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Executive Summary

With the growth and improvement of production automation in manufacturing, Artificial Intelligence (AI) systems must be safe, trusted, and secure, even when operating in dynamic, unstructured and unpredictable environments. In this regard, one of the STAR project goals is to research and make available new technologies to enable standard-based, secure, safe, reliable and trusted human-centric AI systems in manufacturing environments.

STAR aims to research and integrate leading-edge AI technologies like active learning systems, simulated reality systems, explainable AI, human-centric digital twins, advanced reinforcement learning techniques and cyber-defence mechanisms to allow the safe deployment of sophisticated AI systems in production lines, while providing robustness against security attacks.

Another key objective is to validate these technologies in challenging scenarios in manufacturing lines in the areas of quality management, human robot collaboration and AI-based agile manufacturing.

This document reports the content currently available on Market by STAR (the Market Platform of STAR) which only displays content collected until December 2022. This is the first of the two deliverables that are part of task "T7.2 – Integration of Validated Safe and Secure AI Solutions", which aims to integrate the safe and secure AI solutions developed within the scope of the project into the Market Platform.

This Platform was implemented in the context of Task "T7.1 Specification, Detailed Design and Implementation of Market Platform", with the purpose of promoting and demonstrating the project's solutions for secure, safe, trustworthy and ethical AI in manufacturing.

The present deliverable focuses on the project results related to safe and secure AI solutions, but also on the collection of support resources, and their integration into the Market by STAR. All content has been validated, and it is publicly available to STAR stakeholders through a free registration, accessible in <https://www.market.star-ai.eu>.

The current status of the Market by STAR content corresponds to 14 *Assets*, 10 *Success Stories*, 54 *Training Resources*, and 3 *External AI Resources*. The *Assets* consist of the technologies developed within the scope of the project to support the implementation of trusted AI solutions. The *Success Stories* represent the project activities that showcase where and how the Assets are being successfully deployed and used. The *Training Resources* correspond to the Courses and Workshops related to AI, IoT, manufacturing and more. Finally, the *External AI Resources* correspond to the platforms that offer several resources of interest in the AI domain.

During the next months, in collaboration with the rest of WP7 tasks and with the contribution of tasks from other Work Packages, the content of Market by STAR will be continuously updated.

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Table of Contents

EXECUTIVE SUMMARY	2
TABLE OF CONTENTS.....	4
TABLE OF FIGURES.....	7
LIST OF TABLES.....	8
DEFINITIONS, ACRONYMS AND ABBREVIATIONS	10
1 INTRODUCTION.....	12
1.1 WORK PACKAGE 7 OVERVIEW	12
1.2 LINK WITH D7.2	14
1.3 ROADMAP	14
1.4 STRUCTURE OF THE DOCUMENT	15
2 MARKET BY STAR HOMEPAGE	16
3 ASSETS.....	17
3.1 ACTIVE LEARNING (AL).....	17
3.2 AI CYBER-DEFENCE STRATEGIES (ACDS).....	17
3.3 AUTONOMOUS MOBILE ROBOT (AMR) PLANNER USING SAFETY ZONE DETECTION	18
3.4 DISTRIBUTED LEDGER SERVICES FOR DATA RELIABILITY (DLSDR)	22
3.5 FATIGUE MONITORING SYSTEM (FAMS)	23
3.6 FEEDBACK MODULE	24
3.7 HUMAN DIGITAL TWIN CORE INFRASTRUCTURE (HDT)	24
3.8 NATURAL LANGUAGE PROCESSING (NLP).....	25
3.9 PRODUCTION PROCESSES KNOWLEDGE BASE (PPKB)	26
3.10 RISK ASSESSMENT AND MITIGATION ENGINE (RAME)	26
3.11 RUNTIME MONITORING SYSTEM (RMS)	27
3.12 SECURITY POLICIES MANAGER (SPM) – SECURITY POLICIES REPOSITORY (SPR)	28
3.13 SIMULATED REALITY (SR)	29
3.14 EXPLAINABLE ARTIFICIAL INTELLIGENCE (XAI) MODELS AND LIBRARY.....	29
4 SUCCESS STORIES.....	31
4.1 HUMAN-AI COLLABORATION.....	31
4.1.1 <i>Easy reconfiguration for automated part handling</i>	31
4.1.2 <i>Human supervised learning for visual quality inspection</i>	33
4.1.3 <i>Safe collaboration between human and robot</i>	34
4.2 SECURE AI.....	35
4.2.1 <i>Agile production management system data integrity and reliability</i>	36
4.2.2 <i>Employ training for the reduction of human errors</i>	37
4.2.3 <i>Production planning optimization</i>	38
4.2.4 <i>Production processes simulations for accelerated decisions and safe processes</i>	39
4.3 SAFE AI	40
4.3.1 <i>Human intention recognition</i>	40
4.3.2 <i>Robot reconfiguration based on the dynamic layout</i>	42
4.3.3 <i>Safety zones definition</i>	43
5 TRAINING RESOURCES	45
5.1 COURSES.....	45
5.1.1 <i>A Complete Beginner’s Guide to Industry 4.0</i>	45
5.1.2 <i>A Subjective Introduction to the IoT</i>	46
5.1.3 <i>Advanced Diploma in Introduction to Internet of Things</i>	46

5.1.4	<i>Advanced Manufacturing Enterprise</i>	47
5.1.5	<i>Architecting Smart IoT Devices</i>	48
5.1.6	<i>Arduino: Make an IoT environment monitor</i>	48
5.1.7	<i>AWS IoT: The Hobbyists Guide to Home Automation</i>	49
5.1.8	<i>AWS Serverless Design for IoT</i>	50
5.1.9	<i>Beginners Masterclass into Internet of Things</i>	50
5.1.10	<i>Big Data Analytics in IoT domain</i>	51
5.1.11	<i>Build IoT Apps using Raspberry Pi, AspNet Core and SignalR</i>	51
5.1.12	<i>Build your 1st Arduino IoT Project & Game: Arduino for Kids</i>	52
5.1.13	<i>Building a Thing for the Internet of Things IoT</i>	53
5.1.14	<i>Building Internet of Things Projects with Arduino IoT Cloud</i>	53
5.1.15	<i>Capstone: Autonomous Runway Detection for IoT</i>	54
5.1.16	<i>Complete guide for IoT Testing</i>	54
5.1.17	<i>Complete Guide to Build IoT Things from Scratch to Market</i>	55
5.1.18	<i>Complete Python 3 and Raspberry Pi Masterclass</i>	56
5.1.19	<i>Cyber Security in Manufacturing</i>	56
5.1.20	<i>Cybersecurity and Privacy in the IoT</i>	57
5.1.21	<i>Cybersecurity and the Internet of Things</i>	58
5.1.22	<i>Data Analytics in Internet of Things (IoT)</i>	58
5.1.23	<i>Data Science for Executives</i>	59
5.1.24	<i>Data-Driven Decision Making (DDDM) Specialization</i>	60
5.1.25	<i>Digital Transformation and Industry 4.0</i>	60
5.1.26	<i>Digital Transformation and Industry 4.0 Masterclass</i>	61
5.1.27	<i>Digital Transformation from Industry 4.0 to Industry 5.0</i>	62
5.1.28	<i>Digital Transformation in Industry 4.0: A Complete Guide</i>	63
5.1.29	<i>Digital Transformation of Mining</i>	63
5.1.30	<i>Embedded Systems – Shape The World: Multi-Threaded Interfacing</i>	64
5.1.31	<i>Embedded Systems Essentials with Arm: Get Practical with Hardware</i>	65
5.1.32	<i>Emerging Technologies: From Smartphones to IoT to Big Data Specialization</i>	65
5.1.33	<i>Enabling Technologies for Data Science and Analytics: The Internet of Things</i>	66
5.1.34	<i>Exploring AWS IoT</i>	67
5.1.35	<i>Fundamentals of IoT</i>	68
5.1.36	<i>Fundamentals of IoT (Internet of Things)</i>	68
5.1.37	<i>Get started in Internet of Things</i>	69
5.1.38	<i>Hands-on Internet of Things Specialization</i>	69
5.1.39	<i>Imagine IoT</i>	70
5.1.40	<i>Industrial IoT Markets and Security</i>	71
5.1.41	<i>Internet of things</i>	72
5.1.42	<i>Internet of Things: SMTP: Email With IoT device (NodeMCU)</i>	72
5.1.43	<i>Internet of Things (A Practical Way)-Part1</i>	73
5.1.44	<i>Internet of Things (IoT) – The Mega Course</i>	73
5.1.45	<i>Internet of Things (IoT) and Sustainability</i>	74
5.1.46	<i>Internet of Things (IoT) Automation using Raspberry Pi 2</i>	75
5.1.47	<i>Internet of things (IoT) for Beginners: Getting Started</i>	75
5.1.48	<i>Internet of Things (IoT) with Arduino Programming & ESP8266</i>	76
5.1.49	<i>Internet of things and everything: A Workshop on ZIGBEE</i>	76
5.1.50	<i>Internet of Things Business Impact</i>	77
5.1.51	<i>IoT Internet of Things Bundle</i>	78
5.2	WORKSHOPS	79
5.2.1	<i>AI INTEROPERABILITY AI-MAN Workshop</i>	79
5.2.2	<i>AI-MAN WORKSHOP Explainable AI in Manufacturing</i>	80
5.2.3	<i>Ethical and Legal Issues of Artificial Intelligence in Manufacturing</i>	81

6 EXTERNAL AI RESOURCES..... 83

6.1	IOT CATALOGUE.....	83
6.2	EFFRA	84
6.3	AI4EU	84
7	CONCLUSION.....	85

Table of Figures

FIGURE 1: WORK PACKAGE 7 TIMELINE	13
FIGURE 2: RELATIONSHIP BETWEEN WP7 TASKS	14
FIGURE 3: TASK 7.2 ROADMAP	14
FIGURE 4: MARKET BY STAR HOMEPAGE	16

List of Tables

TABLE 1: ASSET - ACTIVE LEARNING	17
TABLE 2: ASSET - AI CYBER-DEFENCE STRATEGIES.....	17
TABLE 3: ASSET - AUTONOMOUS MOBILE ROBOT PLANNER USING SAFETY ZONE DETECTION.....	18
TABLE 4: ASSET - DISTRIBUTED LEDGER SERVICES FOR DATA RELIABILITY	22
TABLE 5: ASSET - FATIGUE MONITORING SYSTEM.....	23
TABLE 6: ASSET - FEEDBACK MODULE	24
TABLE 7: ASSET - HUMAN DIGITAL TWIN CORE INFRASTRUCTURE	24
TABLE 8: ASSET - NATURAL LANGUAGE PROCESSING	25
TABLE 9: ASSET - PRODUCTION PROCESSES KNOWLEDGE BASE.....	26
TABLE 10: ASSET - RISK ASSESSMENT AND MITIGATION ENGINE.....	26
TABLE 11: ASSET - RUNTIME MONITORING SYSTEM	27
TABLE 12: ASSET - SECURITY POLICIES MANAGER – SECURITY POLICIES REPOSITORY.....	28
TABLE 13: ASSET - SIMULATED REALITY	29
TABLE 14: ASSET - EXPLAINABLE ARTIFICIAL INTELLIGENCE (XAI) MODELS AND LIBRARY	29
TABLE 15: SUCCESS STORY - EASY RECONFIGURATION FOR AUTOMATED PART HANDLING.....	31
TABLE 16: SUCCESS STORY - HUMAN SUPERVISED LEARNING FOR VISUAL QUALITY INSPECTION	33
TABLE 17 - SUCCESS STORY - SAFE COLLABORATION BETWEEN HUMAN AND ROBOT	34
TABLE 18: SUCCESS STORY - AGILE PRODUCTION MANAGEMENT SYSTEM DATA INTEGRITY AND RELIABILITY.....	36
TABLE 19: SUCCESS STORY - EMPLOY TRAINING FOR THE REDUCTION OF HUMAN ERRORS	37
TABLE 20: SUCCESS STORY - PRODUCTION PLANNING OPTIMIZATION	38
TABLE 21: SUCCESS STORY - PRODUCTION PROCESSES SIMULATIONS FOR ACCELERATED DECISIONS AND SAFE PROCESSES	39
TABLE 22: SUCCESS STORY - HUMAN INTENTION RECOGNITION	40
TABLE 23: SUCCESS STORY - ROBOT RECONFIGURATION BASED ON THE DYNAMIC LAYOUT	42
TABLE 24: SUCCESS STORY - SAFETY ZONES DEFINITION.....	43
TABLE 25: COURSE - A COMPLETE BEGINNER’S GUIDE TO INDUSTRY 4.0	45
TABLE 26: COURSE - A SUBJECTIVE INTRODUCTION TO THE IOT	46
TABLE 27: COURSE - ADVANCED DIPLOMA IN INTRODUCTION TO INTERNET OF THINGS.....	46
TABLE 28: COURSE - ADVANCED MANUFACTURING ENTERPRISE	47
TABLE 29: COURSE - ARCHITECTING SMART IOT DEVICES.....	48
TABLE 30: COURSE - ARDUINO: MAKE AN IOT ENVIRONMENT MONITOR	48
TABLE 31: COURSE - AWS IOT: THE HOBBYISTS GUIDE TO HOME AUTOMATION	49
TABLE 32: COURSE - AWS SERVERLESS DESIGN FOR IOT	50
TABLE 33: COURSE - BEGINNERS MASTERCLASS INTO INTERNET OF THINGS.....	50
TABLE 34: COURSE - BIG DATA ANALYTICS IN IOT DOMAIN	51
TABLE 35: COURSE - BUILD IOT APPS USING RASPBERRY PI, ASPNET CORE AND SIGNALR.....	51
TABLE 36: COURSE - BUILD YOUR 1ST ARDUINO IOT PROJECT & GAME: ARDUINO FOR KIDS	52
TABLE 37: COURSE - BUILDING A THING FOR THE INTERNET OF THINGS IOT.....	53
TABLE 38: COURSE - BUILDING INTERNET OF THINGS PROJECTS WITH ARDUINO IOT CLOUD	53
TABLE 39: COURSE - CAPSTONE: AUTONOMOUS RUNWAY DETECTION FOR IOT.....	54
TABLE 40: COURSE - COMPLETE GUIDE FOR IOT TESTING	54
TABLE 41: COURSE - COMPLETE GUIDE TO BUILD IOT THINGS FROM SCRATCH TO MARKET	55
TABLE 42: COURSE - COMPLETE PYTHON 3 AND RASPBERRY PI MASTERCLASS.....	56
TABLE 43: COURSE - CYBER SECURITY IN MANUFACTURING	56
TABLE 44: COURSE - CYBERSECURITY AND PRIVACY IN THE IOT.....	57
TABLE 45: COURSE - CYBERSECURITY AND THE INTERNET OF THINGS.....	58
TABLE 56: COURSE - DATA ANALYTICS IN INTERNET OF THINGS (IOT)	58
TABLE 57: COURSE - DATA SCIENCE FOR EXECUTIVES	59
TABLE 49: COURSE - DIGITAL TRANSFORMATION AND INDUSTRY 4.0	60
TABLE 49: COURSE - DIGITAL TRANSFORMATION AND INDUSTRY 4.0 MASTERCLASS	61
TABLE 46: COURSE - DIGITAL TRANSFORMATION FROM INDUSTRY 4.0 TO INDUSTRY 5.0.....	62

TABLE 47: COUSE - DIGITAL TRANSFORMATION IN INDUSTRY 4.0: A COMPLETE GUIDE..... 63

TABLE 47: COUSE - DIGITAL TRANSFORMATION OF MINING 63

TABLE 58: COURSE - EMBEDDED SYSTEMS – SHAPE THE WORLD: MULTI-THREADED INTERFACING..... 64

TABLE 62: COURSE - EMBEDDED SYSTEMS ESSENTIALS WITH ARM: GET PRACTICAL WITH HARDWARE 65

TABLE 59: COURSE - EMERGING TECHNOLOGIES: FROM SMARTPHONES TO IOT TO BIG DATA SPECIALIZATION 65

TABLE 61: COURSE - ENABLING TECHNOLOGIES FOR DATA SCIENCE AND ANALYTICS: THE INTERNET OF THINGS ... 66

TABLE 60: COURSE - EXPLORING AWS IoT 67

TABLE 55: COURSE - FUNDAMENTALS OF IOT 68

TABLE 52: COURSE - FUNDAMENTALS OF IOT (INTERNET OF THINGS) 68

TABLE 51: COURSE - GET STARTED IN INTERNET OF THINGS 69

TABLE 50: COURSE - HANDS-ON INTERNET OF THINGS SPECIALIZATION..... 69

TABLE 53: COURSE - IMAGINE IOT 70

TABLE 54: COURSE - INDUSTRIAL IOT MARKETS AND SECURITY..... 71

TABLE 63: COURSE - INTERNET OF THINGS 72

TABLE 63: COURSE - INTERNET OF THINGS: SMTP: EMAIL WITH IoT DEVICE (NODEMCU) 72

TABLE 63: COURSE - INTERNET OF THINGS (A PRACTICAL WAY)-PART1 73

TABLE 63: COURSE - INTERNET OF THINGS (IoT) – THE MEGA COURSE 73

TABLE 63: COURSE - INTERNET OF THINGS (IoT) AND SUSTAINABILITY..... 74

TABLE 63: COURSE - INTERNET OF THINGS (IoT) AUTOMATION USING RASPBERRY PI 2 75

TABLE 63: COURSE - INTERNET OF THINGS (IoT) FOR BEGINNERS: GETTING STARTED..... 75

TABLE 63: COURSE - INTERNET OF THINGS (IoT) WITH ARDUINO PROGRAMMING & ESP8266 76

TABLE 63: COURSE - INTERNET OF THINGS AND EVERYTHING: A WORKSHOP ON ZIGBEE..... 76

TABLE 63: COURSE - INTERNET OF THINGS BUSINESS IMPACT 77

TABLE 63: COURSE - IoT INTERNET OF THINGS BUNDLE..... 78

TABLE 64: WORKSHOP - AI INTEROPERABILITY AI-MAN WORKSHOP 79

TABLE 65: WORKSHOP - AI-MAN WORKSHOP EXPLAINABLE AI IN MANUFACTURING 80

TABLE 66: WORKSHOP - ETHICAL AND LEGAL ISSUES OF ARTIFICIAL INTELLIGENCE IN MANUFACTURING 81

TABLE 67: EXTERNAL AI RESOURCE - IOT CATALOGUE 83

TABLE 68: EXTERNAL AI RESOURCE - EFFRA..... 84

TABLE 69: EXTERNAL AI RESOURCE - AI4EU 84

Definitions, Acronyms and Abbreviations

Acronym/ Abbreviation	Title
ACDS	AI Cyber-Defence Strategies
AEC	Analytics Engine Configuration
AI	Artificial Intelligence
AI4EU	European AI On-Demand Platform
AIOD	European AI-on-demand
AL	Active Learning
AMR	Autonomous Mobile Robot
AP	Access Point
API	Application Programming Interface
AR	Augmented reality
ARP	Analytics Results Publishing
AWS	Amazon Web Services
BG	Background
CAD	Computer-Aided Design
CNN	Convolutional Neural Network
DB	Data Base
DDDM	Data-Driven Decision Making
DLSDR	Distributed Ledger Services for Data Reliability
EC2	Amazon Elastic Compute Cloud
EFFRA	European Factories of the Future Research Association
EU	European Union
FaMS	Fatigue Monitoring System
GUI	Graphical User Interface
HAR	Human Action Recognition
HDT	Human Digital Twin
HMI	Human Machine Interaction
HVAC	Heating, Ventilating and Air Conditioning
ICT	Information and Communication Technology
IDE	Integrated Development Environment
IIoT	Industrial Internet of Things
IoT	Internet of Things
LIME	Local Interpretable Model Agnostic Explanations
MQTT	Message Queuing Telemetry Transport
PCB	Printed Circuit Board
NLP	Natural Language Processing
RAME	Risk Assessment and Mitigation Engine
RGB	Red, Green and Blue
RMS	Runtime Monitoring System
ROI	Region of Interest
ROS	Robot Operating System
RPA	Robotic Process Automation
RTSP	Real Time Streaming Protocol

SDK	Software Development Kit
SMTP	Simple Mail Transfer Protocol
SPM	Security Policies Manager
SPR	Security Policies Repository
SQL	Structured Query Language
SR	Simulated Reality
TRL	Technology Readiness Level
VDIH	Virtualised Digital Innovation Hub
VR	Virtual Reality
WP	Work Package
XAI	Explainable Artificial Intelligence

1 Introduction

This deliverable, “D7.3 – Integrated Secure and Safe AI Solutions - Initial version”, is the first of the two deliverables that are part of “Task 7.2 – Integration of Validated Safe and Secure AI Solutions”, which aims to integrate the safe and secure AI solutions developed within the scope of the project into the Market Platform.

STAR has a Market Platform, called Market by STAR, whose purpose is to promote and demonstrate the results of the project at one place, accessible on:



www.market.star-ai.eu

The present document focuses on the content currently available on Market by STAR. All content is publicly available to its users through a free registration.

This introductory chapter provides the necessary information to give the reader the context to understand the scope of the activities and the objectives defined, which can be described in the following sections:

- **Work Package 7 overview:** Overview of the whole WP7, its timeline and objectives. Also describes each of the inner subtasks of the WP, including the relationships between them.
- **Roadmap:** Envisioned roadmap for Task 7.2, including the results provided in each of the two deliverables directly related to the task.
- **Link with D7.2:** Relationship between this deliverable and the D7.2.
- **Structure of the document:** Overview of the information provided in the present deliverable.

1.1 Work Package 7 overview

STAR’s Work Package 7 is responsible for the Virtualized Digital Innovation Hub for Secure and Safe AI in Manufacturing. It is active during the execution of the project (from M01 to M36) and it is dedicated to the “*development and establishment of a virtualised digital innovation hub that will integrate resources for secure and safe AI in manufacturing. The hub will be empowered by a market platform that will integrate the project’s results. WP7 sets the following main objectives:*

- (i) *To design and implement an on-line market platform as a hosting environment for the project’s results.*
- (ii) *To integrate STAR’s solutions for safe and secure AI in the market platform.*
- (iii) *To develop and integrate in the market platform innovation management and training resources, which will be offered through the VDIHs.*
- (iv) *To develop a certification programme for AI systems in manufacturing and to make it available through the VDIH.*
- (v) *To ensure close collaboration and linking to the AI4EU project for the purpose of*

creating critical mass and integrating the project’s market platform and VDIH to the AI4EU ecosystem.”

These 5 objectives are directly related to the 5 tasks of the WP7, which also span across the Work Package duration.

Figure 1 depicts the WP7 timeline, providing a view on the start and end date of each task.



Figure 1: Work Package 7 Timeline

Regarding the relationships between the Work Package (WP7) tasks, T7.2 is responsible for the information related to the Assets developed within the scope of the project and the Success Stories resulting from the project activities that showcase where and how the Assets are being successfully deployed and used. It is also responsible for gathering all the content provided by WP7 and made available to STAR stakeholders on the Market Platform. The remaining tasks that are part of WP7 (Figure 2) have the following responsibilities:

- **T7.1:** The implementation and deployment of the Market Platform, Market by STAR, which is a single-entry point to access AI resources and support services.
- **T7.3:** Shall provide all sorts of training resources. This should include documentation, videos, presentations, white papers, etc. These resources should be fed into the Market Platform and made available to STAR stakeholders.
- **T7.4:** The certification program, that shall be used by the Market Platform to provide information to the stakeholders related to STAR certified resources.
- **T7.5:** Details on how to collaborate with the AI4EU platform, which is a well-established platform in the AI domain, offering several resources that could be of interest to the STAR Market Platform stakeholders.

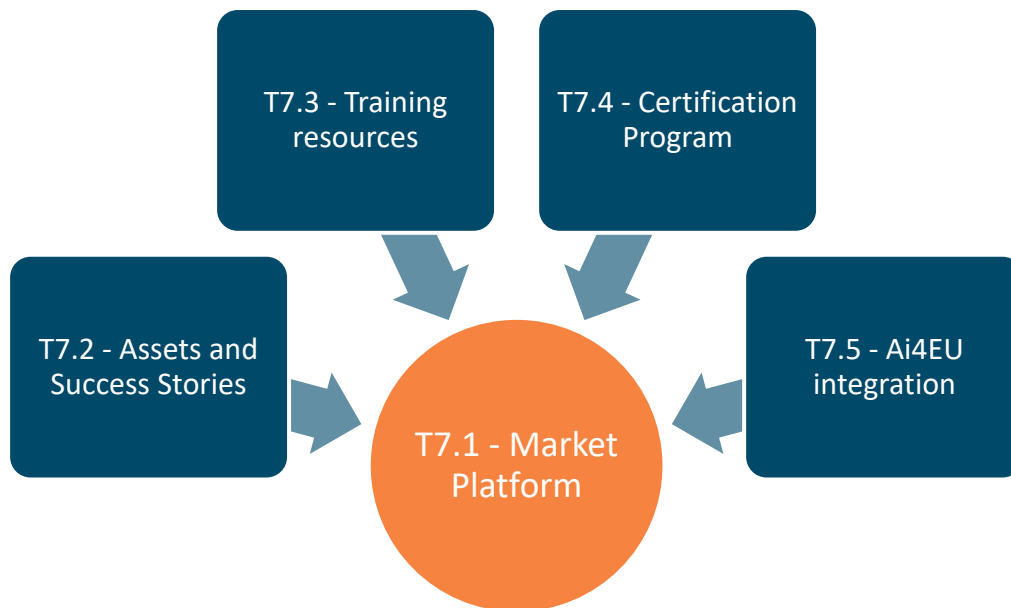


Figure 2: Relationship between WP7 tasks

1.2 Link with D7.2

While the present deliverable focuses on content, D7.2 focuses on implementation and deployment of the Market Platform.

The D7.2, the second and final version of the work carried out in T7.1, focused on the status of the Market Platform infrastructure. It represents the information and structure of the website up to its submission, M24.

1.3 Roadmap

As part of the activities of *Task 7.2 – Integration of Validated Safe and Secure AI Solutions*, there are two deliverables scheduled:

- **D7.3:** Integrated Secure and Safe AI Solutions-Initial version – Delivered on M24
- **D7.4:** Integrated Secure and Safe AI Solutions-Final version – Due on M33

To provide a better understanding of what was reported in each of the two deliverables, a roadmap was created so that the content of each document is clear. Figure 3 provides an overview of Task 7.2 roadmap.

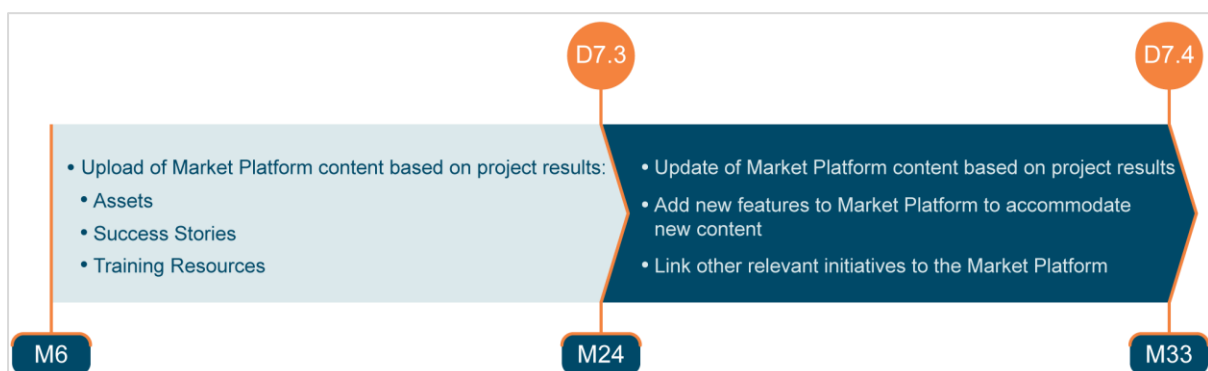


Figure 3: Task 7.2 Roadmap

1.4 Structure of the document

The rest of the deliverable is structured as follows:

- **Market by STAR Homepage:** Provides an overview of the Market by STAR homepage, as well as an introduction to the content currently available, broken down in the following chapters of the document.
- **Assets:** Contains the technologies developed within the scope of the project to support the implementation of trusted AI solutions.
- **Success Stories:** Contains information about Experiences in real-world scenarios, resulting from project activities to show where and how the assets are being successfully deployed and used.
- **Training Resources:** Contains a diversity of courses and workshops in the AI domain.
- **External AI Resources:** Provides platforms with relevant AI resources.
- **Conclusion:** Description of the results obtained.

2 Market by STAR Homepage

The Market by STAR Homepage (Figure 4) reflects the available content, described in this document. Currently, 14 *Assets*, 10 *Success Stories*, 54 *Training Resources*, and 3 *External AI Resources*. The structure of the Homepage also represents the organization of the next chapters:

- **Assets:** Technologies to support the implementation of trusted AI solutions.
- **Success Stories:** Experiences in real-word scenarios.
- **Training Resources:** Courses and workshops in the AI domain.
- **External AI Resources:** Platforms with AI resources.

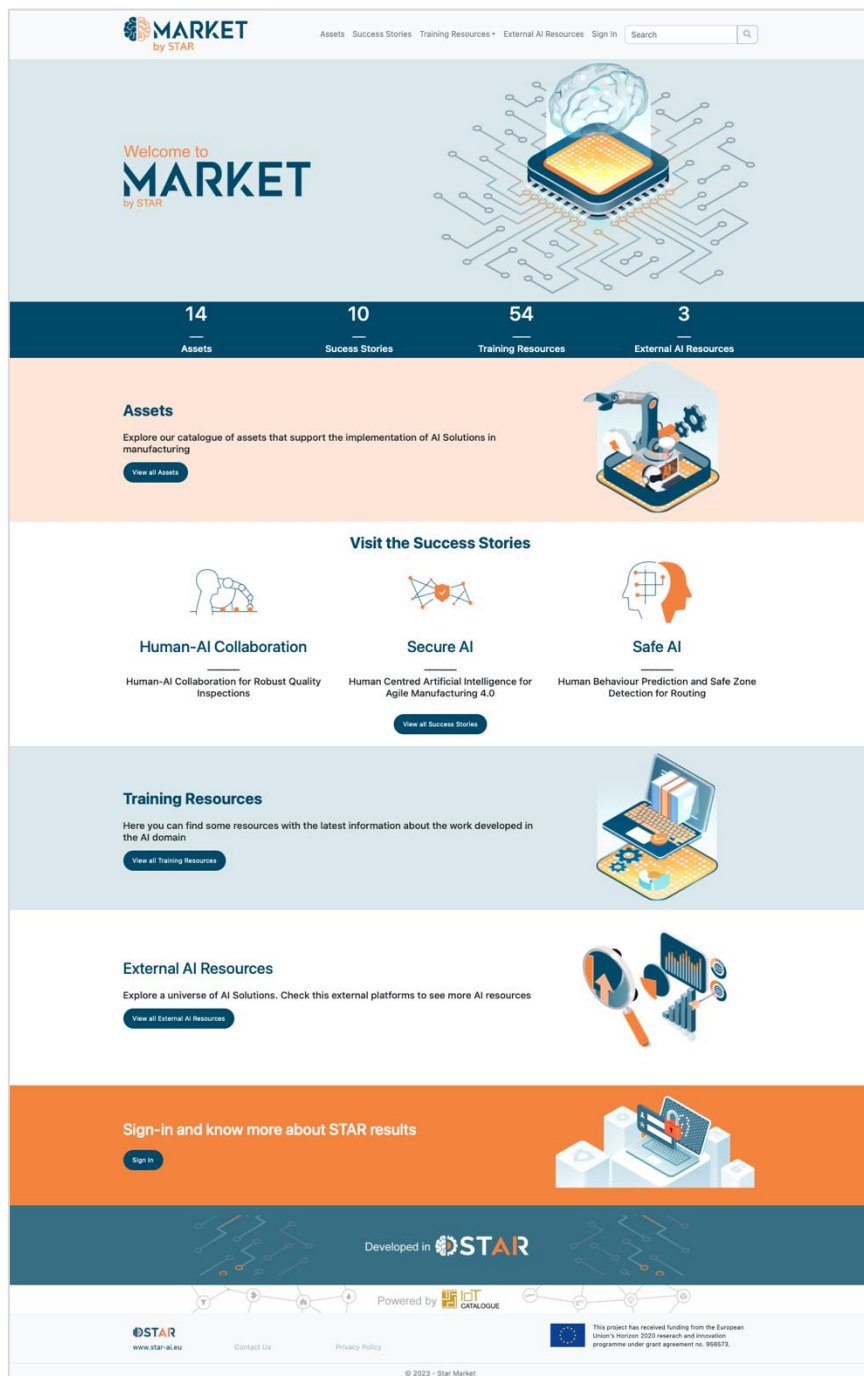


Figure 4: Market by STAR Homepage

3 Assets

This chapter focuses on the technological *Assets* developed in STAR to support the implementation of trusted AI solutions. The *Assets* address different dimensions and elements of trust, security, and safety in the operation of Cyber-Physical Production Systems (CPPS).

Each subchapter is dedicated to an *Asset*, containing a Template with information about it, such as a brief description, type, keywords, owner, the *Success Stories* where the *Asset* is used, among others. In the last field of each Template is provided the link to the *Asset*'s information page on Market by STAR.

3.1 Active Learning (AL)

Table 1: Asset - Active Learning

Active Learning (AL)	
Summary	This module provides a placeholder for AL systems i.e., AI systems that can consult an authority (e.g., a human) in the cases where they lack data/information to take proper decisions.
Type	<ul style="list-style-type: none"> Machine Learning
Keywords	<ul style="list-style-type: none"> Artificial Intelligence
Owner	<ul style="list-style-type: none"> JSI (Entity Website)
Used On (Success Story)	<ul style="list-style-type: none"> Human supervised learning for visual quality inspection (Market by STAR Link)
Market by STAR	Market by STAR Link

3.2 AI Cyber-Defence Strategies (ACDS)

Table 2: Asset - AI Cyber-Defence Strategies

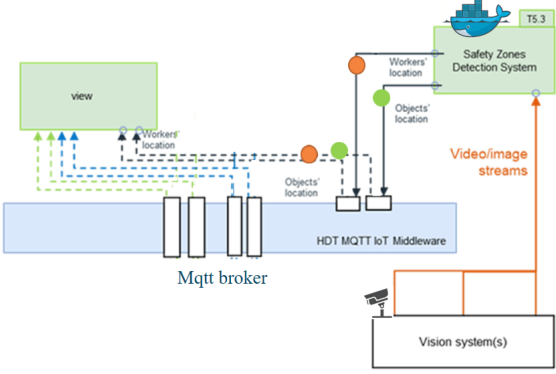
AI Cyber-Defence Strategies (ACDS)	
Summary	The module implements different strategies in response to various attacks against AI systems, notably poisoning and evasion attacks.
Type	<ul style="list-style-type: none"> Data Protection
Keywords	<ul style="list-style-type: none"> Adversarial Attempts Adversarial Data Samples Artificial Intelligence Evasion Attacks Poisoning Attacks
Features	<ul style="list-style-type: none"> Prevent AI inference process evasion Detect data poisoning attacks Sanitize data pipelines from adversarial examples Detect adversarial data samples

	<ul style="list-style-type: none"> • Detection of adversarial attempts against visual inspection systems • Creation of adversarial examples for research and training purposes
Owner	<ul style="list-style-type: none"> • Ubitech (Entity Website)
Used On (Success Story)	<ul style="list-style-type: none"> • Human supervised learning for visual quality inspection (Market by STAR Link) • Agile production management system data integrity and reliability (Market by STAR Link)
Market by STAR	Market by STAR Link

3.3 Autonomous Mobile Robot (AMR) planner using safety zone detection

Table 3: Asset - Autonomous Mobile Robot planner using safety zone detection

Autonomous Mobile Robot (AMR) planner using safety zone detection	
Summary	It is composed by a safety zone detector and a robot planner. The first module will be used to provide insights on the safe placement of robots in a manufacturing environment.
Description	<p>The solution is conceived by merging the following technologies:</p> <ul style="list-style-type: none"> • Dynamic object detection via CNN • Skeleton extraction by human pose detection convolutional neural network (CNN) • 3D-localization and motion in the infrastructure and estimation of human-robot distances using the geometric calibration of fixed RGB cameras • Heterogeneous and homogeneous multi-sensor fusion merging video analytics results coming from cameras dispatched in the production lines including other localization sensor data • All these elements are used to obtain a spatial density map, called HeatMap, that will feed a planner to define a safe trajectory for a fleet of robots <p>This module requires that the work floor layout is monitored actively using cameras. Two ceiling-mounted cameras will stream video data to create real-time layout of the area. Having the livestream data from these two-ceiling cameras allow the layout monitoring and, using the THALES vision-based algorithm, define the safety zones for the robot. The workers, as well as the obstacles, will be detected and an anonymised density chart will be obtained to feed a module that creates a safety path for the robots. There will be no stored data as the layout can change at any time. However, a link to stream the</p>

	<p>live video will be provided. For experimental purposes, data could be collected and stored on the STAR storage infrastructure in order to support offline testing and development prior to the dynamic test and validation of the use case.</p>
<p>Type</p>	<ul style="list-style-type: none"> • System
<p>Keywords</p>	<ul style="list-style-type: none"> • Artificial Intelligence • Industry 4.0 • Safety Zone Detection
<p>Images</p>	 <p>The diagram illustrates the system architecture. At the bottom, a 'Vision system(s)' (represented by a camera icon) sends 'Video/image streams' (indicated by an orange arrow) to the 'HDT MQTT IoT Middleware'. This middleware connects to an 'Mqtt broker' (represented by three vertical bars). From the broker, data is distributed to a 'view' component (green box) and the 'Safety Zones Detection System' (TS.3, green box). The detection system also receives 'Workers' location' (orange dot) and 'Objects' location' (green dot) data. The detection system outputs 'Workers' location' and 'Objects' location' data back to the broker, which then feeds into the 'view' component.</p>
<p>Implementation</p>	<p><u>Deployment requirements:</u></p> <ul style="list-style-type: none"> • Hardware: GPU RTX allowing tensorRT optimizations, RTSP RGB cameras • Software: Nvidia-docker, CUDA driver <p><u>Interoperability mechanisms:</u></p> <ul style="list-style-type: none"> • Input : rtsp stream • Ouput : json message (mqtt and/or http request) <p><u>Runs on:</u></p> <ul style="list-style-type: none"> • Linux <p><u>Tested on:</u></p> <ul style="list-style-type: none"> • Ubuntu 20.04 <p><u>SDK(s):</u></p> <ul style="list-style-type: none"> • The components are docker with configuration files and interchangeable deep learning models <p><u>Linked Components:</u></p> <ul style="list-style-type: none"> • RGB camera/ Network video recorder: This component is linked to the cameras via rtsp. The component grabs the video streams as inputs • AMR fleet optimizer: Safety zones detection component publishes json output via mqtt (or http) to a server/broker

	and the AMR fleet optimizer subscribes to these messages in order to evaluate the best path/trajectory.
AI Model	<p><u>Machine Learning Type:</u></p> <ul style="list-style-type: none"> • Reinforced - AMR Planner • Unsupervised - BG Subtraction • Supervised - Object Classification • Frugal Learning - Object Classification • Deep Learning - Skeleton Reconstruction
Owner	<ul style="list-style-type: none"> • Thales (Entity Website) • University of Groningen (Entity Website)
References	<p><u>Documentation:</u></p> <ul style="list-style-type: none"> • Y. Xu, J. Dong, B. Zhang and D. Xu, "Background modeling methods in video analysis: A review and comparative evaluation," CAAI Transactions on Intelligence Technology, pp. 43-60, 2016. (Link) • K. Toyama, J. Krumm, B. Brumitt and B. Meyers, "Wallflower: Principles and practice of background maintenance," Proceedings of the seventh IEEE international conference on computer vision, vol. 1, pp. 255-261, 1999. (Link) • C. Ridder, O. Munkelt and H. Kirchner, "Adaptive background estimation and foreground detection using kalman-filtering," Proceedings of International Conference on recent Advances in Mechatronics, pp. 193-199, 1995. (Link) • N. Friedman and S. Russell, "Image segmentation in video sequences: A probabilistic approach," arXiv preprint arXiv:1302.1539, 1997. (Link) • C. Stauffer and W. E. L. Grimson, "Adaptive background mixture models for real-time tracking," vol. 2, pp. 246-252, 1999. (Link) • A. Elgammal, D. Harwood and L. Davis, "Non-parametric model for background subtraction," European conference on computer vision, pp. 751-767, 2000. (Link) • P.-L. a. B. G.-A. a. B. R. St-Charles, "SuBSENSE: A universal change detection method with local adaptive sensitivity," IEEE Transactions on Image Processing, vol. 24, no. 1, 2014. (Link) • L. a. Z. F. Jiao, F. Liu, S. Yang, L. Li, Z. Feng and R. Qu, "A Survey of Deep Learning-Based Object Detection," Institute of Electrical and Electronics Engineers (IEEE), vol. 7, 2019. (Link) • R. Girshick, J. Donahue, T. Darrell and J. Malik, "Rich feature hierarchies for accurate object detection and semantic segmentation," IEEE Conference on Computer Vision and Pattern Recognition (CVPR), pp. 580-587, 2014. (Link)

	<ul style="list-style-type: none"> • R. Girshick, "Fast R-CNN," IEEE International Conference on Computer Vision, pp. 1440-1448, 2015. (Link) • S. Ren, K. He, R. Girshick and J. Sun, "Faster R-CNN: Towards realtime object detection with region proposal networks," IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI), vol. 39, pp. 1137-1149, 6. (Link) • K. He, G. Gkioxari, P. Dollar and R. Girshick, "Mask R-CNN," IEEE International Conference on Computer Vision (ICCV), 2017. (Link) • J. Redmon, S. Divvala, G. R. and A. Farhadi, "You only look once: Unified, real-time object detection," IEEE Conference on Computer Vision and Pattern Recognition (CVPR), pp. 779-788, 2016. (Link) • J. Redmon and A. Farhadi, "Yolov3: An incremental improvement," arXiv:1804.02767, 2018. (Link) • W. Liu, D. Anguelov, D. Erhan, C. Szegedy, S. Reed, C.-Y. Fu and A. C. Berg, "SSD: Single shot multibox detector," European Conference on Computer Vision (ECCV), pp. 21-37, 2016. (Link) • K. Simonyan and A. Zisserman, "Very deep convolutional networks for large-scale image recognition," International Conference on Learning Representations (ICLR), 2015. (Link) • K. He, X. Zhang, S. Ren and J. Sun, "Deep residual learning for image recognition," IEEE Conference on Computer Vision and Pattern Recognition (CVPR), pp. 770-778, 2016. (Link) • P. F. Felzenszwalb, R. B. Girshick, D. McAllester and D. Ramanan, "Object detection with discriminatively trained part-based models," IEEE transactions on pattern analysis and machine intelligence, vol. 32, no. 9, pp. 1627-1645, 2009. (Link) • N. Dalal and B. Triggs, "Histograms of oriented gradients for human detection," IEEE Conference on Computer Vision and Pattern Recognition, 2005. (Link) • Z. Cao, G. Hidalgo, T. Simon, S.-E. Wei and Y. Sheikh, "OpenPose: Realtime Multi-Person 2D Pose Estimation using Part Affinity Fields," IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2017. (Link)
<p>Used On (Success Story)</p>	<ul style="list-style-type: none"> • Human intention recognition (Market by STAR) • Robot reconfiguration based on the dynamic layout (Market by STAR) • Safety zones definition (Market by STAR)
<p>Market by STAR</p>	<p>Market by STAR Link</p>

3.4 Distributed Ledger Services for Data Reliability (DLSDR)

Table 4: Asset - Distributed Ledger Services for Data Reliability

Distributed Ledger Services for Data Reliability (DLSDR)	
Summary	Distributed Ledger Services for Data Reliability (DLSDR) provides a decentralized data reliability solution for industrial AI algorithms configurations and results. It offers an Analytics Engine Configuration (AEC) Service that supports Analytics by providing the capability for distributing analytics manifest objects across multiple gateways. Additionally, it offers an Analytics Results Publishing (ARP) Service, that makes it possible for analytics instances to share analytics results on the Distributed Ledger infrastructure, thus contributing to a common data set representing the combined results across the entire distributed system.
Type	<ul style="list-style-type: none"> Blockchain Service
Keywords	<ul style="list-style-type: none"> Artificial Intelligence
Images	<p>The diagram illustrates the DLSDR architecture. At the top, the Blockchain Network is shown as a Channel connecting Blockchain Org 1, Blockchain Org 2, Blockchain Org 3, and a Blockchain Orderer. Each organization involves smart contracts and logs data operations. Below this, the STAR Services section includes an Authentication Server, Blockchain STAR Service Backend (with Admin Dashboard and AP), and a Certification Authority (with Certificate Authority Dashboard). The bottom part shows Organization 1, Organization 2, and Organization 3 connected to the Channel and Orderer via docker containers. Organization 1 has nodes N1, N2, N3; Organization 2 has nodes N1, N2, N3, N4, N5; and Organization 3 has node N1.</p>
Owner	<ul style="list-style-type: none"> Intrasoft (Entity Website)

Used On (Success Story)	<ul style="list-style-type: none"> Human supervised learning for visual quality inspection (Market by STAR Link) Agile production management system data integrity and reliability (Market by STAR Link)
Market by STAR	Market by STAR Link

3.5 Fatigue Monitoring System (FaMS)

Table 5: Asset - Fatigue Monitoring System

Fatigue Monitoring System (FaMS)	
Summary	FaMS uses artificial intelligence (AI) models relying on machine learning to estimate fatigue exertion level and mental stress of subjects based on static data (e.g., age, weight, etc.) as well as dynamic data (e.g., HR, EDA, skin temperature).
Description	<p>Human Digital Twins (HDT) enable the monitoring, understanding, and optimization of all functioning of humans, and provide constant health insight to improve quality of life and well-being.</p> <p>The Fatigue Monitoring System enriches Human Digital Twins using Artificial Intelligence models and machine learning to estimate fatigue exertion level and mental stress of subjects based on static data (e.g., age, weight, etc.) and dynamic data (e.g., HR, EDA, skin temperature).</p>
Type	<ul style="list-style-type: none"> System
Keywords	<ul style="list-style-type: none"> Artificial Intelligence Machine Learning
Owner	<ul style="list-style-type: none"> SUPSI (Entity Website)
References	<ul style="list-style-type: none"> Montini, E., Cutrona, V., Gladysz, B., Dell’Oca, S., Landolfi G., Bettoni, A. A methodology to select wearable devices for Industry 5.0 applications (Link) Bettoni, A., Montini, E., Righi, M., Villani, V., Tsvetanov, R., Borgia, S., ... & Carpanzano, E. (2020). Mutualistic and Adaptive Human-Machine Collaboration Based on Machine Learning in an Injection Moulding Manufacturing Line (Link)
Used On (Success Story)	<ul style="list-style-type: none"> Safe collaboration between human and robot (Market by STAR Link)
Market by STAR	Market by STAR Link

3.6 Feedback Module

Table 6: Asset - Feedback Module

Feedback Module	
Summary	The feedback module interfaces to some interaction modules (e.g., GUI or NLP) that enable the transfer of user data to the feedback module and vice versa.
Type	<ul style="list-style-type: none"> Data Analytics
Owner	<ul style="list-style-type: none"> SUPSI (Entity Website) Qlector (Entity Website)
Used On (Success Story)	<ul style="list-style-type: none"> Human supervised learning for visual quality inspection (Market by STAR Link) Production planning optimization (Market by STAR Link)
Market by STAR	Market by STAR Link

3.7 Human Digital Twin Core Infrastructure (HDT)

Table 7: Asset - Human Digital Twin Core Infrastructure

Human Digital Twin Core Infrastructure (HDT)	
Summary	The platform supports human in the loop processes provides feedback/results on workers’ safety and performance.
Description	<p>Most of the available solutions for creating digital twins force industry solution architects to resort to ad hoc implementations and models. These solutions lack reusability, scalability, and extensibility, which prevents the introduction of a human digital representation into existing twins, thus hindering the full shift to the new Industry 5.0 paradigm. The Human Digital Twin Core Infrastructure (Clawdite platform) is an extensible and flexible IIoT based platform with a dual benefit: On the one hand, it supports the creation of customised data representations of production systems and their entities, including humans; on the other hand, it provides a modular infrastructure with interchangeable components for easy instantiation and commissioning of digital twins. Clawdite's design is suitable for applications with different purposes and supports data flows with different volume, speed and variety. These include but are not limited to:</p> <ul style="list-style-type: none"> Human-Robot Collaboration and Adaptive Automation Worker Well-being Monitoring Production Planning and Allocation
Type	<ul style="list-style-type: none"> Platform

Keywords	<ul style="list-style-type: none"> Artificial Intelligence Workers
Owner	<ul style="list-style-type: none"> SUPSI (Entity Website)
References	<p><u>Documentation:</u></p> <ul style="list-style-type: none"> Montini, E., Cutrona, V., Bonomi, N., Landolfi, G., Bettoni, A., Rocco, P., Carpanzano, E. An IIoT Platform For Human-Aware Factory Digital Twins. Procedia CIRP (Link) Montini, E., Bonomi, N., Daniele, F., Bettoni, A., Pedrazzoli, P., Carpanzano, E., Rocco, P., 2021. The human-digital twin in the manufacturing industry: Current perspectives and a glimpse of future (Link) Montini, E., Bettoni, A., Ciavotta, M., Carpanzano, E., Pedrazzoli, P., 2021. A meta-model for modular composition of tailored human digital twins in production (Link) <p><u>Repository:</u></p> <ul style="list-style-type: none"> https://gitlab-core.supsi.ch/dti-isteps/spslab/public/clawdite
Used On (Success Story)	<ul style="list-style-type: none"> Human intention recognition (Market by STAR Link) Robot reconfiguration based on the dynamic layout (Market by STAR Link) Safe collaboration between human and robot (Market by STAR Link) Safety zones definition (Market by STAR Link)
Market by STAR	Market by STAR Link

3.8 Natural Language Processing (NLP)

Table 8: Asset - Natural Language Processing

Natural Language Processing (NLP)	
Summary	Natural Language Processing related components, proof of concepts and recommendations to facilitate the interaction between humans and machines and to get contextual information enabling efficient collaboration.
Description	The term NLP comprises a broad spectrum of technologies and research topics. In the framework of STAR, NLP covers topics such as user interaction, knowledge graphs or active learning. Traditionally, NLP has also studied aspects that can provide the systems with functionalities that simplify the shop-floor operators' experience with AI systems, such as those that manage human-machine and machine-human operations. In particular, the NLP component is a mix of NLP-related proof of concepts plus consultancy and support opportunity to provide applications with

	chatbots, Speech-to-Text and Text-to-Speech capabilities, with potential extensions like Sentiment Analysis or Polarity detection.
Type	<ul style="list-style-type: none"> Machine Learning Consultancy and Support
Keywords	<ul style="list-style-type: none"> Artificial Intelligence Natural language processing
Features	<ul style="list-style-type: none"> Cloud and local Speech-to-Text Cloud and local Text-to-Speech Sentiment Analysis and Polarity detection
Owner	<ul style="list-style-type: none"> R2M (Entity Website)
References	<p><u>Documentation:</u></p> <ul style="list-style-type: none"> An Abstraction Layer Exploiting Voice Assistant Technologies for Effective Human—Robot Interaction (Link) Multimodal Human Machine Interactions in Industrial Environments (Link)
Market by STAR	Market by STAR Link

3.9 Production Processes Knowledge Base (PPKB)

Table 9: Asset - Production Processes Knowledge Base

Production Processes Knowledge Base (PPKB)	
Summary	This module consolidates domain knowledge about the production processes of the manufacturing environment.
Type	<ul style="list-style-type: none"> Data Management
Keywords	<ul style="list-style-type: none"> Industry 4.0
Owner	<ul style="list-style-type: none"> SUPSI (Entity Website) Qlector (Entity Website)
Used On (Success Story)	<ul style="list-style-type: none"> Human supervised learning for visual quality inspection
Market by STAR	Market by STAR Link

3.10 Risk Assessment and Mitigation Engine (RAME)

Table 10: Asset - Risk Assessment and Mitigation Engine

Risk Assessment and Mitigation Engine (RAME)

Summary	This module is destined to assess risk for assets associated with AI-based systems in manufacturing lines.
Type	<ul style="list-style-type: none"> • Data Protection
Keywords	<ul style="list-style-type: none"> • Artificial Intelligence • Assets • Industry 4.0 • Mitigation Actions • Threats • Vulnerabilities
Features	<ul style="list-style-type: none"> • Management of assets in manufacturing floors using interdependency graph model • Management of vulnerabilities and threats against production lines • Visualization dashboard for incidents and system’s abuse cases • Management of mitigation actions against identified threats
Owner	<ul style="list-style-type: none"> • Ubitech (Entity Website)
Used On (Success Story)	<ul style="list-style-type: none"> • Human supervised learning for visual quality inspection (Market by STAR Link) • Agile production management system data integrity and reliability (Market by STAR Link)
Market by STAR	Market by STAR Link

3.11 Runtime Monitoring System (RMS)

Table 11: Asset - Runtime Monitoring System

Runtime Monitoring System (RMS)	
Summary	RMS is a Data collection framework which provides the specifications and relevant implementation to enable a real time data collection, transformation, filtering, and management service to facilitate data consumers (i.e., analytic algorithms). The framework can be applied in IoT environments supporting solutions in various domains (e.g., Industrial, Cybersecurity, etc.). The design of the framework is driven by configurability, extensibility, dynamic setup and stream handling capabilities.
Type	<ul style="list-style-type: none"> • System

Images	
Linked Components	<ul style="list-style-type: none"> • Apache Kafka (Market by STAR Link) • Beats (Market by STAR Link) • Elasticsearch (Market by STAR Link) • Kibana (Market by STAR Link) • Logstash (Market by STAR Link)
Owner	<ul style="list-style-type: none"> • Ubitech (Entity Website)
Used On (Success Story)	<ul style="list-style-type: none"> • Human supervised learning for visual quality inspection (Market by STAR Link) • Agile production management system data integrity and reliability (Market by STAR Link)
Market by STAR	Market by STAR Link

3.12 Security Policies Manager (SPM) – Security Policies Repository (SPR)

Table 12: Asset - Security Policies Manager – Security Policies Repository

Security Policies Manager (SPM) – Security Policies Repository (SPR)	
Summary	This module specifies and configures security policies that are destined to govern the operation of the DPT, AI Cyber-Defence and RAME modules.
Type	<ul style="list-style-type: none"> • Data Protection
Keywords	<ul style="list-style-type: none"> • Artificial Intelligence
Owner	<ul style="list-style-type: none"> • GTF (Entity Website)
Used On (Success Story)	<ul style="list-style-type: none"> • Employ training for the reduction of human errors (Market by STAR Link) • Human supervised learning for visual quality inspection (Market by STAR Link)
Market by STAR	Market by STAR Link

3.13 Simulated Reality (SR)

Table 13: Asset - Simulated Reality

Simulated Reality (SR)	
Summary	Simulated reality is responsible for producing synthetic data to aid the training and evaluation of AI algorithms. To cope with incomplete training datasets and data hungry AI algorithms the actual production process is emulated to generate both plausible in-distribution data as well as unknown out-of-distribution inputs to evaluate/enhance the robustness and flexibility of AI in real-life production environments.
Type	<ul style="list-style-type: none"> Data Analytics
Keywords	<ul style="list-style-type: none"> Artificial Intelligence
Owner	<ul style="list-style-type: none"> UNIPI (Entity Website)
Used On (Success Story)	<ul style="list-style-type: none"> Human supervised learning for visual quality inspection (Market by STAR Link) Production planning optimization (Market by STAR Link)
Market by STAR	Market by STAR Link

3.14 Explainable Artificial Intelligence (XAI) Models and Library

Table 14: Asset - Explainable Artificial Intelligence (XAI) Models and Library

Explainable Artificial Intelligence (XAI) Models and Library	
Summary	This module provides and executes Explainable Artificial Intelligence models and algorithms.
Description	Similar to the ACDS module, it provides the means for executing different types of XAI algorithms such as algorithms for explaining deep neural networks and general-purpose algorithms (e.g., LIME - Local Interpretable Model Agnostic Explanations) that explain the outcomes of AI-based classifiers. As such, the module is a placeholder of XAI techniques. The latter are structured as a library of algorithms. XAI provides its services to several other modules that leverage explainable algorithms for their operation, such as the AI Cyber Defence Strategies module and the Simulated Reality (SR) module.
Type	<ul style="list-style-type: none"> Platform
Keywords	<ul style="list-style-type: none"> Artificial Intelligence
Owner	<ul style="list-style-type: none"> UNIPI (Entity Website)

Used On (Success Story)	<ul style="list-style-type: none">• Human supervised learning for visual quality inspection (Market by STAR Link)
Market by STAR	Market by STAR Link

4 Success Stories

This chapter contains the *Success Stories*, that consist in experiences in real-world scenarios. The *Success Stories* represent the results of the project activities, showing where and how the *Assets* are being successfully deployed and used. These are also characterized according to value propositions and ICT problems.

The *Success Stories* available on Market by STAR focus on different areas of production and research. Each area of interest is explored by a Pilot of the project and is used as guideline for chapter organization:

- **Human-AI Collaboration:** Human-AI Collaboration for Robust Quality Inspections - Philips Pilot.
- **Secure AI:** Human Centred AI for Agile Manufacturing 4.0 - IBER OLEEF Pilot.
- **Safe AI:** Human Behaviour Prediction and Safe Zone Detection for Routing - DFKI Pilot.

For each *Success Story*, a Template is provided with information organized by section, namely Place (location and characterization), Team (entities involved), Characterization (Value propositions and ICT problems) and Solutions (technologies used to solve the technological problems).

To access the information on Market by STAR, the link is available in the last field of the Template.

4.1 Human-AI Collaboration

The Philips Pilot is exploring the human-AI collaboration for robust quality inspections on the current production of shavers, where there is a strong emphasis on standardization, automation, and minimization of cycle-times within the production lines. However, due to a shift in customer demand, smaller batch production and customized products are more often asked. To comply with this shift in customer demand, production lines need to be reconfigured more often to be able to produce different products with the same assets. These reconfigurations range from adapting the quality control system up to the physical reconfiguration of robots.

4.1.1 Easy reconfiguration for automated part handling

Table 15: Success Story - Easy reconfiguration for automated part handling

Easy reconfiguration for automated part handling	
Description	In this use case, three different building blocks are defined that together could provide flexibility from a part handling perspective. The first building block revolves around the development of a system for automated part recognition and detection. In this building block, the idea is to use a vision setup that can recognize the product in a detection frame based on a knowledge base containing information needed (e.g., photos, CAD drawings, process parameters) for detection, recognition, and localization of a product. Once the identification and localization of the product are completed, this information is transferred to the next building block in which the goal

	<p>is to automatically define the actions for a cobot to pick the part and perform the required operations. This is done in simulated reality by combining information about the cobot and the process combined with the information from the previous building block. Once we know which product must be handled, where this product is located, and what actions the cobot needs to perform we arrive at the third building block. In the third building block, we aim to create a translation of the simulated reality to a real-world action by turning the cobot actions as defined in the simulated reality into an actual cobot program that can be communicated to the cobot. In the end, this would mean that a product can be detected, identified, and localized after which a simulation can be created of the process to be performed after which the simulated reality can be translated to reality in order to perform the process as intended.</p>
Keywords	<ul style="list-style-type: none"> • Artificial Intelligence • Human-AI Collaboration
Place	
Location	<ul style="list-style-type: none"> • Region: Drachten • Country: Netherlands
Characterization	<ul style="list-style-type: none"> • Type of Place: Factory • Type of Production: White Goods & Appliances
Team	
Entities	<ul style="list-style-type: none"> • Philips (Entity Website) • SUPSI (Entity Website)
Contact	<ul style="list-style-type: none"> • Bas Snijders (Email Address)
Characterization	
Value Propositions	<ul style="list-style-type: none"> • Improve Flexibility • Improve Quality • Reduce Repetitive Tasks • Reduce Time to Market
ICT Problems	<ul style="list-style-type: none"> • Detect part orientation • Detect part to be handled
Solutions	
Components	<ul style="list-style-type: none"> • Cobot (Market by STAR Link) • Cobot Vision (Market by STAR Link)
Market by STAR	
Market by STAR Link	

4.1.2 Human supervised learning for visual quality inspection

Table 16: Success Story - Human supervised learning for visual quality inspection

Human supervised learning for visual quality inspection	
Description	In this use case, we aim to investigate and implement solutions that can help setup quality inspection systems in an easy and flexible manner. Normally visual quality inspection systems are trained based on extensive datasets and can be easily optimized due to mass-production and data collection. However, to setup an automated visual quality inspection for lower volume production, alternative solutions are needed since the data volumes available will decrease significantly. Therefore, the aim of this use case is to setup an automated quality inspection in a quick and easy way by employing active learning to the quality inspection algorithms. This would enable the setup of such an automated quality system with a relatively small dataset after which the system can continue learning based on operator input to cases in which the algorithm is not sure about its quality assessment. By doing this, we are aiming to utilize the best of both machines and humans to create a dynamic and efficient production environment.
Keywords	<ul style="list-style-type: none"> • Artificial Intelligence • Human-AI Collaboration
Place	
Location	<ul style="list-style-type: none"> • Region: Drachten • Country: Netherlands
Characterization	<ul style="list-style-type: none"> • Type of Place: Factory • Type of Production: White Goods & Appliances
Team	
Entities	<ul style="list-style-type: none"> • Philips (Entity Website) • SUPSI (Entity Website)
Contact	<ul style="list-style-type: none"> • Bas Snijders (Email Address)
Characterization	
Value Propositions	<ul style="list-style-type: none"> • Improve Flexibility • Improve Quality • Reduce Repetitive Tasks • Reduce Time to Market
ICT Problems	<ul style="list-style-type: none"> • Inspect visual requirements • Learning based on human input • Learning based on incomplete datasets • Learning based on small datasets

Solutions	
Components	<ul style="list-style-type: none"> • Active Learning (Market by STAR Link) • AI Cyber-Defence Strategies (Market by STAR Link) • Apache Kafka (Market by STAR Link) • Cobot (Market by STAR Link) • Cobot Vision (Market by STAR Link) • Distributed Ledger Services for Data Reliability (Market by STAR Link) • Feedback Module (Market by STAR Link) • Production Processes Knowledge Base (Market by STAR Link) • Risk Assessment and Mitigation Engine (Market by STAR Link) • Runtime Monitoring System (Market by STAR Link) • Security Policies Manager – Security Policies Repository (Market by STAR Link) • Simulated Reality (Market by STAR Link) • XAI Models and Library (Market by STAR Link)
Market by STAR	
Market by STAR Link	

4.1.3 Safe collaboration between human and robot

Table 17 - Success Story - Safe collaboration between human and robot

Safe collaboration between human and robot	
Description	This use case is related to the implementation of the human digital twin. This innovative technology is developed to measure and analyze the human aspect within production. The goal is to measure aspects like physical stress, mental stress, job engagement, happiness, and many more. By doing this, we want to investigate how we can link these measured aspects to things like employee well-being, job design, and collaborative systems acting upon data gathered. Due to the low TRL level of this technology, this use case mainly helps to explore the different possibilities and links that can be made with this data to provide additional insights into the added value of a human digital twin in an industrial environment.
Keywords	<ul style="list-style-type: none"> • Artificial Intelligence • Human-AI Collaboration
Place	
Location	<ul style="list-style-type: none"> • Region: Drachten • Country: Netherlands
Characterization	<ul style="list-style-type: none"> • Type of Place: Factory

	<ul style="list-style-type: none"> Type of Production: White Goods & Appliances
Team	
Entities	<ul style="list-style-type: none"> Philips (Entity Website) SUPSI (Entity Website)
Contact	<ul style="list-style-type: none"> Bas Snijders (Email Address)
Characterization	
Value Propositions	<ul style="list-style-type: none"> Improve Working Environment Improve Safety Feeling Increase Satisfaction
ICT Problems	<ul style="list-style-type: none"> Analyse mental stress Monitor mental health Support workers in rapid change
Solutions	
Components	<ul style="list-style-type: none"> Cobot (Market by STAR Link) Cobot Vision (Market by STAR Link) Fatigue Monitoring System (Market by STAR Link) Human Digital Twin Core Infrastructure (Market by STAR Link)
Market by STAR	
Market by STAR Link	

4.2 Secure AI

In turn, the IBER OLEFF is exploring human-centred AI for agile manufacturing 4.0. The complexity and variability of the product may imply the use of different manufacturing and monitoring processes, which can be developed with tools that, themselves, combine these processes into a single workstation and/or multiple tools/workstations, generating the multifunction production cells. It is critical that the production processes are vertically and horizontally integrated, which means that all levels of production management and planning require access to the production line with detailed real-time information. Equally, the entire production line, as well as the other manufacturing cells need to know the general state of any cell for effective real-time optimization and management. The management of this complex process network must be achieved flexibly and responsibly, responding to scheduled production changes as needed to maintain process competitiveness.

4.2.1 Agile production management system data integrity and reliability

Table 18: Success Story - Agile production management system data integrity and reliability

Agile production management system data integrity and reliability	
Description	In this use case it is planned to identify external and internal threats to information systems affecting the production system, mitigate them, and reduce as much as possible the harmful effects.
Keywords	<ul style="list-style-type: none"> Artificial Intelligence Secure AI
Place	
Location	<ul style="list-style-type: none"> Region: Pombal Country: Portugal
Characterization	<ul style="list-style-type: none"> Type of Place: Factory Type of Production: Automotive Interior
Team	
Entities	<ul style="list-style-type: none"> IBER-OLEFF (Entity Website) Unparallel (Entity Website)
Contact	<ul style="list-style-type: none"> Mihail Fontul (Email Address)
Characterization	
Value Propositions	<ul style="list-style-type: none"> Improve Decision-making Improve Learning Process Increase Efficiency Increase Sustainability
ICT Problems	<ul style="list-style-type: none"> Detect data poisoning Identify industrial errors Prevent learning process contamination
Solutions	
Components	<ul style="list-style-type: none"> AI Cyber-Defence Strategies (Market by STAR Link) Distributed Ledger Services for Data Reliability (Market by STAR Link) HMI Console – TP1200 Comfort (Market by STAR Link) HMI Console – X2 base 5 (Market by STAR Link) Microsoft SQL Server (Market by STAR Link) PFC 100 Controller (Market by STAR Link) PLC Controller (Market by STAR Link) ProSeS BDE System (Market by STAR Link) Risk Assessment and Mitigation Engine (Market by STAR Link) Runtime Monitoring System (Market by STAR Link)

	<ul style="list-style-type: none"> Vision Sensor – O2DXXX (Market by STAR Link)
Market by STAR	
Market by STAR Link	

4.2.2 Employ training for the reduction of human errors

Table 19: Success Story - Employ training for the reduction of human errors

Employ training for the reduction of human errors	
Description	This use case is intended to identify and quantify human errors associated with the assembly process. With the help of the right tools, it is expected to achieve better-operating methods and better management of human resources on the assembly line.
Keywords	<ul style="list-style-type: none"> Artificial Intelligence Secure AI
Place	
Location	<ul style="list-style-type: none"> Region: Pombal Country: Portugal
Characterization	<ul style="list-style-type: none"> Type of Place: Factory Type of Production: Automotive Interior
Team	
Entities	<ul style="list-style-type: none"> IBER-OLEFF (Entity Website) Unparallel (Entity Website)
Contact	<ul style="list-style-type: none"> Mihail Fontul (mihail.fontul@iber-oleff.pt)
Characterization	
Value Propositions	<ul style="list-style-type: none"> Improve Flexibility Improve Operative Methods Improve Quality Reduce Human Errors
ICT Problems	<ul style="list-style-type: none"> Learning based on human input Monitor production processes
Solutions	
Components	<ul style="list-style-type: none"> Apache Kafka (Market by STAR Link) HMI Console – TP1200 Comfort (Market by STAR Link) HMI Console – X2 base 5 (Market by STAR Link) PFC 100 Controller (Market by STAR Link) PLC Controller (Market by STAR Link) Microsoft SQL Server (Market by STAR Link)

	<ul style="list-style-type: none"> • ProSeS BDE System (Market by STAR Link) • Security Policies Manager – Security Policies Repository (Market by STAR Link) • Vision Sensor – O2DXXX (Market by STAR Link)
Market by STAR	
Market by STAR Link	

4.2.3 Production planning optimization

Table 20: Success Story - Production planning optimization

Production planning optimization	
Description	This use case has as its main objective the reduction to a minimum of unfinished product stocks. Practically, there will always be a certain stock of the unfinished product, i.e., injected components and purchase elements that will be assembled according to the customer’s monthly or weekly orders. The logistical management and storage of this unfinished product have a relevant cost and therefore the objective will be to reduce it.
Keywords	<ul style="list-style-type: none"> • Artificial Intelligence • Secure AI
Place	
Location	<ul style="list-style-type: none"> • Region: Pombal • Country: Portugal
Characterization	<ul style="list-style-type: none"> • Type of Place: Factory • Type of Production: Automotive Interior
Team	
Entities	<ul style="list-style-type: none"> • IBER-OLEFF (Entity Website) • Unparallel (Entity Website)
Contact	<ul style="list-style-type: none"> • Mihail Fontul (Email Address)
Characterization	
Value Propositions	<ul style="list-style-type: none"> • Optimize Production Processe • Reduce Production Peaks • Reduce Extra Working Hours • Reduce Production Downtimes • Increase Efficiency • Increase Sustainability
ICT Problems	<ul style="list-style-type: none"> • Real-time sensing/ monitoring

Solutions	
Components	<ul style="list-style-type: none"> • Feedback Module (Market by STAR Link) • HMI Console – TP1200 Comfort (Market by STAR Link) • HMI Console – X2 base 5 (Market by STAR Link) • PFC 100 Controller (Market by STAR Link) • PLC Controller (Market by STAR Link) • Microsoft SQL Server (Market by STAR Link) • ProSeS BDE System (Market by STAR Link) • Simulated Reality (Market by STAR Link) • Vision Sensor – O2DXXX (Market by STAR Link)
Market by STAR	
Market by STAR Link	

4.2.4 Production processes simulations for accelerated decisions and safe processes

Table 21: Success Story - Production processes simulations for accelerated decisions and safe processes

Production processes simulations for accelerated decisions and safe processes	
Description	This use case assumes the development of an IT solution that will help production management in making high-level decisions. This solution will be based on real-time simulation of the production process and will benefit from instant production data as well as their history (a specific database will be created). Access to existing data on the production management platforms of the various production areas will be guaranteed. It is to be expected that this solution will be able to present the necessary alternatives to streamline the production process.
Keywords	<ul style="list-style-type: none"> • Artificial Intelligence • Secure AI
Place	
Location	<ul style="list-style-type: none"> • Region: Pombal • Country: Portugal
Characterization	<ul style="list-style-type: none"> • Type of Place: Factory • Type of Production: Automotive Interior
Team	
Entities	<ul style="list-style-type: none"> • IBER-OLEFF (Entity Website) • Unparallel (Entity Website)
Contact	<ul style="list-style-type: none"> • Mihail Fontul (Email Address)

Characterization	
Value Propositions	<ul style="list-style-type: none"> • Improve Decision-making • Increase Efficiency • Increase Sustainability • Reduce Time to Market
ICT Problems	<ul style="list-style-type: none"> • Real-time access to detailed information • Real-time reconfiguration • Real-time simulations
Solutions	
Components	<ul style="list-style-type: none"> • HMI Console – TP1200 Comfort (Market by STAR Link) • HMI Console – X2 base 5 (Market by STAR Link) • PFC 100 Controller (Market by STAR Link) • PLC Controller (Market by STAR Link) • Microsoft SQL Server (Market by STAR Link) • ProSeS BDE System (Market by STAR Link) • Simulated Reality (Market by STAR Link)
Market by STAR	
Market by STAR Link	

4.3 Safe AI

The DFKI Pilot is exploring human behavior prediction and safe zone detection for routing. The focus is a mobile robot, whose main role is to transfer items from one docking station to another. In addition, some tasks are also performed by human workers, thus sharing the same workspace. This implies that the safe coexistence of humans and mobile robot is highly prioritised.

4.3.1 Human intention recognition

Table 22: Success Story - Human intention recognition

Human intention recognition	
Description	This use case plans to detect the human activities and predict their next actions, which then will be combined with robot navigation to create a safer environment. For this matter, DFKI created typical worker scenarios, happening during normal daily work. The behavior of more than 10 participants was recorded, who were supposed to follow the same or similar flow. The recordings were made using wrist sensors which are then analyzed in detail to detect the activity they are currently performing.
Keywords	<ul style="list-style-type: none"> • Artificial Intelligence • HAR (Human Action Recognition) • HDT (Human Digital Twin)

	<ul style="list-style-type: none"> • HMI (Human Machine Interaction) • Safe AI • Safety in Industry
Place	
Location	<ul style="list-style-type: none"> • Region: Kaiserslautern • Country: Germany
Characterization	<ul style="list-style-type: none"> • Type of Place: Research Center • Type of Research: Artificial Intelligence
Team	
Entities	<ul style="list-style-type: none"> • DFKI (Entity Website) • SmartFactory (Entity Website) • Thales (Entity Website)
Contacts	<ul style="list-style-type: none"> • Hooman Tavakoli (Email Address) • André Hennecke (Email Address)
Characterization	
Value Propositions	<ul style="list-style-type: none"> • Improve Working Environment • Increase Safety Feeling • Increase Safety in HMI • Predict Human Intention
ICT Problems	<ul style="list-style-type: none"> • Detect human activities • Estimate next behaviour(s) • Monitor human behaviour
Solutions	
Components	<ul style="list-style-type: none"> • AXIS M3066-V Network Camera (Market by STAR Link) • Autonomous Mobile Robot (AMR) planner using safety zone detection (Market by STAR Link) • Human Digital Twin Core Infrastructure (Market by STAR Link) • Robotino (Market by STAR Link) • Robotino Sim (Market by STAR Link) • ROS – Robot Operating System (Market by STAR Link) • SmartSoft (Market by STAR Link)
Market by STAR	
Market by STAR Link	

4.3.2 Robot reconfiguration based on the dynamic layout

Table 23: Success Story - Robot reconfiguration based on the dynamic layout

Robot reconfiguration based on the dynamic layout	
Description	This use case consists in the dynamic update to the navigation route of the mobile robot, by considering human and/or other (non-moving) objects in the environment. This use case will also enable easier reconfiguration of the robot in case the layout of the environment (including the production stations) changes. The layout is actively monitored by the cameras, and humans, as well as the objects in the layout, are detected. In case of any change, the new coordinates of the stations, where the robot should navigate to, are updated.
Keywords	<ul style="list-style-type: none"> • Artificial Intelligence • HAR (Human Action Recognition) • HDT (Human Digital Twin) • HMI (Human Machine Interaction) • Safe AI • Safety in Industry
Place	
Location	<ul style="list-style-type: none"> • Region: Kaiserslautern • Country: Germany
Characterization	<ul style="list-style-type: none"> • Type of Place: Research Center • Type of Research: Artificial Intelligence
Team	
Entities	<ul style="list-style-type: none"> • DFKI (Entity Website) • SmartFactory (Entity Website) • Thales (Entity Website)
Contacts	<ul style="list-style-type: none"> • Hooman Tavakoli (Email Address) • André Hennecke (Email Address)
Characterization	
Value Propositions	<ul style="list-style-type: none"> • Improve Working Environment • Increase Production Rate • Increase Safety in HMI • Reduce Reconfiguration Time
ICT Problems	<ul style="list-style-type: none"> • Estimate current robot coordinates • Send new coordinates to robot • Update modules coordinates
Solutions	

Components	<ul style="list-style-type: none"> • AXIS M3066-V Network Camera (Market by STAR Link) • Autonomous Mobile Robot (AMR) planner using safety zone detection (Market by STAR Link) • Human Digital Twin Core Infrastructure (Market by STAR Link) • Robotino (Market by STAR Link) • Robotino Sim (Market by STAR Link) • ROS – Robot Operating System (Market by STAR Link) • SmartSoft (Market by STAR Link)
Market by STAR	
Market by STAR Link	

4.3.3 Safety zones definition

Table 24: Success Story - Safety zones definition

Safety zones definition	
Description	<p>The “Human intention recognition” and “Robot reconfiguration based on the dynamic layout” use cases are going to be combined to have a safe environment for the workers and the hardware equipment. The newly received coordinates of the stations will be used to set the robot’s destinations. The speed of the robot and the objects in the layout will also be considered to create a collision-free navigation path for the robot. The human’s current and next activity is also one of the important aspects to take into account during the decision. The points of interest for the robot will be sent as separate data to achieve the original goals of the use case.</p>
Keywords	<ul style="list-style-type: none"> • Artificial Intelligence • HAR (Human Action Recognition) • HDT (Human Digital Twin) • HMI (Human Machine Interaction) • Safe AI • Safety in Industry
Place	
Location	<ul style="list-style-type: none"> • Region: Kaiserslautern • Country: Germany
Characterization	<ul style="list-style-type: none"> • Type of Place: Research Center • Type of Research: Artificial Intelligence
Team	
Entities	<ul style="list-style-type: none"> • DFKI (Entity Website) • SmartFactory (Entity Website)

	<ul style="list-style-type: none"> • Thales (Entity Website)
Contacts	<ul style="list-style-type: none"> • Hooman Tavakoli (Email Address) • André Hennecke (Email Address)
Characterization	
Value Propositions	<ul style="list-style-type: none"> • Improve Working Environment • Increase Production Rate • Increase Safety Feeling • Increase Safety in HMI
ICT Problems	<ul style="list-style-type: none"> • Detect human activities • Determine robot behavior based on human behavior • Update robot plan based on layout information
Solutions	
Components	<ul style="list-style-type: none"> • AXIS M3066-V Network Camera (Market by STAR Link) • Autonomous Mobile Robot (AMR) planner using safety zone detection (Market by STAR Link) • Human Digital Twin Core Infrastructure (Market by STAR Link) • Robotino (Market by STAR Link) • Robotino Sim (Market by STAR Link) • ROS – Robot Operating System (Market by STAR Link) • SmartSoft (Market by STAR Link)
Market by STAR	
Market by STAR Link	

5 Training Resources

One of STAR’s goals is to index *Training Resources* to make it easier for Market by STAR users to access information about safe, trusted and human-centric AI in manufacturing environments. At this stage of the project, the available resources do not meet all the established requirements, but this is expected in next version of the document.

The *Training Resources* currently indexed in the Market by STAR corresponds to:

- **Courses:** Training courses related to AI and Digital Transformation, Industry 4.0, IoT and much more.
- **Workshops:** Resources related to AI and Manufacturing.

5.1 Courses

For each *Course*, a Template is provided with information such as description, keywords, website, details regarding duration, cost, and certification, as well as entities involved. To access the *Course* information on Market by STAR, the link is available in the last field of the Template.

5.1.1 A Complete Beginner’s Guide to Industry 4.0

Table 25: Course - A Complete Beginner’s Guide to Industry 4.0

A Complete Beginner’s Guide to Industry 4.0	
Description	<p>A Complete Beginner’s Guide to the next wave of transformation of people, business and planet.</p> <p>A course with a simple and comprehensive beginner’s guide to Industry 4.0! Understand how Industry 4.0 is accelerating the Digital Transformation of many industries including Agriculture, Livestock and Poultry, Aquaculture, Food and Beverage, Retail, Insurance and much more!</p>
Keywords	<ul style="list-style-type: none"> • Industry 4.0
Website	www.udemy.com
Details	
Duration	26 hours
Cost	84.99 €
Certification	Certificate of completion
Team	
Speaker	<ul style="list-style-type: none"> • CipherDev Labs™
Market by STAR	
Market by STAR Link	

5.1.2 A Subjective Introduction to the IoT

Table 26: Course - A Subjective Introduction to the IoT

A Subjective Introduction to the IoT	
Description	This course covers an overview of selected IoT technologies, tools and methods. Firstly, you'll find out what is IoT then we will guide you through the popular IoT hardware, including Arduino and Espressif ESP8266 and ESP32 System on Chips, sensors and actuators, finally through the introduction to the networking. Right enough for now to let you understand IoT idea, start programming and embrace IoT technology. Even configure your devices to talk to your home network and send data over MQTT to the cloud.
Keywords	<ul style="list-style-type: none"> IoT
Website	www.classcentral.com
Details	
Duration	8 weeks
Cost	FREE
Certification	Certificate of completion
Market by STAR	
Market by STAR Link	

5.1.3 Advanced Diploma in Introduction to Internet of Things

Table 27: Course - Advanced Diploma in Introduction to Internet of Things

Advanced Diploma in Introduction to Internet of Things	
Description	This course describes the fundamental concepts behind the IoT as well as its applications in computer programming. By the end of this course, you will be able to use some concepts of the Internet of Things to solve computational problems using real-life scenarios.
Keywords	<ul style="list-style-type: none"> IoT
Website	alison.com
Details	
Duration	20-30 hours
Cost	FREE
Certification	Certificate of completion

Team	
Institution	<ul style="list-style-type: none"> NPTEL
Market by STAR	
Market by STAR Link	

5.1.4 Advanced Manufacturing Enterprise

Table 28: Course - Advanced Manufacturing Enterprise

Advanced Manufacturing Enterprise	
Description	This course makes students aware of what a digitally connected enterprise is, as they learn about the operational complexity of enterprises, business process optimization and the concept of an integrated product-process-value chain. Students become acquainted with the available tools, technologies and techniques for aggregation and integration of data throughout the manufacturing supply chain and entire product life cycle. They receive foundational knowledge to assist in efforts to facilitate design, planning, and production scheduling of goods and services by applying product life cycle data.
Keywords	<ul style="list-style-type: none"> Industry 4.0
Website	www.coursera.org
Details	
Duration	18 hours
Cost	FREE
Certification	Certificate of completion
Team	
Institution	<ul style="list-style-type: none"> University at Buffalo The State University of New York
Market by STAR	
Market by STAR Link	

5.1.5 Architecting Smart IoT Devices

Table 29: Course - Architecting Smart IoT Devices

Architecting Smart IoT Devices	
Description	<p>This course will teach you how to develop an embedded systems device. In order to reduce the time to market, many pre-made hardware and software components are available today. You'll discover all the available hardware and software components, such as processor families, operating systems, boards and networks. You'll also learn how to actually use and integrate these components.</p> <p>At the end of the course you will be ready to start architecting and implementing your own embedded device! You'll learn how to debug and finetune your device and how to make it run on a low power supply.</p>
Keywords	<ul style="list-style-type: none"> • IoT
Website	www.coursera.org
Details	
Duration	34 hours
Cost	FREE
Certification	Certificate of completion
Team	
Institution	<ul style="list-style-type: none"> • EIT Digital
Market by STAR	
Market by STAR Link	

5.1.6 Arduino: Make an IoT environment monitor

Table 30: Course - Arduino: Make an IoT environment monitor

Arduino: Make an IoT environment monitor	
Description	<p>What you'll learn:</p> <ul style="list-style-type: none"> • Make simple circuits based on the Arduino board. • Acquire data from sensors and display them on an LCD screen. • Upload sensor data to a free cloud logging service and visualise it in a dashboard. • Understand the basics of programming for microcontrollers.
Keywords	<ul style="list-style-type: none"> • IoT

Website	www.udemy.com
Details	
Duration	5 hours
Cost	FREE
Certification	Certificate of completion
Team	
Institution	<ul style="list-style-type: none"> udemy
Market by STAR	
Market by STAR Link	

5.1.7 AWS IoT: The Hobbyists Guide to Home Automation

Table 31: Course - AWS IoT: The Hobbyists Guide to Home Automation

AWS IoT: The Hobbyists Guide to Home Automation	
Description	Embedded Device to AWS Cloud Integration, Publish MQTT data to AWS IoT using a Raspberry Pi or ESP32.
Keywords	<ul style="list-style-type: none"> IoT
Website	www.udemy.com
Details	
Duration	2 hours
Cost	49.99 €
Certification	Certificate of completion
Team	
Institution	<ul style="list-style-type: none"> udemy
Market by STAR	
Market by STAR Link	

5.1.8 AWS Serverless Design for IoT

Table 32: Course - AWS Serverless Design for IoT

AWS Serverless Design for IoT	
Description	Program the ESP8266/ESP32 in Arduino, then enhance, store, and visualize IoT data with AWS Serverless design flows.
Keywords	<ul style="list-style-type: none"> IoT
Website	www.udemy.com
Details	
Duration	9 hours
Cost	54.99 €
Certification	Certificate of completion
Team	
Institution	<ul style="list-style-type: none"> udemy
Market by STAR	
Market by STAR Link	

5.1.9 Beginners Masterclass into Internet of Things

Table 33: Course - Beginners Masterclass into Internet of Things

Beginners Masterclass into Internet of Things	
Description	Learn IoT with Raspberry Pi and Microsoft Azure.
Keywords	<ul style="list-style-type: none"> IoT
Website	www.udemy.com
Details	
Duration	9 hours
Cost	84.99 €
Certification	Certificate of completion
Team	
Institution	<ul style="list-style-type: none"> udemy
Market by STAR	
Market by STAR Link	

5.1.10 Big Data Analytics in IoT domain

Table 34: Course - Big Data Analytics in IoT domain

Big Data Analytics in IoT domain	
Description	<p>What you'll learn:</p> <ul style="list-style-type: none"> • Fusion of Industry 4.0 coupled with big data analytics opens up a new era of technology evolution. • How big data is creating great opportunity in IoT domain for aspiring big data analytics enthusiasts. Learn the steps to define the cognitive problem statement and then turn to solutions. • Start thinking rationally on IoT application with intelligence built into it. • Opens up the different facets and chains in complete value chain and helps you to position yourself. • Think before you jump over on implementation of your next big idea in IoT domain. • Know the prospect and validate against your enthusiasm before jumping to the intelligent device domain.
Keywords	<ul style="list-style-type: none"> • IoT
Website	www.udemy.com
Details	
Duration	1,5 hours
Cost	84.99 €
Certification	Certificate of completion
Team	
Institution	<ul style="list-style-type: none"> • udemy
Market by STAR	
Market by STAR Link	

5.1.11 Build IoT Apps using Raspberry Pi, ASP.NET Core and SignalR

Table 35: Course - Build IoT Apps using Raspberry Pi, ASP.NET Core and SignalR

Build IoT Apps using Raspberry Pi, ASP.NET Core and SignalR	
Description	Developing Internet of Things Applications using Raspberry Pi 3, ASP.NET Core and SignalR Core.
Keywords	<ul style="list-style-type: none"> • IoT

Website	www.udemy.com
Details	
Duration	4 hours
Cost	39.99 €
Certification	Certificate of completion
Team	
Institution	<ul style="list-style-type: none"> • udemy
Market by STAR	
Market by STAR Link	

5.1.12 Build your 1st Arduino IoT Project & Game: Arduino for Kids

Table 36: Course - Build your 1st Arduino IoT Project & Game: Arduino for Kids

Build your 1st Arduino IoT Project & Game: Arduino for Kids	
Description	10+ projects on Arduino Internet of Things (IoT) & Arduino Hardware Gaming for Kids. Easy GUI drag and drop programming.
Keywords	<ul style="list-style-type: none"> • IoT
Website	www.udemy.com
Details	
Duration	2,5 hours
Cost	19.99 €
Certification	Certificate of completion
Team	
Institution	<ul style="list-style-type: none"> • udemy
Speaker	<ul style="list-style-type: none"> • Robolabz STEM School
Market by STAR	
Market by STAR Link	

5.1.13 Building a Thing for the Internet of Things IoT

Table 37: Course - Building a Thing for the Internet of Things IoT

Building a Thing for the Internet of Things IoT	
Description	A hands-on, step-by-step guide to bringing your idea to life, from start to Kickstarter.
Keywords	<ul style="list-style-type: none"> IoT
Website	www.udemy.com
Details	
Duration	3,5 hours
Cost	24.99 €
Certification	Certificate of completion
Team	
Institution	<ul style="list-style-type: none"> udemy
Market by STAR	
Market by STAR Link	

5.1.14 Building Internet of Things Projects with Arduino IoT Cloud

Table 38: Course - Building Internet of Things Projects with Arduino IoT Cloud

Building Internet of Things Projects with Arduino IoT Cloud	
Description	Learn the Internet of Things. Build IoT Projects, Configure IoT Things, Dashboards, Webhooks and build IFTTT Integrations.
Keywords	<ul style="list-style-type: none"> IoT
Website	https://www.udemy.com/course/arduino-iot-cloud/
Details	
Duration	4,5 hours
Cost	84.99 €
Certification	Certificate of completion
Team	
Institution	<ul style="list-style-type: none"> udemy
Market by STAR	

[Market by STAR Link](#)

5.1.15 Capstone: Autonomous Runway Detection for IoT

Table 39: Course - Capstone: Autonomous Runway Detection for IoT

Capstone: Autonomous Runway Detection for IoT	
Description	This capstone project course ties together the knowledge from three previous courses in IoT though embedded systems: Development of Real-Time Systems, Web Connectivity & Security and Embedded Hardware and Operating Systems. The students will develop a larger system using the learning outcomes from these courses, and the students will evaluate the developed system in a real-world programming environment. This course is a true engineering task in which the student must, not only implement the algorithm code, but also handle the interfaces between many different actors and hardware platforms. The students will learn how to motivate engineering decisions and how to choose implementations to make a system actually running. The students will also learn to evaluate the efficiency and the correctness of their system as well as real-world parameters such as energy consumption and cost.
Keywords	<ul style="list-style-type: none"> IoT
Website	www.coursera.org
Details	
Duration	34 hours
Cost	FREE
Certification	Certificate of completion
Team	
Institution	<ul style="list-style-type: none"> EIT Digital
Market by STAR	
Market by STAR Link	

5.1.16 Complete guide for IoT Testing

Table 40: Course - Complete guide for IoT Testing

Complete guide for IoT Testing	
Description	Learn concepts about IoT and relevant testing theories.

Keywords	<ul style="list-style-type: none"> IoT
Website	www.udemy.com
Details	
Duration	1 hour
Cost	84.99 €
Certification	Certificate of completion
Team	
Institution	<ul style="list-style-type: none"> udemy
Market by STAR	
Market by STAR Link	

5.1.17 Complete Guide to Build IoT Things from Scratch to Market

Table 41: Course - Complete Guide to Build IoT Things from Scratch to Market

Complete Guide to Build IoT Things from Scratch to Market	
Description	Build IoT products using Arduino, NodeMCU, ESP8266, IoT Platforms, Sensors, Displays, Keypads, Relays, PCB's, Casing and more.
Keywords	<ul style="list-style-type: none"> IoT
Website	www.udemy.com
Details	
Duration	5,5 hours
Cost	84.99 €
Certification	Certificate of completion
Team	
Institution	<ul style="list-style-type: none"> udemy
Market by STAR	
Market by STAR Link	

5.1.18 Complete Python 3 and Raspberry Pi Masterclass

Table 42: Course - Complete Python 3 and Raspberry Pi Masterclass

Complete Python 3 and Raspberry Pi Masterclass	
Description	Learn Python 3 Basics, Advanced Python, Scientific Python, Raspberry Pi, and Hardware projects in a single course.
Keywords	<ul style="list-style-type: none"> IoT
Website	www.udemy.com
Details	
Duration	20,5 hours
Cost	19.99 €
Certification	Certificate of completion
Team	
Institution	<ul style="list-style-type: none"> udemy
Speaker	<ul style="list-style-type: none"> 80000+ Students Worldwide
Market by STAR	
Market by STAR Link	

5.1.19 Cyber Security in Manufacturing

Table 43: Course - Cyber Security in Manufacturing

Cyber Security in Manufacturing	
Description	<p>Acquire knowledge about security needs and the application of information security systems. Build the foundational skills needed in performing a risk assessment of operational and information technology assets. Gain valuable insights of implementing controls to mitigate identified risks.</p> <p>Main concepts of this course will be delivered through lectures, readings, discussions and various videos.</p>
Keywords	<ul style="list-style-type: none"> Industry 4.0
Website	www.coursera.org
Details	
Duration	22 hours
Cost	FREE

Certification	Certificate of completion
Team	
Institution	<ul style="list-style-type: none"> University at Buffalo The State University of New York
Market by STAR	
Market by STAR Link	

5.1.20 Cybersecurity and Privacy in the IoT

Table 44: Course - Cybersecurity and Privacy in the IoT

Cybersecurity and Privacy in the IoT	
Description	<p>As the Internet of Things (IoT) continues to grow so will the number of privacy and security concerns and issues. As a professional working in the field, it is essential to understand the potential security risks and how to best mitigate them.</p> <p>In this course, you will learn about security and privacy issues in IoT environments. We'll explore the organizational risks posed by IoT networks, and the principles of IoT device vulnerabilities. We'll also look at software and hardware IoT Applications for industry.</p> <p>With billions of devices tracking our every move, privacy is a critical issue. We will explore and discuss the social and commercial implications the IoT brings to society.</p>
Keywords	<ul style="list-style-type: none"> IoT
Website	www.edx.org
Details	
Duration	5 weeks
Cost	FREE
Certification	Certificate of completion
Team	
Institution	<ul style="list-style-type: none"> CurtinX
Market by STAR	
Market by STAR Link	

5.1.21 Cybersecurity and the Internet of Things

Table 45: Course - Cybersecurity and the Internet of Things

Cybersecurity and the Internet of Things	
Description	Welcome! You may have heard about the Internet of Things (IoT). But you may also have wondered about what it is. Or for that matter, what does it mean to you or an organization. This course is for you if you are curious about the most recent trends and activities in the internet capabilities and concerns about programmed devices. There are complexities and areas of necessary awareness when the industrial sector becomes connected to your home. Security policies and practices have not yet caught up to the internet capabilities of some of our most common products. The “connected home”, “consumer wearables”, or even an employee’s HVAC system may cause an unanticipated threat to your business environment.
Keywords	<ul style="list-style-type: none"> • IoT
Website	www.coursera.org
Details	
Duration	11 hours
Cost	FREE
Certification	Certificate of completion
Team	
Institution	<ul style="list-style-type: none"> • University System Of Georgia
Market by STAR	
Market by STAR Link	

5.1.22 Data Analytics in Internet of Things (IoT)

Table 46: Course - Data Analytics in Internet of Things (IoT)

Data Analytics in Internet of Things (IoT)	
Description	<ul style="list-style-type: none"> • Basics of Internet of Things (IoT) • Fundamentals of Data Analytics • Use of Data Analytics in IoT • Data Analytics Platforms and Tools for IoT
Keywords	<ul style="list-style-type: none"> • IoT
Website	www.udemy.com
Details	

Duration	1 hour
Cost	24.99 €
Certification	Certificate of completion
Team	
Institution	<ul style="list-style-type: none"> • udemy
Market by STAR	
Market by STAR Link	

5.1.23 Data Science for Executives

Table 47: Course - Data Science for Executives

Data Science for Executives	
Description	<p>What you will learn:</p> <p>The history of data science, tangible illustrations of how data science and analytics are used in decision making across multiple sectors today, and expert opinion on what the future might hold. A practical understanding of the fundamental methods used by data scientists including, statistical thinking and conditional probability, machine learning and algorithms, and effective approaches for data visualization. The major components of the Internet of Things (IoT) and the potential of IoT to totally transform the way in which we live and work in the not-to-distant future. How data scientists are using natural language processing (NLP), audio and video processing to extract useful information from books, scientific articles, twitter feeds, voice recordings, YouTube videos and much more.</p>
Keywords	<ul style="list-style-type: none"> • IoT
Website	www.edx.org
Details	
Duration	<ul style="list-style-type: none"> • 4 months
Cost	<ul style="list-style-type: none"> • 299 €
Certification	<ul style="list-style-type: none"> • Professional Certificate
Team	
Institution	<ul style="list-style-type: none"> • Columbia University
Market by STAR	
Market by STAR Link	

5.1.24 Data-Driven Decision Making (DDDM) Specialization

Data-Driven Decision Making (DDDM) Specialization	
Description	This specialization explains why it is important to leverage data when contemplating organizational choices, and supplies the tools at the heart of data-driven decision making (DDDM). The three-course series explores how technology enables the collection and organization of unprecedented amounts of data, and how to dissect that data to gain powerful insights. Course topics include analyzing process maps for driving improvement, software for maximizing data analysis, statistical process control, creating metrics dashboards and translating data stories, and the connection between operations technology metrics and organizational performance. Content touches on leadership’s role in instituting an internet of things (IoT) strategy in manufacturing and service environments. Lessons feature case studies highlighting ROI achieved through DDDM, and the cultural changes required for success.
Keywords	<ul style="list-style-type: none"> • IoT
Website	www.coursera.org
Details	
Duration	3 months
Cost	FREE
Certification	Certificate of completion
Team	
Institution	<ul style="list-style-type: none"> • University at Buffalo • The State University of New York
Market by STAR	
Market by STAR Link	

5.1.25 Digital Transformation and Industry 4.0

Table 48: Course - Digital Transformation and Industry 4.0

Digital Transformation and Industry 4.0	
Description	<p>Learn how to manage digital transformation in your organization to win in tomorrow’s world.</p> <p>In this course we will start learning about Industry 4.0 which is actually the foundation of the digital transformation term. Then we</p>

	<p>will have a quick look at the Society 5.0 because it will impact the scope of the digital transformation projects you will be running, especially for the government and public sector. Then we will study basics of digital transformation within different departments of a company and also within different industries. Finally, we will cover several case studies to see real digital transformation projects and how they were managed.</p> <p>The first 2 sections will cover Industry 4.0 and digital transformation which will be theory and information focused. The last section will only consist of real examples and the impacts.</p>
Keywords	<ul style="list-style-type: none"> Industry 4.0
Website	www.udemy.com
Details	
Duration	2,5 hours
Cost	109.99 €
Certification	Certificate of completion
Team	
Speaker	<ul style="list-style-type: none"> ICAN Consultancy
Market by STAR	
Market by STAR Link	

5.1.26 Digital Transformation and Industry 4.0 Masterclass

Table 49: Course - Digital Transformation and Industry 4.0 Masterclass

Digital Transformation and Industry 4.0 Masterclass	
Description	<ul style="list-style-type: none"> Understand what do terms like Digitalization, Industry 4.0, Society 5.0 mean. Build a deep understanding of 7 core Industry 4.0 technologies (AI, IoT, Blockchain, AR/VR, RPA, Cloud, 3D Printing) and their applications in business. Learn the key business drivers of digitalization and a framework for crafting digital strategy. Practice a hands on case to implement digital transformation in a company and address the practical challenges involved. Learn best practices, tip & tricks across various industries and functions to identify, design and implement digital initiatives.
Keywords	<ul style="list-style-type: none"> Industry 4.0

Website	www.udemy.com
Details	
Duration	4 hours
Cost	84.99 €
Certification	Certificate of completion
Market by STAR	
Market by STAR Link	

5.1.27 Digital Transformation from Industry 4.0 to Industry 5.0

Table 50: Course - Digital Transformation from Industry 4.0 to Industry 5.0

Digital Transformation from Industry 4.0 to Industry 5.0	
Description	<p>Take a leap and digitally transform your organization from Industry 4.0 to Industry 5.0 transformation.</p> <p>This course will start learning about Industry 4.0 which is actually the foundation of the digital transformation term. We learn benefits and downsides of Industry 4.0. When we go further in the course we will learn what are different Industry 4.0 Technologies.</p>
Keywords	<ul style="list-style-type: none"> • Industry 4.0
Website	www.udemy.com
Details	
Duration	37 mins
Cost	19.99 €
Certification	Certificate of completion
Team	
Speaker	<ul style="list-style-type: none"> • Online Education Notes • An Online Training Hub
Market by STAR	
Market by STAR Link	

5.1.28 Digital Transformation in Industry 4.0: A Complete Guide

Table 51: Course - Digital Transformation in Industry 4.0: A Complete Guide

Digital Transformation in Industry 4.0: A Complete Guide	
Description	This course provides details about Digital Transformation in the Industry 4.0 environment. Very systematic approach is made to understand all elements of transformation efforts. Course focusses on advantages, challenges and risks in a detailed way. Also discusses various industry scenarios with respect to Digital Transformation. Course also covers Industry 4.0 today's buzz word and focused item in the industry circles.
Keywords	<ul style="list-style-type: none"> • Digital Transformation • Industry 4.0
Website	www.udemy.com
Details	
Duration	2,5 hours
Cost	84.99 €
Certification	Certificate of completion
Team	
Speaker	<ul style="list-style-type: none"> • Global Learning Labs
Market by STAR	
Market by STAR Link	

5.1.29 Digital Transformation of Mining

Table 52: Course - Digital Transformation of Mining

Digital Transformation of Mining	
Description	This course provides learners with an overview of applications of digital technology across the value chain, including automation, monitoring and remote operations, to optimise the value extracted from a minerals deposit. It will also investigate how digitisation of the sector will likely change the required mining skills of the workforce, enhancing the safe exploitation of an orebody.
Keywords	<ul style="list-style-type: none"> • Industry 4.0
Website	www.edx.org
Details	

Duration	8 weeks
Cost	FREE
Certification	Certificate only in pain option
Team	
Institution	<ul style="list-style-type: none"> • CurtinX
Market by STAR	
Market by STAR Link	

5.1.30 Embedded Systems – Shape The World: Multi-Threaded Interfacing

Table 53: Course - Embedded Systems – Shape The World: Multi-Threaded Interfacing

Embedded Systems – Shape The World: Multi-Threaded Interfacing	
Description	<p>Learn how electronic gadgets are designed, developed, and built as embedded systems that shape the world.</p> <p>This is part two of a two part sequence. In this class, we will use interrupts to design a range of real-time systems including an audio player, a data acquisition system, a control system, and an interactive game. This is a hands-on, learn-by-doing course that shows you how to build solutions to real-world problems using embedded systems. These courses use a bottom-up approach to problem solving, building gradually from simple interfacing of switches and LEDs to complex concepts like display drivers, digital to analog conversion, generation of sound, analog to digital conversion, motor control, graphics, interrupts, and communication. We will present both general principles and practical tips for building circuits and programming the microcontroller in the C programming language. You will develop debugging skills using oscilloscopes, logic analyzers, and software instrumentation. Laboratory assignments are first performed in simulation, and then you will build and debug your system on the real microcontroller. At the conclusion of this course, you will possess the knowledge to build your own arcade-style game from the ground up.</p>
Keywords	<ul style="list-style-type: none"> • IoT
Website	www.edx.org
Details	
Duration	8 weeks
Cost	FREE

Certification	Certificate of completion
Team	
Institution	<ul style="list-style-type: none"> The University of Texas at Austin
Market by STAR	
Market by STAR Link	

5.1.31 Embedded Systems Essentials with Arm: Get Practical with Hardware

Table 54: Course - Embedded Systems Essentials with Arm: Get Practical with Hardware

Embedded Systems Essentials with Arm: Get Practical with Hardware	
Description	Spark your creativity with Arm. Level up your Embedded Systems skills by developing working embedded prototypes using the Mbed API and an Arm-based development board and unlock the boundless opportunities of the Internet of Things.
Keywords	<ul style="list-style-type: none"> IoT
Website	www.edx.org
Details	
Duration	10 weeks
Cost	FREE
Certification	Certificate of completion
Team	
Institution	<ul style="list-style-type: none"> ArmEducationXbiaX
Market by STAR	
Market by STAR Link	

5.1.32 Emerging Technologies: From Smartphones to IoT to Big Data Specialization

Table 55: Course - Emerging Technologies: From Smartphones to IoT to Big Data Specialization

Emerging Technologies: From Smartphones to IoT to Big Data Specialization	
Description	This Specialization is intended for researchers and business experts seeking state-of-the-art knowledge in advanced science and technology. The 4 courses cover details on Big Data (Hadoop, Spark,

	Storm), Smartphones, Smart Watches, Android, iOS, CPU/GPU/SoC, Mobile Communications (1G to 5G), Sensors, IoT, Wi-Fi, Bluetooth, LP-WAN, Cloud Computing, AR (Augmented Reality), Skype, YouTube, H.264/MPEG-4 AVC, MPEG-DASH, CDN, and Video Streaming Services. The Specialization includes projects on Big Data using IBM SPSS Statistics, AR applications, Cloud Computing using AWS (Amazon Web Service) EC2 (Elastic Compute Cloud), and Smartphone applications to analyze mobile communication, Wi-Fi, and Bluetooth networks. The course contents are for expert level research, design, development, industrial strategic planning, business, administration, and management.
Keywords	<ul style="list-style-type: none"> • IoT
Website	www.coursera.org
Details	
Duration	7 months
Cost	FREE
Certification	Certificate of completion
Team	
Institution	<ul style="list-style-type: none"> • Yonsei University
Market by STAR	
Market by STAR Link	

5.1.33 Enabling Technologies for Data Science and Analytics: The Internet of Things

Table 56: Course - Enabling Technologies for Data Science and Analytics: The Internet of Things

Enabling Technologies for Data Science and Analytics: The Internet of Things	
Description	<p>The Internet of Things is rapidly growing. It is predicted that more than 25 billion devices will be connected by 2020.</p> <p>In this data science course, you will learn about the major components of the Internet of Things and how data is acquired from sensors. You will also examine ways of analyzing event data, sentiment analysis, facial recognition software and how data generated from devices can be used to make decisions.</p>
Keywords	<ul style="list-style-type: none"> • IoT
Website	www.edx.org

Details	
Duration	5 weeks
Cost	FREE
Certification	Certificate of completion
Team	
Institution	<ul style="list-style-type: none"> ColumbiaX
Market by STAR	
Market by STAR Link	

5.1.34 Exploring AWS IoT

Table 57: Course - Exploring AWS IoT

Exploring AWS IoT	
Description	<p>What you'll learn:</p> <ul style="list-style-type: none"> Program the ESP8266, ESP32, or Raspberry Pi 3 to send data to AWS IoT Core. Connect to AWS free Tier and use relevant AWS services. Understand MQTT, JSON, IoT, and the AWS cloud. Become familiar with device to cloud communication. Place IoT data into Dynamo DB by creating a table and data fields. Gain competency designing graphs and using analytics on IoT data. Code with basic programming structures in JavaScript, Python, and C. Use Node-Red to connect devices to AWS IoT. Get experience with many AWS services vital to IoT like DynamoDB and S3. Learn to Create Security certificates and policy's in AWS IoT.
Keywords	<ul style="list-style-type: none"> IoT
Website	www.udemy.com
Details	
Duration	8,5 months
Cost	54.99 €
Certification	Certificate of completion
Market by STAR	

[Market by STAR Link](#)

5.1.35 Fundamentals of IoT

Table 58: Course - Fundamentals of IoT

Fundamentals of IoT	
Description	An IoT Essentials course to build a strong foundation in Enterprise IoT from Primary building blocks to IoT Architecture.
Keywords	<ul style="list-style-type: none"> IoT
Website	www.udemy.com
Details	
Duration	1 hour
Cost	34.99
Certification	Certificate of completion
Market by STAR	
Market by STAR Link	

5.1.36 Fundamentals of IoT (Internet of Things)

Table 59: Course - Fundamentals of IoT (Internet of Things)

Fundamentals of IoT (Internet of Things)	
Description	What you'll learn: <ul style="list-style-type: none"> Students will develop a strong confidence on topic Internet of Things. Understand the Different Application of Internet of Things. Understand the Different Technology of Internet of Things.
Keywords	<ul style="list-style-type: none"> IoT
Website	www.udemy.com
Details	
Duration	34 mins
Cost	19.99 €
Certification	Certificate of completion
Market by STAR	

[Market by STAR Link](#)

5.1.37 Get started in Internet of Things

Table 60: Course - Get started in Internet of Things

Get started in Internet of Things	
Description	What you'll learn: <ul style="list-style-type: none"> • Internet of Things • Arduino Programming • Working with NodeMCU ESP8266 • Publishing sensor data to cloud server • Subscribing data from cloud server • Google Assistance based Home Automation • MQTT • Adafruit IO • IFTTT • Firebase Database
Keywords	<ul style="list-style-type: none"> • IoT
Website	https://www.udemy.com/course/internet-of-things-lemalabs/
Details	
Duration	3 hours
Cost	59.99 €
Certification	Certificate of completion
Market by STAR	
Market by STAR Link	

5.1.38 Hands-on Internet of Things Specialization

Table 61: Course - Hands-on Internet of Things Specialization

Hands-on Internet of Things Specialization	
Description	WHAT YOU WILL LEARN: <ul style="list-style-type: none"> • How to build an autonomous networked device, how to program and connect this device, how to use wireless networking protocols. • Assembly of networked devices, programming of networked devices.
Keywords	<ul style="list-style-type: none"> • IoT

Website	www.coursera.org
Details	
Duration	4 months
Cost	FREE
Certification	Certificate of completion
Team	
Institution	<ul style="list-style-type: none"> University of Illinois at Urbana-Champaign
Market by STAR	
Market by STAR Link	

5.1.39 Imagine IoT

Table 62: Course - Imagine IoT

Imagine IoT	
Description	<p>What does the Internet of Things (IoT) mean to you? We are entering a new era in which “things” in the physical world are becoming connected digitally. Everything from light bulbs and baby socks to cars and coffee machines. What is possible in a world of connected, sensing, and interacting things?</p> <p>This course is all about showing you how to use IoT to make life better. Or, put another way, you will learn the fundamentals of the Internet of Things (e.g., sensors, the cloud, and more) and be introduced to new interaction paradigms (augmented reality, wearables, and more) that are changing how we interact with the world around us. You will also learn how to design and create your own IoT prototype.</p>
Keywords	<ul style="list-style-type: none"> IoT
Website	www.classcentral.com
Details	
Duration	3 weeks
Cost	FREE
Market by STAR	
Market by STAR Link	

5.1.40 Industrial IoT Markets and Security

Table 63: Course - Industrial IoT Markets and Security

Industrial IoT Markets and Security	
Description	<p>This course can also be taken for academic credit as ECEA 5385, part of CU Boulder’s Master of Science in Electrical Engineering degree.</p> <p>Developing tomorrow’s industrial infrastructure is a significant challenge. This course goes beyond the hype of consumer IoT to emphasize a much greater space for potential embedded system applications and growth: The Industrial Internet of Things (IIoT), also known as Industry 4.0. Cisco’s CEO stated: “IoT overall is a \$19 Trillion market. IIoT is a significant subset including digital oilfield, advanced manufacturing, power grid automation, and smart cities”.</p> <p>This is part 1 of the specialization. The primary objective of this specialization is to closely examine emerging markets, technology trends, applications and skills required by engineering students, or working engineers, exploring career opportunities in the IIoT space. The structure of the course is intentionally wide and shallow: We will cover many topics, but will not go extremely deep into any one topic area, thereby providing a broad overview of the immense landscape of IIoT. There is one exception: We will study security in some depth as this is the most important topic for all “Internet of Things” product development.</p>
Keywords	<ul style="list-style-type: none"> IoT
Website	www.coursera.org
Details	
Duration	22 hours
Cost	FREE
Certification	Certificate of completion
Team	
Institution	<ul style="list-style-type: none"> University of Colorado Boulder
Market by STAR	
Market by STAR Link	

5.1.41 Internet of things

Table 64: Course - Internet of things

Internet of things	
Description	A beginner’s Guide to the world of IoT.
Keywords	<ul style="list-style-type: none"> • IoT
Website	www.udemy.com
Details	
Duration	2,5 hours
Cost	19.99 €
Certification	Certificate of completion
Market by STAR	
Market by STAR Link	

5.1.42 Internet of Things: SMTP: Email With IoT device (NodeMCU)

Table 65: Course - Internet of Things: SMTP: Email With IoT device (NodeMCU)

Internet of Things: SMTP: Email With IoT device (NodeMCU)	
Description	What you’ll learn: <ul style="list-style-type: none"> • IoT based sensor acquisition & automatic email system is discussed in very details. • Just imagine a vending machine which can email to its vendor • It is also helpful in creating product for intruder/stolen vehicle, performance detection of appliances like Air conditioner, washing machine etc. • Learn how to use SMTP protocol for IoT applications
Keywords	<ul style="list-style-type: none"> • IoT
Website	www.udemy.com
Details	
Duration	1 hour
Cost	29.99 €
Certification	Certificate of completion
Market by STAR	
Market by STAR Link	

5.1.43 Internet of Things (A Practical Way)-Part1

Table 66: Course - Internet of Things (A Practical Way)-Part1

Internet of Things (A Practical Way)-Part1	
Description	Internet of Things, Arduino, ESP8266, ESP32, Firebase Database and Android Apps for IoT.
Keywords	<ul style="list-style-type: none"> IoT
Website	www.udemy.com
Details	
Duration	2 hours
Cost	29.99 €
Certification	Certificate of completion
Market by STAR	
Market by STAR Link	

5.1.44 Internet of Things (IoT) – The Mega Course

Table 67: Course - Internet of Things (IoT) – The Mega Course

Internet of Things (IoT) – The Mega Course	
Description	What you'll learn: <ul style="list-style-type: none"> Understand what Internet of Things are? Controlling home appliances from anywhere in the world Use some of the physical devices like Arduino and Raspberry Pi Design some of the IoT applications Attractive Dashboard design for different applications
Keywords	<ul style="list-style-type: none"> IoT
Website	www.udemy.com
Details	
Duration	3,5 hours
Cost	84.99 €
Certification	Certificate of completion
Market by STAR	

[Market by STAR Link](#)

5.1.45 Internet of Things (IoT) and Sustainability

Table 68: Course - Internet of Things (IoT) and Sustainability

Internet of Things (IoT) and Sustainability	
Description	<p>Understand how IoT can address sustainability challenges</p> <p>As our world becomes more and more connected, we use smart devices to overcome different obstacles in our day-to-day lives. But what happens when we turn IoT technology toward global-scale problems like sustainability?</p> <p>On this two-week course, you'll explore the fundamentals of the Internet of Things (IoT), and how we can use this technology to overcome different sustainability challenges that we face today.</p> <p>Guided by the experts at The Mind Lab and Tech Futures Lab, you'll delve into case studies to discover how IoT applications can lead to sustainable decision-making. Using examples from smart cities, transport, utilities, and more, you'll identify the positive and negative implications of technology use in working towards a brighter future.</p>
Keywords	<ul style="list-style-type: none"> • IoT
Website	www.classcentral.com
Details	
Duration	2 weeks
Cost	14 \$
Certification	Paid Certificate
Team	
Institution	<ul style="list-style-type: none"> • FutureLearn
Market by STAR	
Market by STAR Link	

5.1.46 Internet of Things (IoT) Automation using Raspberry Pi 2

Table 69: Course - Internet of Things (IoT) Automation using Raspberry Pi 2

Internet of Things (IoT) Automation using Raspberry Pi 2	
Description	Learn how to use waterproof temperature sensors to remotely display temperature and alert you through Email.
Keywords	<ul style="list-style-type: none"> • IoT
Website	www.udemy.com
Details	
Duration	42 mins
Cost	84.99 €
Certification	Certificate of completion
Market by STAR	
Market by STAR Link	

5.1.47 Internet of things (IoT) for Beginners: Getting Started

Table 70: Course - Internet of things (IoT) for Beginners: Getting Started

Internet of things (IoT) for Beginners: Getting Started	
Description	Learn the Basics of Internet of Things (IoT). And how to connect sensors with Raspberry Pi and Arduino Board.
Keywords	<ul style="list-style-type: none"> • IoT
Website	www.udemy.com
Details	
Duration	1 hour
Cost	24.99 €
Certification	Certificate of completion
Market by STAR	
Market by STAR Link	

5.1.48 Internet of Things (IoT) with Arduino Programming & ESP8266

Table 71: Course - Internet of Things (IoT) with Arduino Programming & ESP8266

Internet of Things (IoT) with Arduino Programming & ESP8266	
Description	<p>What you'll learn:</p> <ul style="list-style-type: none"> • 18 Hands-on Sessions on IoT hardware and IoT Cloud • Learn how to design code and Build IoT Products • Learn to use Arduino IDE and Arduino Programming Language from scratch • Learn how to connect sensors and actuators to commercial cloud platforms • Learn to use microcontrollers like ESP8266, NodeMCU, Arduino. • Learn to fetch data from sensors like temperature, LM35. • Build IoT Projects in this course • All services offered by ThingSpeak Cloud platform – Data Storage, ThingTweet, TalkBack, ThingHTTP, React, TimeControl etc • REST HTTP Methods – GET, POST, PUT etc • API
Keywords	<ul style="list-style-type: none"> • IoT
Website	www.udemy.com
Details	
Duration	5,5 hours
Cost	29.99 €
Certification	Certificate of completion
Market by STAR	
Market by STAR Link	

5.1.49 Internet of things and everything: A Workshop on ZIGBEE

Table 72: Course - Internet of things and everything: A Workshop on ZIGBEE

Internet of things and everything: A Workshop on ZIGBEE	
Description	<ul style="list-style-type: none"> • Zigbee is a popular wireless communication protocol standard ideal for sensor-based networks. This course provides an exposure to Zigbee standard and teaches how you can design a product based on Zigbee, covering a real-life example of Smart Energy Meter.

	<ul style="list-style-type: none"> • The Product certification section teaches you some very important guidelines for laying out your own PCB, which applies to all the wireless technologies PCB boards. • Although there is a lot of data on Zigbee on web, but sometimes too much of it also confuses, hence have only discussed the most relevant, important and needed one for designing a product on Zigbee. • It is the first tutorial of the series and will be followed by Bluetooth Low Energy and 6LowPAN.
Keywords	<ul style="list-style-type: none"> • IoT
Website	www.udemy.com
Details	
Duration	2 hours
Cost	19.99 €
Certification	Certificate of completion
Market by STAR	
Market by STAR Link	

5.1.150 Internet of Things Business Impact

Table 73: Course - Internet of Things Business Impact

Internet of Things Business Impact	
Description	How to make the most out of IoT and Digital Transformation.
Keywords	<ul style="list-style-type: none"> • IoT
Website	www.udemy.com
Details	
Duration	3 hours
Cost	49.99 €
Certification	Certificate of completion
Market by STAR	
Market by STAR Link	

5.1.51 IoT Internet of Things Bundle

Table 74: Course - IoT Internet of Things Bundle

IoT Internet of Things Bundle	
Description	<p>What you'll learn:</p> <ul style="list-style-type: none"> • Learn about the ESP32 and what makes it an excellent choice for Arduino Makers. • Learn about the ESP32 and why you must start using it • Learn how to replace Arduino with ESP32 without coding effort • Program ESP32 Effectively • Become confident in using the ESP32 in your projects. • Learn about the features ESP32 development kit • Create A Simple ESP32 Web Server in Arduino IDE • ESP32 Operating Modes • Station (STA) Mode • Soft Access Point (AP) Mode • Wiring – Connecting Devices to ESP32 • Concept Behind Controlling Things from ESP32 Web Server • ESP32 as HTTP Server using WiFi Access Point (AP) mode • Accessing the Web Server in AP mode • ESP32 as HTTP Server using WiFi Station (STA) mode • Accessing the Web Server in STA mode • Learn about the variants of the ESP32 module. • Learn about the differences and similarities between the ESP32 and the Arduino • Learn how to use the ESP32 advanced capabilities • Learn how to use the ESP32 to connect any project to the Internet and display or exchange data • Use the ESP32 to enable your project to communicate with Bluetooth devices • Read Sensor data using ESP32 Board • Send Email alert when sensor reading goes above a certain value • Create A Simple ESP32 HTTP Request in Arduino IDE • Get a FREE Hosting server and domain name • Create PHP script to insert data into MySQL • Display data on a web page • MySQL database to store readings • Get Sensors Reading • Program ESP32 Effectively • Create a fully functional Project in no Time
Keywords	<ul style="list-style-type: none"> • IoT
Website	www.udemy.com

Details	
Duration	5 hours
Cost	84.99 €
Certification	Certificate of completion
Team	
Institution	<ul style="list-style-type: none"> udemy
Market by STAR	
Market by STAR Link	

5.2 Workshops

For each Workshop, a Template is available with information such as description, keywords, website, details regarding date and duration, agenda, and some documentation. To access the Workshop information on Market by STAR, the link is available in the last field of the Template.

5.2.1 AI INTEROPERABILITY AI-MAN Workshop

Table 75: Workshop - AI INTEROPERABILITY AI-MAN Workshop

AI INTEROPERABILITY AI-MAN Workshop	
Description	This workshop of the AI4MANUFACTURING cluster (STAR EU Project Teaming AI Project COALA Your Factory Assistant XMANAI – EU Project ASSISTANT Project-H2020) where is presented how data interoperability and artificial intelligence interoperability improves industrial automation in industry 4.0 production lines and digital shopfloors. This workshop focuses on how Data and AI Interoperability technologies can boost automation processes in the modern digital shopfloor.
Keywords	<ul style="list-style-type: none"> Artificial Intelligence
Website	ai4manufacturing.com
Details	
Date	24/11/2022
Duration	1:40h
Agenda	
00:00 – 00:05	Introduction to the Workshop
00:05 – 00:25	“Manufacturing data, information, and knowledge made actionable”, Klaas Gadeyne, H2020 Assistant Project

00:25 – 00:45	“On a generalised framework for Time-Aware knowledge graphs”, Franz Krause, H2020 Teaming AI
00:45 – 01:05	“XMANAI foundations for explainability and interoperable AI”, Michele Sesana, H2020, XMANAI Project
01:05 – 01:25	“Using Asset Administration Shel for modelling and deploying Planning Agents in a Smart Factory 0.4”, Vasillis Siatras, H2020 MAS4AI Project
01:25 – 01:30	Discussion – Workshop closing
Resources	
Documents	<ul style="list-style-type: none"> • ICT38 Interoperability FlandersMake • TeamingAI-TimeAware-KnowledgeGraphs • XMANAI-AI-MAN-Workshop • AI-MANUsing-Asset-Administration-Shell
Market by STAR	
Market by STAR Link	

5.2.2 AI-MAN WORKSHOP Explainable AI in Manufacturing

Table 76: Workshop - AI-MAN WORKSHOP Explainable AI in Manufacturing

AI-MAN WORKSHOP Explainable AI in Manufacturing	
Description	Online workshop co-organized by the AI-MAN cluster of projects on AI in Manufacturing.
Keywords	<ul style="list-style-type: none"> • Artificial Intelligence • Explainable AI
Website	ai4manufacturing.com
Details	
Date	10/11/2021
Duration	2h
Agenda	
00:00 – 00:05	Introduction to the Workshop
00:05 – 00:30	“Framework development for responsible AI in manufacturing”, Eduardo Vyhmeister, H2020 ASSISTANT Project
00:30 – 00:55	“AI powered manufacturing services, processes, and products in the knowEdge project”, Christian Beecks, H2020 knowEdge Project

00:55 – 01:20	"XMANAI foundations for explainability and interoperable AI", Michele Sesana, H2020, XMANAI Project
01:20 – 01:45	"Use Cases of XAI in Manufacturing", John Soldatos, H2020 STAR Project
01:45 – 02:00	Discussion – Questions – Answers
Resources	
Documents	<ul style="list-style-type: none"> • Beecks-AI-MAN-knowEdge-XAI • Lampethaki-AI-MAN-XMANAI-XAI • Soldatos-AI-MAN-STAR-XAI • Agenda
Market by STAR	
Market by STAR Link	

5.2.3 Ethical and Legal Issues of Artificial Intelligence in Manufacturing

Table 77: Workshop - Ethical and Legal Issues of Artificial Intelligence in Manufacturing

Ethical and Legal Issues of Artificial Intelligence in Manufacturing	
Description	<p>The workshop is co-organized with the EU ICT-38 Projects community, and will also host a speech by Celine Castets-Renard (ANITI), titled "AI EU Act, Legal Issues and implications on Coala".</p> <p>This workshop was the second of a series, aimed to share learning about specific topics of the ICT 38 projects developments in AI and Manufacturing.</p>
Keywords	<ul style="list-style-type: none"> • Artificial Intelligence • Ethical Issues
Website	ai4manufacturing.com
Details	
Date	11/25/2021
Duration	2h
Agenda	
00:00 – 00:05	Introduction to the Workshop
00:05 – 00:20	"Ethics by Design in the AI-Proficient Project", Marc Anderson and Karen Fort, H2020 PROFICIENT Project
00:20 – 00:35	"Artificial lawyer – collecting and using data for certain legal issues related to manufacturing" Dr. Raphael Thomas Prabucki, H2020 MAS4AI Project

00:35 – 00:05	“AI in Manufacturing, that Works. The Symbiosis of Functionals & Non-Functionals as Main Success Factor”, Arthur van der Wees, H2020 STAR Project
00:50 – 01:05	“Developing a human centric architecture for AI in manufacturing – experiences, insights, challenges”, Jan-Hendrik Passoth and Benedict Lang, H2020 ASSISTANT Project
01:05 – 01:20	“AI EU Act, Legal Issues, and Implications on COALA Project”, Celine Castets-Renard, H2020 COALA Project
01:20 – 01:35	“Comparing the EU and Japanese Legal and Ethical Approaches to AI for Manufacturing”, Dr Andrew A. Adams, Centre for Business Information Ethics, Meiji University, Tokyo, Japan, H2020 EU-Japn.AI
01:35 – 02:00	Discussion – Questions – Answers
Resources	
Documents	<ul style="list-style-type: none"> • Adams-EU-Japan.AI • Anderson-AI-MAN • ArthursLegalStrategiesSystems-STAR • Benedict-Lang-ASSISTANT • Castets-Renard_COALA • Agenda
Market by STAR	
Market by STAR Link	

6 External AI Resources

This chapter describes *External AI Resources*, that are the Platforms used in the context of D2.2 as a search source for the AI scenarios and uses cases. These Platforms offer several resources that could be of interest to the Market by STAR stakeholders, and at the same time contribute to enrich the STAR community with the understanding of AI technologies, their connections, while facilitate by creating bridges between research and business.


The *External AI Resources* present in Market by STAR, which also serve as guidelines for the chapter organization, are:

- **IoT Catalogue:** A One-stop-source for Internet of Things (IoT) knowledge, innovations, and technologies.
- **EFFRA:** A portal to promote the pre-competitive research on production technologies within the European Research Area by engaging the European Commission through partnerships.
- **AI4EU:** A platform that serves as a catalyst to aid AI-based innovation, resulting in new products, services, and solutions to benefit European industry, commerce, and society.

For each *External AI Resource*, a Template is provided with information such as a brief description, keywords, logo and website. To access the information on Market by STAR, the link is available in the last field of the Template.


6.1 IoT Catalogue

Table 78: *External AI Resource - IoT Catalogue*

IoT Catalogue	
Description	IoT Catalogue enables users to explore IoT solutions based on domain-related Value Propositions and/ or ICT Problems described on use-cases defined along applications domains.
Keywords	<ul style="list-style-type: none"> • Artificial Intelligence • IoT
Logo	
Website	https://www.iot-catalogue.com
Market by STAR	
Market by STAR Link	

6.2 EFFRA

Table 79: External AI Resource - EFFRA

EFFRA	
Description	The European Factories of the Future Research Association (EFFRA) is a non-for-profit, industry-driven association promoting the development of new and innovative production technologies.
Keywords	<ul style="list-style-type: none"> • Artificial Intelligence • Connected Factories
Logo	
Website	https://www.effra.eu
Market by STAR	
Market by STAR Link	

6.3 AI4EU

Table 80: External AI Resource - AI4EU

AI4EU	
Description	The European AI-on-demand (AIOD) platform seeks to bring together the AI community while promoting European values. The platform is a facilitator of knowledge transfer from research to multiple business domains.
Keywords	<ul style="list-style-type: none"> • Artificial Intelligence • AI Community
Logo	
Website	https://www.ai4europe.eu
Market by STAR	
Market by STAR Link	

7 Conclusion

This document provides an overview of the Market by STAR platform, more precisely the current status of the content (collected until December 2022). All content is publicly available to users through a free registration.

One of the project goals is to develop and establish a virtualised digital innovation hub that integrates resources for secure and safe AI in manufacturing, empowered by a Market Platform that showcases the results of the project.

For that purpose, Market by STAR offers safe, reliable, and secure AI solutions in manufacturing. It constitutes a single-entry point for accessing resources and support services, being a vehicle for the promotion, dissemination, and exploitation of the project results.

The Market by STAR currently provides content about:

- **Assets:** Technologies developed within the scope of the project to support the implementation of trusted AI solutions. The Assets address different dimensions and elements of trust, security, and safety in the operation of Cyber-Physical Production Systems (CPPS).
- **Success Stories:** Experiences in real-world scenarios, representing the project activities that showcase where and how the Assets are being successfully deployed and used. The Success Stories focused on different areas of production and research. Each one, namely Human-Ai, Secure AI and Safe AI is being explored in a Pilot (Philips, IBER OLEEF and DFKI) of the project.
- **Training Resources:** Diversity of AI resources, namely Courses related to AI, digital transformation and industry 4.0, IoT and more, as well as Workshops related to AI and manufacturing.
- **External AI Recourses:** Platforms used in context of the D2.2 as a research source for the AI scenarios and use cases. These offer a range of resources that may be of interest to the Market by STAR stakeholders.

At the time of deliverable submission, the status of the content corresponds to a total of 14 *Assets*, 10 *Success Stories*, 54 *Training Resources*, and 3 *External AI Resources*.

During the next months, in collaboration with the rest of WP7 tasks and with the contribution of tasks from other Work Packages, the content of the Market by STAR will be continuously updated.