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DELIVERABLE

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Executive Summary

STAR is carrying leading edge Artificial Intelligence research towards designing, developing and validated trustworthy AI systems for modern production lines. Even though the project is research focused, it also acknowledges that the successful deployment of trustworthy AI in industrial organizations requires investment on complementary, non-technical assets such as innovative processes and training of the workforce. This is the reason why one of the main objectives of the STAR project is to develop, curate and provide access to such complementary assets that will reinforce the value of the project's scientific and technological development. A significant part of WP7 of the project is devoted to the production of such support services, notably training and innovation management services. This deliverable describes the Training and innovation management services developed by the STAR Consortium. They include:

- A searchable catalogue of third-party training resources (e.g., courses, training programmes) that are provided to the community through a single-entry point in the STAR market platform¹. The goal of the catalogue is to ease discovery of training resources for manufacturers and other industrial stakeholders with an interest in trustworthy AI and Industry 5.0.
- A list of "tutorial in nature" courses that have been developed by the STAR consortium. They are destined to introduce industrial users (including the workforce) to mainstream digital manufacturing and AI topics. Each course comes with a mini-study guide and an assessment quiz.
- A series of webinars in leading edge trustworthy AI and Industry 5.0 topics, which have been organized by STAR in collaboration with other projects of the AI4Manufacturing cluster².
- A set of complementary knowledge resources in the form of papers, blogs, and the STAR book, which are provided to the STAR community in order to boost its learning goals.
- An innovation support service, which is provided to SMEs and startups in order to allow them to access funding opportunities e.g., Open Calls, Horizon Europe funding opportunities, relevant training resources, and advise for business plan development.
- A training platform that enables stakeholders to identify skills profiles and learning paths. The platform has been partly developed in STAR T5.3 and has been integrated with the STAR market platform as part of WP7.

As already outlined, the above-listed training resources and services are all accessible through the STAR market platform, which is constantly updated with content provided from tasks undertaken both under WP7 but also from other Work Packages. The deliverable presents the information and structure of the training courses up to the date of submission. We envisage the integration of additional training materials, knowledge resources and innovation support resources till the end of the project. These additional resources will be reported and documented in the final report of the project.

¹ <https://www.market.star-ai.eu/>

² <https://ai4manufacturing.com/>

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|----------------------------|---|
| Deliverable Leader: | INTRA-LU |
| Contributors: | INTRA, R2M, RUG |
| Reviewers: | PCL, IBER |
| Approved by: | Charalampos Ipektsidis, John Soldatos (INTRA) |

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Definitions, Acronyms and Abbreviations

| Acronym/ Abbreviation | Title |
|--------------------------|---|
| AI | Artificial Intelligence |
| AIoT | Artificial Intelligence of Things |
| AIOTI | Alliance for the IoT Innovation |
| BDVA | Big Data Value Association |
| CD | Continuous Deployment |
| CI | Continuous Integration |
| CPPS | Cyber Physical Production Systems |
| DevOps | Development and Operations |
| EFFRA | European Factories of the Future Research Association |
| HDT | Human Digital Twins |
| ICT | Information and Communications Technology |
| IIoT | Industrial Internet of Things |
| IoT | Internet of Things |
| ML | Machine Learning |
| QBC | Query By Committee |
| WP | Work Package |
| XAI | Explainable Artificial Intelligence |

1 Introduction

1.1 Scope and Purpose

The main objective of STAR is to research, develop, validate, and deliver solutions for trustworthy Artificial Intelligence (AI) in production lines and for industrial use cases, to empower the emerging human-centred Industry 5.0 paradigm. In this direction, the main technical work packages of the project have already developed and validated a wide range of solutions for trustworthy AI, which span the areas of cyber-security for AI systems, explainable AI systems, trusted human-AI interactions (including trusted Human Robot Collaboration (HRC)) and safety of digital manufacturing systems in production lines. The project's solutions are validated in real life use manufacturing cases in two European factories and in a smart factory testbed. STAR's solutions for trustworthy AI are not however constrained to the context of specific use cases. Rather, they comprise wider, generalized, and reusable infrastructures that can be used to increase the trustworthiness of trusted AI systems in a variety of manufacturing scenarios beyond the STAR validating use cases.

Nevertheless, the practical deployment and operations of the project's solutions is not only a matter of developing and deploying STAR's novel technical/technological assets. It is also a matter of investing in complementary assets that enable the operation of the technological solutions and maximizing their overall value. Such complementary assets include training of workers, novel industrial processes that consider the capabilities of the trusted AI solutions, as well as support in the design, development and integration of innovation AI-based solutions and services for modern production lines. Also, the scope of training extends beyond workers to other stakeholders that design, develop and deploy novel solutions. For instance, it is important for vendors and integrators of industrial solutions to be acquainted with the cutting edge technologies that enable the development of trusted AI solutions for Industry 5.0 use cases. The STAR DoA makes provisions about the development of training and innovation support services, as well as about their integration in the STAR marketplace³ i.e., the project's main promotional channel. Specifically, as part of WP7 of the project, STAR has been specifying and development training and innovation support services, which are seen as complementary assets to the project's research, scientific, and technical developments.

In this context, the purpose of the present deliverable is to present STAR's training and innovation management services, including the content and structure of these services. In terms of training, the project provides a training catalogue of courses developed from third-party providers with clear relevance to STAR developments, as well as a set of "home grown" STAR courses i.e., course developed in the STAR project by the consortium members. Moreover, a series of webinars and papers developed in the project (e.g., the webinars of the AI4Manufacturing cluster where STAR plays a leading role) were also developed and packaged as training courses. The catalogue, the courses, and proper links to the webinars are integrated in the STAR marketplace and publicly available through this channel. Furthermore, the marketplace is linked to the training platform that the project has developed to support workers' training in the manufacturing domain. In terms of innovation support, the project offers access to services that support innovators in their innovative solutions development, including a form-based service that supports innovators with pointers to access to funding and relevant knowledge resources, access to the project's training platform, and access to an

³ Also called STAR Market Platform

AI certification service. The training and innovation support services, through distinct, reinforce each other, as innovators can always access available training resources to improve their innovation capacity and knowledge.

1.2 Methodology

The deliverable has been developed based on the methodology described in Figure 1 and consisted of two main phases:

- Phase 1 – Training and Innovation Management Requirements Analysis (M6-M18):** The first phase (Phase 1) spanned the first year of the work/task that led to the present deliverable. It focused on analysing the main requirements for the STAR training and innovation management services considering the STAR enabling technologies (e.g., Explainable Artificial Intelligence, Active Learning, Human Centred Digital Twins), the technological developments and solutions of the STAR project (including the STAR exploitable assets), as well as the training needs of specific personas such as workers. As part of this phase, the project collected information on the above-listed aspects via desk research. Moreover, a set of initial training materials and knowledge resources were developed.
- Phase 2 – Services Development – Fine Tuning - Integration (M19-M33):** In the scope of these phase, the requirements and needs specified in the previous phase were considered in the development of training and innovation management resources. Moreover, the initial pool of resources developed in Phase 1 was enhanced and fine-tuned. During this phase, the training catalogue was developed, along with STAR “home grown” courses. Likewise, the innovation support services were specified and developed. Most importantly, all the relevant resources were integrated in the STAR marketplace platform.

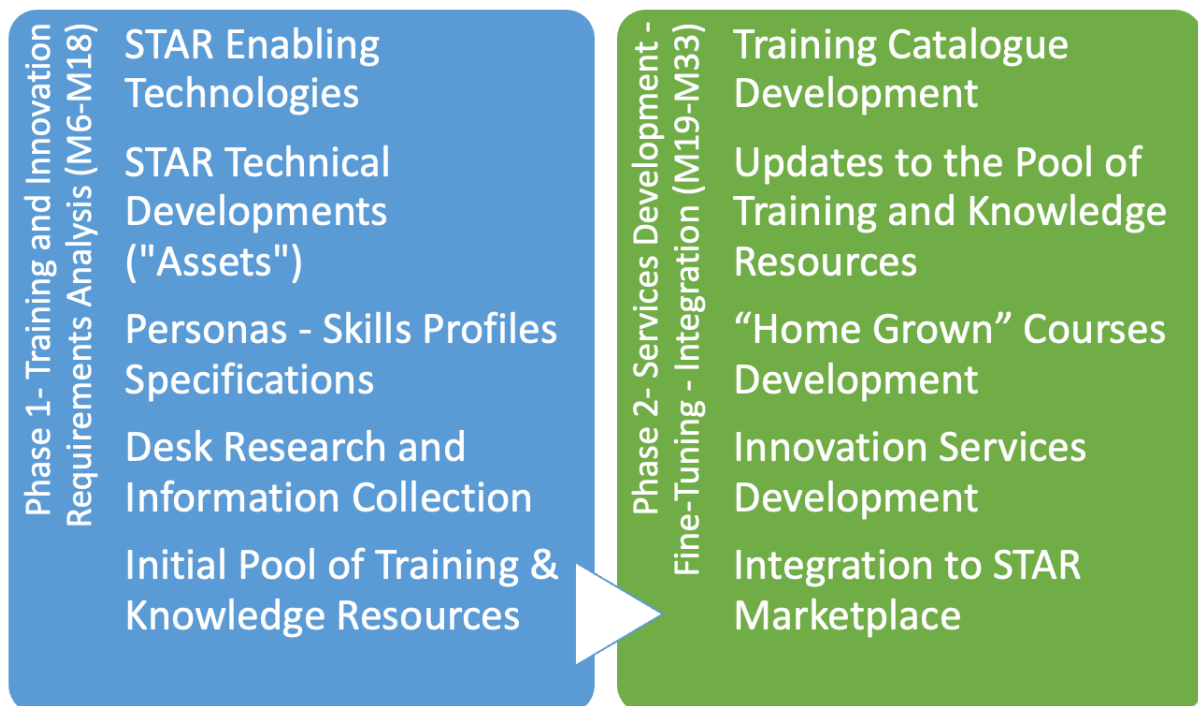


Figure 1: Two Phase Methodology for the Development of the deliverable

Note that some of the training and innovation support resources that are available through the STAR marketplace have been developed in other tasks/workpackages of the project and therefore detailed in other deliverables as well. This is for example the case of the webinars that were organized as part of the project's participation in the AI4Manufacturing cluster, which are already described in WP8 deliverables. Likewise, this is also the case with the workers' training platform that has been originally developed in WP5. The present deliverable leverages and reports these resources without however providing detailed information about them. Interested readers are pointed to the original deliverables where these resources are described.

Apart from its relevance to these deliverables, the present deliverable is also linked closely to deliverable D7.3 which is focused on the content of the STAR market platform. In essence the content and services that are presented in this deliverable constitute part of the content of the market platform, as the services are fully integrated in it.

1.3 Structure of the Document

The structure of the document is as follows:

- Section 2 provides an overview of the target personas that can benefit from the training resources of the project. Specifically, the section describes the three main personas that are envisaged as main users of the training and innovation support services of the project. For each persona, the section specifies a set of skills profiles and learning paths that can be supported based on the courses of the STAR training catalogue.
- Section 3 presents the STAR training catalogue, including the structure and an overview of its contents. The catalogue can be a useful tool for creating Industry5.0 and AI related learning paths for the skills profiles and personas listed in the previous section.
- Section 4 provides an overview of the training courses that have been developed by the STAR project partners i.e., our "home grown" courses.
- Section 5 focuses on other training resources that have been developed during the execution of the project.
- Section 6 presents the innovation support services and the training platform that has been prepared in the project. These services include an innovation form and an AI certification service.
- Section 7 concludes the deliverable, outlining the main outcomes of the work performed.

2 Target Personas, Skills Profiles and Learning Paths

2.1 Rationale

STAR provides a pool of training and innovation support services to complement its scientific and technological developments. Given the scope of the STAR project and the resources available for this task in WP7, the consortium has specified a set of training personas, which have been targeted as part of the process of developing training resources, training materials and innovation management services. Moreover, a set indicative skills profiles under each persona is presented i.e., profiles that the stakeholder role of a persona might have. Each skill profile can be mapped to a number of skills that the persona must possess in order to belong to the skills profile. Likewise, a learning path specifies a roadmap of training activities that can help the persona to acquire a given profile.

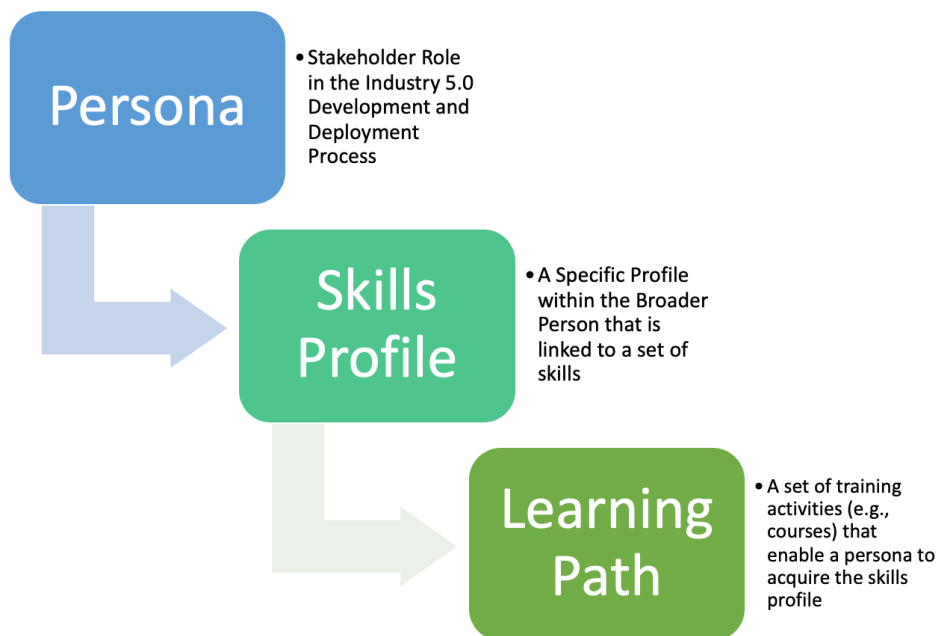


Figure 2: Relationship Between Personas – Skills Profiles – Learning Paths

Figure 2 illustrates the relationship between personas, skills profiles and learning paths. Specifically:

- A persona represents a stakeholder role in the lifecycle of AI-based Industry 5.0 systems.
- A skills profile represents a set of skills that the persona must possess to perform a specific role, task or activity in the process. It is practically linked to a set of qualifications.
- A learning path specifies a roadmap that enable a persona to acquire the qualification of the skills.

2.2 Persona 1: Manufacturing Workers - Industrial Users

The first persona considered by STAR is the manufacturing worker. The training goal for the manufacturing worker is to acquaint him/her with AI in manufacturing, including technical, usability and manufacturing aspects.

Table 1: Examples of Skills Profiles for Different Manufacturing Persona(s)

| Persona | | Example Skills Profile |
|---|-------------------|---|
| Quality Worker | Inspection | Basic Understanding of Artificial Intelligence Data Processing and Analysis Skills Quality Inspection based on AI and Computer Vision AI and Big Data Interfaces and Visualization Using Human Centred Digital Twins |
| Maintenance Worker | | Basic Understanding of Artificial Intelligence Data Processing and Analysis Skills AI-based Predictive Maintenance Intelligent Asset Management AI and Big Data Interfaces and Visualization Using Human Centred Digital Twins |
| Production Manager | | Understanding of Artificial Intelligence Human-Centered Manufacturing AI Use Cases in Manufacturing Production AI Ethics and Responsible AI |
| Business Manager in Manufacturing Enterprise | | Understanding of Artificial Intelligence Human-Centered Manufacturing and Industry 5.0 AI Ethics and Responsible AI Basic Knowledge of AI Regulation Socio-Economic Analysis of Manufacturing Use Cases |

2.3 Persona 2: Vendors – Integrator of Industrial Automation Solutions

This second persona concerns vendors and integrators of industrial automation solutions, notably integrators of digital manufacturing solutions that comply with Industry 4.0/5.0 principles. Table 2 presents examples of popular skills profiles.

Table 2: Examples of Skills Profiles for Different Vendors/Integrators Persona(s)

| Persona | | Example Skills Profile |
|--|--|--|
| Industrial Engineer for Industry 5.0 | | Operational Technology Cyber Physical Production Systems Industrial Internet of Things AI and Industry 5.0 Use Cases in Manufacturing Production (Human Centred) Digital Twins Trustworthy Machine Learning and Artificial Intelligence |
| Industry 5.0 Data Analytics and Machine Learning Engineer | | Understanding of Industry 5.0 Systems Big Data Management Industrial Internet of Things Big Data and Internet of Things Analytics Machine Learning and Artificial Intelligence |

| | |
|---|--|
| Industry 5.0 Solution Architect | Understanding of Industry 5.0 Systems Industrial Networking Infrastructures (4G/5G/6G) Industrial Systems Architectures and Standards Big Data and IoT Systems and Protocols Machine Learning and Artificial Intelligence |
| Industry 5.0 Application Developer | Understanding of Industry 5.0 Systems Cyber Physical Production Systems AI and Industry 5.0 Use Cases in Manufacturing Production Machine Learning and Artificial Intelligence Trustworthy Artificial Intelligence DevOps Processes and Tools (CI/CD) |

2.4 Persona 3: Researcher

As a RIA (Research and Innovation Action) project, STAR provides resources for researchers and academic to build research systems and carry out cutting edge research. Table 3 presents examples of popular profiles.

Table 3: Examples of Skills Profiles for Different Researchers’ Persona(s)

| Persona | Example Skills Profile |
|--|---|
| AI Researchers | Data Processing and Data Analytics Machine Learning and Artificial Intelligence Robotics and Human Robot Collaboration Trustworthy and Explainable Artificial Intelligence |
| IoT/IIoT Researcher | Cyber Physical Production Systems IoT Networks and Protocols Artificial Intelligence of Things (AIoT) |
| Industrial Engineering Researcher | Understanding of Industry 5.0 Systems Operational Technology Cyber Physical Production Systems Machine Learning and Artificial Intelligence Trustworthy and Explainable Artificial Intelligence |

3 Training Catalogue

The STAR Market Platform is the entry point where users can consult the information representing the results of the project all at one place. At the same time, it includes also the Training Resources that STAR has either linked to or developed.

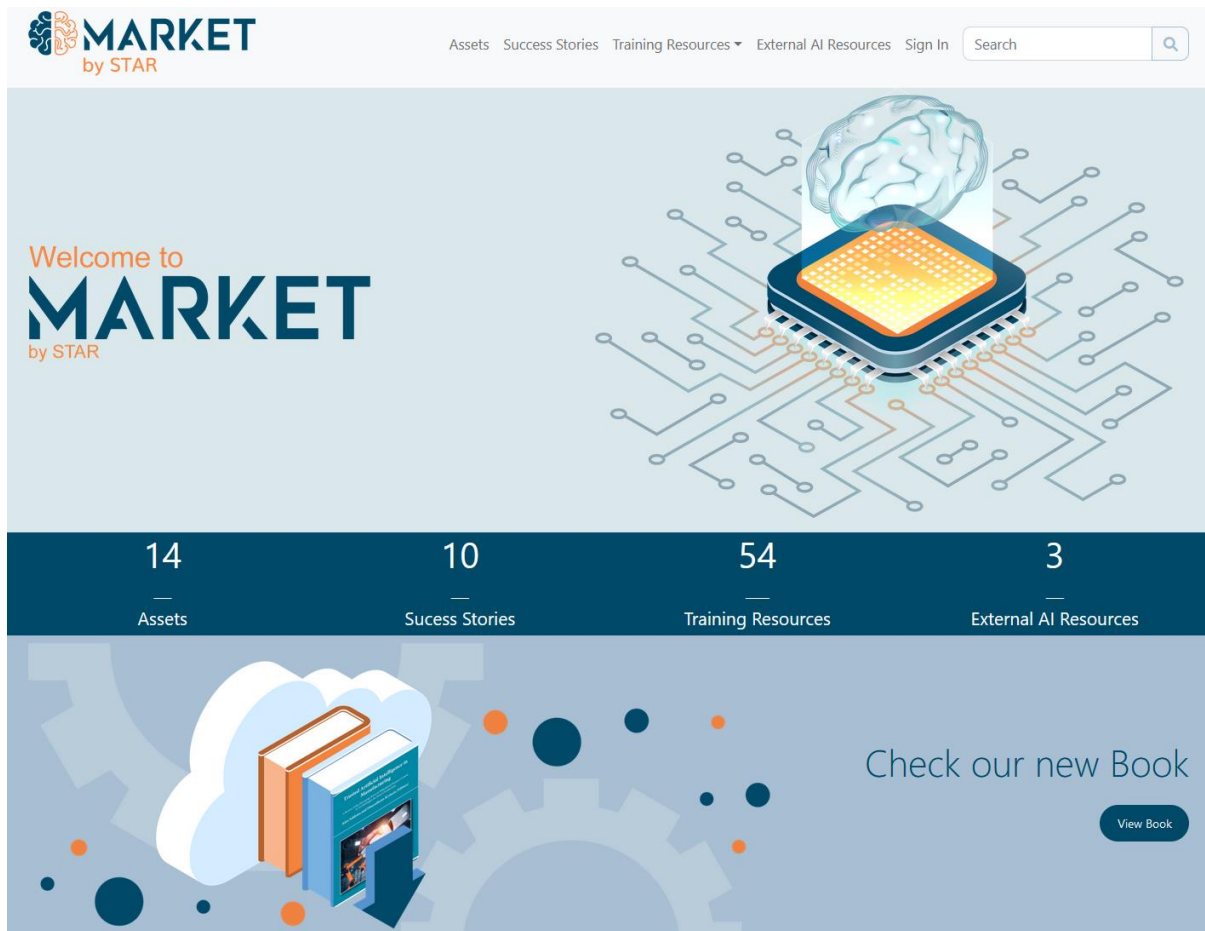
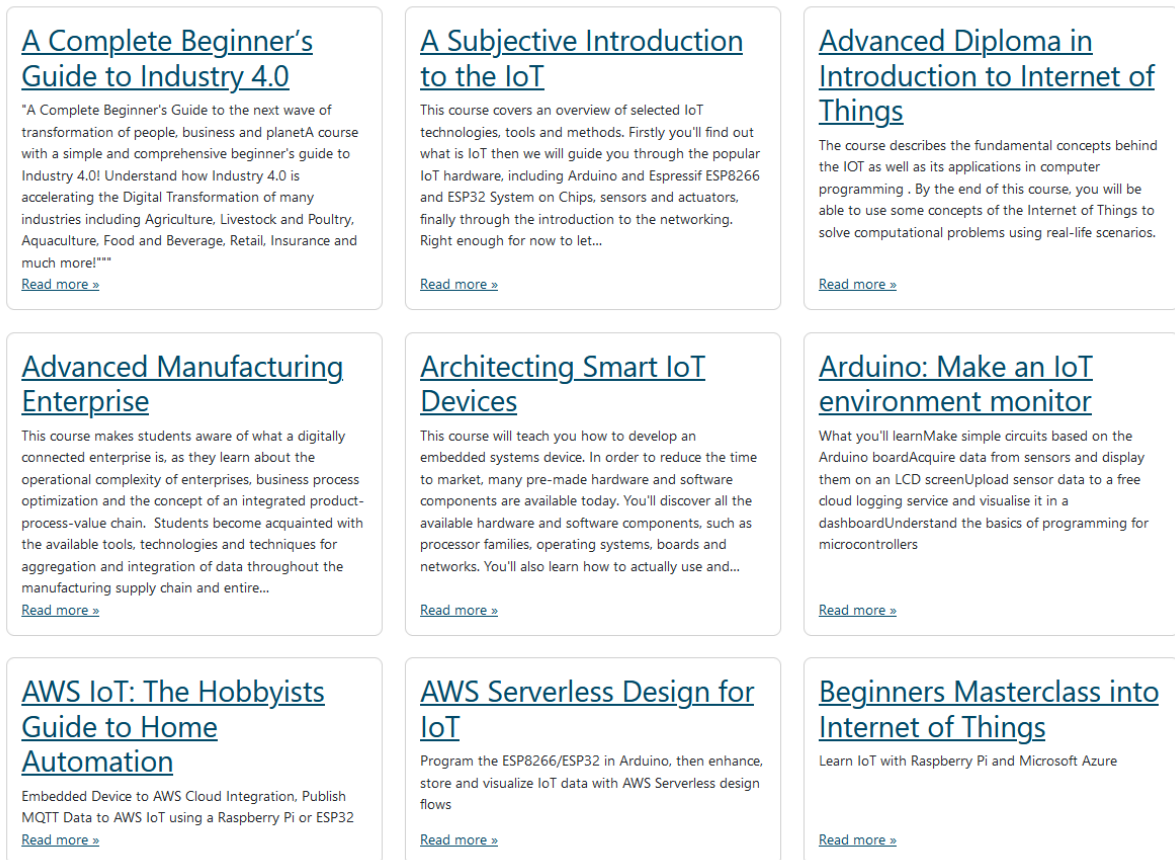


Figure 3: The STAR Marketplace – Market by STAR

3.1 Structure

In order to facilitate access a dedicated page for the courses offered by the STAR Marketplace exists. This page provides a grid view with an overview of all the courses identified by the STAR partners and included within the Market by STAR platform, as also presented in the figure below.

Course



| | | |
|---|--|---|
| <p><u>A Complete Beginner's Guide to Industry 4.0</u></p> <p>*A Complete Beginner's Guide to the next wave of transformation of people, business and planetA 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!*** Read more »</p> | <p><u>A Subjective Introduction to the IoT</u></p> <p>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... Read more »</p> | <p><u>Advanced Diploma in Introduction to Internet of Things</u></p> <p>The 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. Read more »</p> |
| <p><u>Advanced Manufacturing Enterprise</u></p> <p>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... Read more »</p> | <p><u>Architecting Smart IoT Devices</u></p> <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... Read more »</p> | <p><u>Arduino: Make an IoT environment monitor</u></p> <p>What you'll learnMake simple circuits based on the Arduino boardAcquire data from sensors and display them on an LCD screenUpload sensor data to a free cloud logging service and visualise it in a dashboardUnderstand the basics of programming for microcontrollers Read more »</p> |
| <p><u>AWS IoT: The Hobbyists Guide to Home Automation</u></p> <p>Embedded Device to AWS Cloud Integration, Publish MQTT Data to AWS IoT using a Raspberry Pi or ESP32 Read more »</p> | <p><u>AWS Serverless Design for IoT</u></p> <p>Program the ESP8266/ESP32 in Arduino, then enhance, store and visualize IoT data with AWS Serverless design flows Read more »</p> | <p><u>Beginners Masterclass into Internet of Things</u></p> <p>Learn IoT with Raspberry Pi and Microsoft Azure Read more »</p> |

Figure 4: Courses at the STAR Marketplace – Market by STAR

Each course is here listed, using the name of the course and an initial description. Furthermore, each individual course also has its dedicated page.

Each course individual page is divided into the following sections:

- Course Header – consists of a title, keywords, and website.
- Description – a description of the content of the course
- Details – a set of available characteristics of the specific course, such as the duration of the course, the cost for the user and the availability of a certificate of completion
- Team – list of people and/or entities that are responsible for providing the course

An example of such a dedicated course page is provided in the figure below

The screenshot shows the course page for 'Cyber Security in Manufacturing' on the STAR Market platform. The page includes a navigation bar with 'Assets', 'Success Stories', 'Training Resources', 'External AI Resources', and 'Sign Out'. A search bar is also present. The course title is prominently displayed, along with an 'Industry 4.0' tag and the URL 'www.coursera.org'. The 'Description' section states: '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. Main concepts of this course will be delivered through lectures, readings, discussions and various videos.' The 'Details' section shows a duration of '22 hours', a cost of 'FREE', and a 'Certificate of completion'. The 'Team' section lists three contributors: 'University at Buffalo' (Institution), 'The State University of New York' (Institution), and 'Shambhu Upadhyaya' (Speaker). The footer contains the STAR logo, contact information, privacy policy, and a European Union funding notice.

Figure 5: Course Dedicated Page

3.2 Contents Overview

A variety of courses have been identified and made available through the STAR Marketplace.

| Name | Description |
|---|--|
| A Complete Beginner’s Guide to Industry 4.0 | 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 |
| A Subjective Introduction to the IoT | This course covers an overview of selected IoT technologies, tools and methods. |
| Advanced Diploma in Introduction to Internet of Things | The course describes the fundamental concepts behind the IOT as well as its applications in computer programming |
| Advanced Manufacturing Enterprise | 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. |

| | |
|--|---|
| Architecting Smart IoT Devices | 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. |
| Arduino: Make an IoT environment monitor | 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 |
| AWS IoT: The Hobbyists Guide to Home Automation | Embedded Device to AWS Cloud Integration, Publish MQTT Data to AWS IoT using a Raspberry Pi or ESP32 |
| AWS Serverless Design for IoT | Program the ESP8266/ESP32 in Arduino, then enhance, store and visualize IoT data with AWS Serverless design flows |
| Beginners Masterclass into Internet of Things | Learn IoT with Raspberry Pi and Microsoft Azure |
| Big Data Analytics in IOT domain | Fusion of Industry 4.0 coupled with big data analytics opens up a new era of technology evolution |
| Build IOT Apps using Raspberry Pi, ASP.NET Core and SignalR | Developing Internet Of Things Applications using Raspberry Pi 3, ASP.NET Core and SignalR Core |
| Build your 1st Arduino IOT Project & Game: Arduino for Kids | 10 + Projects on Arduino Internet of things (IOT) & Arduino Hardware Gaming for Kids. Easy GUI drag drop programming. |
| Building a Thing for the Internet of Things IoT | A hands on, step-by-step guide to bringing your idea to life, from start to Kickstarter |
| Building Internet of Things Projects with Arduino IOT Cloud | Learn the Internet of Things. Build IoT Projects, Configure IoT Things, Dashboards, Webhooks and build IFTTT Integrations |
| Capstone: Autonomous Runway Detection for IoT | 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. |
| Complete guide for IoT Testing | Learn concepts about IoT and relevant testing theories |
| Complete Guide to Build IOT Things from Scratch to Market | Build IOT products using Arduino, NodeMCU, ESP8266, IOT Platforms, Sensors, Displays, Keypads, Relays, PCB's, Casing & more |
| Complete Python 3 and Raspberry Pi Masterclass | Learn Python 3 Basics, Advanced Python, Scientific Python, Raspberry Pi, and Hardware projects in a single course |
| Cyber Security in Manufacturing | 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. |
| Cybersecurity and Privacy in the IoT | As the Internet of Things (IoT) continues to grow so will the number of privacy and security concerns and issues. |
| Cybersecurity and the Internet of Things | 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 |
| Data Analytics in Internet of Things (IOT) | Basics of Internet of Things (IOT). Fundamentals of Data Analytics. Use of Data Analytics in IOT. |
| Data Science for Executives | The history of data science, tangible illustrations of how data science and analytics are used in decision making across multiple sectors today. |

| | |
|---|--|
| Data-Driven Decision Making (DDDM) Specialization | 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). |
| Digital Transformation and Industry 4.0 | Learn how to manage digital transformation in your organization to win in tomorrow's world. In this course we will start learning about Industry 4.0 which is actually the foundation of the digital transformation term. |
| Digital Transformation and Industry 4.0 Masterclass | 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. |
| Digital Transformation from Industry 4.0 to Industry 5.0 | Take a leap and digitally transform your organization from Industry 4.0 to Industry 5.0 |
| Digital Transformation in Industry 4.0: A Complete Guide | The course details about Digital Transformation in the Industry 4.0 environment. Very systematic approach is made to understand all elements of transformation efforts. |
| Digital Transformation of Mining | 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. |
| Embedded Systems – Shape The World: Multi-Threaded Interfacing | Learn how electronic gadgets are designed, developed, and built as embedded systems that shape the world. |
| Embedded Systems Essentials with Arm: Get Practical with Hardware | 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. |
| Emerging Technologies: From Smartphones to IoT to Big Data Specialization | This Specialization is intended for researchers and business experts seeking state-of-the-art knowledge in advanced science and technology. |
| Enabling Technologies for Data Science and Analytics: The Internet of Things | The Internet of Things is rapidly growing. In this data science course, you will learn about the major components of the Internet of Things and how data is acquired from sensors. |
| Exploring AWS IoT | What you'll learn: Program the ESP8266, ESP32, or Raspberry Pi 3 to send data to AWS IoT CoreConnect to AWS free Tier and use relevant AWS services. Understand MQTT, JSON, IoT, and the AWS cloud. |
| Fundamentals of IoT | An IoT Essentials course to build a strong foundation in Enterprise IoT from Primary building blocks to IoT Architecture |
| Fundamentals of IoT (Internet of Things) | Develop a strong confidence on topic, Internet of Things. Understand the Different Application and Technology of Internet of Things |
| Get started in Internet of Things | Internet of Things, Arduino Programming |
| Hands-on Internet of Things Specialization | Learn how to build an autonomous networked device, how to program and connect this device, how to use wireless networking protocols. |

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| Imagine IoT | 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. |
| Industrial IoT Markets and Security | 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. |
| Internet of things | A beginner's Guide to the world of IoT |
| Internet Of Things: SMTP: Email With IOT device (NodeMCU) | IOT based sensor acquisition & automatic email system is discussed in very detail |
| Internet of Things (A Practical Way)- Part1 | Internet of Things, Arduino, ESP8266, ESP32, Firebase Database and Android Apps for IoT |
| Internet of Things (IoT) – The Mega Course | Understand what Internet of Things is. Controlling home appliances from anywhere in the world |
| Internet of Things (IoT) and Sustainability | Understand how IoT can address sustainability challenge. 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? |
| Internet of Things (IoT) Automation using Raspberry Pi 2 | Learn how to use waterproof temperature sensors to remotely display temperature and alert you through Email. |
| Internet of things (IoT) for Beginners: Getting Started | Learn the Basics of Internet of Things (IoT). And how to connect sensors with Raspberry Pi and Arduino Board |
| Internet of Things (IoT) with Arduino Programming & ESP8266 | 18 Hands-on Sessions on IoT hardware and IoT |
| Internet of things and everything: A Workshop on ZIGBEE | 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 the a real life example of Smart Energy Meter. |
| Internet of Things Business Impact | How to make the most out of IoT and Digital Transformation |
| IoT Internet of Things Bundle | What you'll learn: Learn about the ESP32 and what makes it an excellent choice for Arduino Makers |
| Intelligent Machining | Learn how the integration of smart sensors and controls are helping to improve productivity. You'll be exposed to various sensors and sensing techniques, process control strategies, and open architecture systems that can be leveraged to enable intelligent machining. |
| Intelligent Machining | This course focuses on intelligent machining, i.e. machine tools that are self-aware – they perceive their own states and the state of the surrounding environment – and can make decisions related to machine activity processes. Through this course students will receive a primer on its background, tools, and related terminology. |

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| <p>Leadership 4.0 Masterclass - Leading in VUCA & Industry 4.0</p> | <p>This course aims at providing competencies and skills for Board, C-Suite and Senior Level Leaders operating in today's highly disruptive, VUCA (Volatile Uncertain Complex and Ambiguous World).</p> |
| <p>PLCNext Masterclass - Learn IIoT & Industry 4.0 from Scratch</p> | <p>Get hands on experience on Industrial IoT and Industry 4.0 with PLCNext, SCADA, IIoT Cloud Platforms and Communication The course will cover intermediate concepts of PLC programming, hardware and interfacing techniques, IIoT, OPC-UA and MQTT Protocols, Cloud Platforms and enable students to become IIoT Solutions Architect</p> |
| <p>Roadmap to Success in Digital Manufacturing & Design</p> | <p>This course aims at providing learners with knowledge about digital manufacturing and design (DM&D), which will help them leverage relevant opportunities.</p> |
| <p>Work 4.0 - Impact of Industry 4.0 on Workforce & Workplace</p> | <p>Discover about the Impact of Industry 4.0 on the Workforce and the Workplace - The Future of Work. A course with a simple and comprehensive beginner's guide to "Work 4.0 - The Impact of Industry 4.0 on the Workforce and Workplace"!</p> |

4 STAR Training Courses

4.1 Overview

In addition to aggregating third-party training resources within a catalogue, STAR has developed its own (“home grown”) training resources in the form of short tutorials for industrial workers and the manufacturing workforce. These tutorials are also suitable for introducing novel concepts and technologies to researchers and industrial solution providers that might not be familiar with the themes of the courses. As a first step, the tutorials described in following sections have been developed and are available through the STAR marketplace. However, STAR will continue to develop tutorials on other topics till the end of the project and as part of STAR’s post project exploitation phase that includes maintenance and sustainability of the project’s training and innovation support services through the market platform. Additional resources developed after the delivery of the present document will be described in STAR’s final report.

For each one of the STAR tutorials, the following points and consideration apply:

- **Topics/Themes:** Each tutorial targets a topic that is relevant to Industry 5.0 and trustworthy AI. Though not advanced in term of technical depth, the topics address topical areas beyond the more conventional courses that are part of the earlier presented training catalogue.
- **Format:** Each tutorial is provided in the form of video lectures and accompanying presentations (in PDF format).
- **Accompanying material:** Each tutorial comes with a course description and a rather simple assessment quiz.
- **Relevance to STAR:** The tutorials deal with topics of direct relevance to the STAR research developments. However, they are not trainings on the project developments, but rather address topics of broader interest for the AI, manufacturing and Industry 5.0 communities.

4.2 AI Ethics and Regulations Tutorial

4.2.1 Course Overview

This tutorial aims at introducing manufacturing professionals, AI researchers and providers of AI-based industrial solutions to the ethical considerations that surround AI development. It sheds lights on the ethical concerns and regulatory considerations of AI, while discussing solutions to some of the most pressing ethical challenges. The course introduces some key ethical concepts in the AI world, such as bias, explainability and the ethical principles used in mainstream AI frameworks.

4.2.2 Target Audience

This course is designed for individuals who are interested in gaining an understanding of ethics in artificial intelligence (AI), including the importance of transparency and explainability in AI decision-making. It is suitable for professionals working in the field of AI development for industrial applications, as well as for students and researchers interested in exploring the

ethical implications of AI. The course will also benefit individuals who wish to familiarize themselves with different ethical and regulatory frameworks for AI around the world.

4.2.3 Summary of Contents

The contents of the course include:

- An introduction to Ethics in Artificial Intelligence, which discusses the ethical implications of AI systems and AI-based decisions. It presents some of the main ethical considerations that arise during AI development and explores how different ethical frameworks could remedy the ethical concerns.
- A discussion of the important of regulation for AI systems, including the role of governments and why regulation of AI-based use case is needed. The tutorial also presents the main AI regulation initiatives worldwide, including Europe's AI Act.
- A presentation of main transparency and explainability in AI Decision-making, including the challenges of explainability. The link between explainability, trust and accountability is also presented, including the importance of this link for AI-based decision-making processes. Moreover, methods and techniques to achieve AI explainability are briefly introduced.
- Several future Directions and their ethical implications are discussed, including future directions associated with the evolution of various digital technologies and the ethical challenges that these technologies might pose.

4.2.4 Quiz

Q1: What are the key responsibilities of the government in AI governance and accountability?

- A. Conducting independent audits
- B. Advocacy and raising public awareness
- C. Developing regulations and policies**

Q2: What is a key accountability mechanism in AI regulation that directly relates to AI models and algorithms?

- A. Ethical AI development
- B. Independent Audits and Assessments
- C. Transparency and Explainability**

Q3: What is one of the challenges in AI regulation related to transparency and explainability?

- A. Ensuring data protection
- B. Addressing algorithmic bias
- C. Ensuring accountability
- D. Understanding the decision-making process of AI systems**

Q4: What is one of the ethical challenges in AI regulation related to privacy and data protection?

- A. Addressing bias and discrimination
- B. Ensuring responsibility and accountability
- C. Unauthorized access to sensitive information**
- D. Ensuring transparency and explainability

Q5: What is the name of the international initiative that brings together governments and experts to collaborate on AI-related policy issues?

- A. OECD Principles on Artificial Intelligence
- B. The European Union's Approach to AI Regulation
- C. The Global Partnership on Artificial Intelligence**
- D. The United Nations Guidelines for AI

Q6: Which jurisdiction has a decentralized approach to AI regulation and has various federal agencies providing guidance and regulations for AI practices?

- A. United States**
- B. China
- C. Australia
- D. United Kingdom

Q7: What are the six fundamental principles emphasized in the European Commission's guidelines on AI ethics?

- A. Human agency and oversight, technical robustness and safety, privacy and data governance, transparency, diversity, non-discrimination, and societal and environmental well-being**
- B. Inclusive growth, sustainable development, well-being, fairness, and transparency
- C. Fairness, transparency, explainability, privacy and data protection, accountability, sustainability, and promoting diversity and inclusiveness
- D. Well-being, respect for autonomy, fairness, and explicability

Q8: Which of the following statements about regulation and the Potential Harms of AI is correct?

- A. AI regulation is crucial to mitigate potential harms and ensure responsible development and use of AI.**
- B. AI technology should be left unregulated to promote innovation and progress.
- C. AI technology has no potential harms and does not require regulation.
- D. Regulation is unnecessary as AI technology is inherently safe and beneficial.

Q9: Which of the following statements is correct regarding the transparency of AI systems?

- A. AI regulation can help address this challenge by requiring developers to provide explanations and justifications for the decisions made by AI systems.**
- B. Transparency in AI systems is not necessary and can hinder their performance.
- C. AI systems should remain opaque to maintain their competitive advantage.
- D. Lack of transparency in AI systems is a necessary trade-off for improved performance.

Q10: What is bias in AI systems?

- A. Bias in AI systems refers to the inaccurate predictions made by AI algorithms.
- B. Bias in AI systems refers to the random errors that occur in AI algorithms.
- C. Bias in AI systems refers to the lack of diversity in AI development teams.
- D. Bias in AI systems refers to the systematic favoritism or prejudice towards certain individuals or groups.**

Q11: What of the following can mitigate bias in AI systems?

- A. Regular Bias Audits
- B. Ethical Guidelines and Regulations
- C. Diverse and Representative Training Data
- D. Diverse Development Teams
- E. All of the above**

4.3 Industry 5.0 Impact on Workforce Tutorial

4.3.1 Course Overview

This course introduces Industry 5.0 and sheds light on the potential impact of this industrial revolution on the workforce and the future of work. It aims at helping professionals understand key aspects of the future of work in a rapidly evolving industrial landscape. It is a tutorial on Industry 5.0, the skills it requires, and job opportunities that it will generate. At the same time, it provides basic knowledge on how to identify and fill-in the skills gaps that are likely to emerge during the transition to Industry 5.0.

4.3.2 Target Audience

This course is designed for individuals who are interested in exploring the concept of Industry 5.0 and its impact on the workforce. It is suitable for manufacturing professionals who want to stay updated with the changing dynamics of skills and workforce development in the Industry 5.0 era. As such it is very relevant to the manufacturing business management and to the human resources departments of manufacturing enterprises. Nevertheless, it can also serve the needs of other manufacturing departments that need to understand the evolution of technology and its impact on their own positions and employees.

4.3.3 Summary of Contents

The course presents the key concepts and technologies that underpin Industry 5.0, including the evolution from previous industrial eras to Industry 5.0 and the differences between Industry 4.0 and Industry 5.0. The presentation refers to the key technologies that enable Industry 5.0, including for example Internet of Things (IoT), Artificial Intelligence (AI), Robotics and Automation, Augmented Reality (AR) and Virtual Reality (VR).

The course also presents some of the profound impacts of Industry 5.0 on the workforce, including the creation of new job opportunities and the risks of job displacement. Moreover, the tutorial provides an overview of reskilling and upskilling as vital components of succeeding in Industry 5.0. In this context, methods for identifying and filling in skills gaps are also presented. Finally, the tutorial refers briefly to some of the ethical considerations and concerns of Industry 5.0, to help attendees understand the importance of responsible and ethical practices.

4.3.4 Quiz

The quiz of the course comprises the following questions:

Q1: What does Industry 5.0 involve?

- A. Increased automation and integration of digital technologies
- B. Decreased job opportunities
- C. Implementation of traditional manufacturing processes
- D. Advanced human-centred automation based on digital technologies**

Q2: Which of the following is not useful for identifying skill gaps?

- A. Analyze job descriptions and competency frameworks
- B. Training employees on advanced digital technologies**
- C. Conduct a skills assessment
- D. Solicit feedback from managers and employees
- E. Review future industry trends

Q3: Why is reskilling and upskilling important in Industry 5.0?

- A. To adapt to technological advancements
- B. To meet evolving job requirements
- C. To enhance employability
- D. All of the above**

Q4: How is AI impacting manufacturing decision making?

- A. AI is transforming industrial processes, leading to increased automation and efficiency.
- B. AI algorithms analyze vast amounts of data to provide valuable insights.**

- C. AI-powered systems can optimize workflows and increase productivity in various industries.

Q5: Which technology plays a critical role in Industry 5.0 for real-time data collection and exchange?

A. Internet of Things (IoT)

- B. Artificial Intelligence (AI)
- C. Robotics and Automation
- D. Augmented Reality (AR)

Q6: What is the role of a Data Analyst in Industry 5.0?

- A. Data analysts program and integrate AI technologies.
- B. Data analysts design intuitive user interfaces for digital products.
- C. Data analysts monitor network traffic and respond to security incidents.
- D. Data analysts collect, analyze, and interpret large sets of data to provide valuable insights and make informed business decisions.**

Q7: What skills are essential for a Robotics Engineer in Industry 5.0?

- A. Robotics engineers must be able to design intuitive user interfaces for digital products.
- B. Robotics engineers require a deep understanding of robotics technologies and the ability to solve complex engineering problems.**
- C. Robotics engineers must be able to work to identify and mitigate potential vulnerabilities in systems, networks, and applications.
- D. Robotics engineers must be capable of creating virtual environments and interactive experiences for various applications.

Q8: What role focuses on creating intuitive and user-friendly interfaces for digital products and services?

A. User Experience (UX) Designer

- B. Data Analyst
- C. AI Specialist
- D. Cybersecurity Analyst

Q9: Which is the first step in identifying skill gaps?

- A. Analyze job descriptions and competency frameworks
- B. Conduct a skills assessment**
- C. Solicit feedback from managers and employees
- D. Review future industry trends

4.4 Active Learning for Computer Vision Applications Tutorial

4.4.1 Course Overview

This course aims at helping manufacturing professionals and/or providers of industrial solutions to gain a basic understanding in active learning techniques with emphasis on their use in computer vision applications. It provides insights on the merits of active learning, when compared to conventional machine learning approaches. It also sheds lights on different ways for implementing active machine learning with an emphasis on computer vision applications.

4.4.2 Target Audience

This course is designed for individuals who are interested in expanding their knowledge and skills in active learning techniques specifically applied to computer vision. It is introductory and tutorials in nature. As such it is suitable for manufacturing professionals, researchers, practitioners, or students in the field of computer vision who want to understand and implement active learning methods in tasks like object classification, detection, and segmentation for industrial use cases like quality inspection.

The target audience for this course should be motivated and capable of engaging with technical content. Audiences with foundational knowledge of machine learning for computer vision applications are likely to be able to easily grasp the presented concepts. By the end of the course, individuals who attend the tutorial will have a basic understanding of the various active learning techniques, including their advantages and implementation challenges.

4.4.3 Summary of Contents

The contents of the course include:

- An introduction to Active Learning, which presents what this paradigm is about and what its significance for computer vision is. Various applications of active learning are also introduced, including image classification and object detection related applications.
- A tutorial on Uncertainty Sampling Techniques, which discusses the merits of uncertainty sampling techniques and how they can be used to improve machine learning performance. The course presents the different types of uncertainty sampling, such as entropy-based sampling, margin sampling, and error reduction sampling.
- Information about the popular “Query-by-Committee” approaches to active learning, as well as their relevance to ensemble methods for active learning.
- A discussion of stream-based Active Learning techniques i.e., how active learning can work with data streams. This part of the tutorial presents how active learning strategies can be used in dynamic environments where data may arrive in a streaming fashion.
- A presentation of the relevance of Active Learning to Object Classification, including for example information about instance and image level annotation techniques. These techniques are relevant to the active learning systems that have been developed in STAR.
- A discussion of Active Learning Techniques for object detection and segmentation, which are destined to complete the provided information about the use of active

learning in computer vision applications. The relevant discussion addresses effective annotation strategies for object segmentation, including strategies with the human in the loop that are relevant to STAR's developments.

4.4.4 Quiz

The quiz of the course comprises the following questions:

Q1: What is active learning?

- A. A technique in machine learning that enables model training with minimal labeled data.**
- B. A technique in machine learning that enables model training with maximal labeled data.
- C. A technique in machine learning that requires no labeled data.
- D. A technique in machine learning that only uses labeled data.

Q2: What are the benefits and challenges of active learning?

- A. Benefits include training with maximal labeled data, challenges include selecting random samples.
- B. Benefits include training with minimal labeled data, challenges include selecting random samples.
- C. Benefits include training with minimal labeled data, challenges include selecting the most informative samples.**
- D. Benefits include training with maximal labeled data, challenges include selecting the most informative samples.

Q3: What annotation technique is commonly used for object segmentation and requires annotators to draw polygons around objects of interest?

- A. Scribble Annotation
- B. Bounding Box Annotation
- C. Point Annotation
- D. Polygon Annotation**

Q4: Which active learning strategy focuses on selecting diverse samples that cover a wide range of object variations?

- A. Uncertainty Sampling
- B. Diversity Sampling**
- C. Query-By-Committee
- D. Point Annotation

Q5: What is expected model change in Query-by-Committee approaches?

- A. Expected model change is a measure of the expected impact on the model's performance by labeling a particular instance.**

- B. Expected model change is a measure of the expected impact on the model's performance by selecting informative instances for labeling.
- C. Expected model change is a measure of the expected impact on the model's performance by training multiple models on different subsets of labeled data.
- D. Expected model change is a measure of the expected impact on the model's performance by calculating the entropy of the predictions made by the committee members.

Q6: How is expected model change computed in Query-by-Committee approaches?

- A. There are different methods for computing the expected model change in QBC such as entropy-based measure, KL divergence measure, variance-based measure, and expected gradient length measure.**
- B. Expected model change is computed based on the difference between the prediction distribution of the committee members and the prediction distribution after labeling an instance.
- C. Expected model change is computed by calculating the variance of the predicted labels by the committee members for an instance.
- D. Expected model change is computed by estimating the impact of an instance on the gradients of the model parameters.

Q7: What is batch-mode active learning?

- A. A technique used in transfer learning to improve model performance.
- B. A method for unsupervised learning.
- C. A strategy to select data for model training in traditional batch learning.
- D. A technique used in stream-based active learning where a set of labeled instances is selected from an unlabeled stream of data for annotation by an oracle.**

Q8: What are the steps involved in batch-mode active learning?

- A. Data Stream Ingestion, Model Training, Batch Selection, Instance Annotation, Model Evaluation
- B. Data Stream Ingestion, Feature Extraction, Model Initialization, Batch Selection, Instance Annotation, Model Update, Iteration**
- C. Data Preprocessing, Model Training, Batch Selection, Instance Annotation, Model Evaluation
- D. Data Preprocessing, Feature Extraction, Model Initialization, Batch Selection, Instance Annotation, Model Update, Iteration

Q9: What is one of the applications of active learning in computer vision?

- A. Generating synthetic images
- B. Drawing bounding boxes around objects**
- C. Passive sampling
- D. Randomly selecting training data

Q10: What is margin sampling?

- A. Margin sampling is a technique used in machine learning to select informative and representative data points for model training.**
- B. Margin sampling is a technique used in machine learning to calculate the separation margin between different classes.
- C. Margin sampling is a technique used in machine learning to measure the uncertainty of a model's predictions.
- D. Margin sampling is a technique used in machine learning to rank instances based on their margin values.

Q11: What are the benefits of margin sampling?

- A. Margin sampling offers efficient utilization of labeling resources, improved model performance, and flexibility in selection criteria.**
- B. Margin sampling helps to calculate the entropy of the predicted class probabilities.
- C. Margin sampling focuses on the specific instances causing the highest errors in the model's predictions.
- D. Margin sampling is a technique used to select informative samples and optimize the model's performance.

4.5 Human Centricity Training Manual: Assessment Factors for Human-Centric Artificial Intelligence.

4.5.1 Course Overview

This course aims at helping Manufacturing Organisations and their employees assess the human centricity of their systems. The training manual adopts a comprehensive and cohesive approach, ensuring a thorough understanding of human-centric AI systems' principles, implications, and practical application. Through this training, the goal is to empower participants to assess the human-centricity of AI systems in their workplace and make informed decisions that prioritize the well-being and autonomy of employees.

4.5.2 Target Audience

This course is for professionals in the manufacturing industries who interact with AI-enabled systems or are involved in developing and managing AI-enabled technologies for such industries. These can be:

- System Developers
- Front-line workers
- Operations Managers
- Team Leaders
- Organisations themselves

Upon completion of this course, as a part of a team, you should be able to contribute towards:

- Develop a solid understanding of the principles of human-centric AI and their significance in the development and deployment of AI systems in manufacturing.
- Identify potential ethical risks and pitfalls associated with AI-enabled systems, such as bias, discrimination, and privacy concerns.
- Apply effective methods to assess the human-centricity of AI systems in their organisation, including evaluating accountability, transparency, fairness, safety, privacy, and well-being.
- Implement best practices for creating and maintaining ethical AI systems that align with human interests, values, and regulatory requirements.

4.5.3 Summary of Contents

This training manual consists of ten modules encompassing the essential aspects of human-centricity in AI systems, derived from analysing various guidelines and research articles. These modules are:

- Accountability
- Transparency, Explainability, and Interpretability
- Fairness, Inclusivity, and Non-discrimination
- Safety and Security
- Privacy and Data Agency
- Well-being
- Human Agency and Oversight
- Task and Skill Variety
- Ergonomics and Physical Demand
- Other Considerations for Human-centricity (Problem Solving, Information Processing, Interdependence, Feedback from job/Others, and Ease of Use)

5 Other Training Resources

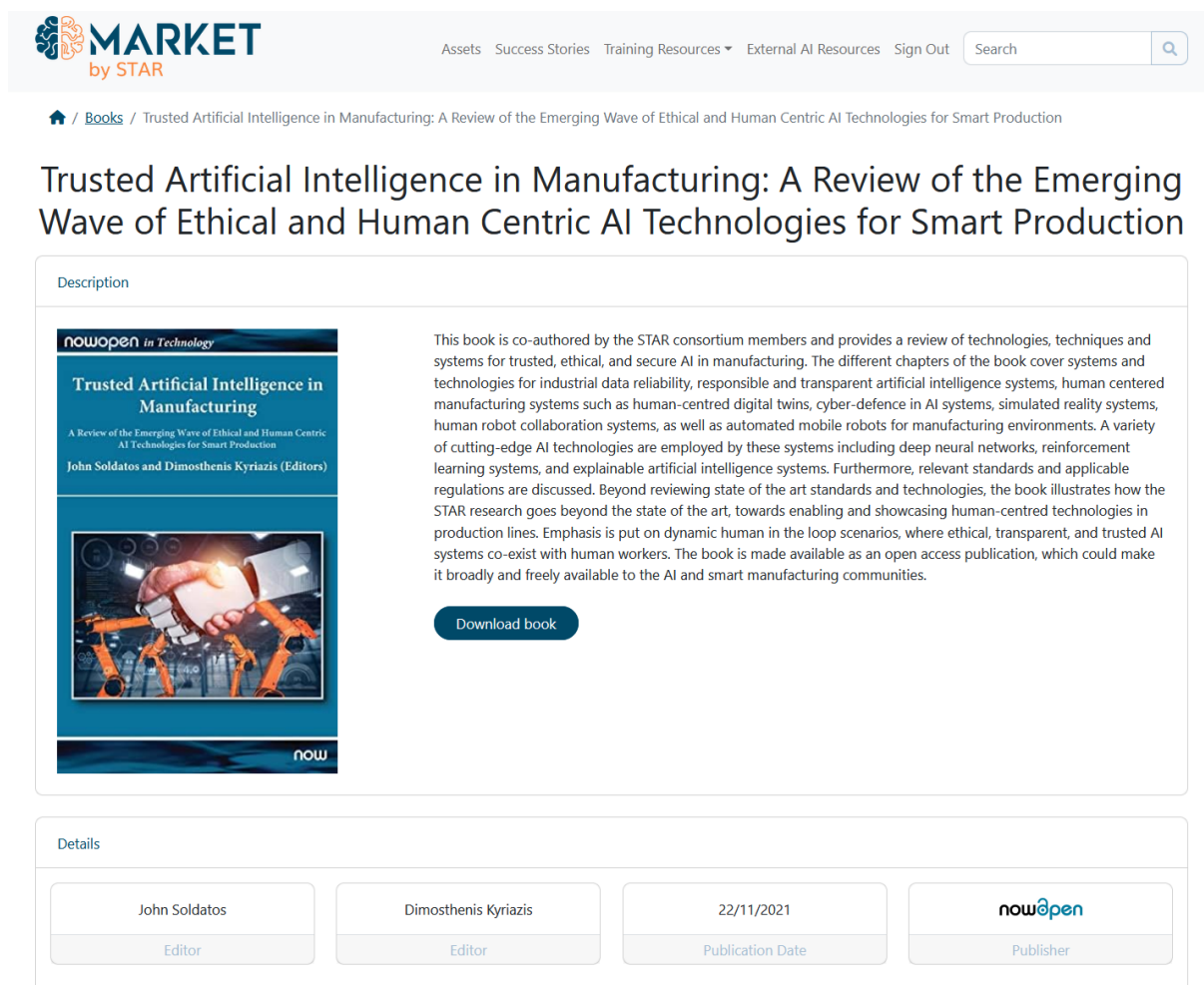
Further to the training courses already presented also other training resources have been prepared by the STAR partners. These are shortly described in the sections below.

5.1 Book

STAR has published the Open Access Book “Trusted Artificial Intelligence in Manufacturing: A Review of the Emerging Wave of Ethical and Human Centric AI Technologies for Smart Production” (<http://dx.doi.org/10.1561/9781680838770>) which has reached 43.433 downloads (Stand: 12 September 2023)

This book is co-authored by the STAR consortium members and provides a review of technologies, techniques and systems for trusted, ethical, and secure AI in manufacturing.

The different chapters of the book cover systems and technologies for industrial data reliability, responsible and transparent artificial intelligence systems, human centered manufacturing systems such as human-centred digital twins, cyber-defence in AI systems, simulated reality systems, human robot collaboration systems, as well as automated mobile robots for manufacturing environments.



The screenshot shows the 'MARKET by STAR' website interface. At the top, there is a navigation bar with links for 'Assets', 'Success Stories', 'Training Resources', 'External AI Resources', and 'Sign Out', along with a search bar. Below the navigation, the breadcrumb path reads: 'Home / Books / Trusted Artificial Intelligence in Manufacturing: A Review of the Emerging Wave of Ethical and Human Centric AI Technologies for Smart Production'. The main content area features the book's title and a detailed description. The book cover image shows a hand holding a glowing cube over a robotic arm. A 'Download book' button is visible below the description. At the bottom, a 'Details' section lists the editors (John Soldatos and Dimosthenis Kyriazis), the publication date (22/11/2021), and the publisher (nowopen).

Figure 6: Information about the book at the STAR Marketplace – Market by STAR

5.2 Booklet

STAR is preparing a booklet that will entail all blog posts that will be published until the end of the project by the STAR consortium. At the time of authoring this deliverable 42 blog posts have been published and are part of the booklet. The final version of the booklet will be included both in the project website and also at the STAR Marketplace.

5.3 Workshops

During the last years STAR has co-organised a variety of webinars together with other ICT-38 projects. All these webinars have also been gathered and included in the STAR Marketplace. They can be found under Training Resources – Workshop.

Each workshop has a dedicated page that provides information related to the respective workshop. As depicted in the example provided, the page provides the following sections:

- Workshop header – Information on the title of the workshop, some keywords, the link to the website and the recordings of the workshop when available.
- Description – a description of the available workshop
- Details – Information related to when the workshop took place and its duration
- Agenda – The agenda of the workshop, so that users can understand the topics discussed and who provided each part of the workshop
- Team – Information on the people and/or entities that took part in the workshop
- Resources – Available resources related to the workshop, such as the individual presentations used during the workshop.

[Assets](#) [Success Stories](#) [Training Resources](#) [External AI Resources](#) [Sign Out](#)

Home / Ethical and Legal Issues of Artificial Intelligence in Manufacturing

Ethical and Legal Issues of Artificial Intelligence in Manufacturing

AI Ethical Issues

ai4manufacturing.com

Description

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". 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.

Details

| | |
|------------|----------|
| 11/25/2021 | 2h |
| Date | Duration |

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 – 00:50 "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 – 2:00 Discussion – Questions – Answers

Team

| | | | |
|---|---|---|---|
| Marc Anderson Speaker | Karen Fort Speaker | Dr. Raphael Thomas Prabucki Speaker | Arthur van der Wees Speaker |
| Jan-Hendrik Passoth Speaker | Benedict Lang Speaker | Celine Castets-Renard Speaker | Dr Andrew A. Adams Speaker |

Resources

| | |
|---|----------------------------|
| 1. Adams-EU-Japan.AI | 2. Anderson-AI-MAN |
| 4. Arthurs.LegalStrategies&Systems-STAR | 5. Benedict-Lang-ASSISTANT |
| 6. Castets-Renard_COALA | Agenda |

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Figure 7: Workshop Courses at the STAR Marketplace – Market by STAR

Dissemination level: Public

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6 Innovation Support Services

6.1 Innovation Support Form

This is a Form-based service that is offered to innovators on AI in Manufacturing (notably SMEs and high-tech startups). The service is based on a form-based input and operates as follows:

- Innovators provide (pitch deck like) information about their innovative product/or service based on an appropriate input form that is available in the STAR market platform.
- The inputted information is analyzed by STAR experts and relevant information, pointers and resources are collected.
- The collected information is curated and provided back to innovators in support of their activities. The following types of support information are provided:
 - Access to finance opportunities, including relevant opportunities in the EU grants ecosystem (also Open Calls).
 - Business plan development considerations, including ideas about target market segments and candidate business models.
 - Links to supporting resources within and outside the STAR market platform, including relevant innovative solutions, links to knowledge resources, and links to relevant training/mentoring courses.

6.2 Training Platform

Multimodal Worker Training Platform is a web service that combines Natural Language Processing and Workers Training Platforms to offer a solution that allows operators to learn more about their occupation, detect knowledge gaps and get training recommendations. All offered through chatbots and multimodal interfaces.

The platform is based on the idea of keeping employees informed about technical solutions and training assets, but above all to allow them to discover gaps in their training and skills, so that they can plan actions.

Always with a Human-centric idea in mind, a web platform has been developed and published that by means of AI and ML techniques (e.g. transformers), together with NLP tools (such as speech processing and generation) and with reference occupational databases (O*NET), offers the user different functionalities:

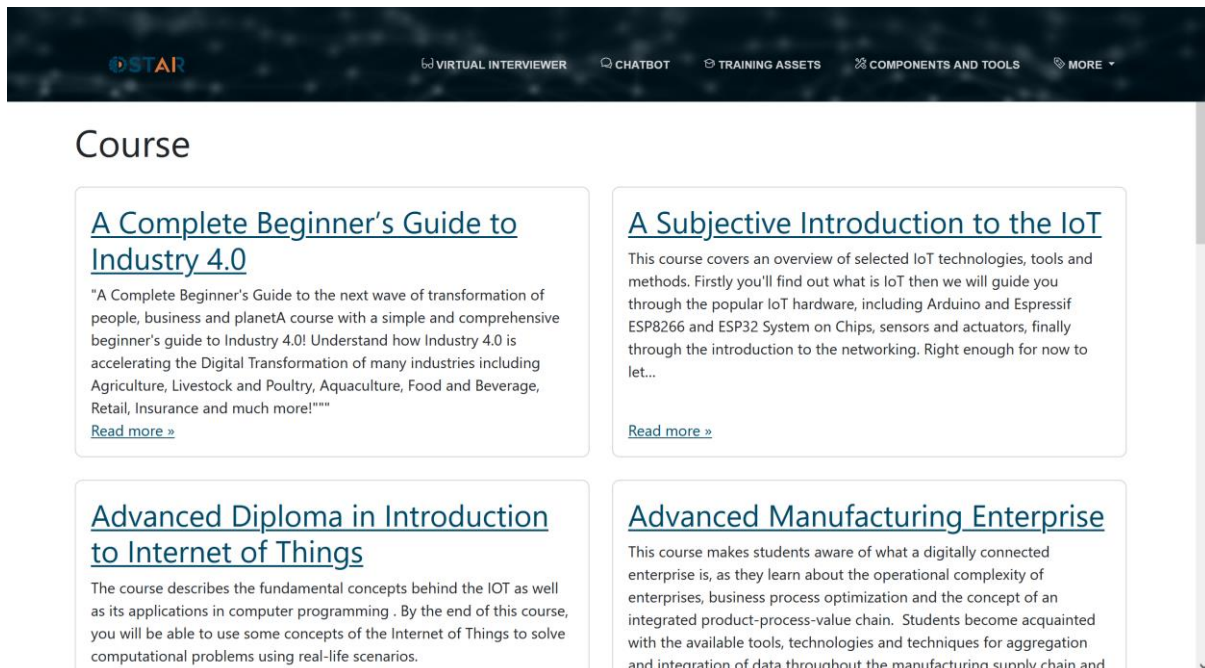
- Multimodal conversational chatbot to collect occupational information.
- CV processing and analysis
- Gap detection for different capabilities (skills, knowledge, tools, tech skills, etc.)
- Chatbot to provide occupational information, such as similarities between jobs or the most common tasks and activities performed in specific positions.
- Information on how an operator's skills evolve, and how their eligibility for a position evolves, based on their current skills and the training they will receive.

- Recommendations for courses and training based on well-known MOOCs and STAR Project materials.

Specifically, as far as training and innovation management services are concerned, the following are the main functionalities. (Note: For more details on the Multimodal Worker Training Platform, please refer to deliverable "D5.10 Workers Training Platform").

6.2.1 Integrated training assets, aligned with Project Marketplace

The idea of this section of the Worker Training Platform was to include a series of relevant materials related to the project. It was intended to be a mix of materials generated in the project along with materials carefully chosen by members of the project. One of the self-imposed requirements was to be in line with the main assets of the project, described in the main project marketplace, and to avoid duplication. To this end, the information available in the project's marketplace has been integrated in a way that does not lead to confusion for the user. The image below shows a screenshot of the the assets training in the Worker Training Platform, following the same content and format of the assets in the marketplace.



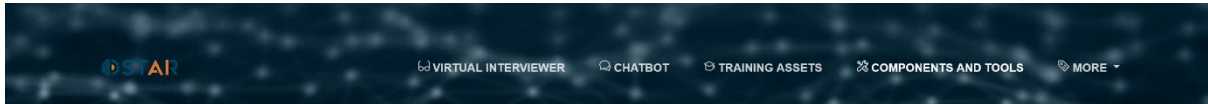
6.2.2 STAR curated courses recommended by the chatbot

In relation to the aforementioned training materials, Netcompany-Intrasoft provided a list of selected materials, always related to topics connected to the project. This information was used to train the AI behind the conversational bot included in the Workers Training Platform. As shown in the image below, some questions to the chatbot result in the recommendation of courses from different online platforms.



6.2.3 MOOC course recommendation

Training materials are a changing resource, and the skill gap assessment evaluates thousands of capabilities. This made it impossible to have a manually selected list for all of them. For this reason, and to always offer the user the most recommended courses on the online platforms, a bridge component has been developed that accesses the MOOCs course ranking for a particular topic or capability and shows the top-4 on the platform for the employees. The image below shows the results for the skill "JavaScript".



Course Recommendations

Find below some training resources found in online Massive Open Online Course platforms.



[The Complete JavaScript Course 2023: From Zero to Expert!](#)

Instructor: Jonas Schmedtmann

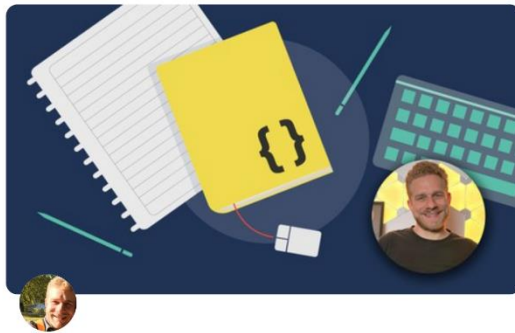
The modern JavaScript course for everyone! Master JavaScript with projects, challenges and theory. Many courses in one!



[The Complete 2023 Web Development Bootcamp](#)

Instructor: Dr. Angela Yu

Become a Full-Stack Web Developer with just ONE course. HTML, CSS, Javascript, Node, React, MongoDB, Web3 and DApps



[JavaScript - The Complete Guide 2023 \(Beginner + Advanced\)](#)

Instructor: Academind by Maximilian Schwarzmüller

Modern JavaScript from the beginning - all the way up to JS expert level! THE must-have JavaScript resource in 2023.



[JavaScript: The Advanced Concepts \(2023 Update\)](#)

Instructor: Andrei Neagoie

Learn modern advanced JavaScript practices and be in the top 10% of JavaScript developers

6.2.4 Eligibility criteria and gap detection

Another point that helps in training management is the already mentioned gap assessment, which is included with the CV analysis. As shown in the image below, the results are displayed with an eligibility value that indicates how far this CV is from an ideal candidate who would have all the skills included in O*NET for a given occupation. This eligibility value is accompanied by a progress bar with another changing value depending on the user's selection. This selection may be due to the fact that the user already has the knowledge, but forgot to detail it in the CV. This can be used to improve the CV. The selection is also useful to know how a particular capability impacts on the eligibility value. For example, in the image it can be seen how through general training in programming and some particular tech skills, the eligibility for computer-related occupations increases considerably.

Analysis results:**20.26% - Not yet eligible...****Your results after the selected improvements:****60.85% - Eligible!**

Missing knowledge or skills by which you can raise your score

Tech Skills:**24.54% - Not yet eligible...**

- ▶ Adobe Systems Adobe Illustrator
- ▶ Advanced business application programming ABAP
- ▶ AJAX
- ▶ Amazon DynamoDB
- ▶ Amazon Elastic Compute Cloud EC2

[more...](#)**Skills:****72.29% - Eligible!**

- ▶ Programming
- ▶ Active Listening

7 Conclusions

STAR is a research-intensive project (RIA) that has already produced innovative results in the area of trustworthy Artificial Intelligence (AI) for production lines. STAR's prototypes foster the development and deployment of trusted AI solutions based on a mix of cyber-security solutions for AI systems, human-AI collaboration systems, human-centred AI systems, as well as systems that boost the safety of Cyber Physical Production Systems in scenarios where they work closely with humans. STAR acknowledges that the successful deployment and use of these solutions also hinges on complementary assets like innovative processes and training of the workforce. To this end, the project has established a set of training and innovation support services in a dedicated section of the STAR marketplace.

In this deliverable, we have provided an overview of the training and innovation support services of STAR, which are destined to cover different profiles (personas) and themes related to Industry 5.0 and trusted AI. The deliverable has outlined the courses that are available as part of the STAR training catalogue, as well as a series of tutorial courses developed by the STAR team. Furthermore, the training platform of the STAR project that is destined to facilitate workers' reskilling and upskilling is presented, along with a form-based service that provides support to innovators in Industry 5.0 and trusted AI. These training and innovation support resources are available through the STAR market platform, which offers a single point of access to all training resources of STAR.

The presented training and innovation support resources are destined to complement the technical developments of the project. In this context, they are also considered as a complementary exploitable outcome as part of the STAR market platform. The project partners will aim at sustaining and expanding these resources through additional training materials and tutorials. The goal will be to support the post project exploitation activities of the project, while at the same time offering useful content to the community and help building a strong ecosystem around STAR and other relevant projects (e.g., projects of the AI4Manufacturing cluster with which STAR collaborates closely).

8 References

| Reference | Name of document |
|-----------|---|
| [REF-01] | STAR D5.10 "Workers' Training Platform-Final version" |