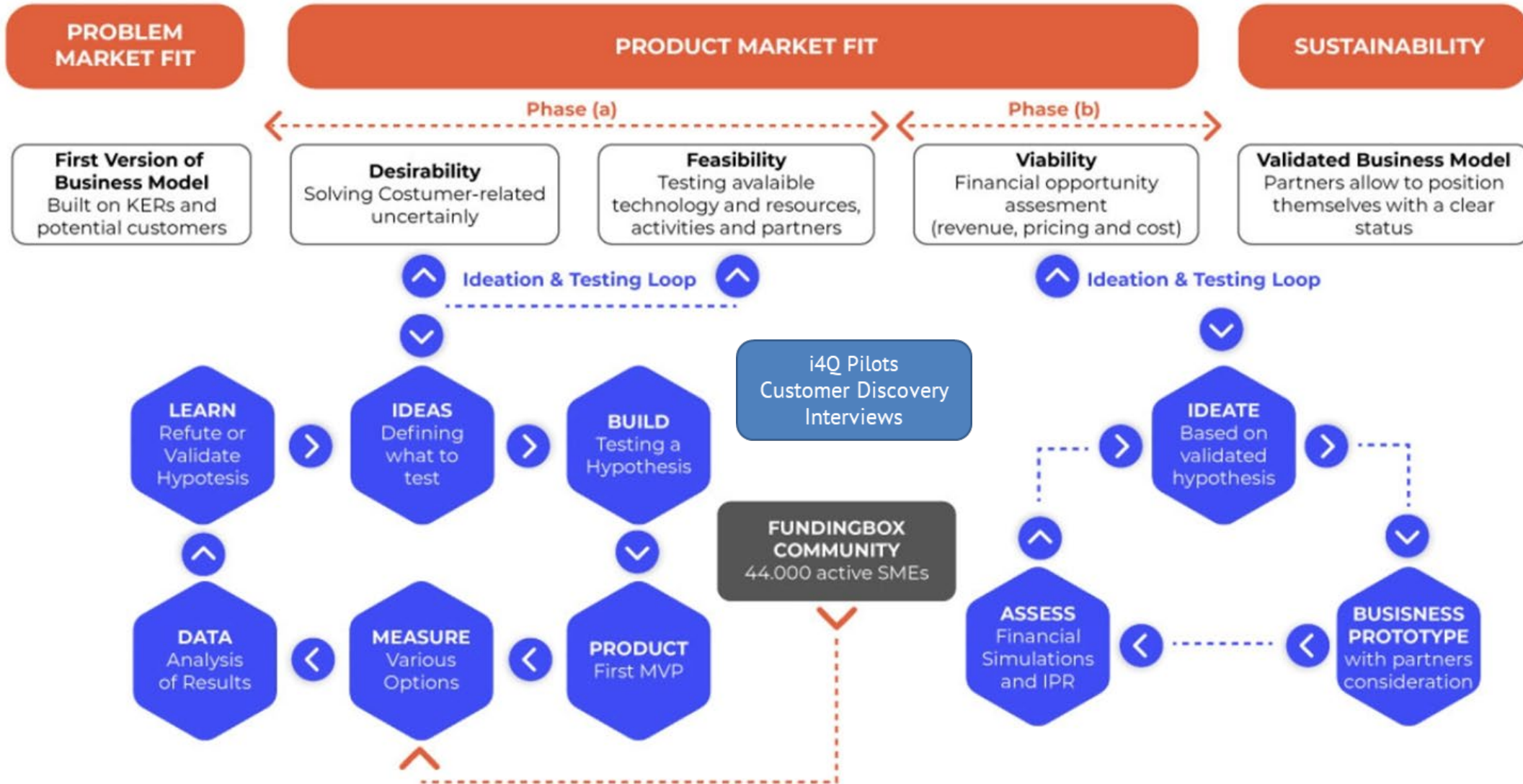
In white goods product quality domain:

- First month in service: Current Value 6776 PPM, Target Value: 1000 PPM
- TTM Time to Market Change: Current Value 2 years (average), Target Value: -20%

In the inspection of automotive plastic parts domain:

- The average production time spent on each part: Current Value 0.9405, Target Value 0.799
- Ratio between the actual product time (APT) and the planned busy time (PBT) for a work unit: Current Value 82.14, Target Value 86,24
- Wasted material per day: Current Value 13.82, Target Value 6,91

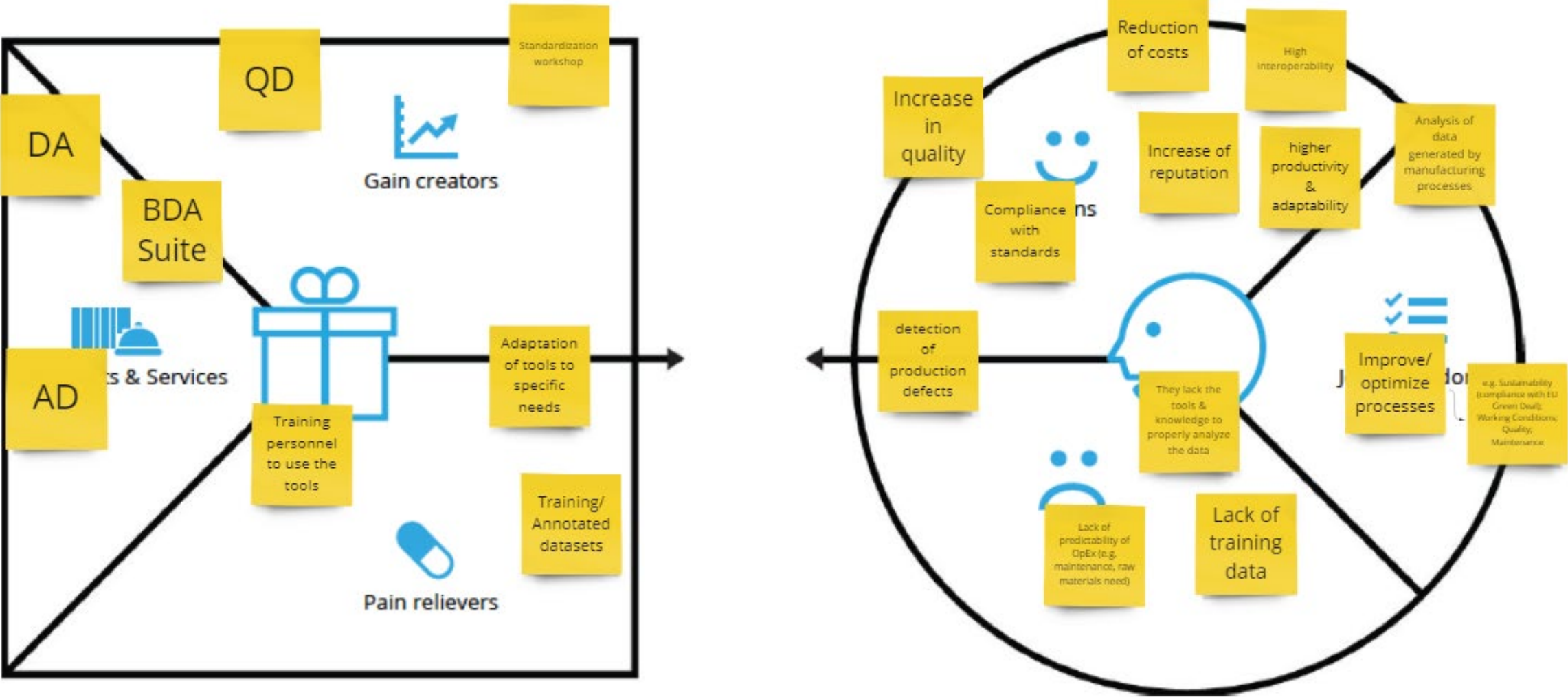
Exploitation



Manufacturing Data Analytics Product Bundle



Buyer Persona



Manufacturing Data Analytics Product Bundle



Value Proposition

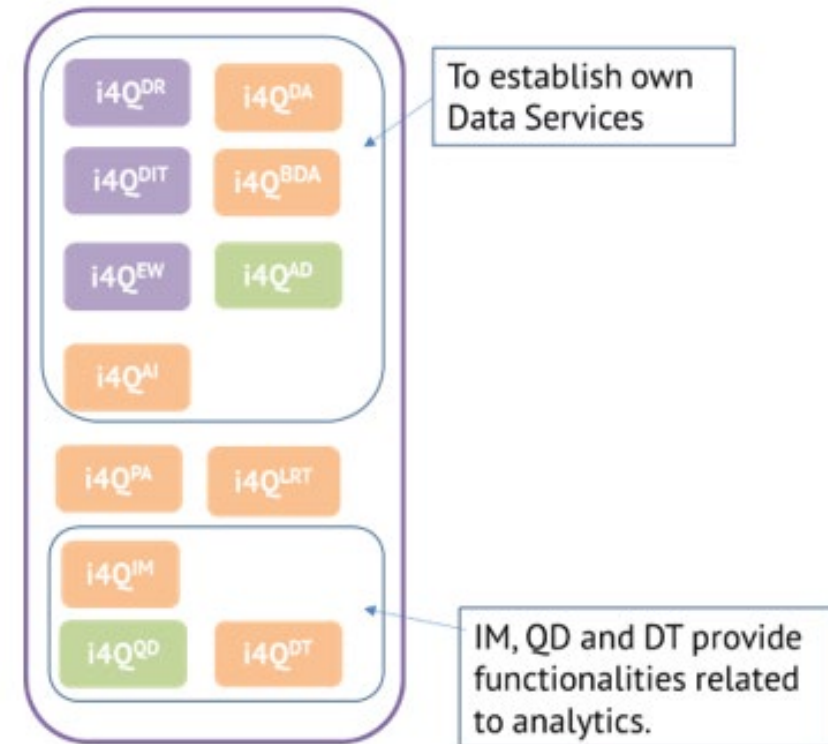
A suite of data analytics tools for manufacturing SMEs that want to have proper knowledge of all their manufacturing processes enabling optimization of operations in a standardized manner unlike manual inspection or individual process solutions.

What is it for?

This solution allows manufacturing companies to analyse data from their manufacturing processes in order to improve or optimize them. This can be used to improve quality, predictability of OpEx (maintenance, raw materials needed, etc), compliance with quality and environmental standards.

How it can help manufacturing companies:

- Increase in product quality
- Reduction of production costs and defects
- Compliance with standards
- High interoperability



Market Analysis & PEDR (Plan for Exploitation and Dissemination of Results) - Plan of Action



M1 – M24

Done

VRM Method

Mapping and classification, by potential commercial/exploitation value.

Exploitation Workshop

Value proposition of each i4Q technology. Identification of value streams, markets, enablers and barriers.

PEDR

KER monitoring, market monitoring, business model analysis and Dissemination Plan and actions. Updated.

Exploitation Workshop

Identification of i4Q products by distinctive features to align target market and joint exploitation strategy and/or individual plans.

M25 – M36

Ongoing

Next exploitation workshop

Redefine and narrow the swot analysis and BMC for the final products and the start-up creation and/or Marketplace approach.

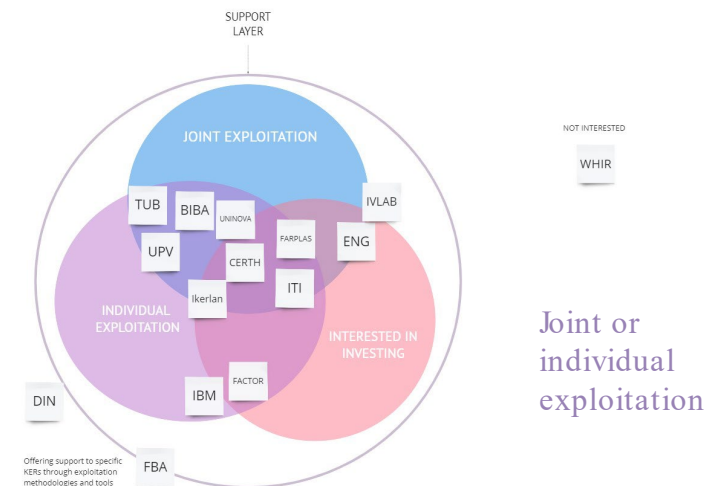
Next

Final PEDR

Focused on Competitors analysis for two potential exploitation paths: i4FS and IV-Lab marketplaces and/or the creation of i4Q start-up - consultancy services using the available solutions, focused on the services offered by the “bundled” solutions (Workshop on May/2022)

Consolidation analysis

Assessment consolidation for Exploitation definition (targeted i4Q value propositions; needed partnerships – Start-up Creation and Sustainability)



Joint or individual exploitation

More about the i4Q Project ...



www.i4q-project.eu



www.twitter.com/I4qProject



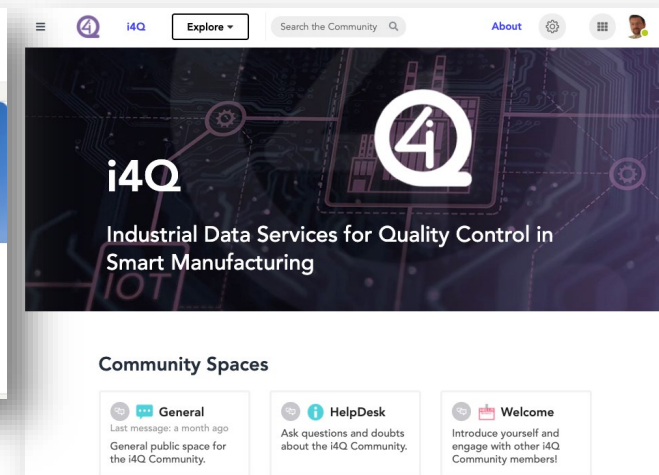
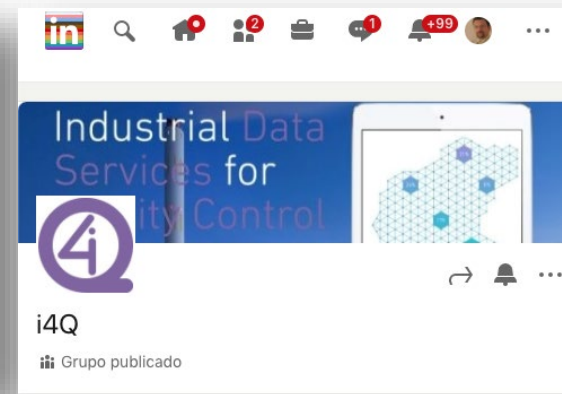
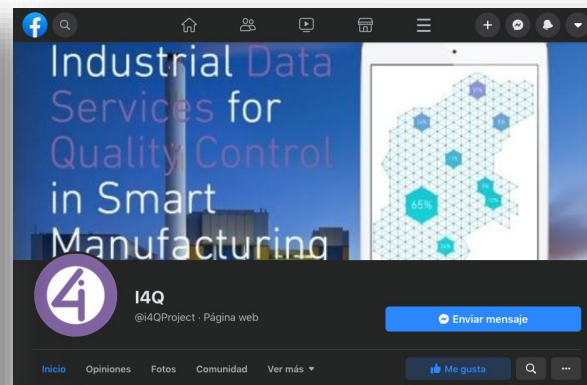
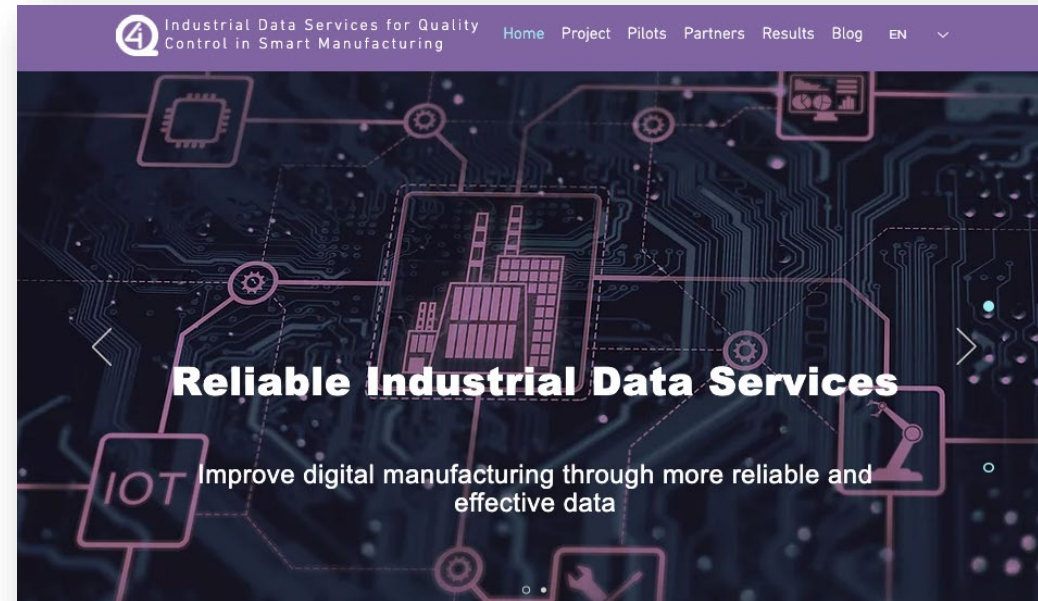
www.facebook.com/i4QProject



www.linkedin.com/groups/12491963/



<https://spaces.fundingbox.com/c/i4Q>



More about the i4Q Project ...



<https://cordis.europa.eu/project/id/958205>

The screenshot shows the CORDIS project page for 'Industrial Data Services for Quality Control in Smart Manufacturing'. The page is part of the Horizon 2020 program. It features a navigation bar with links to Home, Results Packs, Research*EU Magazines, News & Events, Projects & Results, and About Us. The project title is prominently displayed, along with a 'Fact Sheet' and 'Results' tab. The main content area includes a 'Project description' section with language options (DE, EN, ES, FR, IT, PL) and a detailed text description of the project's goals and objectives. A 'Project Information' sidebar on the right provides key details: the project name 'i4Q', grant agreement ID '958205', start date '1 January 2021', end date '31 December 2023', overall budget of '€ 11 442 342,50', and EU contribution of '€ 9 997 485,88'. The project is coordinated by 'ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS' in Greece. A 'Show the project objective' button is located at the bottom of the description section.

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HORIZON 2020 **Industrial Data Services for Quality Control in Smart Manufacturing**

Fact Sheet Results

Project description

DE EN ES FR IT PL

Support and enhance the reliability of industrial data

The amount of industrial data coming from smart small-size and cost-effective interconnected factory devices is huge. The challenge now is how to guarantee data reliability with functions grouped into five basic capabilities around the data cycle: sensing, communication, computing infrastructure, storage, and analysis and optimisation. The EU-funded i4Q project will develop a Reliable Industrial Data Services (RIDS) solution based on the Internet of things (IoT). This is a complete suite based on 22 i4Q solutions that can manage a large amount of industrial data. For instance, the i4Q RIDS will include simulation and optimisation tools for manufacturing line-continuous process qualification, quality diagnosis, reconfiguration and certification for ensuring high manufacturing efficiency, leading to an integrated approach to zero-defect manufacturing.

Show the project objective

Project Information

i4Q
Grant agreement ID: 958205

Start date 1 January 2021 **End date** 31 December 2023

Funded under
H2020-EU.2.1.5.1.

Overall budget
€ 11 442 342,50

EU contribution
€ 9 997 485,88

Coordinated by
ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS
Greece



Thank You!

Ilias Gialampoukidis
heliasgj@iti.gr

Georgia Apostolou
gapostolou@iti.gr



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