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DELIVERABLE

D2.2 – Reference Scenarios and Use Cases for AI in Manufacturing

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Executive Summary

This deliverable identifies a series of scenarios and use cases involving the deployment and use of Artificial Intelligence (AI) in manufacturing with an emphasis on scenarios directly related to STAR project.

AI Scenario's and Use Cases identification focused on two targets. The first is the STAR project and its own scenarios and use cases. Afterwards, external and publicly know scenarios and use cases were identified, such as: EFFRA Portal, IoT-Catalogue.com, Opportunities of Artificial Intelligence Study and AI4EU. In total, 58 AI-related scenarios and use cases were identified.

After the identification of the AI scenarios, they were studied and classified with domains and categories. This enabled an analysis to identify potential similarities between the STAR scenarios and the external ones.

This document provides all the AI Scenarios and Use Cases identified, classified and each one's relation and relevance to the STAR Scenarios. Also included are some statistical analysis of the overall list, per country distribution, domain and categories re-usability and more.

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Definitions, Acronyms and Abbreviations

Acronym/ Abbreviation	Title
AI	Artificial Intelligence
AI4EU	European Artificial Intelligence On-Demand Platform and Ecosystem
AUC	Area Under the Curve
CAD	Computer-aided design
CSES	Centre for Strategy and Evaluation Services
DoA	Description of Action
EFFRA	European Factories of the Future Research Association
HR	Human - Robot
IoT	Internet of Things
RUL	Remaining Useful Life
UC	Use Case
WP	Work Package

1 Introduction

1.1 Method

The purpose of this deliverable is, as stated in the Description of Action (DoA), "*to identify, analyse and document a set of reference scenarios and use cases involving the deployment and use of AI in manufacturing. Emphasis will be paid in scenarios that are directly related to the project's technologies and pilots such as predictive quality (Quality 4.0), human-robot collaboration, generative software design, as well as scenarios involving automated mobile robots. These reference scenarios will be further analysed in terms of their security, safety and ethical requirements, which will accordingly drive the development of the project's technologies*".

This report represents the official deliverable of Task 2.2 of STAR project work plan. Task 2.2 started at M1 of the project and the main goal of the task was to collect examples of scenarios applying AI technologies. The outcome of this task is a library of reference AI use cases and scenarios.

To elaborate on this library of scenarios the elicitation was performed in two groups. The first one, the STAR scenarios and use cases and the second, external and publicly know scenarios and use cases. Figure 1 depicts the first steps made for the identification of the scenarios.

The research for external scenarios and use cases, was performed mainly with the help of platforms, namely IoT-Catalogue.com[1] and EFFRA[2] portal. Through IoT-Catalogue.com it was possible to elicit a list of use cases that are known to use AI in manufacturing, and EFFRA as a portal to promote the development of new and innovative production technologies provides quite good information. In the context of this deliverable, the AI4EU[3] project was analysed to elicit the relevant use cases and scenarios targeted by it.

Apart from the mentioned before but also in the context of external references, an analysis was performed on a study conducted by the Centre for Strategy and Evaluation Services (CSES). The name of the study is Opportunities of Artificial Intelligence[4] and provides an assessment of the state of AI adoption in the European industry.

[1] https://www.iot-catalogue.com
[2] https://www.effra.eu
[3] https://www.ai4eu.eu/showcase-ai-pilots
[4] https://www.europarl.europa.eu/RegData/etudes/STUD/2020/652713/IPOL_STU(2020)652713_EN.pdf

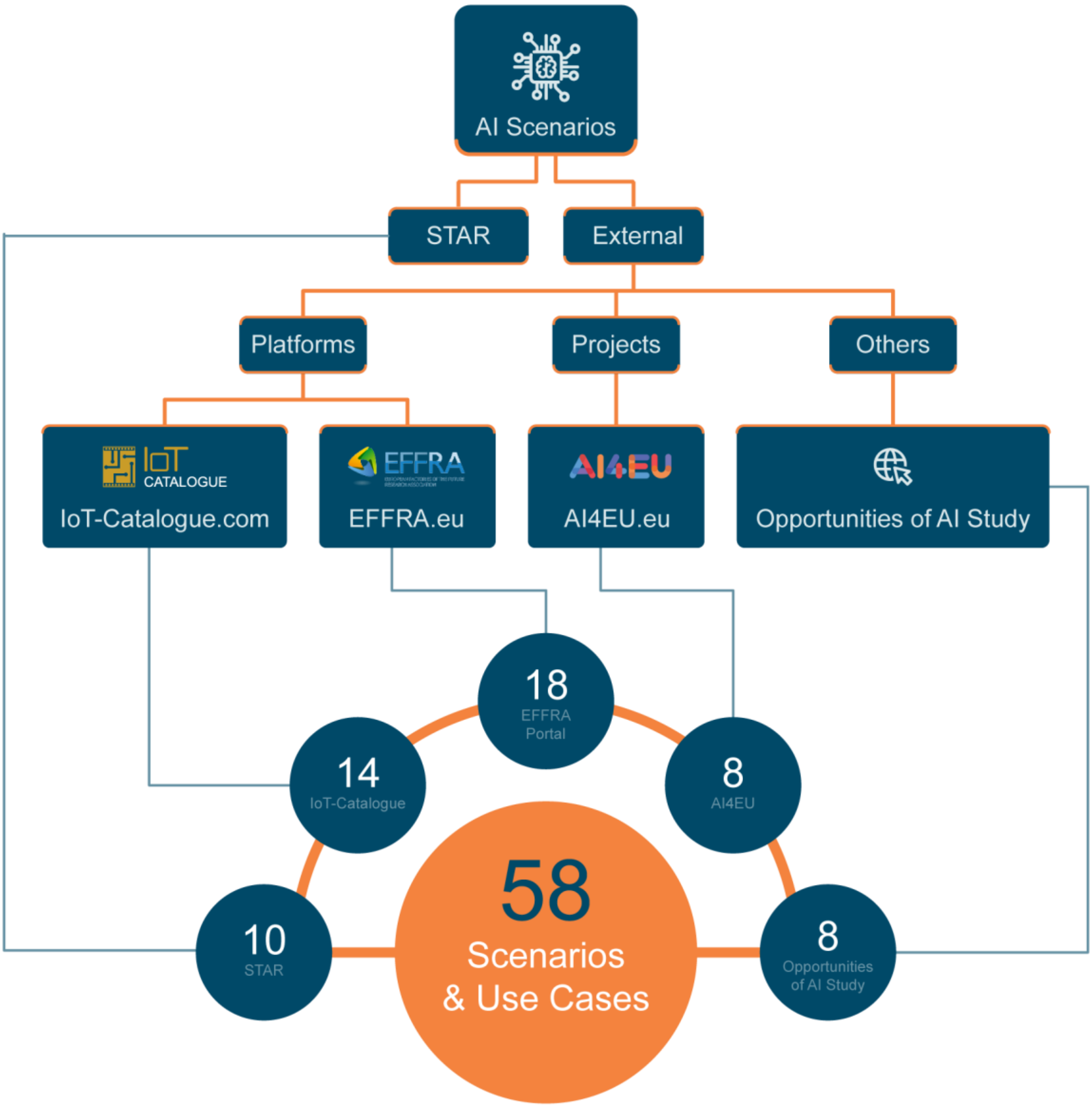

Figure 1 – Identification of AI Scenarios and Use Cases

As it can be seen by analysing both Figure 1 and Figure 2, we have collected a total of 58 AI Scenarios and Use Cases, distributed in the following way:

- STAR: 10;
- IoT-Catalogue.com: 14;
- EFFRA portal: 18;
- AI4EU: 8;
- Opportunities of Artificial Intelligence Study: 8.

Figure 2 represents the organogram of how the work progressed after the identification of the scenarios, as previously described.

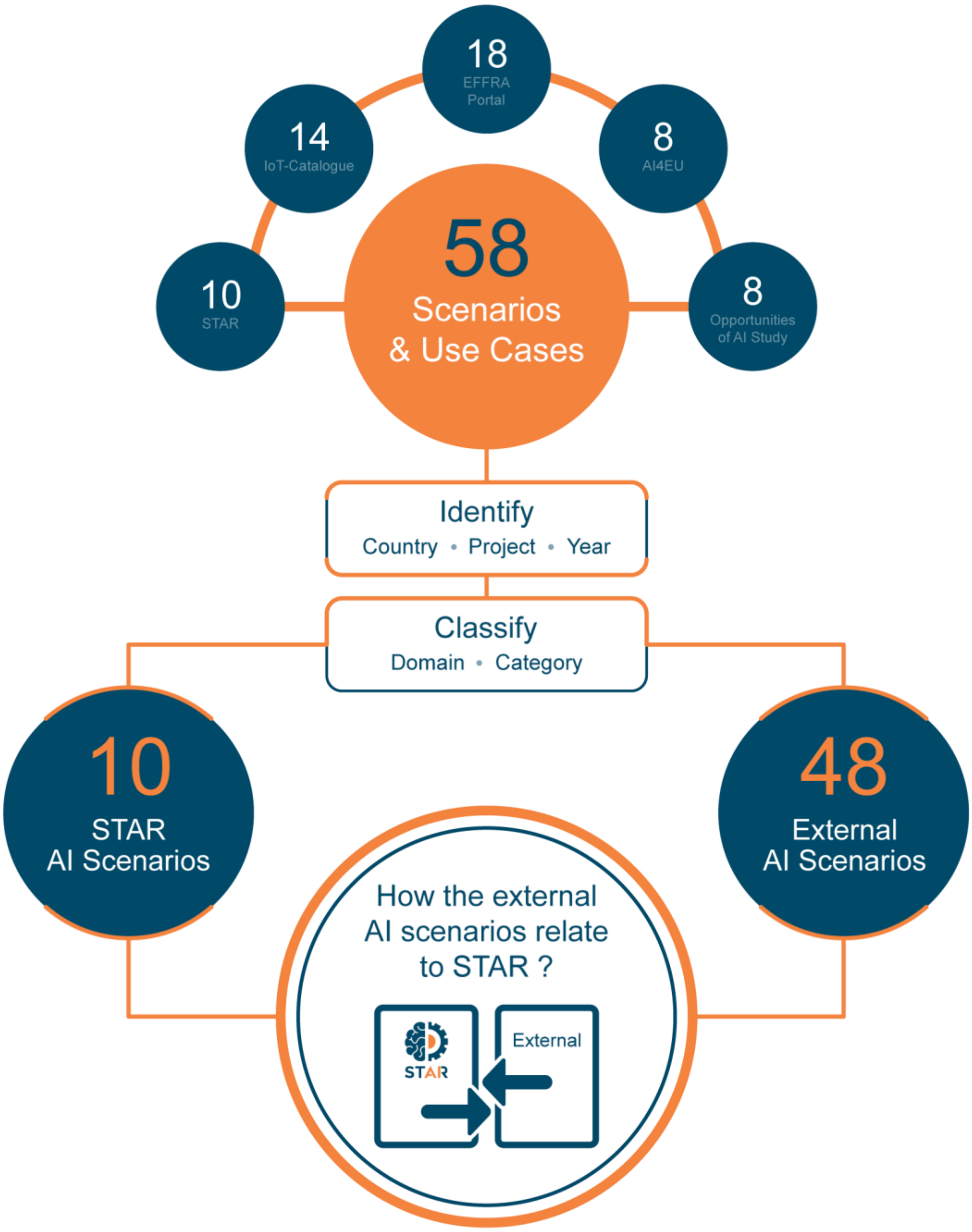

Figure 2 – Methodology used to understand similarities between external and internal scenarios

The work performed to study and understand the similarities between STAR project scenarios and the external ones, followed the following steps:

- Identify and extract the parameters such as Country, project, and year from the elicited scenarios,
- Analyse and classify the collected information and obtain the domain and category of the AI scenario,
- relate the STAR project scenarios with the external scenarios.

This enabled the identification of which external scenarios related to which STAR ones, and the possible relevance in how the external scenarios can be of use for the implementation and deployment of STAR technologies within STAR pilots.

1.2 Organization

The current deliverable is structured as follows:

The first section describes the method used to obtain the AI Scenarios and Use Cases library.

The next section briefly presents the information from the AI scenarios, which are divided by where the information came from, i.e. Project STAR, the project AI4EU, the platform IoT-Catalogue.com and EFFRA Portal, and from Opportunities of Artificial Intelligence Study. All scenario information is not displayed, due to the special limitation of the page and its page view. More information is present in Appendix A (placed by scenario).

The section Analysis displays statistics over key parameters from the Library of AI Scenarios and Use Cases. Namely views over the sources, Project/Initiative, year, country, domain, Category and Related STAR scenario.

Chapter 4 presents the conclusions drawn after identifying the various scenarios and use cases arising from the STAR project, and external and publicly know scenarios and use cases, such as the IoT-Catalogue.com, the EFFRA Portal, AI4EU and Opportunities of Artificial Intelligence.

Finally, Appendix A has the complete information of all AI Scenarios that have been identified.

2 Scenarios

The different AI scenarios described below come from the Project STAR, the project AI4EU, the platform IoT-Catalogue.com and EFFRA Portal, and from Opportunities of Artificial Intelligence Study.

First, we started by identifying examples of scenarios applying AI technologies, after gathering all the scenarios we were able to extract information from them that would be useful for the project, for example the domain, such as manufacturing, or the category, such as the zero-defect production, can provide the context where the scenarios apply and this way help the team in STAR to understand why and how AI is being used in different scenarios. When analysing all the scenarios, some of them are part of projects funded by EC, such as H2020 QU4LITY and H2020 WAZIUP. With the information analysed, we were able to relate and describe the relevance to STAR and relate each STAR scenario with the external ones. In this chapter we provide an overview of the information collected in the analysis of the scenarios. Appendix A, provides the completed detailed information collected and analysed.

2.1 STAR

2.1.1.1 STAR Deliverable D2.1

Table 1 - STAR Deliverable D2.1

Title	Domain	Category
Easy reconfiguration for automated part handling.	Manufacturing	• Flexibility in part handling
Human-supervised learning (Visual quality inspection).	Manufacturing	• Quality inspection; • Human-supervised learning; • Visual inspection
Safe collaboration between human and cobot(s).	Manufacturing	• Safe collaboration HR • Health; • Digital attacks
Production Processes Simulations for Accelerated Decisions and Safe Processes.	Manufacturing	• Simulations of the production processes; • Rapid reconfiguration of production process
Production Planning Optimization.	Manufacturing	• Planning Optimization • Optimal production process • Zero-defect production
Employee Training for Reduction of Human Errors.	Manufacturing	• Human training
Agile Production Management System Data Integrity and Reliability.	Manufacturing	• Digital attacks; • Data governance
Human intention recognition.	Manufacturing Safety	• Human Behaviour Prediction

Robot reconfiguration based on the dynamic layout.	Manufacturing	• Simulations of the production processes; • Rapid reconfiguration of production process
Dynamic path planning using Scenario-1 and Scenario-2	Manufacturing	• Optimization path planning; • Safe collaboration HR

2.2 External

2.2.1 Platforms

2.2.1.1 IoT-Catalogue.com

Table 2 - IoT-Catalogue.com

Title	Domain	Category	Relevance to STAR
BENTELER Predictive Maintenance and Service of a Hot Forming Line	• Manufacturing	• Zero-defect production; • Predictive Maintenance	STAR may use this approach (Predictive maintenance) to achieve Zero-defect production using ideas / knowledge / technologies / solutions from this scenario.
FILL Smart Machine Tool Digital Engineering	• Manufacturing	• Optimal production process; • Zero-defect production; • Predictive Maintenance	STAR may use this approach (Predictive maintenance) to achieve Zero-defect production using ideas / knowledge / technologies / solutions from this scenario. And also, data exploration, model integration and deployment.
Early Lameness Detection through Machine Learning	• Agriculture; • Safety	• Health	May use ideas / knowledge / technologies / solutions from this scenario and relate to STAR. Mounted sensors combination with machine learning algorithms to data analyse and identify anomalies.
Happy Cow	• Agriculture	• Health	May use ideas / knowledge / technologies / solutions from this scenario and relate to STAR. This project combines advanced big-data analysis with machine learning technologies and detects

			issues.
Pig Farm Management	• Agriculture	• Data governance	This scenario intends to link data across the value chain in order to provide the pig, farmers with the necessary information to effectively implement and carry out their management activities.
Poultry Chain Management	• Agriculture	• Planning Optimization	May use ideas knowledge / technologies / solutions from this scenario and relate to STAR. It intends to improve the performance of production chain processes; All data will be collected on a central cloud-based platform. This platform is linked to a Smart Data-Analytics tool, which can provide daily insights and early warnings based on the available data.
Crowd and Capacity Monitoring	• Smart city; • Events	• Human Behaviour Prediction; • Safe collaboration HR • Visual inspection	May use ideas / knowledge / technologies / solutions from this scenario. Like, monitor, record and analyse the environment and consequently detect emerging episodes via e.g. CCTV cameras, advanced video analytics, wearables and several IoT sensors. The STAR may use this for Safe collaboration and human safety, parts recognition and human behaviour.
Sound Level Monitoring	• Smart city; • Media	• Health; • Zero-defect production	May use ideas knowledge / technologies / solutions from this scenario and relate to STAR. The STAR may use this scenario as one approach to improve the health of the human (performance noise exposure at work) and detect faults in the machine (via Noise or vibration measurements).
Critical Cutting Tools	• Manufacturing	• Production process	STAR may use this approach (Predictive maintenance) to

		optimization; • Zero-defect production; • Predictive Maintenance	achieve Zero-defect production using ideas / knowledge / technologies / solutions from this scenario. This scenario will seek to enable the process monitoring of such tools to bring business benefits in higher tool life confidence, and forward planning in costing cutting tool inventories. The data can be used for data analysis, more specifically for machine learning algorithms that can eventually predict URL.
UC1 Remaining Useful Life prediction for cold forming production	• Manufacturing	• Zero-defect production; • Predictive Maintenance	STAR may use this approach (Predictive maintenance) to achieve Zero-defect production using ideas / knowledge / technologies / solutions from this scenario.
UC2 Remaining Useful Life prediction for blank cutting production tooling	• Manufacturing	• Zero-defect production; • Predictive Maintenance	STAR may use this approach (Predictive maintenance) to achieve Zero-defect production using ideas / knowledge / technologies / solutions from this scenario.
Fault detection and isolation in smart building	• Smart building	• Quality inspection • Data governance	Identify faulty devices and defective states, for example a temperature value that does not follow the usual trend of the equipment.
WAZIUP Agriculture MVP	• Agriculture	• Production process optimization	May use ideas knowledge / technologies / solutions from this scenario and relate to STAR. About the monitoring for preventing inputs waste and acquire real-time data.
WAZIUP Fish MVP	• Agriculture	• Production process optimization	May use ideas knowledge / technologies / solutions from this scenario and relate to STAR. About the connections of a network of sensors to monitor the fish, farming in order to improve the current farm management process.

2.2.1.2 EFFRA Portal

Table 3 - EFFRA Portal

Title	Domain	Category	Relevance to STAR
Integrated Artificial Intelligence	• Manufacturing	• Data governance; • Human-supervised learning • Safe collaboration HR • Simulations of the production processes; • Rapid reconfiguration of production process	The STAR project also intends to use digital twins, update it or test proposed changes in the digital twin, and then deploy these changes to the shop floor Integrating the skills and the knowledge of the workers on the shop floor, who work in conjunction with the AI approaches to achieve hybrid decision making. And also, can be important the way that the data is collected and aggregated for analysis (manufacturing system generates large amounts of data).
Fleet Management Platform for Machine Tools	• Manufacturing	• Production process optimization; • Zero-defect production; • Predictive Maintenance	STAR may use this approach (Proactive maintenance) to achieve Zero-defect production using ideas / knowledge / technologies / solutions from this scenario e.g. machine tool condition (RUL), more than 60 KPIs for the health status of machine-tool and its sub-system, performance analysis of this project to optimize its production.
Lombardy Champion - Zero-Hours Quality	• Manufacturing	• Quality inspection; • Zero-defect production	The scenario assess the average quality of the product and to verify the correctness of the production process.
Challenge 1: Performing Car Starter Assembly	• Manufacturing	• Flexibility in part handling; • Visual inspection; • Human-supervised learning	Identify the part that needs to be handled (Grasping deviations use deep Q learning algorithms. Will be detected using precise RGBD sensor). The operator supervise the assembly and correct it if necessary. The

			benefit of this cooperative automation will be in a shorter cycle time. Moreover, the system will become more and more autonomous and hopefully would need less and less assistance from humans.
Visual Detection of Personal Protection Equipment	• Manufacturing • Safety	• Visual inspection; • Health	It can use AI-based visual analytic techniques to ensure operational health and safety compliance. In this scenario, it intends to detect if the human wearing the correct face masks, in STAR case detects if human is in Safe Zone.
Predictive Maintenance demonstrator in lot-size-1 manufacturing furniture domain	• Manufacturing	• Zero-defect production; • Predictive Maintenance	STAR may use this approach (Predictive maintenance) to achieve Zero-defect production using ideas / knowledge / technologies / solutions from this scenario. To detect anomalous working conditions evaluating the risk of machine breakdown and take preventive actions through machine data analysis.
Advanced Predictive System for Plastic Injection Moulding Industry	• Manufacturing	• Production process optimization; • Quality inspection	Like some STAR scenarios this also intends to monitor, analyse (i.e. analyses the data against the optimum parameters to identify process deviations.) and optimize the process.
KOL's Real-time injection moulding process monitoring-control	• Manufacturing	• Quality inspection • Rapid reconfiguration of production process • Flexibility in part handling • Optimal	Process of real-time process monitoring (Collect parameters, Monito, Inspect, introduce AQ control loops at the operational level). Planning to use robots to perform complex moves required for inspection. Also, intended to detect

		production process • Zero-defect production	anomalies and remove the cause of the process failure based on the collected data and by applying control loops, advanced analytics and AI methods.
SIEMENS SIMATIC Products Quality Improvements	• Manufacturing	• Simulations of the production processes; • Zero-defect production	This scenario intended to provide quality forecasting and simulation, (production) control decisions shall be derived at an early stage if quality deviations occur. It implements a closed control loop approach via the deep analysis of process data and the implementation of digital twins for products and production.
MONDRAGON Zero defect and Autonomous Quality in Machinery Building for Capital Goods sector	• Manufacturing	• Production process optimization; • Zero-defect production	The intended objective is to reach zero defects in the production line and final inspection and verification operations. During this multi-stage process, several deviations or process variability may cause geometry and quality defects that cause both extensive rework operations and part scrap. The technologies and the control loops provided by project will make it possible to achieve observability of the product, process and resource states, throughout the system stages.
Improve automatic data acquisition, storage, traceability with user-friendly interfaces and human safety: Pilot 1	• Manufacturing	• Flexibility in part handling; • Quality inspection; • Safe collaboration HR; • Human training; • Data governance	For this scenario, they intends it address quality monitoring and data integration in existing IT infrastructures to ensure medial certification processes. Moreover, due to the complexity of the assembly, collaboration of the robot with the operator in the same workspace is

			foreseen, sharing tasks in the same part assembly. For improving the acceptance of the robotic solution and flexible safety will be evaluated and deployed, along with VR training of the operator.
Improve automatic data acquisition, storage, traceability with user-friendly interfaces and human safety: Pilot 2	• Manufacturing	• Flexibility in part handling	This scenario, they may has a solution to enable the robot training by means of a specialized glove, to place the parts in front of the camera and enable the automated CAD generation.
Improve automatic data acquisition, storage, traceability with user-friendly interfaces and human safety: Pilot 3	• Manufacturing	• Flexibility in part handling; • Human-supervised learning	This scenario, they may has a way to assist the human worker in calibrating and inspecting the frame manufacturing by means of AR technology.
Local Monitoring and Control System	• Manufacturing	• Production process optimization; • Zero-defect production; • Safe collaboration HR	The STAR project can use the enhanced features of this scenario to achieve the adaptive manufacturing systems: ->Process monitoring (monitored signals (e.g. spindle torque) that allow detecting anomalous performance) ->Adaptive feedrate control (consumption vs productivity) ->Component-level energy monitoring (I'm not sure if it's intended). ->Collision Avoidance System

Assembly line: AI-supported optical defects detection	• Manufacturing	• Quality inspection • Visual inspection	It also intends to ensure the highest quality of products. using images taken by one or more cameras. It utilizing AI to learn defects types and acceptance limits, improve testing programs through analysis of false positives resulting in improvements of base models for optical check.
Cleanroom Optimisation Through Machine Learning	• Cleanroom	• Simulations of the production processes	Considering Cleanroom similar to manufactory. This scenario implements the dynamic control and was integrated with the cleanroom simulation model. May use ideas / knowledge / technologies / solutions from this scenario.
Exploring the Challenges of Manufacturing with Learning Machine Vision	• Manufacturing	• Visual inspection	Visual Inspection of a specific product. The camera collects the test material needed to pilot the deep learning algorithm.
Decision Making Robot Could Revolutionise Manufacturing	• Manufacturing	• Flexibility in part handling; • Human-supervised learning	Using a combination of machine learning and visual recognition, the robot can be taught to make assembly decisions based on the components put in front of it.

2.2.2 Projects

2.2.2.1 AIEU

Table 4 - AI4EU

Title	Domain	Category	Relevance to STAR
AI4CITIZEN	• Education;	• Human-supervised learning	May use ideas / knowledge / technologies / solutions from this scenario and relate to STAR. Recommendations depending on the information already available (interest and preferences) and also the feeds back (machine-human interaction).

AI4ROBOTICS	• Manufacturing	• Zero-defect production; • Predictive maintenance	STAR may use this approach (Predictive maintenance) to achieve Zero-defect production using ideas / knowledge / technologies / solutions from this scenario.
AI4INDUSTRY	• Manufacturing	• Human-supervised learning; • Simulations of the production processes • Planning Optimization	Like the STAR's scenery this also intends integrate humans (using Explainable AI) and AI. Humans need to have transparency and understanding of decision-making processes of AI in manufacturing Action planning: the resulting planning prototype can generate plans for producing certain sequences of configurable products and it can provide alternative solutions with small modifications of the goal or the time horizon if the goal as it is stated is not achievable. The time prediction is concerned with estimating the production time from a given production plan. We use a neural network to predict the time that a batch of production items.
AI4HEALTHCARE	• Safety	• Quality inspection	Considering COVID-19 disease detection similar to anomaly detection. This scenario intends to provide a reference dataset in healthcare, which can be used to define algorithms to detect COVID-19 disease. This dataset contains medical images, diagnostic information as well as radiological reports.
AI4MEDIA	• Media	• Visual inspection	Considering a 3D face similar to an object. This scenario intends to identity of the actor is automatically extracted from a single video to create a 3D face identity. The STAR may use a part of this scenario to identify the object.
AI4AGRICULTURE	• Agriculture	• Visual inspection; • Quality inspection;	This scenario intends to achieve its objectives using computer vision and other AI techniques. One aim is assessing the quality of the production (of grapes).
AI4IOT	• Environme	• Health	May use ideas / knowledge /

	nt		technologies / solutions from this scenario and relate to STAR. The STAR may use this scenario as one approach to improve the human health. Monitoring the air quality inside the factory; Explore the use of machine learning (ML) for air quality prediction; Improve data quality and services by combining pollution data with other information.
AI4CYBERSECURITY	• Cybersecurity	• Digital attacks	This scenario intends to support the detection and the prevention of possible cyberattacks against an urban railways (specifically attacks against a distributed system CBTC).

2.2.3 Others

2.2.3.1 Opportunities of Artificial Intelligence Study

Table 5 - Opportunities of Artificial Intelligence Study

Title	Domain	Category	Relevance to STAR
Otto Retail scenario	• Retail	• Human Behaviour Prediction	May use ideas knowledge / technologies / solutions from this scenario and relate to STAR. Analyse billions of transactions to predict customer behaviour (through deep-learning). Transactions in the case of the STAR project may be understood as behaviour sequences.
Ocado Retail Scenario	• Retail	• Production process optimization	May use ideas / knowledge / technologies / solutions from this scenario and relate to STAR. This scenario use machine learning algorithms to steer products over conveyor belts and deliver them to customers. Drivers are then guided through an AI application to find the best route. The STAR may use this for optimization path planning.
DeepMind Electric Utilities Scenario	• Electric Utilities	• Human Behaviour Prediction	May use ideas / knowledge / technologies / solutions from this scenario and relate to STAR. To predict human behaviour (in this

			scenario is electricity demand) by using sensors data.
Nest Electric Utilities Scenario	• Electric Utilities	• Planning Optimization	May use ideas / knowledge / technologies / solutions from this scenario and relate to STAR. It creates a schedule by monitoring data (a user's habits with motion sensors, detecting when homes are empty) and optimising resources (energy use).
Siemens Electronic Manufacturing Scenario	• Manufacturing	• Simulations of the production processes; • Flexibility in part handling	The STAR also intends to replicate the factory floor (virtual factory) and use that to do simulations of the shop floor. This scenario uses an approach for parts identification with via bar codes.
Intel Manufacturing Scenario	• Manufacturing	• Data governance	May use ideas / knowledge / technologies / solutions from this scenario and relate to STAR. To speed up data integration.
Civitas Education Scenario	• Education;	• Human training	STAR may use this approach to improve Human training. using ideas / knowledge / technologies / solutions from this scenario. That is, Identify and engage students/workers and recommend strategies that facilitate Student/workers retention.
Coursera Education Scenario	• Education	• Human training	May use ideas / knowledge / technologies / solutions from this scenario and relate to STAR. Alert teachers/machine when students/workers make recurring mistakes in given assignments, denoting potential gaps in the teaching method.

3 Analysis

This section presents some relevant statistical analysis of the AI Scenarios and Use Cases previous referred and it is split in following scenarios:

- Source: research source of the AI Scenarios and Use Cases;
- Project/Initiative: providers of the AI Scenarios and Use Cases;
- Year: year of the AI Scenarios and Use Cases related with the Project/Initiative;
- Country: countries involved in the AI Scenarios and Use Cases;
- Domain: domains where the AI Scenarios and Use Cases are being applied;
- Category: categories of the AI Scenarios and Use Cases;
- Related STAR: AI Scenarios and Use Cases that are related with STAR Scenarios.

3.1 Scenario per Source

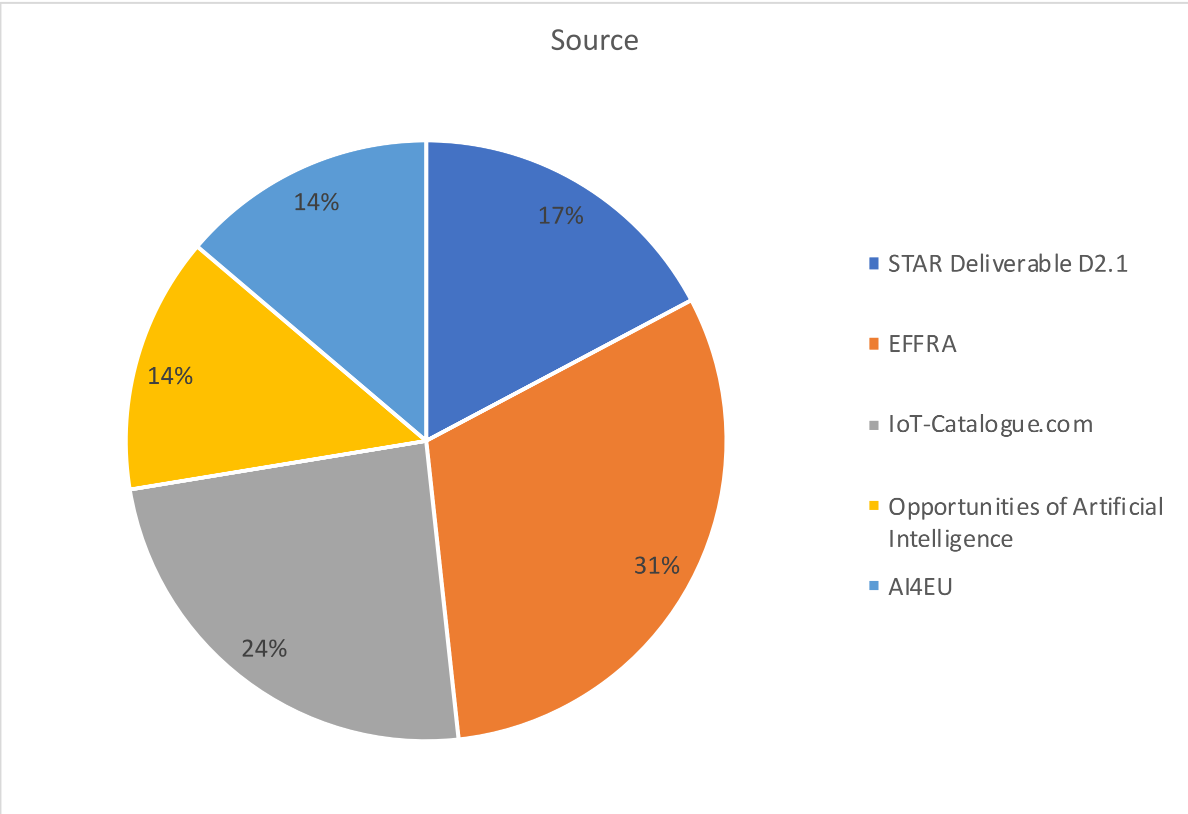

Figure 3 - Analysis of AI scenarios by Source

Figure 3 displays the percentages of scenarios per source. The EFFRA portal has higher number of contributions (18) and the AI4eu and Opportunities of AI lower number (both with 8).

3.2 Scenario per Initiative

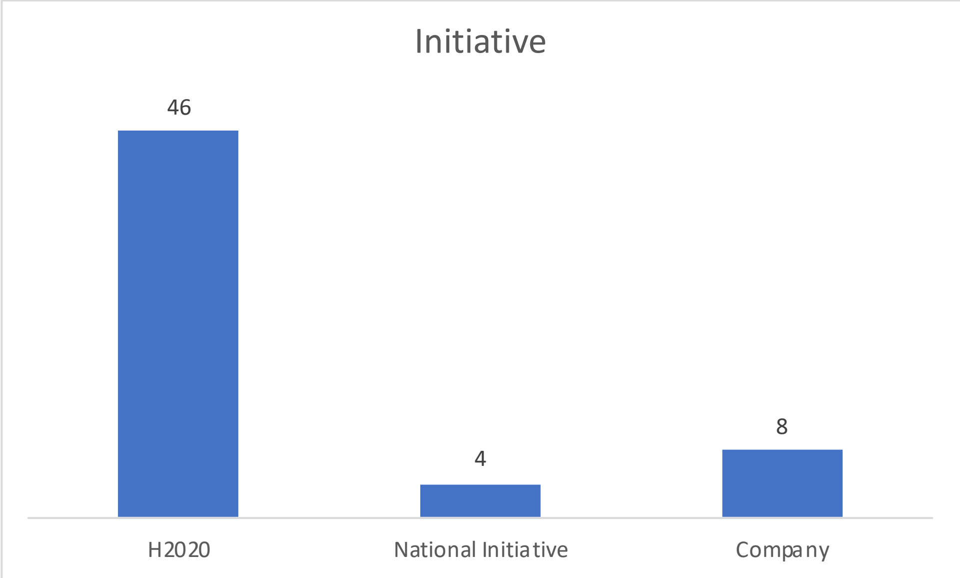

Figure 4 - Analysis of AI scenarios by Initiative

Figure 4 shows the initiatives of the scenarios (abscissa axis) and their counts. H2020 with 46 counts, Company and National Initiative with 8 and 4, respectively. The H2020 Initiative includes the projects that are funded by the European Commission under the H2020 initiative. The National Initiative are initiatives organised by national bodies and the companies' initiatives are scenarios developed by companies and shared with the community.

3.3 Scenario per Year

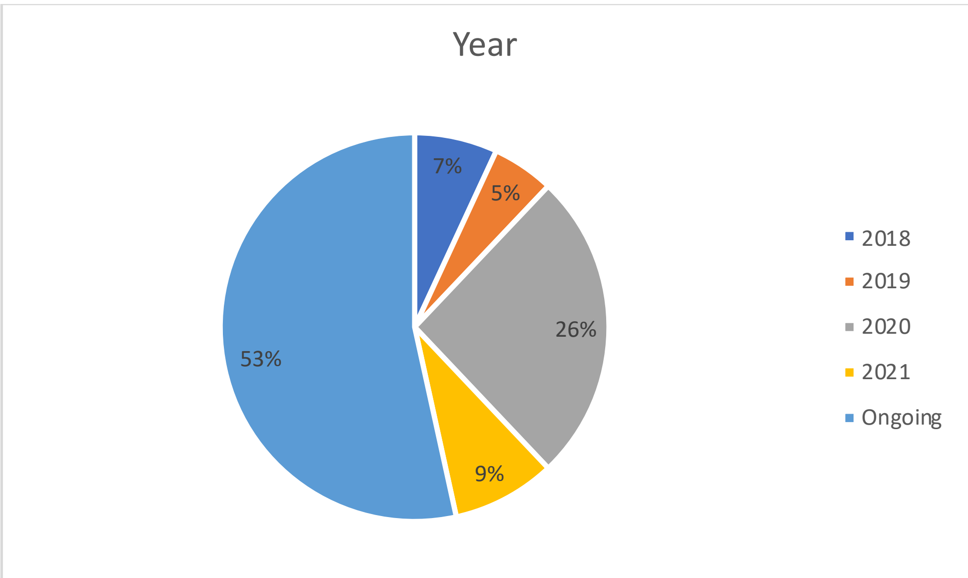

Figure 5 - Analysis of AI scenarios by Year

Most of the scenarios are ongoing (53 percent) and the oldest scenarios are from 2018, depicted in Figure 5. In the case of AI scenarios and use cases elicited from the

Opportunities of AI study there is no information on the year of occurrence of each scenario and use case, for that matter the year of publication of the study was selected.

3.4 Scenario per Country

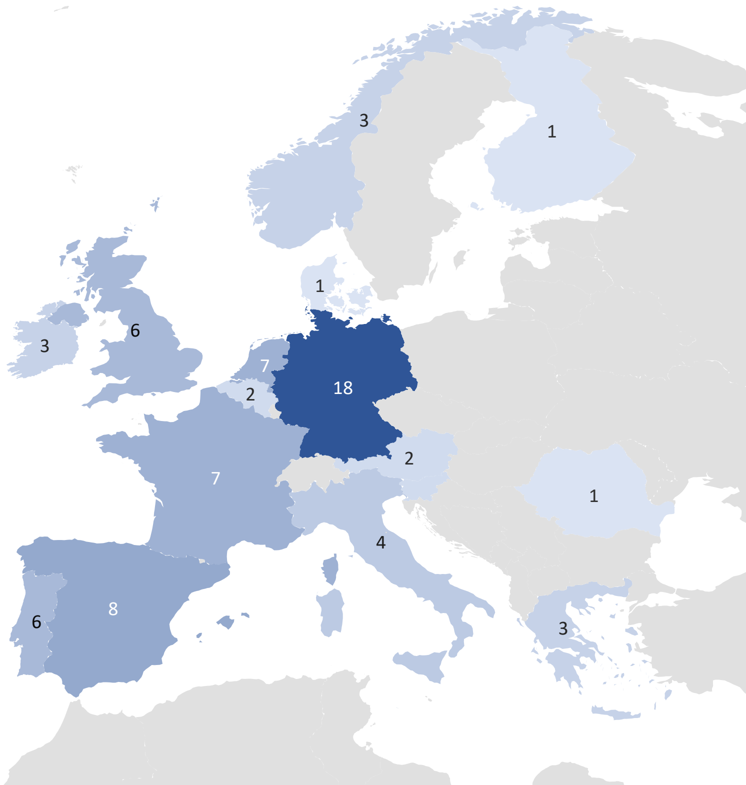

Figure 6 - Scenario EU Country + UK

Figure 6 shows the number of scenarios per EU countries (and also the United Kingdom). The greater the participation, the darker the country on the map. Germany has the higher participation (18).

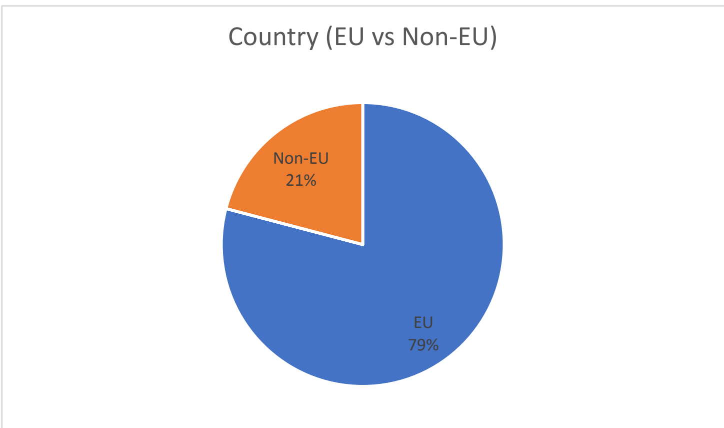

Figure 7 - Analysis of AI scenarios by Country (EU vs Non-EU)

In Figure 7 shows that the majority of the collected scenarios (79%) are from EU, mostly because the analysed study was focused on EU. Of the total of scenarios, 68 are from EU and the other 18 are Non-EU. The 18 Non-EU are, for example, UK (6), Africa (7), and United States (4).

3.5 Scenario per Domain

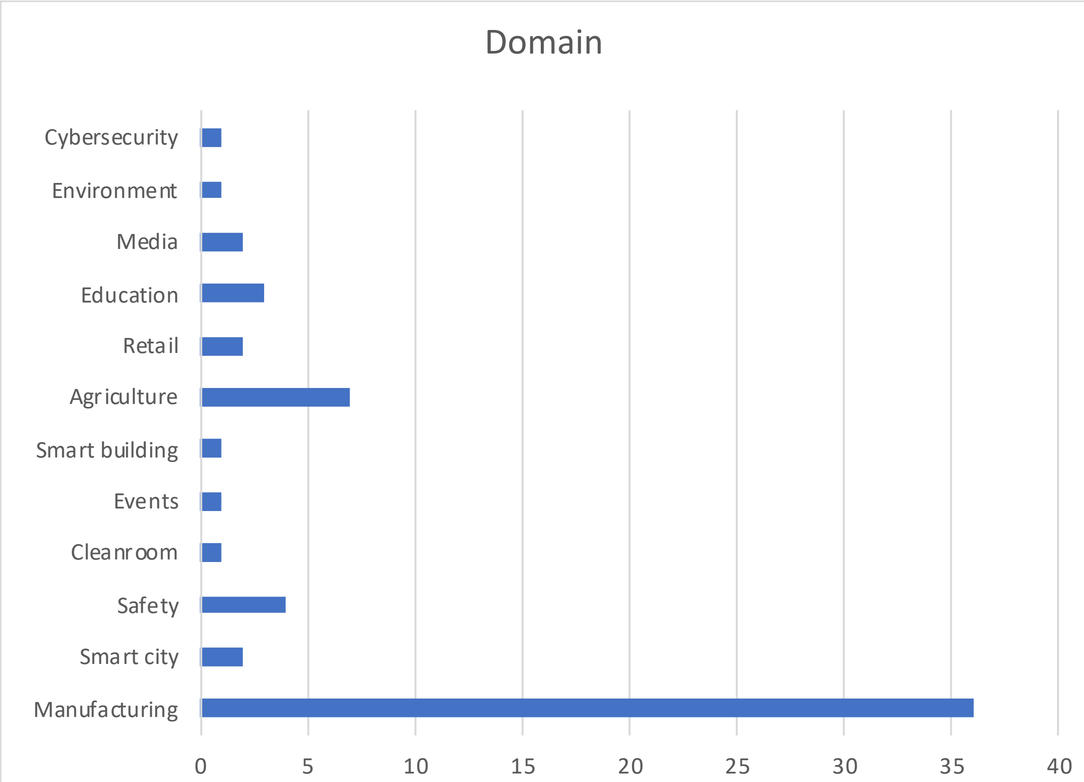

Figure 8 – Analysis of AI scenarios by Domain

Figure 8 depicts the scenarios per each of the 12 different domains, in which Manufacturing has the greatest prominence (36 scenarios). This happened due to the fact that when initiating the search for AI scenarios, our focus was on STAR, more concretely on scenarios that could be relevant to our project. This of course led us to identify multiple manufacturing scenarios which present a certain degree of similarity with the STAR scenarios.

3.6 Scenario per Category

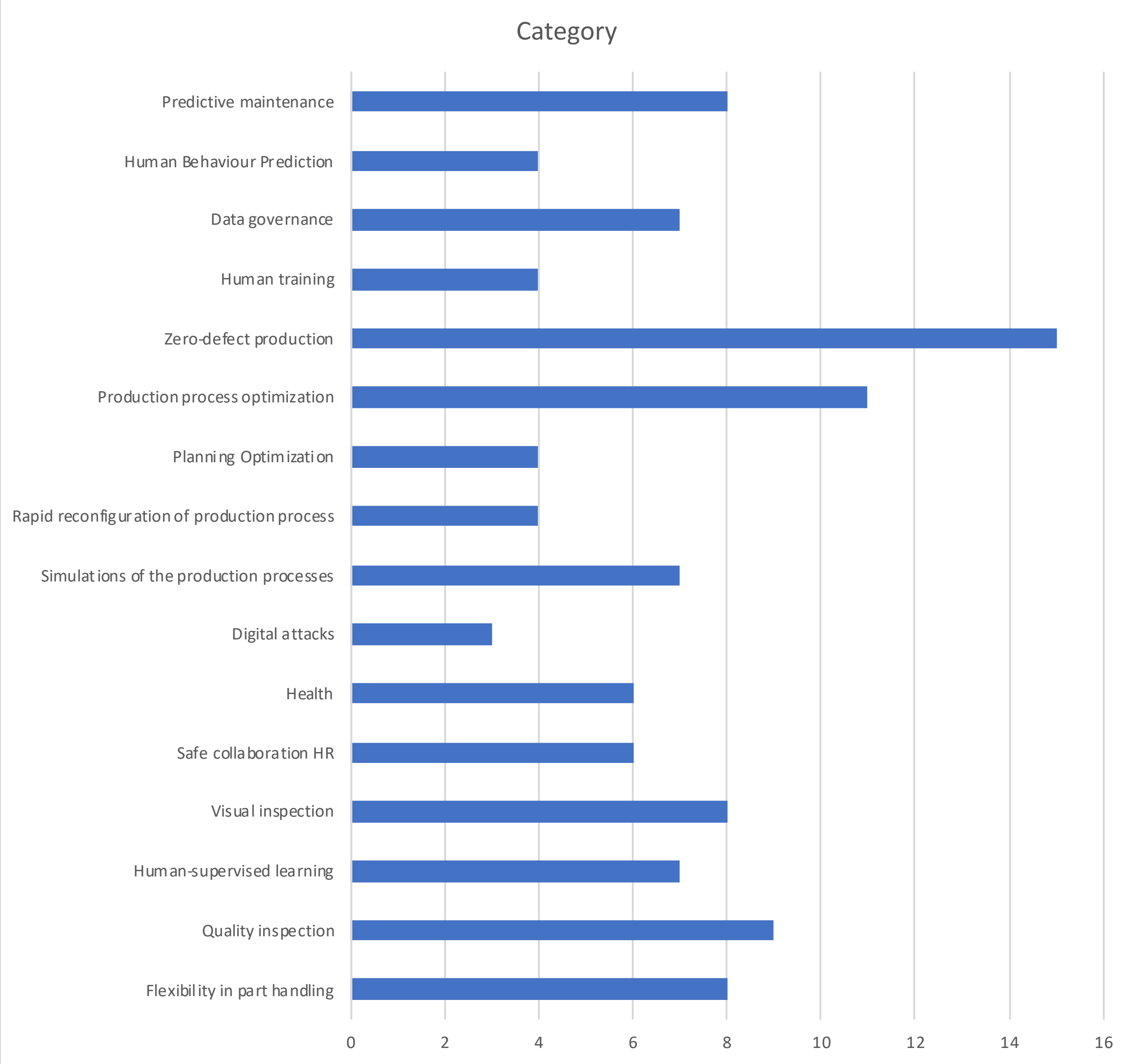

Figure 9 - Analysis of AI scenarios by Category

As depicted in last Figure 9, has 16 different categories, in which Zero-defect production's category has the greatest prominence (15 counts in the scenario).

Note: The category of Predictive Maintenance is not a STAR category, but STAR project may use ideas / knowledge / technologies / solutions to achieve Zero-defect production.

3.7 Relationships between scenarios

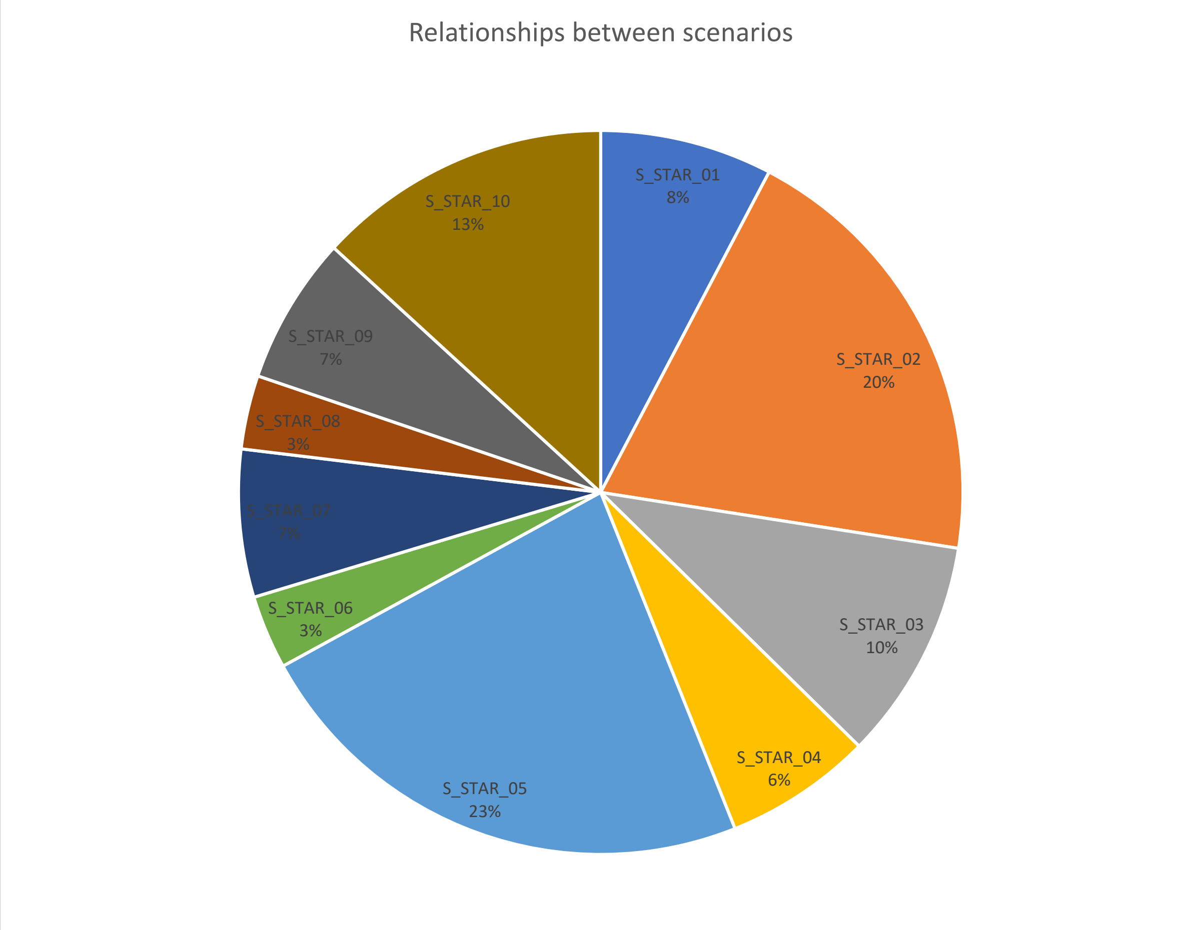

Figure 10 – Relationships between scenarios

Depicted in Figure 10 are the relationships between external scenarios and the STAR ones. In fact, the chart shows that all STAR scenarios can be related to some of the external scenarios found. The table below (

Table 6) identify which external scenarios relate to the STAR ones. The table only provides the name of each scenario (from both STAR and external), but more details can be found in their dedicated section within Appendix A.

Table 6 - Relationships between STAR and External Scenarios

STAR Scenario	Related External Scenario
A.1 Easy reconfiguration for automated part handling (S_STAR_01)	• A.12 KOL's Real-time injection moulding process monitoring-control • A.21 Challenge 1: Performing Car Starter Assembly • A.24 Improve automatic data acquisition, storage, traceability with user-friendly interfaces and human safety: Pilot 1 • A.25 Improve automatic data acquisition, storage, traceability with user-friendly interfaces and human safety: Pilot 2 • A.26 Improve automatic data acquisition, storage, traceability with user-friendly interfaces and human safety: Pilot 3

	• A.27 Decision Making Robot Could Revolutionise Manufacturing • A.47 Siemens Electronic Manufacturing Scenario
A.2 Human-supervised learning (Visual quality inspection) (S_STAR_02)	• A.11 Advanced Predictive System for Plastic Injection Moulding Industry • A.12 KOL's Real-time injection moulding process monitoring-control • A.13 Assembly line: AI-supported optical defects detection • A.14 Visual Detection of Personal Protection Equipment • A.15 Integrated Artificial Intelligence • A.18 Lombardy Champion - Zero-Hours Quality • A.19 Exploring the Challenges of Manufacturing with Learning Machine Vision • A.21 Challenge 1: Performing Car Starter Assembly • A.24 Improve automatic data acquisition, storage, traceability with user-friendly interfaces and human safety: Pilot 1 • A.26 Improve automatic data acquisition, storage, traceability with user-friendly interfaces and human safety: Pilot 3 • A.27 Decision Making Robot Could Revolutionise Manufacturing • A.31 Crowd and Capacity Monitoring • A.33 Fault detection and isolation in smart building • A.51 AI4CITIZEN • A.53 AI4INDUSTRY • A.54 AI4HEALTHCARE • A.55 AI4MEDIA • A.56 AI4AGRICULTURE
A.3 Safe collaboration between human and cobot(s) (S_STAR_03)	• A.14 Visual Detection of Personal Protection Equipment • A.15 Integrated Artificial Intelligence • A.16 Local Monitoring and Control System • A.24 Improve automatic data acquisition, storage, traceability with user-friendly interfaces and human safety: Pilot 1 • A.32 Early Lameness Detection through Machine Learning • A.35 Happy Cow • A.38 Sound Level Monitoring • A.57 AI4IOT • A.58 AI4CYBERSECURITY
A.4 Production Processes Simulations for Accelerated Decisions and Safe Processes (S_STAR_04)	• A.12 KOL's Real-time injection moulding process monitoring-control • A.15 Integrated Artificial Intelligence • A.20 Cleanroom Optimisation Through Machine Learning • A.22 SIEMENS SIMATIC Products Quality Improvements • A.47 Siemens Electronic Manufacturing Scenario • A.53 AI4INDUSTRY
A.5 Production Planning Optimization (S_STAR_05)	• A.11 Advanced Predictive System for Plastic Injection Moulding Industry • A.12 KOL's Real-time injection moulding process monitoring-control

	• A.16 Local Monitoring and Control System • A.17 Fleet Management Platform for Machine Tools • A.18 Lombardy Champion - Zero-Hours Quality • A.22 SIEMENS SIMATIC Products Quality Improvements • A.23 Predictive Maintenance demonstrator in lot-size-1 manufacturing furniture domain • A.28 MONDRAGON Zero defect and Autonomous Quality in Machinery Building for Capital Goods sector • A.29 BENTELER Predictive Maintenance and Service of a Hot Forming Line • A.30 Critical Cutting Tools • A.34 FILL Smart Machine Tool Digital Engineering • A.37 Poultry Chain Management • A.38 Sound Level Monitoring • A.39 UC1 Remaining Useful Life prediction for cold forming production • A.40 UC2 Remaining Useful Life prediction for blank cutting production tooling • A.41 WAZIUP Agriculture MVP • A.42 WAZIUP Fish Farming MVP • A.44 Ocado Retail Scenario • A.46 Nest Electric Utilities Scenario • A.52 AI4ROBOTICS • A.53 AI4INDUSTRY
A.6 Employee Training for Reduction of Human Errors (S_STAR_06)	• A.24 Improve automatic data acquisition, storage, traceability with user-friendly interfaces and human safety: Pilot 1 • A.49 Civitas Education Scenario • A.50 Coursera Education Scenario
A.7 Agile Production Management System Data Integrity and Reliability (S_STAR_07)	• A.15 Integrated Artificial Intelligence • A.24 Improve automatic data acquisition, storage, traceability with user-friendly interfaces and human safety: Pilot 1 • A.33 Fault detection and isolation in smart building • A.34 FILL Smart Machine Tool Digital Engineering • A.36 Pig Farm Management • A.48 Intel Manufacturing Scenario
A.8 Human intention recognition (S_STAR_08)	• A.31 Crowd and Capacity Monitoring • A.43 Otto Retail scenario • A.45 DeepMind Electric Utilities Scenario
A.9 Robot reconfiguration based on the dynamic layout (S_STAR_09)	• A.12 KOL's Real-time injection moulding process monitoring-control • A.15 Integrated Artificial Intelligence • A.20 Cleanroom Optimisation Through Machine Learning • A.22 SIEMENS SIMATIC Products Quality Improvements • A.47 Siemens Electronic Manufacturing Scenario • A.53 AI4INDUSTRY

A.10 Dynamic path planning using Scenario-1 and Scenario-2 (S_STAR_10)	• A.11 Advanced Predictive System for Plastic Injection Moulding Industry • A.12 KOL's Real-time injection moulding process monitoring-control • A.15 Integrated Artificial Intelligence • A.16 Local Monitoring and Control System • A.17 Fleet Management Platform for Machine Tools • A.24 Improve automatic data acquisition, storage, traceability with user-friendly interfaces and human safety: Pilot 1 • A.28 MONDRAGON Zero defect and Autonomous Quality in Machinery Building for Capital Goods sector • A.30 Critical Cutting Tools • A.31 Crowd and Capacity Monitoring • A.41 WAZIUP Agriculture MVP • A.42 WAZIUP Fish Farming MVP • A.44 Ocado Retail Scenario

4 Conclusions

In this deliverable, D2.2, a set of reference scenarios and use cases involving the deployment and use of AI in manufacturing have been identified, analysed, and documented. In total, 58 scenarios and use cases were identified through the STAR project (10), the IoT-Catalogue.com platform (14), the EFFRA.eu platform (18), the AI4EU.eu project (8) and by the study Opportunities of AI Study (8) conducted by the Centre for Strategy and Evaluation Services (CSES).

To finalize, the relation between the AI Scenarios and Use Cases, different statistics were made, using source, project/initiative, year, country, domain, category and related to STAR. One of the conclusions we reached from the analysis of the graphs was that the three scenarios with the highest percentage are: Easy reconfiguration for automated part handling (20%), Production Planning Optimization (23%) and Dynamic path planning using Scenario-1 and Scenario-2(13%), reaching more than 50%.

Appendix A List of AI Scenarios

A.1 Easy reconfiguration for automated part handling

ID number	S_STAR_01
Description	It revolves around exploring the possibilities of implementing flexibility in part handling. The first topic that is being explored to achieve flexibility, is automated complex part handling. This means that a system needs to be defined so that it, among other things, can identify the part that needs to be handled, but also the orientation of this part. This is needed to be able to determine where and how the system decides to pick up the part and additionally, how it needs to place the part.
Source	STAR Deliverable D2.1
Link	STAR Deliverable D2.1
Domain	Manufacturing
Category	Flexibility in part handling
Project	H2020 STAR
Country	The Netherlands
Year	Ongoing
Related STAR Scenario	-
Relevance to STAR	-

A.2 Human-supervised learning (Visual quality inspection)

ID number	S_STAR_02
Description	It revolves around the exploration and development of a flexible visual quality inspection system. Due to its exploitation in product ramp-up stages, the system needs to be effortlessly configurable based on small and incomplete datasets. Also, due to its application on low volume production runs, the visual quality inspection system should be learning fast to adapt for new parts. This means that it is no longer viable to have a reconfiguration effort of 1000+ cycles. Furthermore, to create a trustworthy system, a human in the loop is suggested. Whenever the visual quality inspection system has a low confidence in its decision, human input can be asked. This human input then overrides the system's decision and feeds back this input to its learning module so that the next time, human input for a similar decision is not required anymore. Since there is a human in the loop, the system needs to be able to log and explain its decisions. Therefore, XAI techniques will be explored where the system can register and rationalize its decisions. Also, because there is a human in the loop, it is possible to select samples at random and ask for human input to validate the decisions made by the system. This way, the system should be learning from both sample checks, as well as human input regarding low confidence cases.
Source	STAR Deliverable D2.1
Link	STAR Deliverable D2.1
Domain	Manufacturing
Category	Quality inspection; Human-supervised learning; Visual inspection;
Project	H2020 STAR
Country	The Netherlands
Year	Ongoing
Related STAR Scenario	-

Relevance to STAR	-

A.3 Safe collaboration between human and cobot(s)

ID number	S_STAR_03
Description	It revolves around safety of the complete system. First, all possible risks need to be identified to ensure safety of the demonstrator. However, during this the goal is also to look further than the standard safety risks currently considered in the industry. The first identified risks are related to human and cobots operating in a shared space. In this shared space, two cobots need to operate without colliding with each other. Next to that, shared safety systems, like proximity alerts, need to be explored so that possible unsafe situations can be prevented. Another identified safety topic within this, it is related to digital safety. In this topic prevention of different kinds of digital attacks (i.e., poisoning attacks, evasion attacks) is explored. Finally, the Philips also intends to look further than the "basic" safety and explore the topic of employee mental health. This means that mental health monitoring via devices (e.g., wearables) could be explored to identify possible risks which can be acted upon the system so that a perfectly synergized and shared working space between human and cobot can be created.
Source	STAR Deliverable D2.1
Link	STAR Deliverable D2.1
Domain	Manufacturing
Category	Safe collaboration HR; Health; Digital attacks
Project	H2020 STAR
Country	The Netherlands
Year	Ongoing
Related STAR Scenario	-
Relevance to STAR	-

A.4 Production Processes Simulations for Accelerated Decisions and Safe Processes

ID number	S_STAR_04
Description	It is expected that the future STAR AI platform will allow to accelerate the decisions at the production management level, through simulations of the production processes in real time, reaching the desired flexibility of them. An agile production system will allow rapid reconfiguration of production processes to accommodate sudden customer orders, produce a highly configurable product with quality and in the shortest possible timeframe. To achieve this goal, individuals charged with the high-level planning and management need to have detailed access to the production line with detailed real time information, need to know the general state of any production cell for effective real-time optimization and management.
Source	STAR Deliverable D2.1
Link	STAR Deliverable D2.1
Domain	Manufacturing
Category	Simulations of the production processes; Rapid reconfiguration of production process

Project	H2020 STAR
Country	Portugal
Year	Ongoing
Related STAR Scenario	-
Relevance to STAR	-

A.5 Production Planning Optimization

ID number	S_STAR_05
Description	The management of this complex process network has to be achieved flexibly and responsibly, reacting to scheduled production changes as needed to maintain process competitiveness, based on efficiency, effectiveness and zero-defect production. Advanced online process sensing/ monitoring systems and different parameters and variables into the manufacturing process and products, including non-destructive testing techniques, to measure dimensions and defects, with contactless and agile technologies should be incorporated on these adaptive manufacturing systems. The maximization of productivity due to the linearization of the productive planning will have important consequences in the reduction of the work peaks and consequently in the reduction of the number of extra work hours, as well as the reduction of the production downtimes.
Source	STAR Deliverable D2.1
Link	STAR Deliverable D2.1
Domain	Manufacturing
Category	Planning Optimization; Optimal production process; Zero-defect production
Project	H2020 STAR
Country	Portugal
Year	Ongoing
Related STAR Scenario	-
Relevance to STAR	-

A.6 Employee Training for Reduction of Human Errors

ID number	S_STAR_06
Description	Human factors play a predominant role in IBER's production processes i.e., the processes are not fully automated. Hence, training of human resources in the various production processes will be planned and carried out in advance, in accordance with appropriate operational methods. The flexibility of human resources training, to accommodate the agile production will be achieved with the help of the future STAR AI platform, which will lead to improvement of operative methods and consequently to the reduction of human errors associated with learning and assimilation. Moreover, due to continuous monitoring of production processes, human errors associated with overspecialization (i.e., when an operator is performing the same functions in the same workplaces over a given period) will be reduced. Practically the phenomenon can be described as the loss of operator concentration due to overconfidence, with consequences on productivity and quality of work performed.

Source	STAR Deliverable D2.1
Link	STAR Deliverable D2.1
Domain	Manufacturing
Category	Human training
Project	H2020 STAR
Country	Portugal
Year	Ongoing
Related STAR Scenario	-
Relevance to STAR	-

A.7 Agile Production Management System Data Integrity and Reliability

ID number	S_STAR_07
Description	It will take advantage of STAR's security and data governance technologies in order to ensure the integrity, confidentiality, availability, non-repudiation and authenticity of industrial data used by AI systems and processes. Techniques for decentralized validation of industrial data will be employed, notably techniques that audit/validate datasets derived from sensors and unreliable data sources. Likewise, the UC will leverage the project's cyber-defense techniques against Deep Neural Networks, with emphasis on confronting attempts for contaminating machine learning and deep learning algorithms. Identify inappropriate data, eliminate it, so as to prevent the contamination of the learning process itself, leading to wrong analyses and alerts.
Source	STAR Deliverable D2.1
Link	STAR Deliverable D2.1
Domain	Manufacturing
Category	Digital attacks; Data Governance
Project	H2020 STAR
Country	Portugal
Year	Ongoing
Related STAR Scenario	-
Relevance to STAR	-

A.8 Human intention recognition

ID number	S_STAR_08
Description	Determines what a human's next behaviour(s) will be.
Source	STAR Deliverable D2.1
Link	STAR Deliverable D2.1
Domain	Manufacturing; Safety
Category	Human Behaviour Prediction
Project	H2020 STAR
Country	Germany
Year	Ongoing
Related STAR Scenario	-
Relevance to STAR	-

A.9 Robot reconfiguration based on the dynamic layout

ID number	S_STAR_09
Description	Sends the coordinates of the modules to the robot dynamically.
Source	STAR Deliverable D2.1
Link	STAR Deliverable D2.1
Domain	Manufacturing
Category	Simulations of the production processes; Rapid reconfiguration of production process
Project	H2020 STAR
Country	Germany
Year	Ongoing
Related STAR Scenario	-
Relevance to STAR	-

A.10 Dynamic path planning using Scenario-1 and Scenario-2

ID number	S_STAR_10
Description	Computes the new path based on the previous scenario outputs and robot behaviour. Motivation: In the current implementation, the robot stops in case a human is detected in front of the moving trajectory, and the production pauses. This scenario will merge previous two scenarios and realize an improved navigation by enabling a recalculation of the path to the destination. Business Objectives: More important roles for AI in the production environment, where the human safety is in consideration.
Source	STAR Deliverable D2.1
Link	STAR Deliverable D2.1
Domain	Manufacturing
Category	Production process optimization; Safe collaboration HR
Project	H2020 STAR
Country	Germany
Year	Ongoing
Related STAR Scenario	
Relevance to STAR	

A.11 Advanced Predictive System for Plastic Injection Moulding Industry

ID number	S_EFFR_01
Description	The Advanced Predictive System (APS) processes and manages the data coming from the DAS through the wireless network (WCN) to predict and optimise the injection moulding process. The predictions and recommendations produced by the APS are stored in a centralised server called the content management system (CMS) for future analysis and sent to the mobile app of the location based content delivery via a standard wireless network. The APS system applies novel and advanced artificial intelligence and machine learning techniques which create the robust and accurate prediction and optimisation of the injection moulding processes compared to the traditional statistical process control (SPC) currently available in the market.

	The PREVIEW APS system has two subsystems- 1. Setup Predictive Systems (SPS): The SPS subsystem is responsible for providing recommendations to tune key parameters of the production process for a particular mould/machine configuration. This feature is capable of providing the following: recommendations, predictions and alarms; representative examples of these are provided below: • SPS Recommendations: Example – "Increase holding pressure 11%". • SPS Alarm: Example – "Possible bad pieces in less than 10 cycles, Production is deviating towards holding pressure: 800". 2. Production Control System (PCS): This subsystem monitors the production process and offers full traceability of the production, predicts parts quality, provides feedback to the process with identification of defect types and triggers early and predictive alarms to correct the production process. Some examples of part quality and defect prediction, PCS prediction and statistics, and alarms, are as follows: • Part Quality Prediction and Defect Type: Example-"Good parts", "Bad parts-Shrinkage", "Bad parts-Flash". • PCS Alarm: Example – "Producing bad parts, possible bad pieces in less than 10 cycles". Both of the subsystems work based on the PREVIEW system's Mould-DNA concept. In Mould-DNA a machine learning model is generated for a specific mould-machine configuration from trials (training phase) carried out previously by the operator which contains data of the mould cavity sensors and machine configurations, mould cavity pressure and temperature, machine parameters and the quality of produced parts. The PCS subsystem analyses the mould cavity pressure and temperature curves along with the machine parameters and compares them with the Mould-DNA model which creates real-time prediction of the part quality and launches production alerts and early alarms for the deviated production. The SPS module analyses the cavity data against the optimum machine parameters to identify process deviations. The APS system has the full compatibility and seamless integration with the INFLATE protocol designed for the PREVIEW wireless network and also with the central server. The most attractive functionalities of the APS system are as follows: 1. Parallel processing of multi moulds/machines in the production floor. 2. Data fusion for combining the information of different sensors. 3. Automatic identification of data incoherency and raising of alarms. 4. Less samples required for the training of the system. 5. Part quality and types of defect prediction at more than 95% of accuracy. 6. Warnings and preventive alarms in a few injection cycles for production quality deviation. 7. Machine configuration identification up-to 80% of accuracy. 8. Machine tuning recommendations in an iterative process. 9. Storage of the processed data for creating an historical database. 10. Advanced production control and set-up recommendations statistics display.

Source	EFFRA
Link	https://portal.effra.eu/result/show/1479
Domain	Manufacturing
Category	Production process optimization; Quality inspection
Project	H2020 PREVIEW - PREdictiVe system to recommend Injection mold sEtup in Wireless sensor networks
Country	Spain
Year	2018
Related STAR Scenario	S_STAR_02 S_STAR_05 S_STAR_10
Relevance to STAR	Like some STAR scenerios this also intends to monitor, analyse (i.e. analyses the data against the optimum parameters to identify process deviations.) and optimize the process.

A.12 KOL's Real-time injection moulding process monitoring-control

ID number	S_EFFR_02
Description	Kolektor (KOL) is known as the world's largest manufacturer of commutators, the second largest European manufacturer of slip rings and the second largest European manufacturer of plastic-bonded magnetic products. Injection moulding is enabling technology for production of all these parts. The scope of this pilot project will be a production line where Kolektor produces one type of products. The aim of this pilot is to detect, possibly predict, and remove the cause of the process failure as soon as possible, ideally in real-time. In the process of real-time process monitoring, we are planning to: (i) Collect moulding process parameters; (ii) Monitor environmental parameters; (iii) Inspect moulding tool and moulded parts; (iv) Introduce AQ control loops at the operational level. Based on the collected data and by applying control loops, advanced analytics and artificial intelligence methods we will better understand the moulding process and will be able to detect anomalies and failures as soon as possible. Because of the geometry of a moulding tool and number of cavities, it is not possible to inspect all cavities at once. Therefore, we are planning to use robots to perform complex moves required for inspection. We would like to study if it is possible to automate the removal of root cause of the bad parts being produced (like cleaning the cavity with dry ice).
Source	EFFRA
Link	https://portal.effra.eu/result/show/3918
Domain	Manufacturing
Category	Quality inspection; Rapid reconfiguration of production process; Flexibility in part handling; Production process optimization; Zero-defect production
Project	H2020 QU4LITY - Digital Reality in Zero Defect Manufacturing
Country	Slovenia
Year	Ongoing
Related STAR Scenario	S_STAR_01 S_STAR_02

	S_STAR_04 S_STAR_09 S_STAR_05 S_STAR_10
Relevance to STAR	Process of real-time process monitoring (Collect parameters, Monito, Inspect, introduce AQ control loops at the operational level). Planinng to use robots to perform complex moves required for inspection. Also, intended to detect anomalies and remove the cause of the process failure based on the collected data and by applying control loops, advanced analytics and AI methods.

A.13 Assembly line: AI-supported optical defects detection

ID number	S_EFFR_03
Description	The CONT industrial partner supplies automotive components for different car producers. To ensure the highest quality of products it uses automatic and manual final tests. The automatic test presumes comparison of images taken by one or more cameras, placed in the check stations along the assembly line, with images of expected product. If the product fails during the automatic test it is sent to the operator that performs manual test, while comparing the product image with reference image. In order, to reduce the number of quality incidents (e.g. related to false positives) during automatic test, ZDMP platform offers a set of services utilizing Artificial Intelligence to learn defects types and acceptance limits, improve testing programs though analysis of false positives resulting in improvements of base models for optical check.
Source	EFFRA
Link	https://portal.effra.eu/result/show/4505
Domain	Manufacturing
Category	Quality inspection; Visual inspection
Project	H2020 ZDMP - Zero Defect Manufacturing Platform
Country	Romania
Year	Ongoing
Related STAR Scenario	S_STAR_02
Relevance to STAR	It also intends to ensure the highest quality of products. using images taken by one or more cameras. It utilizing AI to learn defects types and acceptance limits, improve testing programs though analysis of false positives resulting in improvements of base models for optical check.

A.14 Visual Detection of Personal Protection Equipment

ID number	S_EFFR_04
Description	Through their wide-ranging applications in the manufacturing environments, it is increasingly evident that Artificial Intelligence techniques can increase process reliability and efficiency. Expanding the applications areas of AI in the manufacturing environments, in the EFPF project a specific use-case investigates the use of AI-based visual analytic techniques to ensure operational health and safety compliance. In this use case, a tool for automatic detection of

	facemasks has been implemented using AI-based visual analytic techniques. The tool orchestrates various systems in the spray booth area of the shop floor to ensure operational safety, compliance with relevant procedures as well as efficiency in the painting process. The EFPF solution detects that the operator is wearing the correct face masks, checks that the required air temperature is available and opens the spray value automatically. At the same time, the extraction system is turned on and the safety lights indicate the status. The solution utilises a small computer that hosts the EFPF Factory Connector, which is responsible for establishing the connection between various hardware and software components. The AI visual analytic algorithms are tuned to process real-time video feeds. Advance machine learning techniques were used to train the models that are able to recognise compliance with relevant safety procedures (e.g. use of correct mask, the positioning of mask etc) or raise alarms if anomalies or non-compliance are detected. The Factory Connector also provides remote access and connection to the EFPF Data Spine so that the relevant data can be directly analysed to provide valuable intelligence. Through this visual analytic tool, the painting process was optimised in terms of process reliability and operational safety. The tool provides another building block towards increased digitalisation in the manufacturing sector.
Source	EFFRA
Link	https://portal.effra.eu/result/show/4508
Domain	Manufacturing; Safety
Category	Visual inspection; Health
Project	H2020 EFPF - European Connected Factory Platform for Agile Manufacturing
Country	Germany
Year	Ongoing
Related STAR Scenario	S_STAR_02 S_STAR_03
Relevance to STAR	It can use AI-based visual analytic techniques to ensure operational health and safety compliance. In this scenario, it intends to detect if the human wearing the correct face masks, in STAR case detects if human is in Safe Zone.

A.15 Integrated Artificial Intelligence

ID number	S_EFFR_05
Description	Any complex manufacturing system generates large amounts of data, and this data is often underutilised and little value is generated. Due to FA3D2's highly flexible nature, it is an extremely complex system with many sources of variability which require understanding and compensating for. The integrated digital twin system of FA3D2 simplifies the gathering and contextualising of data via an OPC UA-based service bus. This data is collected and aggregated in a cloud-based environment for analysis. Machine learning approached and other analytical tools are being developed to analyse the data, update virtual twins or test proposed changes in the digital twin, and then deploy these changes to the shop floor via the same digital pipeline as the virtual commissioning

	process. Key to this approach is integrating the skills and knowledge of the workers on the shop floor, who work in conjunction with the AI approaches to achieve hybrid decision making – the combination of human and machine intelligence.
Source	EFFRA
Link	https://portal.effra.eu/result/show/4483
Domain	Manufacturing
Category	Data governance; Human-supervised learning; Safe collaboration HR; Simulations of the production processes; Rapid reconfiguration of production process
Project	ATI Initiative FA3D2 - Future Automated aerospace Assembly Demonstrator project: Phase 2
Country	Great Britain
Year	Ongoing
Related STAR Scenario	S_STAR_07 S_STAR_02 S_STAR_03 S_STAR_10 S_STAR_04 S_STAR_09
Relevance to STAR	The STAR project also intends to use digital twins, update it or test proposed changes in the digital twin, and then deploy these changes to the shop floor Integrating the skills and the knowledge of the workers on the shop floor, who work in conjunction with the AI approaches to achieve hybrid decision making. And also can be important the way that the data is collected and aggregated for analysis (manufacturing system generates large amounts of data).

A.16 Local Monitoring and Control System

ID number	S_EFFR_06
Description	An advanced local monitoring and control system has been developed, based in ARTIS hardware and integrating new features developed by Twin-Control partners. ARTIS Genior Modular is able to connect to machine CNC/PLC and get internal signals at a high sample rate. Additional modules are used to measure additional signals (total power consumption, vibrations…), that are also integrated inside the ARTIS Genior Modular. All acquired signals are requested by ARTIS OPR, that acts as a long-term storage system and provides additional features like OPC based communication, computation capabilities and connection to cloud platforms, like KASEM. Apart from the complete monitoring capabilities, this system has enhanced features: Process monitoring: after a learning stage of a specific process, process related thresholds are defined for all monitored signals (e.g. spindle torque) that allow detecting anomalous performance. The integration of the new process models developed in Twin-Control will allow the determination of these thresholds without the need of a learning stage (suitable for small batch processes) Adaptive feedrate control: According to a defined spindle consumption setpoint, the system is able to adapt machine tool feedrate to increase productivity. Component-level energy monitoring: a low-cost energy

	monitoring concept is proposed, based on the disaggregation of the machine's total power consumption. Collision Avoidance System: a graphical simulation environment that uses real positions of the machine, and able to predict collisions and stop the machine in advance. Expected impact: • Reduction of 10 % in cycle times • Reduction of 10 % in scrap parts • Reduction of 5-10 % in tooling costs • Reduction in energy consumption (35%) • Reduction of manual activities for process control (50 %) • Increase in machine up-time (1 %)
Source	EFFRA
Link	https://portal.effra.eu/result/show/1133
Domain	Manufacturing
Category	Production process optimization; Zero-defect production; Safe collaboration HR
Project	H2020 TWIN-CONTROL - Twin-model based virtual manufacturing for machine tool-process simulation and control
Country	Germany
Year	2018
Related STAR Scenario	S_STAR_05 S_STAR_10 S_STAR_03
Relevance to STAR	The STAR project can use the enhanced features of this scenario to achieve the adaptive manufacturing systems: Process monitoring (monitored signals (e.g. spindle torque) that allow detecting anomalous performance). Adaptive feedrate control (consumption vs productivity) Component-level energy monitoring (I'm not sure if it's intended Collision Avoidance System.

A.17 Fleet Management Platform for Machine Tools

ID number	S_EFFR_07
Description	A cloud based fleet-wide platform for machine tool condition, performance analysis and proactive maintenance has been developed. The KASEM® platform, provides an easy-to-use interface, allowing creation of algorithms and visualization of the evolution of indicators or the generated reports. The solution provides: More than 60 KPIs for the health status of machine-tool and its sub-systems: axis, spindle, magazine, hydraulic group, clamping systems, cooling systems, … An accurate and dynamic diagnostic tool thanks to a root-cause analysis and modelling of physics Additional indicators obtained by the implementation of the Quick Machine Tool Characterization tests developed in Twin-Control. Integration of Remaining Useful Life (RUL) calculation of critical components based on real usage conditions. Expected impact: Reduction of 30 % in corrective maintenance costs; Increase in machine up-time (2-4 %).
Source	EFFRA
Link	https://portal.effra.eu/result/show/1135
Domain	Manufacturing
Category	Production process optimization; Zero-defect production; Predictive Maintenance.

Project	H2020 TWIN-CONTROL - Twin-model based virtual manufacturing for machine tool-process simulation and control
Country	France
Year	2018
Related STAR Scenario	S_STAR_05 S_STAR_10
Relevance to STAR	STAR may use this approach (Proactive maintenance) to achieve Zero-defect production using ideas / knowledge / technologies / solutions from this scenario e.g. machine tool condition (RUL), more than 60 KPIs for the health status of machine-tool and its sub-system, performance analysis of this project to optimize its production

A.18 Lombardy Champion - Zero-Hours Quality

ID number	S_EFFR_08
Description	At Whirlpool, statistical quality controls are done by the Zero Hours Quality department (ZHQ), where in-depth tests are performed on a significant sample of products as they leave the assembly line (Quality Gate). The objectives of ZHQ are to assess the average quality of the delivered product and to verify the correctness of the production process. Currently, ZHQ is implemented as a CPS where products under test are connected to a number of fixed workstations. Tests are driven by rules that are stored in a Factory database, and results are collected in the same storage facility. The main problems with the current ZHQ implementation are physical constraints on the mobility of operators, per-station hardware costs, lack of integration with Factory and Corporate information systems, partial exploitation of data and hard-coded logic. The new-generation architecture developed in BEinCPPS leverages a lightweight Shopfloor infrastructure – based on a mix of custom-developed and commodity hardware on the product's side (CPU and Power Board) and on Android mobile applications as the human-machine interface (HMI) – and a Cloud layer for cross-plant data storage and computationally-intensive data analysis tasks. The implementation of this new-generation design leverages the three BEinCPPS Platforms – i.e., SmartSystems, IoT and Future Internet – from which a selection of hardware and software components have been deployed across the three physical levels defined by the BEinCPPS Reference Architecture: Field, Factory and Cloud. On the Field level, Whirlpool-specific hardware (Controller and Actuator boards) and software components (the Test Executor) are interconnected by the Deterministic Ethernet implementation (TSN by TTTech) provided by BEinCPPS' SmartSystems Platform. A custom Android application on tablet devices (Test Front End) plays the HMI role. The Actuator board is custom-built on Whirlpool's specs: its role is to interface the product under test, providing physical measurements to the Controller board and allowing the Controller board to operate and monitor the high-voltage appliance power supply. The Controller is a standard PC104 board that hosts a Windows operating system. The Controller runs the Test Executor software, which is a modified version of a legacy workstation-based application. The Test Executor

	embeds the local logic that drives the Actuator board: as the name implies, it executes test rules and collects results. In this new version, the software does not include the HMI and operates instead as a headless Field service that is exposed as an OPC-UA Address Space, thus enabling a tight integration of the Controller/Actuator bundle with the Factory and the Cloud levels. It is worth noting that the development of the OPC-UA Address Space used for in Whirlpool experimentation was entirely done by means of the UA Modeler tool, which is a Virtual World component. The Field level is completed by peripherals that provide the physical connection with tested appliances and HMI functionality. One of them, the Bar-Code Reader, is directly plugged into the Controller board and is used for the fast identification of the product items under test. However, the key element of the system is the tablet device which provides the user's Front End to three different applications: Test Operation, Test Results, and Rule Editor. All of them are Android applications that are developed in the scope of WP4 and are directly connected to the Cloud. From an architectural perspective, however, the Test Front End belongs to the Field level, while the Results and Editor Front Ends are Factory level components, as their users play a different role in the ZHQ business process. In the new-generation ZHQ architecture, the Factory level is not merely a logical environment for the Result and Editor Front End mobile applications: its main role is to host the IDAS OPC UA Agent, which acts as a gateway between the Field and the Cloud levels. This component is a IoT Platform's protocol adapter belonging to the Fast Lane – i.e., the FIWARE-based channel for Field-Factory-Cloud communications. The only customization required for the Whirlpool scenario is the configuration of specific mappings between the OPC-UA Address Space and the NGSI context used to publish and subscribe to the Field data stream. Such customization was easily done by editing a configuration file and did not require any modification to the software. Last but not least, the Cloud level is where most of the BEinCPPS value is delivered. This software layer is entirely deployed on external computing facilities. In this first iteration, this means the Common Cloud Environment (CCE) that is provided by the BEinCPPS project. The CCE hosts several components from the FI Platform: FIWARE Orion Context Broker, FIWARE Wirecloud, FIWARE Cosmos, FITMAN DyCEP and FITMAN CAM. Orion Context Broker is the middleware that provides publish/subscribe services using the NGSI standard, while Cosmos and DyCEP are generic Big Data Processing engines that run BEinCPPS-specific data analytics. In the context of the Lombardy demonstrator, Wirecloud is used as a provisional HMI to monitor the Field data flow during the execution of tests on appliances.
Source	EFFRA
Link	https://portal.effra.eu/result/show/1187
Domain	Manufacturing
Category	Quality inspection; Zero-defect production
Project	H2020 BEinCPPS - Business Experiments in Cyber Physical Production Systems
Country	Italy

Year	2018
Related STAR Scenario	S_STAR_02 S_STAR_05
Relevance to STAR	The scenario assess the average quality of the product and to verify the correctness of the production process.

A.19 Exploring the Challenges of Manufacturing with Learning Machine Vision

ID number	S_EFFR_09
Description	Learning-based Machine Vision Tackled the Challenge The challenge of ABB consisted of inspection of a one specific product on the automatic assembly line. They needed a system to make sure the product is assembled correctly. To make it easier, the factory already had a camera on the assembly line's final inspection station. That camera collected the testing material needed to pilot the deep learning algorithm. Algorithms based on neuro-networks are one of the most recent trends on the field, but already familiar to Mika Saarinen: "The development process was amazingly easy. This is a technical challenge we have been trying to solve with traditional rule-based algorithms for years, but it is not going to happen that way. The novelty of algorithms based on deep neuro-networks is that we can now solve problems that were previously very difficult." The solution's Proof of Concept (PoC) is ready, waiting only for the paperwork to be completed until it can be utilised in production. The project was called Cognex Vidi Deep Learning Machine Vision PoC. We tested learning machine vision instead of traditional machine vision in one automation cell. The co-operation with AP Vision went well and the results are promising. The learning machine vision was able to perform the inspection in this cell more reliably than previously used rule-based application. Programming the system was faster and easier than it was with the old method. We are considering expanding the utilisation of the new technology into new implementations after this project is completed. -Mikko Jukkanen, ABB Seamless Co-operation Reboot IoT Factory has been establishing ecosystem that creates easy co-operation among researchers, SMEs and factories. The companies have fresh networks, and chances to introduce their products and technology to the new audiences. The project work has fitted seamlessly to AP Vision's everyday business and there have been fruitful consequences. The company got another case, a chance to work with GE Healthcare Finland in a project that aimed to implement Cognex's neuro-network AI camera into inspecting the coupling cables' solders of an oxygen measurement sensor. This solution is ready and currently being used in production.
Source	EFFRA
Link	https://portal.effra.eu/result/show/4488
Domain	Manufacturing
Category	Visual inspection
Project	Reboot IoT Factory Initiative
Country	Finland

Year	2021
Related STAR Scenario	S_STAR_02
Relevance to STAR	Visual Inspection of a specific product. The camera collect the test material needed to pilot the deep learning algorithm

A.20 Cleanroom Optimisation Through Machine Learning

ID number	S_EFFR_10
Description	Objective: • Analyse the underlying potential for energy reduction in cleanrooms. • The possibility of reducing current air change rate without affecting critical quality parameters were tested in four cleanrooms using fixed air change rate reduction or dynamic air change control. • Cleanroom and HVAC data was collected, a simulation model was developed replicating each of the four cleanrooms and its associated HVAC systems to test with different air change rates and analyse its implications. • A machine learning algorithm was developed to implement the dynamic control and was integrated with the cleanroom simulation model.
Source	EFFRA
Link	https://portal.effra.eu/result/show/4519
Domain	Cleanroom
Category	Simulations of the production processes
Project	Irish Manufacturing Research Initiative
Country	Ireland
Year	Ongoing
Related STAR Scenario	S_STAR_04 S_STAR_09
Relevance to STAR	Considering Cleanroom similar to manufactory. This scenario implements the dynamic control and was integrated with the cleanroom simulation model. May use ideas / knowledge / technologies / solutions from this scenario

A.21 Challenge 1: Performing Car Starter Assembly

ID number	S_EFFR_11
Description	The subject of the collaborative process is the assembly of a part of the car starter for a car manufacturer. This part of the process comprises of inserting copper sliding rings into metal pallets, which are then transferred to the molding machine. Currently, the process of inserting sliding rings into the pallet is performed manually and is considered hard to automate. The process is demanding due to the high flexibility and elasticity of the sliding rings. Previous attempts of automation failed for two reasons: it was not possible to grasp the sliding rings, because they are often stuck together on the transport plate; it was not possible to assure the required success rate of the insertion due to the flexibility and elasticity of the rings. The vision of the project is to develop a robotic system that will assist the worker or even replace the worker when he will not be present. Therefore, with the worker and the robot both

	capable of executing the same operations, the work sharing will be assigned dynamically. The task of the worker will be to a) grasp the rings from the transport pallet and put them on the table, and b) to supervise the assembly and correct it if necessary. The worker will often leave the cell, since he will have to supervise also other production cells. Insertion of slide rings can be divided into three phases: grasping the part from the table, where the part position is not defined in advance, rough insertion of the part and fine adjustment of the part. The initial learning will be accomplished by observing humans using technology developed in WP4. From this data, the system will generate approximate trajectories and probabilities associated with the confidence of the captured trajectories. In the next learning stage, the operator will manually guide the robot along this trajectory and perform fine tuning (WP4). After the learning, the robot will start with exploitation phase and autonomous refinement of the assembly trajectory (WP4). The objective for learning will be to minimize the contact forces and torques and to successfully accomplish the assembly task. Success of the assembly operation will be determined from a) observing whether human operator had to correct the assembly; and b) from vision sensor, where the system will learn from the human feedback. Grasping deviations will be detected using precise RGBD sensor. In order to generalize to the different grasping situations, we will apply deep Q learning algorithms, which will map RGBD image to the assembly policy. The benefit of this cooperative automation will be in a shorter cycle time. Moreover, the system will become more and more autonomous and hopefully would need less and less assistance from humans. Note that in a modern production, humans normally assist more than one work cells and it is less likely that humans would tightly cooperate with other humans all the time. This use case will be the pilot case for many similar work-cells in “Kolektor” factory. Although “Kolektor” is not an SME, there are plenty of work processes that do not justify fixed automation, as this would elevate the production cost in low-batches production and increase the setup time. By applying reconfigurable hardware elements, the same work cell will be used in many operations that are currently performed manually. This concept has a great dissemination potential to many tasks in SME and craft production.
Source	EFFRA
Link	https://portal.effra.eu/result/show/3546
Domain	Manufacturing
Category	Flexibility in part handling; Visual inspection; Human-supervised learning;
Project	H2020 CoLLaboratE - Co-production CeLL performing Human-Robot Collaborative AssEmbly
Country	Slovenia
Year	Ongoing
Related STAR Scenario	S_STAR_01 S_STAR_02
Relevance to STAR	Identify the part that needs to be handled (Grasping deviations use deep Q learning algorithms. will be detected using precise RGBD sensor). The operator supervises the assembly and correct it if necessary. The benefit of this

	cooperative automation will be in a shorter cycle time. Moreover, the system will become more and more autonomous and hopefully would need less and less assistance from humans.

A.22 SIEMENS SIMATIC Products Quality Improvements

ID number	S_EFFR_12
Description	At Amberg, Siemens' Digital Factory Division is manufacturing its SIMATIC products. Core of the manufacturing process is the production of the circuit boards, which are later on assembled with the housing parts to form the final product.The overall objective is the introduction of AQ control loops for testing improvement and thus for overall production efficiency, while at the same time further raising the quality rate of finished products. This shall be achieved by implementing a closed control loop approach via the deep analysis of process data and the implementation of digital twins for products and production. Data from control loops throughout the manufacturing lines are to be collected and analysed via data mining and machine learning techniques, allowing to systematically identifying faulty products and the respective failure causes, providing the base for the intended improvements. By means of quality forecasting and simulation, (production) control decisions shall be derived at an early stage if quality deviations occur, thus avoiding further added value in ok products.
Source	EFFRA
Link	https://portal.effra.eu/result/show/3914
Domain	Manufacturing
Category	Simulations of the production processes; Zero-defect production
Project	H2020 QU4LITY - Digital Reality in Zero Defect Manufacturing
Country	Germany
Year	Ongoing
Related STAR Scenario	S_STAR_04 S_STAR_05 S_STAR_09
Relevance to STAR	This scenario is intended to provide quality forecasting and simulation, (production) control decisions shall be derived at an early stage if quality deviations occur. It implements a closed control loop approach via the deep analysis of process data and the implementation of digital twins for products and production

A.23 Predictive Maintenance demonstrator in lot-size-1 manufacturing furniture domain

ID number	S_EFFR_13
Description	The Predictive Maintenance demonstrator is focused on the monitoring of the operation of an edge banding machine to detect anomalous working conditions evaluating the risk of machine breakdown and take preventive actions through machine data analysis. This experimentation has been deployed in a real manufacturing environment in the Spanish

	company LAGRAMA. They produce high-quality home furniture and they are located in Vinaròs (Spain). The operator gets live information from the UI, which is accessible from the portal. The operator can monitor information, such as the failure prediction and confidence in the prediction. Sensors readings can be monitored from the UI as well to help identify the location of a fault. Working in batches means many machines stop and, of course, affects whether a machine is running all the time continuously. Predicting when the edge banding machine may need maintenance of a part or motor is a significant advance for LAGRAMA since it can prevent any part from being damaged, decreasing productivity and consequently losses and a bad image in the face of customers for late deliveries. To predict when the edge banding machine requires some maintenance operation, machine data is captured from the machine by retrofitting sensors (temperature, electric current and air pressure) to parts of the machine. The sensors are connected to an interface board on the Industreweb Factory Connector, which monitors the values and publishes them to the EFPF Data Broker. The Analytics component monitors these data and builds up a machine learning model. This enables the publication of a special event to the Message Broker when the machine operation values indicate some potential problem. This way, the Risk component, which is subscribed to the Analytics Component's output topic, can evaluate if there is a risk of a machine breakdown and, in such case, this component triggers an alert to maintenance staff in LAGRAMA. In summary, we can conclude that the value proposition for LAGRAMA is: • Reduction of the reaction time when some problem arises during production • Reduction of the machine downtime due to primary failure in the machine • Avoiding failures that may affect the quality of produced goods through the detection of abnormal machine operation.
Source	EFFRA
Link	https://portal.effra.eu/result/show/4506
Domain	Manufacturing
Category	Zero-defect production; Predictive Maintenance
Project	H2020 EFPF - European Connected Factory Platform for Agile Manufacturing
Country	Spain
Year	Ongoing
Related STAR Scenario	S_STAR_05
Relevance to STAR	STAR may use this approach (Predictive maintenance) to achieve Zero-defect production using ideas / knowledge / technologies / solutions from this scenario. To detect anomalous working conditions evaluating the risk of machine breakdown and take preventive actions through machine data analysis.

A.24 Improve automatic data acquisition, storage, traceability with user-friendly interfaces and human safety (Pilot 1)

ID number	S_EFFR_14
Description	Challenge Improve automatic data acquisition, storage, traceability with user-friendly interfaces and human safety. Simple tools for the set-up of robotized human-centric cells for production lines in different manufacturing scenarios: Pilot 1: Manufacturing of a healthcare component for diagnostic imaging. SHOP4CF scope: • Collaborative assembly or gearbox • Some parts assembled by the robot – some parts assembled by the worker • AR to indicate worker instructions / tasks • Final quality checks of assembled part • Communication with MES • Robot training for part shorting SHOP4CF scope: • Robot teaching using a specialized glove. • Optimize the positioning during the robot teaching for the automated CAD model generation • Part optimal sorting and positioning using Reinforcement Learning • Provide/monitor information and data from the components (e.g. percentage of scanning of a part) • Frame manufacturing AR assistance SHOP4CF scope: • Use a projector to display task instructions to the worker and for the frame generation and inspection of the frame created.
Source	EFFRA
Link	https://portal.effra.eu/result/show/4514
Domain	Manufacturing
Category	Flexibility in part handling; Quality inspection; Safe collaboration HR; Human training; Data governance
Project	H2020 SHOP4CF - Smart Human Oriented Platform for Connected Factories
Country	Germany
Year	Ongoing
Related STAR Scenario	S_STAR_01 S_STAR_02 S_STAR_03 S_STAR_10 S_STAR_06 S_STAR_07
Relevance to STAR	For this scenario, they intends to address quality monitoring and data integration in existing IT infrastructures to ensure medial certification processes. Moreover, due to the complexity of the assembly, collaboration of the robot with the operator in the same workspace is foreseen, sharing tasks in the same part assembly. For improving the acceptance of the robotic solution and flexible safety will be evaluated and deployed, along with VR training of the operator.

A.25 Improve automatic data acquisition, storage, traceability with user-friendly interfaces and human safety (Pilot 2)

ID number	S_EFFR_15
Description	Challenge: Improve automatic data acquisition, storage, traceability with user-friendly interfaces and human safety. Simple tools for the set-up of robotized human-centric cells for production lines in different manufacturing scenarios: Pilot 2: Robot training for part sorting. Pilot 2: This use case relates to sorting contact pads, parts of electrical switches. For the autonomous assembly of those switches, the contacts must be stored and placed in a well-defined position. However, the specifications of such pads change quite frequently, and long time is spent by system integrators for teaching a new part. The objective of the SHOP4CF solution is to enable the robot training by means of a specialized glove, to place the parts in front of the camera and enable the automated CAD generation. Health device gearbox assembly. SHOP4CF scope: • Collaborative assembly or gearbox • Some parts assembled by the robot – some parts assembled by the worker • AR to indicate worker instructions / tasks • Final quality checks of assembled part • Communication with MES • Robot training for part shorting SHOP4CF scope: • Robot teaching using a specialized glove. • Optimize the positioning during the robot teaching for the automated CAD model generation • Part optimal sorting and positioning using Reinforcement Learning • Provide/monitor information and data from the components (e.g. percentage of scanning of a part) • Frame manufacturing AR assistance SHOP4CF scope: • Use a projector to display task instructions to the worker and for the frame generation and inspection of the frame created.
Source	EFFRA
Link	https://portal.effra.eu/result/show/4514
Domain	Manufacturing
Category	Flexibility in part handling
Project	H2020 SHOP4CF - Smart Human Oriented Platform for Connected Factories
Country	Germany
Year	Ongoing
Related STAR Scenario	S_STAR_01
Relevance to STAR	This scenario, may have a solution to enable the robot training by means of a specialized glove, to place the parts in front of the camera and enable the automated CAD generation.

A.26 Improve automatic data acquisition, storage, traceability with user-friendly interfaces and human safety (Pilot 3)

ID number	S_EFFR_16
Description	Challenge Improve automatic data acquisition, storage, traceability with user-friendly interfaces and human safety. Simple tools for the set-up of robotized human-centric cells for production lines in different manufacturing scenarios: Pilot 3: Frame manufacturing AR assistance. Pilot 3: In this use case, a robotic arm is used to manufacture 3D printed parts out of aluminum wire deposited on an aluminum substrate. Prior to the task, a human worker must calibrate the robotic arm, by pointing the frame of where the manufacturing should take place on the substrate. Without real-time instructions, it is difficult for inexperienced workers to follow-up on the actions they need to perform for the robot calibration. Additionally, they need to be able to inspect the frame that was identified by the robotic arm after the calibration, as improper calibration could result in faulty manufacturing, even out of the bounds of the substrate. The objective of the SHOP4CF pilot is to assist the human worker in calibrating and inspecting the frame manufacturing by means of AR technology. Health device gearbox assembly. SHOP4CF scope: • Collaborative assembly or gearbox • Some parts assembled by the robot – some parts assembled by the worker • AR to indicate worker instructions / tasks • Final quality checks of assembled part • Communication with MES • Robot training for part shorting SHOP4CF scope: • Robot teaching using a specialized glove. • Optimize the positioning during the robot teaching for the automated CAD model generation • Part optimal sorting and positioning using Reinforcement Learning • Provide/monitor information and data from the components (e.g. percentage of scanning of a part) • Frame manufacturing AR assistance SHOP4CF scope: • Use a projector to display task instructions to the worker and for the frame generation and inspection of the frame created.
Source	EFFRA
Link	https://portal.effra.eu/result/show/4514
Domain	Manufacturing
Category	Flexibility in part handling; Human-supervised learning
Project	H2020 SHOP4CF - Smart Human Oriented Platform for Connected Factories
Country	Germany
Year	Ongoing
Related STAR Scenario	S_STAR_01 S_STAR_02
Relevance to STAR	This scenario, may have a way to assist the human worker in

	calibrating and inspecting the frame manufacturing by means of AR technology.

A.27 Decision Making Robot Could Revolutionise Manufacturing

ID number	S_EFFR_17
Description	A flexible industrial robot with the decision-making capability of a human operator has been developed by robotics experts at the Coventry-based Manufacturing Technology Centre. Using a combination of machine learning and visual recognition, the robot can be taught to make assembly decisions based on the components put in front of it, in a breakthrough development that could save manufacturers the costs of expensive fixed tooling. Now the MTC has developed a flexible automation demonstrator to show manufacturers how the robotics can be used to create a low cost, reactive assembly system. The demonstrator mimics a typical electronic assembly using multiple components. Most automation technology in industry is specifically programmed to a given task and is unable to accept input variations. Changing the process can require major investment in fixturing and reprogramming. The MTC system is trained to recognise components and assembly variables and retrieve solutions from its database. It combines a robot operating system with a collaborative robot and low-cost vision sensors. In trials, the MTC's system returned a 99 percent successful detection rate and demonstrated that it was possible to swap the input tray and change the component mix with little effect on performance.
Source	EFFRA
Link	https://portal.effra.eu/result/show/4551
Domain	Manufacturing
Category	Flexibility in part handling; Human-supervised learning
Project	The Manufacturing Technology Centre (MTC) Initiative
Country	United Kingdom
Year	Ongoing
Related STAR Scenario	S_STAR_01 S_STAR_02
Relevance to STAR	Using a combination of machine learning and visual recognition, the robot can be taught to make assembly decisions based on the components put in front of it

A.28 MONDRAGON Zero defect and Autonomous Quality in Machinery Building for Capital Goods sector

ID number	S_EFFR_18
Description	The goal of MONDRAGON Corporation roadmap for the coming years, as a global business group, is to change the structure of the businesses, leading their evolutions towards higher added value and developing new activities in leading sectors. Machinery Building for Capital Goods is a main industrial division within the Corporation providing high-quality –high-performance solutions based on smart technology in a wide variety of sectors (automotive, aerospace, energy, railway, oil &gas, capital goods, white goods, etc.). Danobat

	Group, Fagor Arrasate, and other leading corporate brands represent a benchmark in machines, solutions and advanced services in the area of Machine Tools. Given the strategic importance of the Machine Tools industry, and in the context of QU4LITY, MONDRAGON proposes two process pilots in the Machinery Building for Capital Goods scenario; two realities that can be complementary in many customers' value chains: • Use Case MONDR1: Multi-stage zero-defect manufacturing rayway axes production line: Manufacturing Processes with Cutting/Grinding Machinery, leaded by DANOBAT (DAN). The objective of MONDR1 pilot is to reach zero defects in the production line of axles that includes several stages: machining (grinding and turning), finishing stages, as well as in-process and final inspection and verification operations. During this multi-stage process, several deviations or process variability may cause geometry and quality defects that cause both extensive rework operations and part scrap. The technologies and the control loops provided by QU4LITY will make it possible to achieve observability of the product, process and resource states, throughout the system stages. • Use Case MONDR2: Zero-Defects Manufacturing digital Hot Stamping process: Manufacturing Processes with Hot Stamping Machinery, leaded by FAGOR. The objective of this MONDR2 pilot is to reach zero defects in the hot stamping cooling temperatures, transfer speed, loss of temperature in the transfer or settings of press and identifying exactly the process developed in the manufacturing of the parts.
Source	EFFRA
Link	https://portal.effra.eu/result/show/3917
Domain	Manufacturing
Category	Production process optimization; Zero-defect production
Project	H2020 QU4LITY - Digital Reality in Zero Defect Manufacturing
Country	Spain
Year	Ongoing
Related STAR Scenario	S_STAR_05
Relevance to STAR	The intended objective is to reach zero defects in the production line and final inspection and verification operations. During this multi-stage process, several deviations or process variability may cause geometry and quality defects that cause both extensive rework operations and part scrap. The technologies and the control loops provided by project will make it possible to achieve observability of the product, process and resource states, throughout the system stages.

A.29 BENTELER Predictive Maintenance and Service of a Hot Forming Line

ID number	S_IoTC_01
Description	Big Data is a fundamental base to facilitate productivity, efficiency and agility for the automotive industry of the future.'

	Smart Factory Big Data Pilot Motivation. Deployment and evaluation of a predictive maintenance framework at BENTELER: • Standardized process from data acquisition to integration within the maintenance process. • Systematic collection and analysis of machine data of a hydraulic press system and a scrap belt. • Detection and prediction of fault patterns in the production process at BENTELER. • Fault Detection and Prediction based on Machine Data • Detection of machine errors before they occur. • Avoidance of breakdowns. • Decrease in downtime, improvement of the production process efficiency.
Source	IoT-Catalogue.com
Link	https://www.IoT-Catalogue.com/validations/5f159fa3478fff8292546b3a
Domain	Manufacturing
Category	Zero-defect production; Predictive Maintenance
Project	H2020 BOOST
Country	Germany
Year	2020
Related STAR Scenario	S_STAR_05
Relevance to STAR	STAR may use this approach (Predictive maintenance) to achieve Zero-defect production using ideas / knowledge / technologies / solutions from this scenario.

A.30 Critical Cutting Tools

ID number	S_IoTC_02
Description	These are critical cutting tools used in machining operations to remove material and create holed features in the engine cylinder head. These tools experience unpredictable breakages and their life in service is that defined by the vendor. JLR will benefit from monitoring these machining processes and applying PdM in order to predict breakages and remaining useful life. The critical tool life data are delivered via Zoller TMS to query the CNC machines for remaining parts for all tools within the system. An alert will be generated for tool changes if a cutting tool is near the forecasted warning limit, or is already broken. The accountable tool crib staff will subsequently receive a notification to act and carry out shopfloor activities,e.g. tool change & collection, tool station check-in, tool replenishment, tool pre-setting and Kanban to be ready and available for the next alert event. The production time lost due to tool breakages is currently recorded in SAP, as downtime against the tool breakage fault code. When the CNC machine returns to operations, the fault code will close with a total duration against it. Currently, the critical machining cutting tools are susceptible to unpredictable breakages and difficulty to monitor during machining processes, due to the complex machining mechanisms and multiple cutting edges. PROPHESY will seek to enable the process monitoring of such tools to bring business benefits in higher tool life confidence, and forward planning in costing cutting tool inventories. MMS ARTIS C-

	Thru is the system that monitors and gathers data from 3 different sensors in the CNC machines. Spindle torque, spindle vibration and Z-axis torque signals provide data that is stored in a local server and can be withdrawn CSV files. This files can then be used for data analysis, more specifically for machine learning algorithms that can eventually predict URL. As part of the demonstrators, some of the most problematic tools have been used to provide meaningful data to the data analysis partners. The goal of the demonstrators is to demonstrate a transition from the currently employed preventive maintenance to PdM, as a means of reducing unplanned breakdown along with the two hours stoppage that is associated with preventive maintenance. As part of the task, PROPHESY-CPS and PROPHESY-ML will be deployed in order to enable data integration from multiple sources and production systems (i.e. equipment, sensors, devices, software), as well as its analysis towards deriving predictions on the state of the equipment. The demonstrator will be operated in-real life conditions and continually improved based on feedback from the pilot operations. Training of employees will also take place as part of this task.
Source	IoT-Catalogue.com
Link	https://www.IoT-Catalogue.com/validations/5e95bde196521358a749a8a0
Domain	Manufacturing
Category	Optimal production process; Zero-defect production; Predictive Maintenance
Project	H2020 PROPHESY
Country	United Kingdom
Year	2020
Related STAR Scenario	S_STAR_05 S_STAR_10
Relevance to STAR	STAR may use this approach (Predictive maintenance) to achieve Zero-defect production using ideas / knowledge / technologies / solutions from this scenario. This scenario will seek to enable the process monitoring of such tools to bring business benefits in higher tool life confidence, and forward planning in costing cutting tool inventories. The data can be used for data analysis, more specifically for machine learning algorithms that can eventually predict URL.

A.31 Crowd and Capacity Monitoring

ID number	S_IoTC_03
Description	To strengthen the security and safety management of such events, MONICA Crowd and Capacity Monitoring solution provides a cloud-based IoT platform supporting a series of components that can be used to monitor, record and analyse the environment and consequently detect emerging episodes at an early stage so security and first responder staff can intervene before things get out of control. By monitoring crowd capacity levels, the event organisers can ensure that they do not have more visitors than the allowed capacity at the venue, noise levels can be measure to ensure compliance with city ordinances and regulations and environmental factors can be monitored for increased safety of roller

	coasters, scene gear, and other event infrastructures. The MONICA Crowd and Capacity Monitoring consists of a series of sensor components which can be deployed for a variety of purposes related to crowd behaviour, security and safety of visitors. It connects to powerful CCTV cameras and advanced video analytics, wearables and several IoT sensors such as wind speed, noise and other environmental sensors and hence is capable of collecting important information about crowd size, flow, object detection as well as early warning of security and safety threats. Providing this information to the MONICA Crowd Management and Communication solution allows security staff to obtain enhanced, real-time oversight and decision support for interventions and proposed actions. The MONICA Crowd and Capacity Monitoring solution can be used in any type of open- air, gated and non-gated event. It can be used for short term deployment (e.g. for a specific concert); for a recurrent event (monthly or seasonal) or for semi-permanent events (night life area, traffic).
Source	IoT-Catalogue.com
Link	https://www.IoT-Catalogue.com/validations/5e68fbd28ffbccc2f4db7073
Domain	Smart city; Events
Category	Human Behaviour Prediction; Safe collaboration HR; Visual inspection;
Project	H2020 MONICA
Country	Germany; England; France; Denmark; Italy
Year	2020
Related STAR Scenario	S_STAR_02 S_STAR_08 S_STAR_10
Relevance to STAR	May use ideas / knowledge / technologies / solutions from this scenario. Like, monitor, record and analyse the environment and consequently detect emerging episodes via e.g. CCTV cameras, advanced video analytics, wearables and several IoT sensors. The STAR may use this for Safe collaboration and human safety, parts recognition and human behaviour.

A.32 Early Lameness Detection through Machine Learning

ID number	S_IoTC_04
Description	Early lameness is a considerable problem in the dairy industry. It causes pain and discomfort for the cow, while lowering fertility and milk yield for the farmer. Since current solutions come with high-initial costs and complex equipment, this use case utilises leg mounted sensors - measuring step count, lying time and swaps per hour - in combination with machine learning algorithms to identify lame cattle at an early stage. These data are analysed in the cloud and anomalies are sent to farmers' mobile device to treat affected animals immediately and avoid further effects. As opposed to a general approach, this use case customises the data models to dynamically adjust as weather and farm conditions change. By detecting early lameness before it can be visually captured, treatment costs are decreased while animal welfare is improved.
Source	IoT-Catalogue.com

Link	https://www.IoT-Catalogue.com /validations/5e4af9af35fde97f602a80c7
Domain	Agriculture; Safety
Category	Health
Project	H2020 IoF2020
Country	Portugal; Ireland; Israel
Year	2021
Related STAR Scenario	S_STAR_03
Relevance to STAR	May use ideas / knowledge / technologies / solutions from this scenario and relate to STAR. Mounted sensors combination with machine learning algorithms to data analyse and identify anomalies.

A.33 Fault detection and isolation in smart building

ID number	S_IoTC_05
Description	The objective of the use case is to offer to smart building maintenance technicians capabilities to ensure continuous solution operation taking into account lifecyle management of the full value chain: connectivity or communication service provider changes, diverse set of connectivity mechanisms including GPRS, Zigbee, Sigfox, IoT platform or cloud provider change, change or addition of devices in IoT infrastructure, etc. Smart building maintenance technicians should be capable of getting alerts from faulty devices and read reports/ statistics about defective objects. They are also capable of controlling remotely faulty devices by allowing such actions: turn off/on device and reconfigure devices. They should also be capable of configuring maintenance rules and policies (threshold, ML algorithm) and notifications/ alerts parameters (access points: email, sms, web interface). The objective of this experiment is to identify faulty devices and defective states, for example a temperature value that does not follow the usual trend of the equipment. In this experiment, we integrate a smart building infrastructure deploying equipment of types: AirConditioner, Air quality (Co2 sensor), doorSensor, electricalCounter, waterCounter, temperature, humidity, luminosity, blind, fan, lamp, and window. There are about 1000 devices. F2I-VAS subscribes to events published by smart building devices, integrated through Vicinity Infrastructure node. F2I-VAS monitors smart building data, identifies defective states and transmits to end user the corresponding alert(s) and maintenance action(s).
Source	IoT-Catalogue.com
Link	https://www.IoT-Catalogue.com/validations/5de0ed030b4bc8cbb98f8978
Domain	Smart building
Category	Quality inspection; Data governance
Project	H2020 VINICITY
Country	France
Year	2019
Related STAR Scenario	S_STAR_02 S_STAR_07
Relevance to STAR	Identify faulty devices and defective states, for example a temperature value that does not follow the usual trend of the equipment.

A.34 FILL Smart Machine Tool Digital Engineering

ID number	S_IoTC_06
Description	FILL will become the leading smart machine builder by long-term reduction of machine development times. First to market with the leading-edge technology based on smart engineering and industrial big data.' • Factory 4.0 Big Data Pilot Motivation • Model-based and big data-driven engineering process. • Machine and Process Models Optimization Engine. • Machine Big Data Logger and Exchange Platform. • 3D Production Simulation. • Model-based and big data-driven engineering process • Model management & data analytics process: • Digital asset repository. • Big Data & data processing pipelines. • Data exploration, model integration and deployment. • Service development process: • Extending Fill business model by Digital services (Model as a Service). • Smart Maintenance.
Source	IoT-Catalogue.com
Link	https://www.IoT-Catalogue.com/validations/5f159fa415fe13591d3ea3cc
Domain	Manufacturing
Category	Data governance; Zero-defect production; Predictive Maintenance
Project	H2020 BOOST
Country	Austria
Year	2029
Related STAR Scenario	S_STAR_05 S_STAR_07
Relevance to STAR	STAR may use this approach (Predictive maintenance) to achieve Zero-defect production using ideas / knowledge / technologies / solutions from this scenario. And also, data exploration, model integration and deployment.

A.35 Happy Cow

ID number	S_IoTC_07
Description	The adoption of technology in the European dairy farming sector lags behind compared to other farming sub-sectors: less than 20% of all dairy farmers use fertility management tools and less than 10% use feed and health monitoring systems. This use-case aims to encourage a technology uptake in dairy farming by combining advanced big data analysis with machine learning technologies. This will allow the farmer to understand his animals better, detect issues at an early stage and get suggestions on potential solutions, thus increasing the farm's productivity.
Source	IoT-Catalogue.com
Link	https://www.IoT-Catalogue.com/validations/5a82d2c836acc6d2aa8c5100
Domain	Agriculture
Category	Health
Project	H2020 IoF2020

Country	Belgium; Ireland; The Netherlands; Germany
Year	2021
Related STAR Scenario	S_STAR_03
Relevance to STAR	May use ideas / knowledge / technologies / solutions from this scenario and relate to STAR. This project combines advanced big-data analysis with machine learning technologies and detects issues.

A.36 Pig Farm Management

ID number	S_IoTC_08
Description	The demands for sustainable production in the competitive pig farming industry can only be met when the whole production chain from farm to fork becomes more efficient. To optimise the management of pig farms, data collection and analysis is key. This use-case focuses on linking data across the value chain in order to provide the pig farmers with the necessary information to effectively implement and carry out their management activities.
Source	IoT-Catalogue.com
Link	https://www.IoT-Catalogue.com/validations/5b4cbe74b8f13022bb5e6d82
Domain	Agriculture
Category	Data governance
Project	H2020 IoF2020
Country	The Netherlands; Belgium
Year	2021
Related STAR Scenario	S_STAR_07
Relevance to STAR	This scenario intends to link data across the value chain in order to provide the pig farmers with the necessary information to effectively implement and carry out their management activities.

A.37 Poultry Chain Management

ID number	S_IoTC_09
Description	It intends to improve the performance of poultry production chain processes through IoT driven technologies. The focus lies mainly on the growth of poultry with respect to animal welfare and to achieve a desired and accurate end weight. This starts with an adequate environment in which the birds feel comfortable, as well as good-quality feed and water. In this use-case IoT technology is applied at three critical points in the poultry chain: at the farm, during transport and in the slaughter house. All data will be collected on a central cloud-based platform. This platform is linked to a Smart Data-Analytics tool (Smart Farm Assistant), which can provide daily insights and early warnings based on the available data.
Source	IoT-Catalogue.com
Link	https://www.IoT-Catalogue.com/validations/5b45f17f7e5cd662c57acd43
Domain	Agriculture
Category	Planning Optimization
Project	H2020 IoF2020
Country	Spain

Year	2021
Related STAR Scenario	S_STAR_05
Relevance to STAR	May use ideas knowledge / technologies / solutions from this scenario and relate to STAR. It intends to improve the performance of production chain processes; All data will be collected on a central cloud-based platform. This platform is linked to a Smart Data-Analytics tool, which can provide daily insights and early warnings based on the available data.

A.38 Sound Level Monitoring

ID number	S_IoTC_10
Description	When assessing sound levels, for instance in public urban areas, it's important that the measured sound levels are reliable, accurate and traceable. Therefore, it is required to use a type-approved, accredited and calibrated Sound Level Meter, which measures correctly under changing environmental conditions like temperature, humidity, and wind speed. Such installations are often bulky, complicated to install and difficult to collect real-time data from. The MONICA IoT Enabled Sound Level Meter is a practical, easy to use answer to this problem. The MONICA IoT Sound Level Meter (SLM) solution provides real-time monitoring (measuring and displaying) of sound levels at discrete outdoor locations in the city. It is enabled for use in Internet of Things applications and is easy to deploy in the urban space. It collects data in real-time and sends them directly to backend databases. It can also perform real-time sound analysis so that sound contribution levels from different sources can be separated and pre-defined sound events can be detected. The MONICA solution uses professional Brüel & Kjær IoT Sound Level Meters to measure instantaneous broadband sound levels (several acoustic parameters such as LAeq or LCeq), 5-minute average sound level (LAeq) and 1/3 octave spectrum. In addition, the SLM can provide GPS positioning and source contribution analysing. Data are exposed on a gateway and may be transmitted to cloud servers or the user's proprietary servers or CMS (Content Management System) platforms.
Source	IoT-Catalogue.com
Link	https://www.IoT-Catalogue.com/validations/5e56679370ff1f64c651eead
Domain	Smart city; Media
Category	Health; Zero-defect production
Project	H2020 MONICA
Country	France; Italy
Year	2020
Related STAR Scenario	S_STAR_03 S_STAR_05
Relevance to STAR	May use ideas knowledge / technologies / solutions from this scenario and relate to STAR. The STAR may use this scenario as one approach to improve the health of the human (performance noise exposure at work) and detect faults in the machine (via Noise or vibration measurements)

A.39 UC1 Remaining Useful Life prediction for cold forming production

ID number	S_IoTC_11
Description	This UseCase is defined around the cold forming tooling for high precision metal parts. Data is being collected from several sources and fed into a PROPHESY-ML algorithm in order to determine the RUL of the wear parts involved. A schematic overview of UC1 is provided in the Photo Gallery.
Source	IoT-Catalogue.com
Link	https://www.IoT-Catalogue.com/validations/5e4af930722f83f669c70498
Domain	Manufacturing
Category	Zero-defect production; Predictive Maintenance
Project	H2020 PROPHESY
Country	The Netherlands
Year	2020
Related STAR Scenario	S_STAR_05
Relevance to STAR	STAR may use this approach (Predictive maintenance) to achieve Zero-defect production using ideas / knowledge / technologies / solutions from this scenario.

A.40 UC2 Remaining Useful Life prediction for blank cutting production tooling

ID number	S_IoTC_12
Description	This UseCase relates to machine UK02 (cutting out machine). The main purpose is to predict the RUL (remaining useful life) of specific wear parts within a tool assembly. Ten wear parts are considered: 5 identical punches (on the lower die half) and 5 identical cutting plates (on the upper die half). A schematic overview of UC2 is provided in the Photo Gallery.
Source	IoT-Catalogue.com
Link	https://www.IoT-Catalogue.com/validations/5e4af9a6781f36ba42d30c70
Domain	Manufacturing
Category	Zero-defect production; Predictive Maintenance
Project	H2020 PROPHESY
Country	The Netherlands
Year	2020
Related STAR Scenario	S_STAR_05
Relevance to STAR	STAR may use this approach (Predictive maintenance) to achieve Zero-defect production using ideas / knowledge / technologies / solutions from this scenario.

A.41 WAZIUP Agriculture MVP

ID number	S_IoTC_13
Description	In modern agriculture, different factors can be monitored, like water quality, weather conditions, storage conditions etc. Having the ability to monitor and, if possible, control those factors is the key to increase the productivity. In this use case, the problem that is going to be addressed on the farm is related to soil monitoring for preventing inputs waste and

	acquire real-time weather data.
Source	IoT-Catalogue.com
Link	https://www.IoT-Catalogue.com/validations/5a6b4fc5659fef0f31ceadda
Domain	Agriculture
Category	Production process optimization
Project	H2020 WAZIUP
Country	Togo; Ghana; Burkina Faso; Senegal
Year	2019
Related STAR Scenario	S_STAR_05 S_STAR_10
Relevance to STAR	May use ideas knowledge / technologies / solutions from this scenario and relate to STAR. About the monitoring for preventing inputs waste and acquire real-time data.

A.42 WAZIUP Fish Farming MVP

ID number	S_IoTC_14
Description	In fish farming, relevant information can be monitored, like water quality, dissolved oxygen, the water temperature in the fish pond and the information about possible actions to take. This use case connects a network of sensors to monitor the fish farming in order to improve the current farm management process by giving farmers the ability to monitor their ponds remotely and in a near real-time way. Opportunities of Artificial Intelligence.
Source	IoT-Catalogue.com
Link	https://www.IoT-Catalogue.com/validations/5a6efe43951d340775eae7a1
Domain	Agriculture
Category	Production process optimization
Project	H2020 WAZIUP
Country	Ghana; Burkina Faso; Senegal
Year	2019
Related STAR Scenario	S_STAR_05 S_STAR_10
Relevance to STAR	May use ideas knowledge / technologies / solutions from this scenario and relate to STAR. About the connections of a network of sensors to monitor the fish, farming in order to improve the current farm management process.

A.43 Otto Retail scenario

ID number	S_OpAI_01
Description	The Germany-based e-commerce merchant Otto was able to cut stock by 20% and reduce product return through deep-learning, which helped it analyse billions of transactions to predict customer behaviour with 90% accuracy.
Source	Opportunities of Artificial Intelligence
Link	https://www.europarl.europa.eu/RegData/etudes/STUD/2020/652713/IPOL_STU(2020)652713_EN.pdf
Domain	Retail
Category	Human Behaviour Prediction
Project	Company Otto
Country	Germany
Year	2020

Related STAR Scenario	S_STAR_08
Relevance to STAR	May use ideas knowledge / technologies / solutions from this scenario and relate to STAR. Analyse billions of transactions to predict customer behaviour (through deep-learning). Transactions in the case of the STAR project may be understood as behaviour sequences

A.44 Ocado Retail Scenario

ID number	S_OpAI_02
Description	Online supermarkets, such as Ocado in the UK, use machine learning algorithms to steer products over conveyor belts and deliver them to customers. Robots prepare bags for delivery vans whose drivers are then guided through an AI application to find the best route.
Source	Opportunities of Artificial Intelligence
Link	https://www.europarl.europa.eu/RegData/etudes/STUD/2020/652713/IPOL_STU(2020)652713_EN.pdf
Domain	Retail
Category	Production process optimization
Project	Company Otto
Country	United Kingdom
Year	2020
Related STAR Scenario	S_STAR_05 S_STAR_10
Relevance to STAR	May use ideas / knowledge / technologies / solutions from this scenario and relate to STAR. This scenario use machine learning algorithms to steer products over conveyor belts and deliver them to customers. Drivers are then guided through an AI application to find the best route. The STAR may use this for optimization path planning.

A.45 DeepMind Electric Utilities Scenario

ID number	S_OpAI_03
Description	DeepMind, which was purchased by Google, has worked with the national grid in the UK to predict electricity demand by using weather related variables and smart meters to optimise consumption.
Source	Opportunities of Artificial Intelligence
Link	https://www.europarl.europa.eu/RegData/etudes/STUD/2020/652713/IPOL_STU(2020)652713_EN.pdf
Domain	Electric Utilities
Category	Human Behaviour Prediction
Project	Google company DeepMind
Country	United Kingdom
Year	2020
Related STAR Scenario	S_STAR_08
Relevance to STAR	May use ideas / knowledge / technologies / solutions from this scenario and relate to STAR. To predict human behaviour (in this scenario is electricity demand) by using sensors data.

A.46 Nest Electric Utilities Scenario

ID number	S_OpAI_04
Description	Google company Nest's Wi-Fi thermostat can create a heating schedule by monitoring a user's habits with motion sensors, detecting when homes are empty and optimising energy use.
Source	Opportunities of Artificial Intelligence
Link	https://www.europarl.europa.eu/RegData/etudes/STUD/2020/652713/IPOL_STU(2020)652713_EN.pdf
Domain	Electric Utilities
Category	Planning Optimization
Project	Google company Nest's
Country	United States
Year	2020
Related STAR Scenario	S_STAR_05
Relevance to STAR	May use ideas / knowledge / technologies / solutions from this scenario and relate to STAR. It creates a schedule by monitoring data (a user's habits with motion sensors, detecting when homes are empty) and optimising resources (energy use).

A.47 Siemens Electronic Manufacturing Scenario

ID number	S_OpAI_05
Description	At Siemens' Electronic Works Amberg, production is controlled through programmable logic circuits in a virtual factory replicating the factory floor. Bar codes help products communicate with machines to manufacture parts and detect defects. Approximately 75% of production is fully automated.
Source	Opportunities of Artificial Intelligence
Link	https://www.europarl.europa.eu/RegData/etudes/STUD/2020/652713/IPOL_STU(2020)652713_EN.pdf
Domain	Manufacturing
Category	Simulations of the production processes; Flexibility in part handling.
Project	Company Siemens Electronic
Country	Germany
Year	2020
Related STAR Scenario	S_STAR_04 S_STAR_09 S_STAR_01
Relevance to STAR	The STAR also intends to replicate the factory floor (virtual factory) and use that to do simulations of the shop floor.

A.48 Intel Manufacturing Scenario

ID number	S_OpAI_06
Description	Intel deployed data scientists to speed up data integration in its R&D department. The company achieved 10% higher yield for integrated-circuit products.
Source	Opportunities of Artificial Intelligence
Link	https://www.europarl.europa.eu/RegData/etudes/STUD/2020/652713/IPOL_STU(2020)652713_EN.pdf
Domain	Manufacturing
Category	Data governance

Project	Company Intel
Country	United States
Year	2020
Related STAR Scenario	S_STAR_07
Relevance to STAR	May use ideas / knowledge / technologies / solutions from this scenario and relate to STAR. To speed up data integration.

A.49 Civitas Education Scenario

ID number	S_OpAI_07
Description	Civitas Learning and Salesforce have collaborated on services for universities that identify and engage with students at risk of dropping-out. Salesforce tools use machine learning to recommend engagement strategies facilitating retention.
Source	Opportunities of Artificial Intelligence
Link	https://www.europarl.europa.eu/RegData/etudes/STUD/2020/652713/IPOL_STU(2020)652713_EN.pdf
Domain	Education
Category	Human training
Project	Company Civitas Learning and Company Salesforce
Country	United States
Year	2020
Related STAR Scenario	S_STAR_06
Relevance to STAR	STAR may use this approach to improve Human training. using ideas / knowledge / technologies / solutions from this scenario.

A.50 Coursera Education Scenario

ID number	S_OpAI_08
Description	Coursera provides online classes that use machine learning to alert teachers when students make recurrent mistakes in given assignments, denoting potential gaps in the course materials.
Source	Opportunities of Artificial Intelligence
Link	https://www.europarl.europa.eu/RegData/etudes/STUD/2020/652713/IPOL_STU(2020)652713_EN.pdf
Domain	Education
Category	Human training
Project	Company Coursera
Country	United States
Year	2020
Related STAR Scenario	S_STAR_06
Relevance to STAR	May use ideas / knowledge / technologies / solutions from this scenario and relate to STAR.

A.51 AI4CITIZEN

ID number	S_AIEU_01
Description	Citizens are routinely engaging with the public sector in a variety of domains and for different needs. Finding the right contact and associated procedure, understanding and following the instructions and procedure in the proper manner and making the right decision when several alternatives exist is not

	straightforward. While this is difficult for adults, it is becoming even more challenging for teenagers that discover for the first time a complex procedure involving not only their school but also a strange world: the business world. AI4Citizen pilot choose to focus on the newly established Italian scheme called Aternanza Scuola Lavoro[1] (ie. school-work alternation – ASL) that involves circa 1.5 million of 15 to 19 years-old pupils for 200-400 hours over three years through practical experience to help to consolidate the knowledge acquired at school and to test the attitudes of students and students on the field, to enrich their training and guide their study path and, ultimately, to help them to choose their future work[2]. To better understand the peculiarity of this use case, we defined four personas on the know-how of the Bruno Kessler Foundation (FBK) partner and on a series of interviews: • Ludovica, a 18 years old student attending the fourth class of the classic high school, looking for an opportunity to work in a team within three weeks internship. While she is a fast and keen learner and an enthusiastic person, she is having difficulty to understand the job offer and if her skills are matching company's interest; • Arnoldo, a 61 years old teacher that shares with a colleague the management of the ASL office at his Institute; he likes to help students - more than 300 per year - to find out the right internship. Besides placement, the aim of their office is to follow on the administrative paperwork collecting students'forms, final reports prepared by the students and evaluation forms prepared by the company tutor, but he also like to detect potential problems; • Carolina, a 48 years old assistant of a large research center who is taking care of the relationships with different schools, interacting with tutors like Arnoldo to select an interesting team of interns, and onboarding them, to chase researchers to collect internship offers, final and evaluation reports; • Rosanna, a 37 years old busy researcher who likes to have teams of two to four interns every summer to help her on pet projects, to get some youngster vibes and to transmit her passion about her work. During interviews to teachers, researchers and parents, we identified the main scenario and the pain points involving the different personas. We described the current process together with the AI enabled scenario. Since FBK is running a conventional portal for the schools of the Trento region, we decided to focus on two specific problems in the scenario, that are particularly time consuming and not supported by the current version of the conventional portal: how to best inform and guide Carolina in her internship quest with a teenager ready conversational interface; how to support Arnoldo to build teams of complementary interns while optimizing the acquisition of new skills and their personal wishes. The next descriptions explain how AI will modify Ludovica's quest for the perfect internship. [1] ASL was established by the Law n. 107 – 2015 – https://www.gazzettaufficiale.it/eli/id/2015/07/15/15G00122/sg [2] More details can be found in the Italian Education Ministry

	(MIUR) website http://www.alternanza.miur.gov.it/cos-e-alternanza.html
Source	AI4EU
Link	https://www.ai4eu.eu/ai4citizen-0
Domain	Education
Category	Human-supervised learning
Project	H2020 AI4EU
Country	Germany; Italy; Spain
Year	Ongoing
Related STAR Scenario	S_STAR_02
Relevance to STAR	May use ideas / knowledge / technologies / solutions from this scenario and relate to STAR.

A.52 AI4ROBOTICS

ID number	S_AIEU_02
Description	The pilot consists of two different setups: 1) one setup is related to measuring wearing of the wrist on robots, and 2) another setup is related to measuring wearing of paint pumps used in relation to robotized painting. In both setups, one or more vibration sensors are attached to strategic places and vibration data is measured. The measured values from the vibration sensors are then uploaded on the AI4EU platform. Both setups are set up to run in a 24/7 interval time and will continuously upload vibration data on the platform. There will also be uploaded metadata such as measurement of play in gears, leakage in pumps, service intervals and maintenance logs. Based on the vibration data and the metadata, the goal of the pilot experiment is to develop predictive maintenance models which can estimate when running maintenance service is needed, and what kind of maintenance.
Source	AI4EU
Link	https://www.ai4eu.eu/ai4robotics-0
Domain	Manufacturing
Category	Zero-defect production; Predictive maintenance
Project	H2020 AI4EU
Country	Norway; Greece
Year	Ongoing
Related STAR Scenario	S_STAR_05
Relevance to STAR	STAR may use this approach (Predictive maintenance) to achieve Zero-defect production using ideas / knowledge / technologies / solutions from this scenario

A.53 AI4INDUSTRY

ID number	S_AIEU_03
Description	Flexible manufacturing represents a key element of the Industry 4.0 objective. Complete automation and possibility to quickly adapt production to various customer requirements will cause considerable advances in large-scale manufacturing. Symbolic and Machine Learning techniques are constantly being developed, tested, and implemented to construct 'smart' factories. However, we cannot simply integrate AI methods in industry and allow them to completely automate the systems. Humans need to have transparency and understanding of

	decision-making processes of AI in manufacturing, in order to build trust of such systems. The AI4Industry pilot focuses on developing methods for aiding flexible manufacturing in 'smart' factories, as well as advance the area of Explainable AI (XAI) in order to integrate humans and AI and aid flexible manufacturing. The idea of the pilot is to showcase methods for aiding flexible manufacturing on an experimental facility, to present the usefulness of these methods and the possibility to later implement them in a large-scale industrial environment. The experimental facility represents a small-scale factory for producing plastic cans closed with plastic lids. It is a sort of a toy product. The setup is equipped with 2 assembly modules (modules that perform cap on can assembly – module 1 puts red or blue caps, module 2 puts red or white caps on cans), 1 feeding station (that puts cans into production and can optionally insert a metal inlay in the product), 1 sorting station (which sorts the final products into a customer or user preference), and, finally, 1 disassembly station (which consists of 2 parts – a robotic manipulator that takes products and moves them to a holding place where it disassembles it afterwards). This setup used for demonstrating how the proposed AI methods in industry perform, what it means to add flexibility and transparency to the system, and how we can scale them to large facilities. The problem we want to solve is divided into 2 parts: adding flexibility and adding transparency to manufacturing. The AI4Industry pilot consists of 3 main research areas, that can be correlated to 3 approaches to solve the problem: Skill Matching and Explanations, Planning, and Time Prediction. Skill matching and explanations. To understand what skill matching is, we first need to understand the notion of a skill. A skill represents a description of a machine's capabilities. In other words, a skill represents an action or a process that the machine can perform with respect to certain restrictions it has. As an example, consider an assembling action, that represents assembling of caps on cans. We know the type of action and we know the 2 types of materials used (caps and cans). We can also know certain restrictions that the skill has (e.g. the machine can only assemble caps on cans if the cap has a diameter 20mm and the can has diameter 20mm). This a description of a skill and it can be modeled in various ways. How we represent skills is through ontologies, specifically model them in the programming package Protégé. Ontologies represent formal naming's, definitions of concepts, relations between concepts, data properties, etc. They are based on Description Logics (DLs), which are an expressive and decidable part of First Order Logic (FOL). This gives the intelligent part of the model by allowing for reasoning capabilities, such as checking whether a logical expression is satisfiable with respect to the domain knowledge, checking whether everything is consistent in the model, listing of hierarchies and relations between concepts, etc. Protégé is an easy to use tool that offers all these features, which is why we use it. Figure 1 represents a skill offered by a machine modeled in Protégé. Now that we know the definition of a skill and how we represent it, we can move onto skill matching. Skill matching in the scope of industry represents matching a

	skill that a machine offers to a requirement that a product has. For e.g., consider the skill that is shown on Figure 1. The skill represents an assembly process, where a robot presses red or blue caps with width up to 180mm (adjustable gripper for different caps – if a can with larger width comes the machine can be reconfigured to work with it) on cans with width of 20mm. A requirement, on the other hand, can be considered also a type of a skill description, except this is from the product side. A skill requirement would ask for a specific process (i.e. action/operation/skill) and machines that are in production will need to answer to these requirements. Skill matching also indicates whether a machine that has a certain skill can answer to requirements of a product that has come into production. This is done by utilizing reasoning techniques in ontologies to ask for a contradiction between the skill offer and skill requirement. Upon receiving the output from skill matching, we have a list of machines with certain skills that can or cannot answer to a product's requirements. The explanations part represents generating explanations for why there is a negative match between a machine's skill and a product's requirements. This gives understanding why a product cannot be manufactured and users in the facility can quickly remedy the situation, whether that is reconfiguring a specific machine or replacing it with another one that can answer to the product's requirements. To exemplify this, consider again the skill offer from Figure 1, and a product requirement with specific properties of the parts used in Figure 2. An explanation consists of presenting the reasons why this is a negative match. To generate explanations, we utilize something that is called justifications in ontologies. Justifications represent a minimal subset of ontology axioms, for which an entailment holds (i.e. it logically follows from them). An explanation for a negative match, between the skill offer in Figure 1 and skill requirement in Figure 2 (top left) is shown on Figure 3. From Figure 3, we can interpret the statements of the explanation. Starting from the top statement 1, we see that involving an initial material is the same as involving a material in the process AssemblyBR, which involves 2 things (statement line 2). Statements 5, 3, and 7 show us that one of the involved materials of the requirement is a physical object named blueCap_1, which is a type of Cap and has 200mm width. Statement 6 is what we call a closure statement, stating the main reason why there is a negative match between the offer and request, that is the width. If we compare statements 3 and 8, we can extract that the requested cap is 200mm, but the offered one is up to 180mm and that they are not compatible. This is a raw output from the explanation mechanism. Currently, we are adjusting the presentation of explanations according to users familiar with the production facility. Action planning is an AI method for selecting actions that achieve a desired goal from a desired initial state. As a demonstration of Integrative AI, we use Answer Set Programming with External Computations to integrate Answer Set Planning with ontological reasoning over an existing industrial OWL ontology that is in use at Siemens and evosoft. This permits us to perform expressive reasoning than would be impossible within the ontology while it also

	permits us to reuse the existing ontology without converting either from ASP to OWL or vice versa. The resulting planning prototype can generate plans for producing certain sequences of configurable products and it can provide alternative solutions with small modifications of the goal or the time horizon if the goal as it is stated is not achievable. The solver tool that is used in this pilot is called Hexlite[1]. During the work in this pilot was developed a plugin for integrating OWL ontologies into action planning with Hexlite. The solver has already been published to the AI4EU platform as a component and we plan to publish the OWL ontology integration plugin in future milestones. The time prediction is concerned with estimating the production time from a given production plan. We use a neural network to predict the time that a batch of production items (bases that are capped in the production process) will take to be finished. The production plan, which is the input to the neural network, consists of the order and time of feeding of the bases. Since the available data could not be used for this scenario, we have written a simulation of the process and trained the neural networks on the simulated data. We tried different architectures, loss functions and components for the neural network. The attention architecture, which could have provided explainability, did not train well. We ended up with an architecture of stacked LSTMs with temporal dropout. In the case that the feeding time of the bases is variable, we have developed the special preprocessing step which enables the training of the neural networks. Using a quantile loss for training the network reduced even slightly the absolute mean error. The time prediction part of the pilot is connected with the research topic "Verifiable AI" of the work package 7.2. To rely on a machine learning approach one needs to have an idea of the weaknesses of the system. Uncertainty estimation is one method to determine the variance of a model and forecast a fault. The aim of the experiments is to estimate the uncertainty of the model to distinguish situation where the model is confident and those where the prediction of the model has a high variance and therefore is less reliable. Therefore, different approaches to measure uncertainty are evaluated on the use-case described above.
Source	AI4EU
Link	https://www.ai4eu.eu/ai4industry-0
Domain	Manufacturing
Category	Human-supervised learning; Simulations of the production processes; Planning Optimization
Project	H2020 AI4EU
Country	Germany; Austria
Year	2021*
Related STAR Scenario	S_STAR_02 S_STAR_04 S_STAR_05 S_STAR_09
Relevance to STAR	Like the STAR's scenery this also intends integrate humans (using Explainable AI) and AI. Humans need to have transparency and understanding of decision-making processes of AI in manufacturing. Action planning: the resulting planning prototype can generate plans for producing certain sequences

	of configurable products and it can provide alternative solutions with small modifications of the goal or the time horizon if the goal as it is stated is not achievable. The time prediction is concerned with estimating the production time from a given production plan. We use a neural network to predict the time that a batch of production items.

A.54 AI4HEALTHCARE

ID number	S_AIEU_04
Description	Europe has been heavily affected by the COVID-19 pandemic. The first challenge is to fight against COVID-19. The global containment strategy currently ongoing in most European countries aims to slow down the dissemination and reverse the epidemic growth, hoping to lower the number of cases and the speed of dissemination. However, the capability to deploy at scale the screening of the population remains critical to switch from this global containment to more specific ones. Today, the RT-PCR test provides results between a few hours and two days[1]. Moreover, it cannot be generalized everywhere due to a lack of availability. Others complementary solutions need to be deployed, particularly in the hospital environment. A recent study done on a large dataset[2] has demonstrated that clinical signs of the COVID-19 are visible on chest Computed Tomography (CT scan), and expert radiologists can detect them. A recent Chinese-American study[3] has shown the capability to differentiate the COVID-19 infection to other viral pneumonia. All the published articles[4],[5],[6] confirm the visibility of signs at an early stage. They confirm also the superior and excellent sensitivity of the scanner compared to RT-PCR test. For instance, a Chinese study[7], based on more than 1 000 patients, reports a better sensibility of chest CT (98%) than the RT-PCR one (71%): "About 81% of the patients with negative RT-PCR results but positive chest CT scans were re-classified as highly likely or probable cases with COVID-19, by the comprehensive analysis of clinical symptoms, typical CT manifestations and dynamic CT follow-ups". To conclude, the use of chest CT offers many advantages such as Scans are routinely used for pulmonary diseases, Its protocol is well-known by the medical staff of European countries. The use of this kind of equipment is extremely high and well-spread in hospitals and in the medical environment as a whole. In this context, Artificial Intelligence (AI) can help to test suspected population in a shorter time than RT-PCR test can do with a higher constancy of its results. A recent publication of a China study[8] made on 3 332 patients reveals an interesting level of performances obtained by the use of Deep Learning techniques. AI can also provide other algorithms like categorization of the kind of pulmonary diseases (COVID-19, SRAS or Community Acquired Pneumonia) and definition of the disease severity degree. Some AI algorithms are currently on the market (like the Chinese company Infervision[9]). They offer interesting results in terms of performances. But they raise significant issues such as explainability and verifiability of their results. They will require improvements. Training of algorithms should also work with large and real data sets,

	included in research and medical programs, to ensure the robustness of the results and their scalability. Thus, Europe must help to set-up a robust and European-based values approach, allowing the creation of algorithms respecting the five interconnected dimensions of human-centred AI considered in AI4EU[10]. This pilot aims to provide a reference dataset in healthcare which can be used to define algorithms which detect COVID-19 disease. This dataset contains medical images, diagnostic information as well as radiological reports. The first phase of this pilot consists in the definition, collection and formatting of a publishable corpus. The data collected will be from the field of conventional radiology. They will be composed of performed image, the age and sex of the patient, the clinical indications, the purpose of the examination and finally the radiological report. The corpus will consist of at least 100,000 complete records from at least 5 different producing facilities. The collected data will be anonymized. The second phase focuses on the extraction and organization of concepts. We will rely on the SNOMED-CT ontology, the reference for medical terms. This extraction of the concepts and their logical organization of SNOMED-CT will lead to a comparison of the concepts connected together by the SNOMED-CT references and consolidated by the guides of the good practices formalized in the same way. This may result in a search engine for concepts that can search for similar reports. We will define KPIs to evaluate the normalization of the report based on the involved concepts.
Source	AI4EU
Link	https://www.ai4eu.eu/ai4healthcare-0
Domain	Safety
Category	Quality inspection
Project	H2020 AI4EU
Country	France; Spain
Year	Ongoing
Related STAR Scenario	S_STAR_02
Relevance to STAR	Considering COVID-19 disease detection similar to anomaly detection. This scenario intends to provide a reference dataset in healthcare, which can be used to define algorithms to detect COVID-19 disease. This dataset contains medical images, diagnostic information as well as radiological reports.

A.55 AI4MEDIA

ID number	S_AIEU_05
Description	The creation of video content in many languages, with local vocal and face expressions, is a costly process. To get an optimal result, one must reshoot each targeted language. Thanks to AI, it is possible to create many translations from a single shot. Interdigital R&D and Inria combined their knowledge to create a first system able to create a 3D face animation from audio and video. The identity of the actor is automatically extracted from a single video to create a 3D face identity. The animation of the lips is automatically extracted from audio to animate the lips of the 3D face. Media content is much more enjoyable when actors talk in viewers'

	native language. It includes speaking as well as natural expressions, especially facial expressions. To get such results, big brands must shoot and produce each content locally. It leads to very expensive production campaigns. A solution to reduce costs is to shoot in one language and seamlessly repurpose to many countries. Thanks to usual tools in media industry called "face rigs", artists can model a 3D face of any actor, and edit or transfer facial expressions from one actor to another. For instance, an actor can be shot for each language in a studio, where only its face is shot. Then, its facial expression can be applied to the actor of the main footage. For instance, a popular actor like Tom Cruise speaks in English in the main footage, and an Italian actor can speak in its native language in front of a camera. Then the lips and facial expressions of the Italian actor can be applied to a digital Tom Cruise. The result is Tom Cruise speaking Italian in a very natural way. The Fig.5.1 illustrates this workflow. Current solutions to get such a result is thanks to many artists that manually capture facial expressions from one actor and apply them to another one. This process is extremely time-consuming: to capture 2 to 3 seconds of facial expression, 5 human days are required on average. Although it reduces the overall cost, it remains very expensive. Thanks to the power of current AI tools, we can automate as much as possible the processes involved in this workflow [1]. Considering the face identity and expressions, Interdigital R&D is able to automatically compute the face rig parameters from a single video. For instance, the main footage can be used to create a 3D face model of the main actors. Similarly, the footage for each language can be used to get the face animation parameters. Considering the voice, Inria is able to automatically compute the mouth and lips parameters from an audio file. It can be the speaking of the actual dubbing actor or an audio speech synthesized from a text file. By the end, all parameters are combined (identity, face expressions and lips movements) to create a realistic dubbed face animation. Last but not least, the overall workflow respects the industry standards. It means that artists keep full control over the end result and edit/intervene at all steps the output of the capture and synthesis tools. For instance, artists could like to change a bit the expressions of dubbing actors to better fit the context of the main scene. This kind of update is likely to happen since the dubbing actors are performing alone in front of a camera and could not be aware of all details on the main stage.
Source	AI4EU
Link	https://www.ai4eu.eu/ai4media-0
Domain	Media
Category	Visual inspection
Project	H2020 AI4EU
Country	France; Spain
Year	Ongoing
Related STAR Scenario	S_STAR_02
Relevance to STAR	Considering a 3D face similar to an object. This scenario intends to identity of the actor is automatically extracted from a single video to create a 3D face identity. The STAR may use a part of this scenario to identify a part.

A.56 AI4AGRICULTURE

ID number	S_AIEU_06
Description	The objective of AI4Agriculture pilot is threefold: 1) assessing the quality of the production of grapes; 2); counting the number of fruits (grapes); and 3) predicting the yield. It will be done using computer vision and other AI techniques and showcasing the AI4EU platform in the context of agriculture. The pilot will be trained and validated with data from the Ribera del Duero wine region in Spain, which is a registered Denomination of Origin. This imposes some restrictions that impact directly on the objectives and scenarios of usage of the pilot. In particular, there is a limit for maximum production of a vineyard, traditionally established at 7000 kilos of grapes per hectare. This means that often grapes must be taken from the plants in order to not exceed the allowed production. This means that the pilot is not aiming towards a maximization of yield production, but rather to ensure its quality. What we agreed with some selected vineyards is that grapes from a small area in the land parcels will not be taken (in order to comply with Denomination of Origin rules), so we can extrapolate results from these areas to wider wine exploitation. The current methodology starts by agreeing with the vineyards on the selection of three parcels. Each one will represent different level of production: high, medium and low. These levels will be defined based on the production results from previous years. Later a few lines will be defined as a "no-take" zone, where the grapes will not be taken from the plants before harvesting. We will use models to select the most interesting areas for data collection using for instance NDVI (multiespectral index for plant vigor) and other variables (i.e. soil, plant variety, plant plantation year, etc.). During the summer of 2020, in the months after veraison (fruit color change), we expect to take pictures and analyse plants and fruits (probably on a weekly basis) with the SMR mobile data collection app. In parallel drones with a multiespectral sensor will be flown in order to get NDVI from the sampled plants. This data will be later crossed with real production from the vineyard in order to know how many Kg these plants produced. For fruit quality we use the same samples to try to identify plagues or diseases that could affect final production. We would like to use, if allowed data from the vineyard, such as laboratory grape and wine analysis, data from fertilization, soil and the parcel (plant varieties, year of plantation, etc.). This data along with multiespectral data from drone flights to correlate NDVI with final product quality.
Source	AI4EU
Link	https://www.ai4eu.eu/ai4agriculture-0
Domain	Agriculture
Category	Visual inspection; Quality inspection;
Project	H2020 AI4EU
Country	Spain; Germany; Spain; Greece
Year	Ongoing
Related STAR Scenario	S_STAR_02
Relevance to STAR	This scenario intends to achieve its objectives using computer vision and other AI techniques. One aim is assessing the quality of the production (of grapes). The STAR may use ideas

	/ knowledge / technologies / solutions from this scenario and relate to STAR detecting and assessing the quality of the component.

A.57 AI4IOT

ID number	S_AIEU_07
Description	Air pollution is a widespread problem due to its impact on both humans and the environment. Providing decision makers with AI-based solutions requires to monitor the ambient air quality (AQ) accurately and timely, as AI models highly depend on the underlying data used to justify the predictions. Unfortunately, in the urban context, the hyper-locality of AQ, varying from street to street, makes this difficult to monitor using high-end sensors, as the cost of the amount of sensors needed for such local measurements is too high. In addition, development of pollution dispersion models is challenging. This pilot will: i) Explore the use of machine learning (ML) for air quality prediction in the city of Trondheim, Norway, using air quality data captured by IoT devices; ii) Improve data quality and services by combining pollution data with other information (such as mobility patterns, weather forecasts, environmental data); iii) Demonstrate exploitation of the AI4EU platform. The pilot will address research challenges tied to: i) Development of reliable forecasting models based on various sensor setups and data sources; ii) Detection of anomalies originating in sensor data (missing data, noisy data, drifting sensors, etc.); iii) Visualization and explanation of models and results to decision makers (decision support for citizens, city planners, etc.). The pilot will address these challenges by building AI components with links to activities in WP7, in particular the tasks on Physical and Explainable AI. The anticipated impacts of the pilot will be a better understanding of AI capabilities for IoT, but also proof of concepts for more precise, real-time measurements of air pollution and data driven decision tools. A wider motivation for the pilot and more detailed information is available in a separate white paper[1]. [1] Insert link to whitepaper, see draft at https://www.overleaf.com/project/5e8c67f2999f7d0001a7aa81
Source	AI4EU
Link	https://www.ai4eu.eu/ai4iot-0
Domain	Environment
Category	Health
Project	H2020 AI4EU
Country	Norway; Greece; Portugal
Year	Ongoing
Related STAR Scenario	S_STAR_03
Relevance to STAR	May use ideas / knowledge / technologies / solutions from this scenario and relate to STAR. The STAR may use this scenario as one approach to improve the human health. Monitoring the air quality inside the factory; Explore the use of machine learning (ML) for air quality prediction; Improve data quality and services by combining pollution data with other information.

A.58 AI4CYBERSECURITY

ID number	S_AIEU_08
Description	The pilot intends to support the detection and the prevention of possible cyberattacks against an urban railways control system. More specifically, it concerns the detection of attacks against a distributed system, identified as CBTC (Communication Based Train Control), described hereafter. Nowadays, CBTC often replaces older fixed-block signaling track portions, where the track is divided into physical sections and only one train is allowed in each section. Using CBTC, block locations and lengths can be dynamically changed, depending on trains location, weight and speed on the line. One main advantage of a moving block system such as CBTC is that the space between trains is reduced, allowing for greater trains-running capacity. A typical CBTC system is comprised of wayside equipment, on-board equipment, and DCS (Data Communication Systems). The figure given on the right hand-side highlights physical communication means, between ground systems and the trains. While a typical urban line is divided into several zones, the wayside equipment is connected through the wired backbone network. It includes an ATS (Automatic Train Supervision) which plans the overall traffic of the line as part as an OC (Operational Center), and the WATP (Wayside Automatic Train Protection) which is part of a ZC (Zone Controller). The wayside equipment communicates with the onboard equipment which roughly executes the OATO (Onboard Automatic Train Operation) and the OATP (Onboard Train Protection), through the wireless network. The figure on the right clarifies the WATP and the main role of the ZC, especially regarding sensitive information which is exchanged through the overall network. Roughly speaking, state information about all trains and trains to the ground and conversely is very sensitive information. LMA (Limit Movement Authorization) is a sensitive information calculated from the physical elements of the tracks and the global positions of all trains. The critical chain of executions linked to two consecutive trains is the following: The position and speed of the foregoing train are transmitted to ZC through the wireless network. From information received still through wireless network from the foregoing train and the information of the safe route from other ground elements CI (Control Interlocking), ZC generates and forwards the limitation of the movement authority (LMA), a location on the line that the train cannot travel cross, to the following train. The VOBC (Vehicle On Board Control) controls the train to run below the protective curve, which is calculated based on the LMA and the status of the train.
Source	AI4EU
Link	https://www.ai4eu.eu/ai4cybersecurity-0
Domain	Cybersecurity
Category	Digital attacks
Project	H2020 AI4EU
Country	France; Norway; Germany
Year	Ongoing
Related STAR Scenario	S_STAR_03
Relevance to STAR	This scenario is intends to support the detection and the

	prevention of possible cyberattacks against an urban railways (specifically attacks against a distributed system CBTC).