AI4VET4AI

AI-powered next generation of VET

Co-funded by
the European Union

Project 101104579

D4.3: Methodology on AI use-case presentations for VET teaching purposes

Partner:	Solvership (PI)
Work Package:	Work package 4: Curriculum/syllabus development for AI skills in VET
Task:	T4.3: AI use cases selection and discussion on methodology of their presentation in VET environment
Due date:	14/07/2025
Work package Leader:	Solvership (PI)

Start date of project: 15 June 2023 **Duration:** 48 months

DOCUMENT HISTORY		
Version	**Date**	**Changes**
1.1	11/07/2025	**First version of the document.**
2.1	14/07/2025	**Final version of the document.**

DISSEMINATION LEVEL		
PU	Public, fully open	X
SEN	Sensitive (limited under the GA conditions)	
CLASS	EU classified, confidential	

Co-funded by the European Union

MAIN AUTHORS	
Name	**Organisation**
Tomislav Hlupić	Solvership (PI)

QUALITY REVIEWERS	
Name (Quality Reviewer 1, Quality Reviewer 2)	**Organization**
Maja Brkljačić, Elena Pavić	Algebra University (AU)

Co-funded by the European Union

TABLE OF CONTENTS

Co-funded by the European Union

Executive summary

This deliverable introduces a structured and adaptable methodology for developing and presenting AI use-case scenarios tailored for vocational education and training (VET). The methodology is one of the central outputs of Work Package 4 (WP4) of the AI4VET4AI project and aims to equip VET educators with the tools, strategies, and frameworks needed to bring artificial intelligence into classrooms in a way that is engaging, pedagogically sound, ethically grounded, and aligned with real-world industry needs.

The methodology focuses on creating practical use-case presentations-scenario-based teaching tools that simulate authentic AI applications in various sectors. These use-cases are designed to support the development of learners' problem-solving, digital, ethical, and critical thinking skills by situating them in realistic, industry-relevant situations where AI plays a transformative role.

To develop this methodology, the consortium organized a participatory design workshop in Belgrade, where educators, researchers, and domain experts engaged in a Six Thinking Hats activity. This creative and structured thinking technique enabled the group to examine AI use across multiple perspectives: factual/logical (White Hat), emotional (Red Hat), critical (Black Hat), optimistic (Yellow Hat), creative (Green Hat), and process-focused (Blue Hat). Through this approach, the partners collaboratively explored AI opportunities, risks, ethical dilemmas, and teaching strategies across different vocational sectors.

During the workshop, participants formed thematic groups aligned with key industry sectors such as healthcare, education, tourism, retail, and logistics. Each group developed a draft AI use-case scenario using a predefined structure and supporting materials. These initial outputs were then further refined through consortium discussions, template-based standardization, and alignment with curricular goals.

The resulting methodology presented in these deliverable builds on the workshop experience and subsequent work, and offers:

- A step-by-step process for creating AI use-case scenarios
- A template for structuring scenario content
- Guidelines for aligning use-cases with VET curricula
- Suggestions for promoting ethical reflection and inclusive teaching
- Practical recommendations for classroom implementation, including group work, role-playing, and formative assessment approaches

Each use-case developed through this methodology incorporates the following elements:

- Contextual background and industry relevance
- Description of the AI application involved
- Stakeholders and roles (e.g. technician, customer, regulator)
- Technical, social, and ethical challenges
- Discussion prompts and reflective questions
- Learning outcomes linked to DigComp, LifeComp, and/or EntreComp
- Optional extensions, including simulations, project work, or policy debate

The methodology is designed to be flexible and adaptable. It can be used to create new use-cases by teachers or learners themselves and can be embedded in both IVET and CVET curricula across a wide range of sectors. The

Co-funded by
the European Union

structure encourages co-creation, active learning, and cross-disciplinary collaboration-features essential for building relevant AI literacy in VET.

By enabling educators to build and deliver use-case scenarios, this deliverable supports one of the project's broader goals: ensuring that AI education in VET goes beyond coding or tool use and instead empowers learners to understand, evaluate, and shape AI systems responsibly. It helps bridge the gap between theoretical AI knowledge and practical, ethical application in the workplace.

The annex to this deliverable contains selected use-case examples developed by AI4VET4AI partners, offering inspiration and reference models for wider adoption across European VET ecosystems.

Co-funded by
the European Union

1. Introduction

Artificial Intelligence (AI) is no longer a futuristic concept but a present-day reality, rapidly transforming how businesses operate, how decisions are made, and how services are delivered. As AI adoption accelerates across industries, the need for workers with both technical AI fluency and ethical awareness is growing. For vocational education and training (VET) systems, this shift presents both a challenge and an opportunity: how to prepare learners not only to work with AI tools, but also to think critically about their use, design, and societal impact.

Within the AI4VET4AI project, the goal of Work Package 4 (WP4) has been to address this challenge by creating curricula, teacher training materials, and learning methodologies that support the integration of AI into IVET (Initial VET) and CVET (Continuing VET) systems. While Deliverables D4.1 and D4.2 focus on learner and teacher curricula respectively, Deliverable D4.3 responds to the need for practical and pedagogical methods that help teachers bring AI into the classroom through scenario-based learning.

Specifically, this deliverable introduces a methodology for creating and presenting AI use-case scenarios - realistic, problem-based teaching tools that situate AI applications within sector-specific contexts. These use-cases are not designed merely to demonstrate how AI works; instead, they place learners in the role of decision-makers, collaborators, and ethical evaluators within AI-infused workplaces. By actively working through the use-case, learners develop a deeper understanding of the practical implications, trade-offs, and interdisciplinary considerations involved in deploying AI.

The foundation for this methodology was laid during a hands-on workshop, where members of the AI4VET4AI consortium participated in a structured creative exercise based on Edward de Bono's Six Thinking Hats framework. This method provided a unique lens through which educators, researchers, and AI experts could explore AI implementation from six distinct perspectives:

- White Hat - facts and data surrounding the AI application
- Red Hat - emotional responses and intuitive reactions
- Black Hat - risks, limitations, and critical perspectives
- Yellow Hat - benefits and optimistic potential
- Green Hat - creative alternatives and innovation
- Blue Hat - process control and next steps

Using this structure, small groups each tackled a specific sector - such as tourism, healthcare, education, or retail - and were tasked with identifying a plausible AI use-case, exploring its practical implementation, and debating its broader implications. Each group produced a scenario draft that included a defined AI application (e.g. chatbots, recommendation engines, generative AI, predictive models), target user groups, ethical or operational challenges, and initial ideas for how this could be used in VET teaching.

Several cross-cutting insights emerged from this process:

- AI is context-dependent - its usefulness, risks, and acceptability vary widely between industries and even job roles.
- Ethical issues must be central - concerns such as bias, transparency, data privacy, and fairness were consistently highlighted.
- Use-case scenarios are ideal tools for encouraging critical and interdisciplinary thinking in learners.

Co-funded by
the European Union

- Teachers need structured support - to confidently present complex AI topics, educators benefit from a clear process, templates, and examples.

Building on this foundation, the consortium co-designed a use-case methodology template, which forms the core of this deliverable. This template guides educators in building their own AI scenarios using a standard set of components:

- Title and context: A brief, compelling overview of the sector and AI application
- Scenario description: A short narrative introducing the learner to the situation
- Key actors and roles: Stakeholders involved in or impacted by the AI system
- Learning objectives: Aligned with DigComp, LifeComp, EntreComp or other national frameworks
- AI technology explained: Description of the AI tool or system in use (e.g. natural language processing, computer vision)
- Ethical and legal dimensions: Specific questions or dilemmas related to trust, privacy, bias, accountability
- Data sources and limitations: What kind of data is used, and what are its constraints?
- Activities and prompts: Group work, discussion questions, or mini-projects that engage learners
- Assessment suggestions: Ideas for formative or summative evaluation
- Adaptation tips: How the scenario could be modified for different learning levels or settings

This methodology is designed to be flexible and scalable. It can be applied in classroom settings, online learning environments, or blended formats. It is suitable for both IVET and CVET contexts, and can be adapted for different learner levels (EQF 3-6). Educators may create their own scenarios from scratch using the template or adapt existing ones provided in the annex of this deliverable.

What makes this methodology particularly valuable is its emphasis on active, learner-centered education. Rather than passively receiving information about AI, learners are asked to evaluate decisions, anticipate outcomes, and explore unintended consequences. In doing so, they begin to develop a holistic AI competence - one that blends technical literacy with digital responsibility, collaboration, and communication.

Furthermore, the use-case approach fosters interdisciplinary learning, drawing on elements of technology, ethics, law, communication, and business. It aligns well with emerging educational priorities across Europe, including the EU Digital Education Action Plan and national strategies for AI and digital transformation in education.

In summary, the methodology outlined in this deliverable reflects a pedagogical philosophy grounded in realism, reflection, and responsibility. It provides VET educators with a clear, structured path for integrating meaningful AI discussions into their teaching, even in cases where neither the teacher nor the learners are AI experts. Through scenario-based learning, we can help prepare the next generation of workers to not only use AI systems but to understand, question, and shape them for the benefit of society.

2. Methodology on AI use-case presentations

The methodology for developing AI use-case scenarios within the AI4VET4AI project was built on a participatory, structured, and pedagogically grounded approach, with a strong emphasis on critical thinking, ethical awareness, and real-world applicability. Its core is the belief that learners should not only understand AI technologies but also actively engage with them in complex, human-centered contexts. To this end, the methodology combines scenario-based learning, collaborative creation, and interdisciplinary reflection.

2.1 Foundational approach: the six thinking hats workshop

The starting point for this methodology was a co-creative workshop, using the **Six thinking hats technique** developed by Edward de Bono. The method was chosen for its ability to generate well-rounded, multi-perspective discussions by assigning different roles to participants, each representing a specific cognitive angle:

- **White Hat**: factual and data-driven thinking
- **Red Hat**: emotional and intuitive responses
- **Black Hat**: risk analysis and caution
- **Yellow Hat**: optimism and benefits
- **Green Hat**: creativity and innovation
- **Blue Hat**: process coordination and synthesis

Participants were divided into groups based on industry sectors (e.g., healthcare, education, tourism, logistics), each tasked with exploring the role of AI in that context. Moving through each hat in sequence, the groups:

- Identified existing AI applications and data sources (White Hat)
- Explored emotions and perceptions about AI (Red Hat)
- Mapped potential risks, ethical concerns, and system limitations (Black Hat)
- Highlighted positive impacts, efficiencies, and value creation (Yellow Hat)
- Proposed innovative and unconventional AI use-cases (Green Hat)
- Structured and synthesized all insights into scenario drafts (Blue Hat)

The workshop generated five preliminary case studies (see Annex), which served as templates and inspiration for broader application in VET curricula.

2.2 Scenario template design

Following the workshop, the consortium refined a standardized **AI use-case template**, inspired by both the workshop results and ethical design principles from the European AI Act. This template serves as the backbone of the methodology and supports consistency, adaptability, and scalability.

Each scenario is structured around the following components:

- **Sector and title**: Definition of the relevant industry and a clear, descriptive title
- **Scenario overview**: A realistic, narrative-based situation that involves the application of AI

- **AI technologies**: Description of the AI tools or systems used (e.g., computer vision, NLP, machine learning)
- **Stakeholders and roles**: Identification of actors involved in the scenario (e.g., users, regulators, data scientists)
- **Data and infrastructure**: Explanation of what data is required and how the AI system functions
- **Benefits and outcomes**: Description of positive impacts, such as efficiency gains or personalization
- **Risks and ethical issues**: Clear articulation of potential downsides, including fairness, privacy, and bias
- **Learning objectives**: Pedagogical goals, aligned with DigComp, LifeComp, or sectoral frameworks
- **Activities and reflections**: Suggested in-class activities, discussion prompts, or simulations
- **Assessment ideas**: Proposals for evaluating learner engagement or understanding

The structure ensures that AI is introduced not only as a technical topic but as a **multifaceted system** with implications across society, economy, and values.

2.3 Use-case development process

The full development process for a use-case scenario follows these key stages:

- **Sector selection**: Choose an industry or vocational domain relevant to learners' future professions (e.g., hospitality, logistics).
- **Contextual exploration**: Conduct a mini-research phase, drawing on facts and real-world examples using the White Hat approach.
- **Scenario framing**: Draft a realistic situation or narrative that anchors the AI application in a recognizable context.
- **Six hats review**: Optionally revisit the Six Thinking Hats to explore diverse angles: ethical, emotional, creative, risk-based, etc.
- **Template population**: Fill in the use-case template, focusing on clarity, realism, and pedagogical alignment.
- **Peer review**: Share with colleagues or working groups for validation and improvement.
- **Implementation**: Integrate the scenario into IVET/CVET lessons through active learning strategies (e.g., role-play, debates, group decision-making).

This process can be used both by individual educators and institutional teams, and can be integrated into curriculum planning cycles or continuing professional development (CPD) programs.

2.4 Pedagogical foundations

The use-case methodology is informed by several pedagogical principles:

- **Problem-based learning (PBL)**: Learners confront complex, open-ended problems that mirror real-world tasks
- **Inquiry-based learning**: Learners ask questions, evaluate information, and draw their own conclusions
- **Critical digital literacy**: Learners explore not only how AI works but why and for whom it works, and with what consequences
- **Ethics-by-design**: Ethical awareness is embedded at every stage of use-case development and classroom delivery

The methodology supports both **content mastery** and **transversal competence development**, such as collaboration, creativity, and civic responsibility - aligning well with the EU's key competence frameworks for lifelong learning.

2.5 Scalability and adaptation

To ensure wide applicability across different educational settings, the methodology was designed with adaptability in mind:

- It can be used in IVET and CVET programs
- Scenarios can be designed for various EQF levels (3-6)
- Delivery modes may include face-to-face, online, or blended learning
- Scenarios can be adapted for local/regional context, sectoral focus, or national curriculum alignment

The use-case framework also enables **modular implementation** - individual scenarios can be used as standalone sessions, or bundled into larger thematic units on AI, digital transformation, or ethics in technology.

3. Conclusion

This deliverable presents a comprehensive and flexible methodology for developing AI use-case scenarios tailored to vocational education and training. Rooted in participatory design and interdisciplinary reflection, the approach equips educators with the tools to foster critical thinking, ethical awareness, and real-world understanding of AI among learners. By offering structured templates, practical guidance, and adaptable examples, the methodology bridges the gap between abstract AI concepts and tangible classroom experiences. It ultimately contributes to preparing a workforce that is not only digitally competent but also capable of shaping AI technologies responsibly and inclusively across diverse vocational sectors.

Co-funded by
the European Union

4. Annex

4.1 Customer Relationship Management - using AI to provide better service to customers

<table>
<tr><td colspan="5">USE CASE "AI-Driven Guest Sentiment Analysis"</td></tr>
<tr><td rowspan="3">Intended purpose</td><td>Context of use</td><td colspan="3">This use case focuses on applying AI to analyse guest feedback and sentiment from sources such as online reviews, surveys, and social media. By identifying recurring themes and gauging both positive and negative sentiment, the system provides hotels with clear, actionable insights to enhance service quality. Integrated within CRM platforms and review monitoring tools, the AI runs on cloud infrastructure and connects directly with feedback databases to deliver real-time analysis. Customer experience teams and hotel managers use this information to track guest satisfaction and quickly address areas needing improvement, enabling them to make informed decisions that support a more responsive and customer-focused service approach.</td></tr>
<tr><td>Scope</td><td colspan="3">Collection and analysis of structured and unstructured feedback data, identifying sentiment trends, categorising feedback by topic (e.g., cleanliness, staff behavior, amenities), and generating reports or alerts for service teams, supporting proactive service recovery and continuous improvement.</td></tr>
<tr><td>SDGs</td><td colspan="3">SDG 9: Industry, Innovation, and Infrastructure. SDG 12: Responsible Consumption and Production</td></tr>
<tr><td colspan="2">Type of product</td><td>Customer experience management systems / feedback analytics platforms</td><td>Is it a safety component?</td><td>no</td></tr>
<tr><td colspan="2">Application area(s)</td><td colspan="3">Customer Feedback Analysis; Service Quality Monitoring; CRM Systems; Social Media Listening</td></tr>
<tr><td colspan="2">Primary actor</td><td colspan="3">Customer experience manager</td></tr>
<tr><td colspan="2" rowspan="2">Stakeholders and Interests <involved and</td><td>Stakeholder</td><td>Description</td><td></td></tr>
<tr><td>Hotel Management</td><td colspan="2">Gain insights into guest satisfaction and areas for improvement</td></tr>
</table>

Co-funded by the European Union

affected persons and groups>	Guests	Benefit from improved service based on their feedback
	Customer Support Teams	Receive alerts and insights to address issues proactively
Success end condition	Improved guest satisfaction and loyalty through data-driven service enhancements	
Failure protection	Manual review of feedback and traditional surveys	
Trigger	Submission of guest feedback or detection of new online reviews	
Main course	**Step**	**Action**
	1	Data Aggregation – Collect feedback from surveys, review sites, and social media
	2	Sentiment Analysis – Use NLP models to classify sentiment and extract key themes
	3	Categorisation – Organise feedback by topic and urgency
	4	Reporting – Generate dashboards and alerts for hotel staff
	5	Action & Follow-up – Implement service improvements and respond to guests
Extensions	**Step**	**Branching action**
	1a	Multilingual Feedback – AI translates and analyzes feedback in multiple languages
	2a	Real-Time Alerts – Negative sentiment triggers immediate notification to staff
Open Issues	Bias in sentiment models; Data privacy concerns; Integration with legacy CRM systems; Misinterpretation of sarcasm or cultural nuances	

USE CASE "Voice-Enabled In-Room Concierge"

Co-funded by the European Union

Intended purpose	**Context of use**	AI-powered voice assistants are used in hotel rooms to offer in-room concierge services, allowing guests to request services, control room settings, and access information about hotel amenities using natural language commands. These voice-enabled devices are integrated with the hotel's service management system and operate on secure, cloud-based AI platforms. Configured to respond to a wide range of guest queries and control smart room features, they provide a seamless and convenient experience. Commonly adopted in luxury and tech-savvy hotels, these systems help streamline service delivery while enhancing comfort and personalisation throughout the guest's stay.		
	Scope	The system supports voice-activated room service requests, housekeeping, wake-up calls, local recommendations, and smart room controls (e.g., lighting, temperature). It also integrates with CRM systems to personalise responses based on guest profiles and preferences.		
	SDGs	SDG 9: Industry, Innovation, and Infrastructure. SDG 11: Sustainable Cities and Communities		
Type of product		Smart hospitality systems / voice assistant platforms	**Is it a safety component?**	no
Application area(s)		In-Room Services; Guest Experience; Smart Room Controls; Accessibility		
Primary actor		Hotel guest		
Stakeholders and Interests		**Stakeholder**	**Description**	
		Guests	Enjoy hands-free, personalised service	
		Hotel Staff	Receive automated service requests, reducing manual workload	
		IT & Operations Teams	Maintain and optimise voice assistant performance	
Success end condition		Frictionless, personalised in-room service experience		
Failure protection		Fallback to traditional phone or app-based service requests		
Trigger		Guest initiates a voice command		
Main course		**Step**	**Action**	

Co-funded by the European Union

	1	Device Setup – Install and configure voice assistant in guest rooms
	2	System Integration – Connect to hotel CRM, service management, and IoT systems
	3	Voice Interaction – AI processes guest commands and queries
	4	Service Fulfillment – Requests are routed to appropriate departments
	5	Feedback Loop – Collect guest usage data to improve responses
Extensions	**Step**	**Branching action**
	1a	Accessibility Mode – Enhanced voice recognition for guests with disabilities
	2a	Multilingual Support – Guests can interact in their preferred language
Open Issues	Privacy concerns with in-room listening; Voice recognition accuracy; Integration with older hotel infrastructure; Guest consent and data handling	

USE CASE "AI-Powered Travel Assistance"		
Intended purpose	**Context of use**	While airlines and hotels are experiencing a surge in customer service queries across customer support email, chat and messaging; guests expect quick, convenient, and personal resolutions for their needs. AI chatbot powered travel assistance enhances customer service by resolving common travel queries. By automating responses to booking inquiries, flight updates, baggage policies, and loyalty programs, AI reduces the workload for human agents and ensures fast, convenient support. It improves efficiency, minimizes disruptions and boosts customer satisfaction. AI-driven chatbots and virtual agents handle routine requests, freeing up human staff to focus on complex issues, leading to improved service quality.
	Scope	The scope of AI-powered travel assistance includes elements like handling customer inquiries related to booking, flight updates, baggage policies, upgrades, loyalty programs and disruptions. It enables airlines, hotels and online travel agencies to automate responses to high-volume, repetitive queries while ensuring personalized customer support.
	SDGs	SDG 8: Decent Work and Economic Growth; SDG 9: Industry, Innovation, and Infrastructure; SDG 12: Responsible Consumption and Production; SDG 13: Climate Action

Co-funded by the European Union

Type of product	travel management systems /intelligent booking systems	**Is it a safety component?**	no
Application area(s)	Booking & Reservations; Customer Support; Personalized Travel Planning; Loyalty Programs & Rewards		
Primary actor	customer		
Stakeholders and Interests <involved and affected persons and groups>	**Stakeholder**	**Description**	
	Travel Companies	implement AI to enhance customer service and streamline operations	
	Customers/Travelers	interact with AI assistants for booking, inquiries, and personalized recommendations	
	Human Agents	handle complex issues that AI cannot resolve, ensuring a seamless experience	
Success end condition	seamless, efficient, and highly personalized travel experiences		
Failure protection	slower, more fragmented customer service		
Trigger	customer inquiry or request		
Main course	**Step**	**Action**	
	1	Define Objectives & Scope – Identify the specific customer service challenges AI will address, such as booking automation, flight updates or multilingual support	
	2	Data Collection & Integration – Gather historical customer interactions, booking data and travel policies. Integrate AI with existing CRM, booking systems, and communication channels	

Co-funded by the European Union

	3	System Deployment & Testing – Implement AI-powered chatbots or virtual assistants across websites, apps and messaging platforms. Conduct testing to ensure accuracy and reliability.
	4	User Experience Optimization – Refine AI interactions based on customer feedback, improving personalization, response speed and contextual understanding.
	5	Monitoring & Continuous Improvement – Analyze AI performance, track customer satisfaction and update models to enhance efficiency and adaptability.
Extensions	**Step**	**Branching action**
	1a	Disruptions & Emergency Handling – If a flight is delayed or canceled, AI can offer rebooking options or compensation details.
	2a	Personalized Recommendations – AI can adjust itineraries based on traveler preferences, budget or loyalty status.
Open Issues	Improper data use; Bias & fairness; Data privacy & security; Accuracy & reliability; Human-AI collaboration; Multilingual & cultural adaptation; Integration challenges	

USE CASE "AI for revenue and pricing optimization"		
	Context of use	Hotels worlwide are starting to use AI for optimization of their pricing and revenue streams. AI software solutions analyses market trends, competitor pricing, and historical booking data to provide hotels with strategies for pricing adjustments, accurate predictions of occupancy rates, profitability during peak and low seasons, and the ways in which resources need to be employed. The software solutions are sometimes developed inhouse by large hotel chains (e.g., Hilton, Mariott), while in other cases the hotels are using solutions developed by external startups and IT companies. The solutions allow integration with existing softwares used by hotels.
	Scope	The scope of AI solutions for revenue and pricing optimization include elements like monitoring of the real-time and historical data in terms of demand, occupancy rates, competitor prices, local events to adjust room prices automatically across distribution channels, modules for adjusting the AI through creation of inputs/rules based on specific expertise that your staff has. The solutions also can take into consideration the time of booking, length of stay, external factors like weather and personalized booking experience (e.g., returning guests or loyalty program members might be offered special rates or exclusive deals, enhancing customer retention and loyalty).

Co-funded by the European Union

	SDGs	SDG 8: Decent Work and Economic Growth; SDG 9: Industry, Innovation, and Infrastructure; SDG 12: Responsible Consumption and Production		
Type of product		Revenue and pricing management systems	**Is it a safety component?**	no
Application area(s)		Revenue & Pricing Systems; Booking & Reservations; Loyalty Programs & Rewards		
Primary actor		finance and/or revenue & pricing managers		
Stakeholders and Interests <involved and affected persons and groups >		**Stakeholder**	**Description**	
		Travel companies	Use AI solutions to automatically adjust their pricing strategies based on hotels dynamic pricing to ensure that their profitability margin remains acceptable through time	
		Booking agents	Use AI solutions to provide customers with insights on possible price changes dependent on different time of booking (present vs future; possibility of discounts/offers)	
Success end condition		precise revenue predictions, revenue opmization, offering competitive and attractive rates to guests		
Failure protection		lost revenue, increased use of employees time in an inefficient manner		
Trigger		more than 10 rooms under management and inefficient pricing strategies		
Main course		**Step**	**Action**	
		1	Mapping revenue/pricing process - Mapping the steps of existing process for revenue and pricing with identification of data sources and systems currently used	

Co-funded by the European Union

	2	Data identification and preparation - Recognizing existing and required databases to be used, defining exact datapoints that are required and defining database cleaning rules
	3	System integration and testing - Integrate all the required systems and run tests on small sets of data; identify potential mistakes and reiterate the process on larger sets of data to ensure high-levels of accuracy
	4	System demplyment - Start the use of the system across all selling channels
	5	Monitoring and improvement - Perform comparison on AI results and previous models used for pricing and revenue optimization; created modifications as needed
Extensions	**Step**	**Branching action**
	1a	External agents - integration with systems of external travel providers and platforms to ensure alignment in the pricing offered to hotel guests
Open Issues	Lack of proper integration with other hotel systems; Improper data used; Mistakes in model predictions; Data privacy and security; Accuracy and reliability	

Co-funded by the European Union

4.2 Using AI for Understanding Tourism Impact and Improving Sustainability

<table>
<tr><td colspan="5">USE CASE "AI-Powered Vandalism Prevention at Greek Cultural Heritage Sites"</td></tr>
<tr><td rowspan="3">Intended purpose</td><td>Context of use</td><td colspan="3">The AI system is designed to enhance visitor experience, improve destination management, and prevent vandalism at cultural heritage sites. It leverages real-time data analytics to optimize resource use while promoting sustainable tourism practices. The system operates in outdoor environments at historical monuments and archaeological sites across Greece. It uses existing CCTV infrastructure enhanced with AI-powered video analytics to monitor visitor behavior in real-time. The hardware includes edge computing devices capable of functioning under varying lighting and weather conditions, ensuring robust performance.</td></tr>
<tr><td>Scope</td><td colspan="3">The AI application aims to support sustainable tourism by improving security, managing visitor flows, and preserving cultural heritage. It also contributes to strategic planning for tourism destinations.</td></tr>
<tr><td>SDGs</td><td colspan="3">SDG 11: Sustainable Cities and Communities
SDG 12: Responsible Consumption and Production
SDG 16: Peace, Justice, and Strong Institutions</td></tr>
<tr><td colspan="2">Type of product</td><td>type of product/system of which this use case is a component</td><td>AI-powered video analytics system integrated into CCTV infrastructure</td><td>yes</td></tr>
<tr><td colspan="2">Application area(s)</td><td colspan="3">Cultural heritage preservation
Tourism destination management
Visitor behavior monitoring
Vandalism prevention</td></tr>
<tr><td colspan="2">Primary actor</td><td colspan="3">On-site security personnel</td></tr>
<tr><td colspan="2" rowspan="4">Stakeholders and Interests <involved and affected persons and groups></td><td>Stakeholder</td><td>Description</td><td></td></tr>
<tr><td>Local authorities</td><td colspan="2">Responsible for cultural site management and ensuring compliance with regulations.</td></tr>
<tr><td>Tourism industry entities</td><td>Interested in improving visitor experiences and promoting sustainable practices.</td><td></td></tr>
<tr><td>Security personnel</td><td>Tasked with responding to alerts generated by the AI system.</td><td></td></tr>
</table>

Co-funded by the European Union

	Visitors	Beneficiaries of safer and more organized experiences at cultural heritage sites.
Success end condition	Cultural heritage sites are preserved with minimal vandalism, visitor experiences are enhanced, and tourism destinations operate sustainably.	
Failure protection	If abandoned, manual monitoring systems should remain operational to ensure basic security at cultural sites.	
Trigger	The system starts monitoring when CCTV cameras detect movement or activity within designated areas.	
Main course	**Step**	**Action**
	1	AI analyzes video feeds for unusual behavior patterns or potential vandalism.
	2	Alerts are sent to on-site security personnel for immediate intervention.
	3	Data is transmitted to a central monitoring station for further analysis and recordkeeping.
Extensions	**Step**	**Branching action**
	1a	If vandalism is detected, local authorities are notified for legal action.
Open Issues	Ethical concerns regarding privacy due to real-time monitoring. Potential misuse of data collected by the system. High costs associated with implementing AI systems at smaller sites or for SMEs in tourism.	

USE CASE "Sustainable Tourism Management with FLOWS AI System"		
Intended purpose	**Context of use**	The FLOWS AI system is deployed on hiking trails in Alpine regions of Slovenia, where real-time visitor behavior is monitored via trail-based sensors. It functions in high-traffic, environmentally sensitive areas. Data is processed through a centralized platform combining mobile and web interfaces used by both tourists and park authorities. The system operates on networked IoT sensor infrastructure integrated with AI-driven forecasting modules.
	Scope	Forecast pedestrian flows, optimize visitor distribution, and trigger alerts for rerouting during peak congestion.

Co-funded by the European Union

	SDGs	11. Sustainable Cities and Communities; 13. Climate Action; 15. Life on Land	
Type of product	type of product/system of which this use case is a component	**AI-enabled software platform integrated with IoT trail sensors and mobile/web interfaces for real-time monitoring and prediction.**	no
Application area(s)	Tourism, Environment and Conservation		
Primary actor	Park Authorities; Tourists/Hikers; Local Governments; Tourism Operators		
Stakeholders and Interests <involved and affected persons and groups>	**Stakeholder**	**Description**	
	Hikers	Direct users affected by congestion; benefit from guidance and alerts	
	Local communities	Economic stakeholders who rely on tourism but are impacted by overcrowding	
	Environmental NGOs	Monitor ecological impact and advocate for sustainable management	
	Conservationists	Support protection of sensitive Alpine ecosystems	
Success end condition	Visitor flows are effectively balanced, reducing congestion, protecting sensitive environments, and enhancing the visitor experience through data-driven alerts and route planning.		
Failure protection	If the AI system fails, authorities fall back to manual monitoring, static signage, and traditional visitor guidance practices to ensure safety and access continuity.		
Trigger	Real-time data from trail sensors initiates the congestion forecasting process at regular 30-minute intervals.		
Main course	**Step**	**Action**	
	1	Sensors collect real-time foot traffic data	
	2	AI models forecast congestion levels	
	3	System notifies users (e.g., via website, app) about expected congestion.	

Co-funded by the European Union

	4	Stakeholders are alerted with forecasts and recommended adaptive actions, such as visitor rerouting, hike rescheduling, or resource reallocation.	
	5	Congestion maps are displayed on public platforms to guide both tourists and planners.	
Extensions	**Step**	**Branching action**	
	2a	If weather anomalies occur, retrain AI model dynamically using updated data	
	3a	Manual overrides in case of system failure	
	3b	Allow public push notifications for congestion alerts	
	4a	Alert escalation if thresholds are breached continuously	
Open Issues	Data privacy risks: sensor and mobile Data must be anonymized. Misuse potential: biased recommendations or unfair visitor restrictions. Overreliance: authorities may neglect manual observation.		

Co-funded by the European Union

4.3 Using AI for process automation in teaching and for creating personalised recommendations for learner

<table>
<tr><td colspan="5">USE CASE: Understanding Foundations of AI for Personalized Learning and Growth</td></tr>
<tr><td rowspan="3">Intended purpose</td><td>Context of use</td><td colspan="3">The system is intended for use in classes or extracurricular activities to support students and teachers. It is available as a web platform on school computers, tablets and personal devices. It does not require installation and uses the school network securely.</td></tr>
<tr><td>Scope</td><td colspan="3">The goal is to introduce students to the basic workings of AI and, through individualized tasks, encourage personal development and the active and responsible use of AI technology in learning.</td></tr>
<tr><td>SDGs</td><td colspan="3">SDG 4: Quality Education, SDG 10: Reduced Inequalities, SDG 9: Industry, Innovation, and Infrastructure</td></tr>
<tr><td colspan="2">Type of product</td><td>AI educational platform</td><td>Is it a safety component?</td><td>no</td></tr>
<tr><td colspan="2">Application area(s)</td><td colspan="3">Educational Technology, Artificial Intelligence in Education, STEM Education, Digital Literacy</td></tr>
<tr><td colspan="2">Primary actor</td><td colspan="3">students in secondary school</td></tr>
<tr><td colspan="2" rowspan="6">Stakeholders and Interests <involved and affected persons and groups></td><td>Stakeholder</td><td>Description</td><td></td></tr>
<tr><td>students</td><td colspan="2">users who learn through play and individualized practical tasks</td></tr>
<tr><td>teachers</td><td colspan="2">They receive reports on student work quickly</td></tr>
<tr><td>pedagogical service</td><td colspan="2">users using data for preventive conversations, risk detection in less successful</td></tr>
<tr><td>school principal</td><td colspan="2">the user to whom it serves as information about the need to change the curriculum</td></tr>
<tr><td>parents</td><td colspan="2">users who track their child's progress</td></tr>
<tr><td colspan="2">Success end condition</td><td colspan="3">The student understands the basics of AI and applies them to tasks. Shows interest in technology and develops capable critical thinking and problem solving.</td></tr>
<tr><td colspan="2">Failure protection</td><td colspan="3">The collected data is confidential, anonymous and used exclusively for educational purposes. If the student is not making progress, the tasks are simplified, and a message</td></tr>
</table>

Co-funded by the European Union

	is sent to the teacher and the pedagogical service as support in learning. Teachers have control over the solving of the tasks and can adjust the difficulty of the tasks.	
Trigger	The student registers on the platform through their school account and starts a quiz to assess their knowledge of AI.	
Main course	**Step**	**Action**
	1	The student takes a quiz to assess knowledge and thinking skills.
	2	AI analyzes quiz results and creates an individualized learning path for the student.
	3	The student solves tasks on AI concepts.
	4	AI tracks progress, regularity in solving, and type of error.
	5	AI adapts content to the student based on the collected data.
	6	The student completes the final challenge and gives feedback on what they learned.
	7	The system generates a report to the student and teacher about the student's success.
Extensions	**Step**	**Branching action**
	3a	If the student progresses faster, the system offers more advanced tasks.
	4a	If the student shows difficulty in mastering the material, the AI offers additional explanations and additional examples.
	5a	If a student is interested in a particular area, the system offers content according to the selected area.
Open Issues	Teacher training needed to work with AI tools. Differences in digital literacy among students. Transparency of AI systems and the possibility of influencing their task selection.	

USE CASE: Optimising Study Efficiency and Academic Performance with AI

Co-funded by the European Union

Intended purpose	**Context of use**	This AI system is intended for use in secondary and higher education institutions across the EU and partner regions, particularly within VET contexts. It runs on standard classroom/school ICT infrastructure, including LMS platforms, tablets, laptops, or desktops with internet access. It adapts to diverse learning environments—rural, urban, low-resource, and high-tech—through cloud-based integration.		
	Scope	The AI system supports personalised academic coaching, time management, and collaborative learning. It analyses learner behavior, performance, and preferences to generate tailored study strategies and workload management plans, aiming to increase academic success and learner well-being.		
	SDGs	SDG 4: Quality Education SDG 5: Gender Equality SDG 8: Decent Work and Economic Growth SDG 10: Reduced Inequalities SDG 9: Industry, Innovation and Infrastructure		
Type of product		AI-powered educational support and planning tool integrated into student learning and assessment systems (a component of a digital learning environment or LMS).	**Is it a safety component?**	No
Application area(s)		Education, training, vocational education and training (VET), student support services, educational technology, youth empowerment and career development		
Primary actor		Student learner (the individual using AI tools to enhance academic performance, time/task management, and group work dynamics)		
Stakeholders and Interests <involved and affected persons and groups>		**Stakeholder**	**Description**	
		Students	primary users benefiting from personalized learning and planning support. Interests are around academic success, well-being, and skills development.	
		Teachers/educators	facilitators who guide students using AI insights. Interests include workload reduction, meaningful engagement.	
		School Administrators	oversee implementation. Interests are geenrally centered on resource allocation, improved academic outcomes	

Co-funded by the European Union

	Parents/Guardians	concerned with student progress and data transparency. Stakeholder interests are largely focused on developing a better understanding of their child's learning.
	Policy Makers/ EU Partners	are the project stakeholders primarily interested in ensuring alignment with educational reform and meeting just transition goals.
	Technology Providers	are the developers of AI systems who are focused on usability, performance, and ethical compliance.
Success end condition	Student learner independently apply AI-enhanced strategiesto achieve improved academic performance, well-being, and efficient time/task management. Educators successfully integrate AI to support learners, and collaborative work becomes more balanced and effective.	
Failure protection	If goals are abandoned, students revert to traditional study and time-management methods, with human educator oversight ensuring basic learning continuity. Manual feedback and group facilitation remain in place while data governance frameworks prevent harm.	
Trigger	Student enrols in the module or accesses the LMS-integrated AI tool for academic planning, feedback analysis, or collaborative work support.	
Main course	**Step**	**Action**
	Student login	Student logs into the AI-enhanced learning environment
	Data ingestion	System collects real-time and historical academic, behavioural, and contextual data
	AI analysis	AI models analyse this data to identify patterns and needs (e.g. gaps in understanding, time management issues)
	Feedback generation	Personalized suggestions are generated (e.g. reorganize study time, recommend peer collaboration)
	Student response	Student interacts with the recommendations, implements feedback, or engages with peers or learning content
	Teacher dashboard update	Educator monitors student progress via dashboards

Co-funded by the European Union

	Loop completion	Iterative updates refine recommendations based on ongoing inputs
Extensions	**Step**	**Branching action**
	Student ignores feedback multiple times	Student rejects feedback or shows low engagement
	Collaboration breakdown detected	Peer group collaboration fails due to conflict or tech issues
	Inappropriate AI output	AI recommendation is flagged as inappropriate or irrelevant
	Parental opt-out	Parental override of data sharing or profiling is triggered
Open Issues	Bias in AI models	
	Gaming the system	
	Privacy concerns	
	Overreliance on AI	
	Technical inequality	

USE CASE: Innovative learning techniques using AI to identify and adapt learning to the learner's emotional state		
Intended purpose	**Context of use**	The system is designed for implementation in higher education and vocational training institutions. It operates as a cloud-based platform, accessible through web browsers and dedicated mobile applications, and integrates with existing learning management systems. Hardware requirements include secure servers for data processing and storage, with client-side access through standard computing devices (laptops, tablets, smartphones).
	Scope	Researches show, that learning outcomes are strongly related to the emotional state of both, students and teachers. This AI system detect learner's emotions to tailor interactions based on the user's emotional state and enhance the effectiveness of learning, creates personalised learning paths and engagement patterns. It dynamically adapts content, pacing, resource recommendations and interventions for

Co-funded by the European Union

		lowering boredom and improve student engagement to optimise individual learning outcomes, while providing teachers with actionable insights for intervention and support.		
	SDGs	SDG 3: Good health and well beeing - Personalization of learning for students/teacher weel being DG 4: Quality Education - Enhances educational outcomes through personalization DG 10: Reduced Inequalities - Provides tailored support to address diverse learning needs		
Type of product		AI-powered adaptive learning platform	**Is it a safety component?**	no
Application area(s)		Educational Technology; Machine Learning; Natural Language Processing; Learning Analytics; Intelligent Tutoring Systems		
Primary actor		Students in higher education and VET		
Stakeholders and Interests <involved and affected persons and groups>		**Stakeholder**	**Description**	
		Students	Primary users seeking personalized learning experiences and improved educational outcomes	
		Educators	Config learning objectives, review AI-generated insights, provide human oversight + intervention	
		Student counsellors	Get AI help with information when intervention is needed	
		EDU Institutions	Implementation oversight, ensuring quality education and well being of students and teachers	
Success end condition		The system captures nonverbal cues such as facial expressions, body movements, speech prosody, and student dilation to evaluate the needs and capabilities of individual students. AI powered identifying of student's emotional state promotes a personalised approach, which leads to less boredom, increased student engagement, which leads to improved learning outcomes. The AI system also analyses the teacher's emotional state and sends feedback and suggestions, as research shows that the teacher's emotional state also has a strong impact on learning outcomes.		

Co-funded by the European Union

Failure protection	* human oversight with manual override (fallback to standard non-adaptive content) * comprehensive data privacy and security measures * regular auditing of algorithmic bias and accuracy	
Trigger	* voluntary student inscription * recommended student inscription due to performance deviations / deficiencies	
Main course	**Step**	**Action**
	1	Students use AI powered learning platform.
	2	System analyses emotional state of students and teacher
	3	AI generates customised learning path according to emotional state of individual student.
	4	System analyses emotional state of teacher and gives them feedback
	5	System continuously collects interaction data (facial expressions, body movements, speech prosody, and student dilation) for analysis
	6	AI analyses emotional patterns to identify boredom and student's angagement
	7	System recommends targeted actions to address specific challenges of learning and also gives feedback to teacher
	8	System automatically and continuously recalibrates learning path and intervensions
Extensions	**Step**	**Branching action**
	6a	If unusual patterns detected -> System alerts teacher for potential human intervention
	7a	If student demonstrates boredom -> System learning environment to motivate and give them the psychological support

Co-funded by the European Union

	7b	If student struggles -> System alert teacher/student counsellor and provides additional information
Open Issues	* data privacy concerns: collecting detailed patterns of student/teacher emotional state * potential algorithmic bias and efficiency and accuracy of capturing and interpreting emotional state * need for transparent explanation of how AI determines emotional state * preservation of social learning components	

Co-funded by the European Union

4.4 Human-AI Collaboration in Teaching and Learning

<table>
<tr><td colspan="5">USE CASE "AI-Powered Adaptive Learning System for Personalized Education"</td></tr>
<tr><td rowspan="3">Intended purpose</td><td>Context of use</td><td colspan="3">The system is designed for implementation in higher education and vocational training institutions. It operates as a cloud-based platform, accessible through web browsers and dedicated mobile applications, and integrates with existing learning management systems. Hardware requirements include secure servers for data processing and storage, with client-side access through standard computing devices (laptops, tablets, smartphones).</td></tr>
<tr><td>Scope</td><td colspan="3">This AI system creates personalised learning paths by analysing student performance, learning styles and engagement patterns. It dynamically adapts content difficulty, pacing, and resource recommendations to optimise individual learning outcomes, while providing instructors with actionable insights for intervention and support.</td></tr>
<tr><td>SDGs</td><td colspan="3">SDG 4: Quality Education - Enhances educational outcomes through personalization
SDG 10: Reduced Inequalities - Provides tailored support to address diverse learning needs</td></tr>
<tr><td colspan="2">Type of product</td><td>AI-powered adaptive learning platform</td><td>Is it a safety component?</td><td>no</td></tr>
<tr><td colspan="2">Application area(s)</td><td colspan="3">Educational Technology; Machine Learning; Natural Language Processing;
Learning Analytics; Intelligent Tutoring Systems</td></tr>
<tr><td colspan="2">Primary actor</td><td colspan="3">Students in higher education and vocational training</td></tr>
<tr><td colspan="2" rowspan="4">Stakeholders and Interests <involved and affected persons and groups></td><td>Stakeholder</td><td colspan="2">Description</td></tr>
<tr><td>Students</td><td colspan="2">Primary users seeking personalized learning experiences and improved educational outcomes</td></tr>
<tr><td>Educators</td><td colspan="2">Config learning objectives, review AI-generated insights, provide human oversight + intervention</td></tr>
<tr><td>EDU Institutions</td><td colspan="2">Implementation oversight, ensuring alignment with curriculum standards and learning objectives</td></tr>
<tr><td colspan="2">Success end condition</td><td colspan="3">Identifying knowledge gaps promotes a personalised approach, which leads to increased student engagement,
which leads to improved learning outcomes.</td></tr>
</table>

Co-funded by the European Union

Failure protection	* human oversight with manual override (fallback to standard non-adaptive content) * comprehensive data privacy and security measures * regular auditing of algorithmic bias	
Trigger	* voluntary student inscription * recommended student inscription due to performance deviations / deficiencies	
Main course	**Step**	**Action**
	1	Student completes initial assessment (to establish baseline knowledge and learning preferences)
	2	System analyses performance data and creates personalised learning profile
	3	AI generates customised learning path (with appropriate content)
	4	Student engages with adaptive content
	5	System continuously collects interaction data for analysis
	6	AI analyses performance patterns to identify knowledge gaps or learning barriers
	7	System recommends targeted resources to address specific challenges
	8	System provides automated feedback based on performance
	9	System automatically and continuously recalibrates learning path
Extensions	**Step**	**Branching action**
	6a	If unusual patterns detected -> System alerts instructor for potential human intervention
	7a	If student demonstrates mattery -> System accelerates pace and increases complexity
	7b	If student struggles -> System provides additional material and simplified explanations
Open Issues	* data privacy concerns: collecting detailed patterns of learning behaviour * potential algorithmic bias * need for transparent explanation of how AI determines learning paths * preservation of social learning components	

Co-funded by the European Union

USE CASE "AI-Powered Automated Grading and Feedback System for Education"				
Intended purpose	**Context of use**	The system is designed for implementation in higher education institutions as a cloud-based platform with secure APIs to connect to existing learning management systems. It works across desktops, tablets and mobile devices and requires minimal hardware infrastructure beyond standard education technology. The platform uses natural language processing and machine learning algorithms running on secure servers with robust data encryption to process, analyse and grade submissions across multiple subjects and assignment types.		
	Scope	The AI system automates the assessment and grading of student work, from multiple choice tests to essay assignments, ensuring consistent assessment while providing immediate and personalised feedback. It aims to reduce teacher workload, eliminate grading bias, increase assessment frequency and improve learning outcomes through faster, more detailed feedback loops, while maintaining human oversight of the assessment process.		
	SDGs	SDG 4: Quality education - Improve educational outcomes through efficient and consistent assessment SDG 10: Reduce inequalities - Provide standardised assessment regardless of background SDG 9: Industry, innovation and infrastructure - Support technological advancement and education.		
Type of product		AI-powered assessment platform with automated grading capabilities	**Is it a safety component?**	no
Application area(s)		Educational technology; Natural language processing; Machine learning; Learning analytics; Automated assessment; Feedback systems		
Primary actor		Educators (teachers and professors)		
Stakeholders and Interests <involved and affected persons and groups>		**Stakeholder**	**Description**	
		Educators	Configure grading parameters, review automated assessment	
		Students	Receive timely feedback on assignments to improve learning outcomes	
		EDU Institutions	Improve assessment efficiency, maintain academic standards, collect student performance data	
Success end condition		reduced marking time (positive for teachers), enabling faster personalised feedback cycles (improved student performance)		

Co-funded by the European Union

Failure protection	* human oversight and regular review (auditing) * override facilities for teachers to intervene * transparent explanation of grading decisions (accessible to students and teachers)		
Trigger	Student submission of assignments through the learning management system		
Main course	**Step**	**Action**	
	1	Educator creates an assignment + assessment criteria and uploads it to the system	
	2	Student submits assignment	
	3	AI analyses each submission based on an established rubric	
	4	AI generates detailed feedback highlighting strengths and areas for improvement	
	5	Educator reviews selected submissions and automatic grading results	
	6	Once approved, system releases grades and feedback to students	
Extensions	**Step**	**Branching action**	
	3a	If submission contains suspected plagiarism: System flags for detailed teacher review	
	5a	Educator approves or rejects result	
	5b	Educator adds comments	
	5c	Educator alters/ overwrites result from AI system	
Open Issues	* Risk of algorithmic bias reflecting historical grading patterns or training data imbalances * Privacy concerns regarding the collection and analysis of student performance data * Risk of teachers becoming overly dependent on automated systems *Potential for students to learn how to "game" the system rather than master content		

USE CASE "AI-Powered Course Design Assistant for Educators"

Co-funded by the European Union

Intended purpose	**Context of use**	The system is designed for implementation in higher education and vocational training programmes as a cloud-based platform that integrates with existing learning management systems. It operates through web browsers and mobile applications, requiring minimal specialised hardware beyond standard computing devices. The platform uses natural language processing and content generation capabilities to support educators throughout the entire course development process, from initial planning to final delivery.	
	Scope	The system streamlines and enhances the course preparation process by automating repetitive tasks, generating customisable content, aligning materials with curriculum standards and providing data-driven insights for course improvement. It serves as a comprehensive planning tool that helps educators save time by creating more engaging and accessible course materials.	
	SDGs	SDG 4: Quality education: Improves the quality of teaching through better course design SDG 8: Decent work and economic growth: Reduces teacher workload and improves productivity SDG 10: Reducing inequalities: Helps create more accessible and inclusive course materials	
Type of product		AI-powered course design platform	**Is it a safety component?** no
Application area(s)		Educational Technology; Natural Language Processing; Content Generation; Learning Management Systems	
Primary actor		Educators (teachers and professors)	
Stakeholders and Interests <involved and affected persons and groups>		**Stakeholder**	**Description**
		Educators	Seeks streamlined course preparation and improved teaching material
		EDU Institutions	Ensure curriculum standards and quality assurance in course design
Success end condition		successful alignment of course materials with learning objectives and reduced course preparation time	
Failure protection		* human review and approval required for all AI-generated content * human intervention and alternative course design when AI components fail * clear transparency on which elements are AI-assisted and which are human-generated	
Trigger		* Educator initiates new course development project * curriculum changes require course modification	
Main course		**Step**	**Action**

Co-funded by the European Union

	1	Educator inputs course parameters (subject, level, learning outcomes, and time constraints)
	2	System analyses curriculum requirements
	3	System suggests course framework + syllabus (weekly topics, readings, and assessment schedule)
	4	Educator reviews suggested framework + syllabus
	5	AI generates educational content according to syllabus and educators comments
	6	Educator customizes and refines materials to match teaching style and student needs
	7	System formats all materials for integration with institutional learning management system
Extensions	**Step**	**Branching action**
	2a	If previous course data exists: AI analyzes past outcomes to suggest evidence-based improvements
	4	Educator approves or rejects suggestions + adds additional comments
Open Issues	* Varying levels of AI literacy among educators affecting effective tool usage * Potential overreliance on AI-generated content + risk of reducing educator agency * Challenges in maintaining copyright compliance when generating content * Privacy concerns regarding institutional data * Potential for algorithmic bias in content recommendations and course structure * Ensuring sufficient transparency about how AI-generated recommendations are determined	

Co-funded by the European Union

4.5 Case Study: Synthetic Patient Records how and why

USE CASE: Student-Doctor AI anomaly Detection				
Intended purpose	**Context of use**	A student-doctor accesses a multimodal AI application including an online chatbot trained with synthetic patient data that simulates a patient with various types of mental health issues. The student-doctor agrees to be monitored by an notification system using a microphone and front camera and a context camera. The system detects emotive facial expressions, voice intonation, and word usage which will indicate when the Student -Doctor is under performing. The system also checks that the AI chatbot is not hallucinating. The alert system is controlled by the instructor who receives alerts, can review summary information and contact the student doctor. The anomaly detection will also notify the chatbot to update its beahavior.		
	Scope	Detection of anomalies during the student-doctor and AI chatbot interaction. The student-doctors' facial expression, voice, and body language are analysed to alert to behaviour that may indicate possible bad practices while talking to a simulated patient with mental issues. Monitoring of the output of the AI chatbot is used for detection of generative AI hallucinations.		
	SDGs			
Type of product		type of product/system of which this use case is a component	**Is it a safety component?**	No
Application area(s)		AI systems intended to be used to trigger instructor intervention based on student misconceptions or chatbot hallucinations		
Primary actor		Student Doctor		
Stakeholders and Interests		**Stakeholder**	**Description**	
		Instructor	Person who receives notifications of possible misconceptions.	
		AI application	Chatbot application which receives notification to update its system prompt	
Success end condition		The Doctor student and his/her behaviour are monitored by the multimodal misconception detector and notifications are triggered on student misconception or AI hallucinations.		

Co-funded by the European Union

Failure protection		Human in the loop: The instructor is alerted to any incident and takes action.	
Trigger		After starting of the system. The student doctor accepts the terms and conditions of use by clicking on the "accept" button in the user interface.	
Main course		**Step**	**Action**
		1	The images from the cameras, audio signal from the microphone are captured and analysed in real-time.
		2	An algorithm identifies the student doctors facial expressions, voice and AI application input to detect possible misconceptions
		3	An algorithm reviews the output of the AI chatbot to detect AI hallucinations
		4	A notification is triggered to the Ai application if the conditions for AI chatbot hallucinations are detected
		5	A notification is triggered to the instructor if the conditions for misconceptions are detected
Extensions		**Step**	**Branching action**
		2a	The image and sound quality is too poor and the student cannot be identified.
Open Issues		The detection system may have accuracy issues depending on the environmental conditions (background noise, lighting etc.) Bandwidth requirements for online connectivity may bias against deployment in rural areas Latency of intervention from instructor may vary depending on group size Algorithm for misconception detection may vary in accuracy depending on demographic. Data is deleted, however, training the AI may require a subset of the data	

USE CASE (Synthetic Patient Datasets for Algorithm Testing)

Co-funded by the European Union

Intended purpose	**Context of use**	As part of their coursework, students use open-source synthetic data generation tools to create datasets that simulate various patient populations. They apply these datasets to test AI algorithms for tasks such as disease prediction or triage classification. The system provides feedback on data quality, realism, and model performance. Instructors supervise the process and can reuse high-quality datasets in other modules.		
	Scope	Creation, exploration, and evaluation of synthetic health datasets by students to understand data pipeline workflows, patient diversity, and AI system behaviour.		
	SDGs			
Type of product	type of product/system of which this use case is a component	**Is it a safety component?**	no	
Application area(s)	AI education tools that simulate realistic health data environments for experimentation, especially in contexts where real patient data cannot be used due to privacy regulations.			
Primary actor	Medical Student			
Stakeholders and Interests <involved and affected persons and groups>	**Stakeholder**	**Description**		
	Instructor	Person that evaluates student submissions and supervises experimentation		
	Synthetic Data Generator	Tool used to create synthetic patient data		
	AI Model	AI model tested with student-generated datasets		
Success end condition	The student successfully creates a structured, high-quality synthetic dataset, applies it to the AI model, and interprets the results in a report.			
Failure protection	Instructors guide dataset review before model testing. Sandbox environments prevent model misuse or harmful deployment.			

Co-funded by the European Union

Trigger	The present use case is triggered when the student initiates the "Create Synthetic Dataset" activity in the course platform.	
Main course	**Step**	**Action**
	1	The student defines patient population characteristics (e.g., age, gender, symptoms, diagnosis) and their distributions.
	2	The Synthetic Data Generator creates a dataset based on the given parameters.
	3	The student explores and visualizes the data for bias inspection.
	4	The dataset is used to test a pre-trained AI model.
	5	The AI model output and data quality metrics are visualized.
	6	The student inspects model behaviour and downloads a report.
Extensions	**Step**	**Branching action**
	2a	The Synthetic Data Generator produces implausible distributions or incomplete attributes.
	5a	The AI model under test performs poorly due to unrealistic or biased synthetic data
Open Issues	Risk of misunderstanding of AI model outputs. The AI models may perform poorly when tested on unrealistic or biased data. Ethical implications of using synthetic data that "looks real" to non-experts and students.	

USE CASE (Emergency Triage Scenario Simulator with Synthetic Data)		
Intended purpose	**Context of use**	Students participate in simulated emergency room scenarios using a real-time dashboard that displays dynamic vital signs and clinical indicators generated from synthetic patient data. An AI triage assistant provides risk scoring and prioritization recommendations. Students must assess the recommendations, validate or override them, and justify their decisions. Instructors monitor performance and receive alerts if students deviate from expected decision patterns or overlook critical signs.

Co-funded by the European Union

	Scope	Simulation of high-pressure triage decision-making using synthetic data to mimic ER conditions. Includes evaluation of AI-human interaction and decision accuracy in time-sensitive environments.		
	SDGs			
Type of product		type of product/system of which this use case is a component	**Is it a safety component?**	No
Application area(s)		AI systems intended to be used for simulating emergency medical scenarios in clinical education and assessing student preparedness in human-AI collaboration.		
Primary actor		Student (Nursing or Medical Student)		
Stakeholders and Interests <involved and affected persons and groups>		**Stakeholder**	**Description**	
		Instructor	Person that monitors and evaluates decisions made under pressure by the Student	
		Synthetic Data Generator	AI system that produces real-time synthetic patient vitals and records	
Success end condition		Student correctly assesses triage priority using the tool, makes the correct decision, and reflects on their decision-making processes.		
Failure protection		Instructor can override AI and student decisions in the simulation. All student decisions are logged and reviewed post-scenario. No real patients involved.		
Trigger		The student begins the simulation by entering the emergency triage interface and acknowledging the system terms of use.		
Main course		**Step**	**Action**	
		1	Synthetic patient data are initialized and visualized on the dashboard.	

Co-funded by the European Union

	2	The AI system assigns preliminary risk scores and priority flags.
	3	The student reviews data and AI suggestions, then decides to accept or modify the AI recommendation.
	4	The student documents their reasoning and chosen intervention path.
	5	The instructor dashboard displays key decision points and flags any missed critical conditions.
Extensions	**Step**	**Branching action**
	3a	The student overrides AI suggestion with an incorrect triage level according to guidelines, triggering instructor alert.
Open Issues	Students may over rely on AI recommendations and this aspect may mask weak clinical reasoning. The system requires tailoring to national triage protocols and educational frameworks.	

Co-funded by the European Union

4.6 Supporting Doctor - Patient Interactions with AI

USE CASE - Doctor Patient Communication Barriers		
Intended purpose	**Context of use**	The AI system is deployed in healthcare settings where communication barriers affect interactions between doctors and patients, such as hospitals, clinics, and telemedicine services. It is used in multilingual, multicultural, or cognitively diverse environments, including urban and resource-limited areas. The system operates on standard clinical hardware such as desktop computers, tablets, and mobile devices, and can be integrated with electronic health record (EHR) systems. Its functions include real-time language translation, speech recognition, and summarization to support accurate and efficient clinical communication. **Ava is a good example.** Use case: Real-time captioning for the deaf and hard-of-hearing during in-person or remote conversations. How it works: Uses AI speech recognition to provide live subtitles on smartphones, tablets, or computers. Deployment: Used in healthcare settings to help patients follow conversations with medical staff. Strength: Multi-speaker detection, captioning accuracy, cross-device functionality.
	Scope	Designed to provide real-time, AI-powered transcription to support communication for deaf and hard-of-hearing individuals. In healthcare settings, it enables patients to follow spoken conversations with doctors and medical staff by displaying accurate, real-time captions on their personal devices. The system identifies multiple speakers, labels them, and transcribes dialogue to enhance clarity and autonomy during clinical interactions. Ava is intended for use in hospitals, clinics, and telemedicine contexts where professional interpreters may not be immediately available, helping to ensure equitable, accessible communication in both scheduled and spontaneous medical encounters.
	SDGs	SDG 3: Good Health and Well-being Ensures access to healthcare by improving communication equity for people with hearing disabilities. SDG 10: Reduced Inequalities Promotes social inclusion by addressing communication barriers faced by people with disabilities in clinical settings. SDG 4: Quality Education Indirectly supports health literacy by enabling patients to better understand medical information and make informed decisions. SDG 9: Industry, Innovation and Infrastructure Demonstrates inclusive innovation through AI technology adapted to accessibility needs.

Co-funded by the European Union

		SDG 17: Partnerships for the Goals Encourages collaboration between healthcare providers, tech developers, and disability advocacy groups.		
Type of product		This use case is a component of the following type of product/system: AI-powered real-time communication accessibility system Assistive communication technology Speech-to-text accessibility platform Inclusive digital health communication tool	**Is it a safety component?**	yes
Application area(s)		1. Healthcare and Clinical Settings Doctor–patient communication Emergency room and triage support Telemedicine and remote consultations Patient education and discharge instructions 2. Accessibility and Disability Inclusion Enabling equitable access to services for deaf and hard-of-hearing individuals Compliance with accessibility regulations (e.g., ADA, EU Accessibility Act) 3. Public Health and Health Literacy Supporting understanding of medical information Enhancing participation in informed decision-making 4. Health Administration and Front Desk Communication Scheduling, intake, and registration processes 5. Training and Medical Education		

Co-funded by the European Union

	Assisting deaf or hard-of-hearing medical students or trainees Facilitating inclusive learning environments		
Primary actor	The deaf or hard-of-hearing patient They are the main user who interacts with the AI system to receive real-time transcription and ensure effective communication during medical consultations. Secondary actors: healthcare providers (doctors, nurses, administrative staff) who speak during the consultation and whose speech is transcribed by the system.		
Stakeholders and Interests <involved and affected persons and groups>	1. Deaf and Hard-of-Hearing Patients (Primary stakeholders) Interest: Clear, autonomous access to medical information and equal communication with healthcare providers. 2. Healthcare Providers (Doctors, Nurses, Administrative Staff) Interest: Accurate, efficient communication with patients; improved patient understanding and compliance; reduced reliance on interpreters in routine situations. 3. Hospitals and Clinics Interest: Enhancing patient experience, ensuring legal compliance with accessibility standards (e.g., ADA, EU Accessibility Act), improving service delivery and patient safety. 4. Family Members or Caregivers Interest: Ensuring loved ones understand diagnoses, treatment plans, and follow-up care, especially when communication barriers	**Description**	

Co-funded by the European Union

	exist. 5. Health IT Departments Interest: Integrating smoothly with existing systems and ensuring data security, performance, and usability. 6. Accessibility Advocates and Disability Organizations Interest: Promoting inclusive healthcare technologies and ensuring meaningful participation of people with disabilities in digital health transformation. 7. Health Policymakers and Regulators Interest: Encouraging adoption of equitable digital health tools and monitoring compliance with accessibility legislation. 8. developers and AI Providers Interest: User adoption, performance validation, and product improvement based on feedback from real-world healthcare environments.		
	1. Deaf and Hard-of-Hearing Patients (Primary stakeholders) Interest: Clear, autonomous access to medical information and equal communication with healthcare providers. 2. Healthcare Providers (Doctors, Nurses, Administrative Staff) Interest: Accurate, efficient communication with patients; improved patient understanding and compliance; reduced reliance on interpreters in routine situations.		

Co-funded by the European Union

	3. Hospitals and Clinics Interest: Enhancing patient experience, ensuring legal compliance with accessibility standards (e.g., ADA, EU Accessibility Act), improving service delivery and patient safety. 4. Family Members or Caregivers Interest: Ensuring loved ones understand diagnoses, treatment plans, and follow-up care, especially when communication barriers exist. 5. Health IT Departments Interest: Integrating smoothly with existing systems and ensuring data security, performance, and usability. 6. Accessibility Advocates and Disability Organizations Interest: Promoting inclusive healthcare technologies and ensuring meaningful participation of people with disabilities in digital health transformation. 7. Health Policymakers and Regulators Interest: Encouraging adoption of equitable digital health tools and monitoring compliance with accessibility legislation. 8. Developers and AI Providers Interest: User adoption, performance validation, and product improvement based on feedback from real-world healthcare environments.	

Co-funded by the European Union

Success end condition	Deaf or hard-of-hearing patients are able to fully understand and participate in medical consultations independently and in real time, using Ava to access accurate, reliable, and contextually appropriate transcriptions of spoken communication. More specifically, success includes: Real-time transcription is accurate and understandable throughout the consultation. The patient reports feeling informed, included, and confident in the communication. No essential information is missed due to communication barriers. The healthcare provider can conduct the consultation effectively without additional delays or misunderstandings.
Failure protection	In cases where it fails to provide accurate or complete transcription (e.g. due to technical errors, poor audio quality, or complex medical language), predefined backup measures are activated. These include: Immediate availability of a certified sign language interpreter or communication assistant, either on-site or via remote video interpreting services. Fallback to written communication, such as typed dialogue or pre-prepared medical information sheets. Provider training in communication strategies for interacting with deaf or hard-of-hearing patients. These safeguards ensure that communication remains clear, ethical, and inclusive, even if the AI system underperforms or becomes unavailable.
Trigger	A medical consultation begins with a deaf or hard-of-hearing patient, prompting the activation or launch of real-time transcription system to facilitate accessible communication between the

Co-funded by the European Union

<table>
<tr><td></td><td colspan="2">patient and healthcare provider.

This trigger can be manual or automated (integrated into the clinic's patient intake or EHR system).</td></tr>
<tr><td>Main course</td><td>The patient arrives for a scheduled or walk-in medical consultation.

The patient or healthcare staff activates the device on a compatible device (e.g., tablet or smartphone).

It begins real-time transcription of spoken dialogue, identifying and labeling multiple speakers.

The patient reads the transcribed text on their device as the consultation progresses.

The conversation continues, with Ava providing live captions throughout the interaction.

The patient and provider complete the consultation, with full mutual understanding.

The patient receives any relevant summaries or follow-up instructions, with or without Ava's support.

Session ends; transcription data is securely handled or deleted, as per privacy policy.</td><td>Action

Patient identified as deaf or hard-of-hearing

Input: Patient profile or self-identification

Output: Accessibility support flag activated

Application is launched on a compatible device (tablet, smartphone, or computer)

Input: Device with internet connection and microphone

Output: interface ready for real-time use

Microphone is activated and begins listening

Input: Live spoken conversation

Output: Real-time transcription displayed on screen

Multiple speakers detected and labeled (e.g., doctor, nurse)

Input: Audio input with speaker differentiation

Output: Structured, labeled transcript

Patient reads transcription in real time

Input: Transcribed text

Output: Comprehension and engagement in consultation

Clarifications and interactions continue with it operating in the background</td></tr>
</table>

Co-funded by the European Union

		Input: Ongoing spoken communication Output: Continuous transcription support Consultation concludes Output: Complete transcript of the session (if needed or permitted) Optional Input: Request to save or share summary Goal Delivery Patient fully understands the consultation and can make informed decisions about care. Cleanup and Post-Session Handling Session is closed Action: User exits or closes the app Data is handled per privacy policy If configured: Transcript is deleted or securely stored with consent Output: Compliance with data protection requirements (e.g., GDPR, HIPAA)
Extensions	**Step**	**Branching action**
	Medical Terminology Not Recognized	If term is partially recognized → displays best-effort transcription with [uncertain] tags. If term is not recognized → provider manually types the correct term. If miscommunication risks safety → transcription paused, verbal clarification and written notes used.

Co-funded by the European Union

	Audio Quality is Poor	If it detects unclear audio → prompts for speaker to repeat. If noise persists → user is notified to relocate or switch input method. If audio remains unusable → fallback to written communication or interpreter is called.
Open Issues	Accuracy in Medical Contexts AI transcription may struggle with medical jargon, drug names, or non-standard accents, potentially leading to miscommunication. Data Privacy and Security Handling of sensitive patient conversations may raise compliance concerns under GDPR, HIPAA, etc., especially if transcripts are stored or shared. Lack of Domain Adaptation not specifically trained on clinical language or healthcare workflows, which can limit usability in complex consultations. Dependence on Internet Connectivity performance is tied to network availability, which may be unreliable in some settings. Limited Multilingual or Non-English Support Full support may be limited to certain languages, which restricts use for multilingual deaf patients. No Integration with EHR Systems Lack of direct integration into electronic health records may hinder seamless documentation or workflow.	

USE CASE (name as a short active phrase)

Co-funded by the European Union

<table>
<tr><td rowspan="3">Intended purpose</td><td>Context of use</td><td colspan="3">The AI system is used in outpatient, primary care, and home-based settings to monitor, remind, and motivate patients to follow their prescribed medication regimens. It interacts with patients via mobile apps, SMS, or voice assistants.</td></tr>
<tr><td>Scope</td><td colspan="3">AI-supported adherence interventions aim to reduce medication drop-off, improve treatment outcomes, and support behavioral change. The system identifies patients at risk of non-adherence, engages them through personalized messages or voice interactions, and alerts care teams when intervention is needed. The ultimate goal is to close the gap between prescription and actual medication intake.</td></tr>
<tr><td>SDGs</td><td colspan="3">SDG 3: Good Health and Well-being; SDG 9: Industry, Innovation and Infrastructure; SDG 10: Reduced Inequalities</td></tr>
<tr><td colspan="2">Type of product</td><td>Mobile health application; AI-powered engagement platform; Clinical decision support system (CDSS) extension</td><td>Is it a safety component?</td><td>No</td></tr>
<tr><td colspan="2">Application area(s)</td><td colspan="3">Chronic disease management; Mental health and psychiatric care; Post-operative care; Geriatric and palliative care</td></tr>
<tr><td colspan="2">Primary actor</td><td colspan="3">Patient (end-user of the AI system, responsible for medication adherence)</td></tr>
<tr><td colspan="2" rowspan="7">Stakeholders and Interests <involved and affected persons and groups></td><td>Stakeholder</td><td colspan="2">Description</td></tr>
<tr><td>Patient</td><td colspan="2">Seeks support and motivation to stay on track with medications</td></tr>
<tr><td>Primary Care Physician</td><td colspan="2">Relies on accurate adherence data to adjust treatments</td></tr>
<tr><td>Pharmacist</td><td colspan="2">Monitors refills and can intervene when adherence issues are flagged</td></tr>
<tr><td>Caregiver</td><td colspan="2">May assist patients with AI tools, especially in elderly or disabled cases</td></tr>
<tr><td>Health System Administrator</td><td colspan="2">Interested in improved outcomes and reduced hospital readmissions</td></tr>
<tr><td>Insurer / Payer</td><td colspan="2">Aims to lower long-term costs through better adherence</td></tr>
</table>

Co-funded by the European Union

	AI Tool Provider	Designs and updates the system to improve usability and predictive accuracy	
Success end condition	The patient consistently adheres to their prescribed medication schedule, leading to improved clinical outcomes, fewer adverse events, and reduced healthcare costs. Engagement with the AI system is sustained, feedback is positive, and healthcare providers report more informed and efficient consultations due to improved adherence tracking.		
Failure protection	Mechanisms to ensure that AI system errors or patient disengagement do not lead to harm: Fallback protocols: If a patient misses multiple interactions, the system automatically escalates the case to a human care coordinator. Redundancy: Critical medication reminders are duplicated via multiple channels (e.g., push notification, SMS, and voice). Override by clinician: All AI-driven suggestions and alerts are reviewable and editable by healthcare professionals. Data audit trails: System actions and patient responses are logged to allow for clinical review and troubleshooting.		
Trigger	The AI system is activated when a new medication is prescribed and documented in the patient's EHR. Alternatively, it may be triggered during chronic care onboarding or after a risk flag is raised based on previous non-adherence data or refill gaps.		
Main course	**Step**	**Action**	
	1	AI receives prescription data from the EHR.	
	2	Patient is enrolled and receives onboarding via chatbot or app.	
	3	Daily reminders and adherence check-ins are initiated.	
	4	AI monitors response patterns and identifies potential non-adherence.	
	5	Personalized messages are adapted based on behavioral and linguistic analysis.	

Co-funded by the European Union

	6	Alerts are sent to clinicians if risk thresholds are breached.
	7	Patient progress is logged and visualized in clinician dashboard.
Extensions	**Step**	**Branching action**
	1a	If a patient does not respond for 72 hours, the system escalates to a human outreach team or caregiver.
	2a	In cases of suspected side effects (detected through keyword analysis or sentiment), the system triggers a follow-up questionnaire or flags the physician.
	3a	In multilingual or low-literacy cases, AI switches to voice-based interaction and simplifies language complexity.
Open Issues	Data privacy: Ensuring HIPAA/GDPR-compliant handling of sensitive patient data across communication platforms. Bias: Risk of the AI system underperforming for certain demographic groups due to lack of representative training data. Sustained engagement: Long-term adherence to the system itself may decline, requiring continuous UX optimization. Clinical integration: Seamless and standardized integration into various EHR systems remains a technical hurdle. Accountability: Defining clear liability when automated suggestions lead to adverse outcomes.	

USE CASE - Pre Admission Symptom Collection and Triage		
Intended purpose	**Context of use**	The AI system is used before a doctor-patient interaction, in telehealth and in-person settings, to collect patient-reported symptoms and provide structured, triaged summaries for clinicians. This occurs via chatbot, online form, or voice assistant interfaces.
	Scope	To collect and triage patient symptoms efficiently before a consultation, reducing administrative time and improving the accuracy and structure of patient data shared with healthcare providers. The goal is to enable clinicians to focus on clinical reasoning and empathy rather than data collection.

Co-funded by the European Union

	SDGs	SDG 3: Good Health and Well-being; SDG 9: Industry, Innovation and Infrastructure		
Type of product		Patient-facing triage chatbot; Symptom-checker API; EHR-integrated intake tool	**Is it a safety component?**	yes
Application area(s)		Primary care; Telehealth; Emergency triage; Pediatric and geriatric care		
Primary actor		Patient (who interacts with the system to describe symptoms)		
Stakeholders and Interests <involved and affected persons and groups>		**Stakeholder**	**Description**	
		Patient	Gains a more efficient and structured interaction with healthcare services	
		Physician	Receives cleaner, structured symptom data pre-consultation, aiding diagnosis	
		Nurse/Medical Assistant	Can prioritize patient needs based on triaged information	
		Health IT Staff	Responsible for integrating and maintaining system functionality	
		Healthcare Provider Organization	Improves consultation throughput and reduces delays	
		AI Vendor	Delivers updated models and ensures safe and accurate symptom assessment	
Success end condition		Patient symptoms are accurately collected, triaged, and provided to clinicians in a structured summary before the consultation, improving diagnosis accuracy, consultation efficiency, and patient satisfaction.		
Failure protection		Includes human-in-the-loop review of flagged inputs, escalation for ambiguous or urgent symptoms, fallback to manual intake, and audit logs to review questionable data summaries.		
Trigger		System activates when a patient books an appointment or initiates a virtual care session.		
Main course		**Step**	**Action**	

Co-funded by the European Union

	1	Patient initiates consultation request.
	2	AI chatbot or voice assistant begins symptom intake.
	3	AI identifies missing data or red flags.
	4	System summarizes symptoms in structured format.
	5	Summary is sent to clinician dashboard prior to visit.
Extensions	**Step**	**Branching action**
	3a	If patient reports alarming symptoms (e.g., chest pain), the system may direct them to emergency services.
	3a	If a language barrier is detected, the system adjusts the interface or adds translation support.
Open Issues	Clinical liability in case of missed symptoms; Ensuring accessibility for low-literacy or differently-abled users; Integration variance across healthcare systems; Trust-building in underserved populations.	

Co-funded by the European Union

4.7 Using AI for personalised advertising campaings

<table>
<tr><td colspan="5">USE CASE - AI capabilities and resources for a successful advertising campaign</td></tr>
<tr><td rowspan="3">Intended purpose</td><td>Context of use</td><td colspan="3">In today's highly competitive and data-rich advertising landscape, businesses face significant challenges in reaching the right audience with the right message at the right time. Traditional advertising methods often rely on broad targeting and manual optimization, leading to inefficiencies, wasted ad spend, and suboptimal campaign performance. The sheer volume of consumer data, coupled with evolving privacy regulations and fragmented media channels, makes it increasingly difficult for marketers to gain a comprehensive understanding of their target audience and predict campaign outcomes.
AI capabilities offer a transformative solution by enabling automated data analysis, predictive modelling, personalized content generation, and real-time campaign optimization. This use case addresses the need for a more intelligent, agile, and data-driven approach to advertising, moving beyond guesswork to evidence-based decision-making. It is particularly relevant for marketing teams, advertising agencies, and businesses of all sizes seeking to maximize their advertising impact and achieve measurable results.</td></tr>
<tr><td>Scope</td><td colspan="3">The scope of this use case encompasses the entire lifecycle of an advertising campaign, from initial strategy and audience segmentation to content creation, media buying, real-time optimization, and post-campaign analysis. It includes: 1) Audience Intelligence, 2) Predictive Analytics, 3) Content Personalization & Generation, 4) Automated Media Buying & Optimization, 5) Performance Monitoring & Reporting, 6) Fraud Detection.
The focus is on integrating AI as a core component of the advertising workflow, enhancing human decision-making with data-driven insights and automation, rather than fully replacing human marketers.</td></tr>
<tr><td>SDGs</td><td colspan="3">SDG 8: Decent Work and Economic Growth; SDG 9: Industry, Innovation and Infrastructure; SDG 12: Responsible Consumption and Production; SDG 16: Peace, Justice, and Strong Institutions (indirectly through ethical AI)</td></tr>
<tr><td colspan="2">Type of product</td><td>Integrated AI Platform,
Modular AI Service, AI-Enhanced Features within Existing Platforms</td><td>Is it a safety component?</td><td>yes/no</td></tr>
<tr><td colspan="2">Application area(s)</td><td colspan="3">Digital Marketing Agencies
E-commerce
Retail & Consumer Goods
Any Business Running Online Advertising</td></tr>
</table>

Co-funded by the European Union

Primary actor	VET Institution/Educator		
Stakeholders and Interests	**Stakeholder**	**Description**	
	stakeholder name	stakeholder description	
	Students/Professionals Advertisers Marketing Teams/Managers Consumers	Students/Professionals: people who need to improve their professional knowledge and skills. Businesses Advertisers interested in maximizing ROI, increasing brand awareness, driving sales, and acquiring new customers efficiently. Marketing Teams/Managers interested in achieving campaign KPIs, optimizing ad spend, gaining deeper audience insights, and streamlining workflows. Consumers: Indirectly interested in receiving more relevant and less intrusive advertisements, leading to a better online experience.	
Success end condition	The project is considered successful when 80% of students demonstrate proficiency in using AI for design an advertising campaign. Student feedback indicates high satisfaction with the VR training, and local farming businesses report improved readiness of VET graduates. The AI tools must be accurately trained on relevant data, integrated seamlessly with existing platforms, and continuously monitored and refined for optimal performance.		
Failure protection	Failure protection includes rigorous testing of the VR simulation, regular updates to the AI algorithms, and ongoing technical support. A backup plan involves traditional, non-VR training methods. Data privacy and security measures will be implemented to protect student information. Regular evaluations will assess the system's effectiveness.		
Trigger	The primary trigger for adopting AI in advertising for "Any Business Running Online Advertising" is the desire to improve campaign performance and efficiency in a competitive digital landscape. This often stems from challenges like stagnant growth, high customer acquisition costs, inefficient ad spend, or the inability to effectively scale personalized marketing efforts.		
Main course	**Step**	**Action**	
	1	Data Ingestion & Analysis: AI systems ingest data from various sources (CRM, website	

Co-funded by the European Union

		analytics, third-party data providers) to build comprehensive user profiles.
	2	Predictive Persona Creation: Machine learning models identify clusters of users with similar attributes and behaviours, generating dynamic audience personas that predict future engagement.
Extensions	**Step**	**Branching action**
	1a	Performance Monitoring & Anomaly Detection: AI tracks metrics live, alerting to underperformance or unusual trends.
	1b	Automated Bid & Creative Adjustment: Algorithms instantly adjust bids, reallocate budgets, and suggest new creatives for better ROAS.
	2a	Varying Field Conditions: Students must adapt their equipment settings and operating techniques to optimize performance in each condition.
	2b	Varying Field Conditions: The AI system adjusts the simulation in real-time, making the conditions more challenging or easier based on the student's performance.
Open Issues		

USE CASE - Legal Frameworks, Compliance, and Ethical AI to avoid bias		
Intended purpose	**Context of use**	The increasing use of AI in advertising raises concerns about data privacy, discriminatory targeting, and algorithmic bias. This use case addresses the critical need for robust mechanisms to ensure AI-driven campaigns adhere to legal regulations (e.g., GDPR, CCPA) and ethical principles, preventing harm and maintaining consumer trust.
	Scope	The scope includes: 1) Regulatory Compliance: Adherence to data protection and advertising laws, 2) Bias Detection & Mitigation: Identifying and correcting algorithmic bias in targeting and content, 3) Transparency & Explainability:

Co-funded by the European Union

		Ensuring AI decisions are understandable and justifiable, 4) Data Governance: Secure and ethical management of consumer data, 5) Ethical Guidelines Integration: Embedding ethical principles into AI development and deployment		
	SDGs	SDG 10: Reduced Inequalities; SDG 16: Peace, Justice, and Strong Institutions; SDG 17: Partnerships for the Goals		
Type of product		Professional Certification Course University Elective/ Specialization Corporate Training Module	**Is it a safety component?**	yes
Application area(s)		Digital Marketing Legal & Compliance Departments AI Developers & Data Scientists Businesses of All Sizes		
Primary actor		VET Institution/Educator		
Stakeholders and Interests		**Stakeholder**	**Description**	
		stakeholder name	stakeholder description	
		Students/Lerners Educators/Instructors Employers. Course Providers Industry experts	Students/Learners: Seek to gain advanced AI and simulation skills for career advancement. Educators/Instructors: Design and deliver the course content effectively. Employers: Look for candidates with expertise in advanced predictive analytics. Course Providers (Universities, EdTech platforms): Develop and market the course, ensuring quality. Industry Experts: Provide real-world case studies and insights.	
Success end condition		Success is achieved when learners can confidently apply generative AI and simulation techniques to solve complex prediction problems, demonstrate improved predictive accuracy in real-world scenarios, and contribute to data-driven decision-making in their respective fields.		

Co-funded by the European Union

Failure protection	Failure protection includes rigorous testing of the sensor technology and AI algorithms, regular updates to the system based on user feedback, and comprehensive training for instructors. A backup plan involves traditional welding training methods and certified instructors. Data privacy and security measures will be in place.	
Trigger	Learners are triggered to explore ABMs when facing complex systems where individual interactions drive emergent behaviour, when needing to explore "what-if" scenarios at a granular level, or when seeking to understand system dynamics from a bottom-up perspective.	
Main course	**Step**	**Action**
	1	Master Generative AI Model Architectures. This action focuses on understanding the theoretical foundations and practical implementation of various generative AI model
	2	Apply Simulation Techniques for Prediction. This action involves utilizing simulation methods to model complex systems and generate future scenarios for improved predictions.
Extensions	**Step**	**Branching action**
	1a	Learn GANs & VAEs: Study the principles, training, and applications of Generative Adversarial Networks and Variational Autoencoders.
	1b	Explore Diffusion Models: Understand the latest advancements in diffusion models for high-fidelity data generation.
	2a	Develop Monte Carlo Simulations: Learn to use random sampling for uncertainty quantification and prediction.
	2b	Build Agent-Based Models: Design and implement simulations where individual agents interact to predict emergent system behaviours.

Co-funded by the European Union

Open Issues	

USE CASE - How to leverage generative AI models and simulations for prediction				
Intended purpose	**Context of use**	Traditional predictive models often rely on historical data patterns. Generative AI and simulations offer a powerful new approach by creating synthetic data, exploring counterfactuals, and simulating complex scenarios to improve prediction accuracy, especially in data-scarce or rapidly changing environments. This course addresses the growing need for professionals to master these advanced techniques.		
	Scope	The course scope includes: Generative Model Fundamentals: Understanding GANs, VAEs, and other generative architectures, Simulation Techniques: Monte Carlo, agent-based modelling, discrete-event simulation, Synthetic Data Generation: Creating realistic data for training and testing, Predictive Applications: Applying generative AI to forecasting, risk assessment, and scenario planning, Ethical Considerations: Addressing bias and fairness in generated data and prediction		
	SDGs	SDG 4: Quality Education SDG 8: Decent Work and Economic Growth SDG 9: Industry, Innovation and Infrastructure		
Type of product		Professional Certification, A structured program leading to a credential. Part of a broader data science or AI curriculum. Corporate Training Module	**Is it a safety component?**	yes
Application area(s)		Digital Marketing AI Developers & Data Scientists Businesses of All Sizes		
Primary actor		VET Institution/Educator		
Stakeholders and Interests		**Stakeholder**	**Description**	
		stakeholder name	stakeholder description	

Co-funded by the European Union

	Students/VET Graduates Employers Industry Associations Government Agencies Career Services	Students/VET Graduates and employers: people who need to improve their professional knowledge and skills. Industry association:which support the and re-skill of the HR for improving sector's competitiveness. Government agenciess: which set the standards for VET in the specific sector. Career Services: whcih support students, VET graduates and employees int their professional journey.
Success end condition	The project is considered successful when 90% of students achieve industry-recognized welding certifications, with a significant reduction in training time compared to traditional methods. Student feedback indicates high satisfaction, and employers report improved welding skills among graduates.	
Failure protection	Failure protection includes rigorous testing of the matching algorithms, regular updates with the latest labor market data, and ongoing collaboration with employers and VET institutions. A backup plan involves traditional job placement services and career counseling. Data privacy and security measures will be implemented.	
Trigger	The VET institution will implement the AI-powered job matching system. This includes integrating the system with their student records and career services, collecting graduate data, collaborating with employers to gather job information, and providing training to both graduates and employers on how to use the platform.	
Main course	**Step**	**Action**
	1	Profile Creation: Graduates create detailed profiles on the platform, including their skills, qualifications, and career preferences.
	2	Job Recommendations: The AI system provides graduates with a list of personalized job recommendations based on their profiles and employer needs.
Extensions	**Step**	**Branching action**
	1a	Skills Gap: The system recommends specific training resources or courses to help the graduate bridge the gap.
	1b	Skills Gap: The system suggests alternative job options that are better aligned with the graduate's current skill set.

Co-funded by the European Union

	2a	Employer Feedback: The system analyses the feedback to identify areas where the graduate may need further training or support.
	2b	Employer Feedback: The system refines its matching algorithms to improve the quality of future recommendations.
Open Issues	list of any open issues and foreseeable misuses of the system that should be taken into account, if any	

Co-funded by the European Union

4.8 AI in market research

<table>
<tr><td colspan="5">Analyse Customer Sentiment for Brand Reputation Management</td></tr>
<tr><td rowspan="3">Intended purpose</td><td>Context of use</td><td colspan="3">The AI-powered sentiment analysis system is deployed within digital marketing teams, customer support departments, and brand management agencies across various industries. It operates in global markets, analysing sentiment trends in different languages and cultural contexts. Functionally, it integrates with Customer Relationship Management (CRM) software and business intelligence tools to provide seamless insights.
The system runs on cloud-based AI models, ensuring scalability, fast processing, and real-time analysis. It is accessible via web-based platforms and mobile applications, requiring only an internet connection. The backend processing occurs on high-performance cloud servers, while users interact through desktops, tablets, and smartphones for flexibility and ease of access.</td></tr>
<tr><td>Scope</td><td colspan="3">The AI-powered sentiment analysis system is designed to help businesses track and manage brand perception by analysing customer sentiment in real time. It leverages machine learning and Natural Language Processing (NLP) to classify feedback from social media, product reviews, and online forums, identifying sentiment trends and potential risks. The system integrates seamlessly with CRM and business intelligence tools, providing real-time insights to marketing teams and customer support departments. By detecting shifts in consumer sentiment early, it enables businesses to proactively address concerns, refine marketing strategies, and protect brand reputation, ensuring a data-driven and responsive approach to reputation management.</td></tr>
<tr><td>SDGs</td><td colspan="3">The AI-powered sentiment analysis system contributes to Goal 9: Industry, Innovation, and Infrastructure by enhancing digital infrastructure with advanced AI technologies, enabling businesses to access real-time brand insights. It fosters innovation in market research, automating data-driven decisions that improve strategies and strengthen business resilience in the digital economy.

For Goal 12: Responsible Consumption and Production, the system helps companies identify and address ethical concerns in customer feedback, promoting responsible business practices. It enables businesses to detect sustainability issues, respond to customer expectations for ethical products, and reduce reputational risks, encouraging more sustainable consumption.</td></tr>
<tr><td colspan="2">Type of product</td><td>AI software system that processes textual data to generate</td><td>Is it a safety component?</td><td>no</td></tr>
</table>

Co-funded by the European Union

	sentiment insights	
Application area(s)	Brand Reputation Management: AI system used to monitor and analyze public perception, helping businesses maintain a positive brand image through data-driven decision-making. Customer Sentiment Analysis: Machine learning models process feedback from social media, product reviews, and online forums to assess consumer sentiment and detect emerging trends. Digital Marketing Optimization: AI-powered insights enable marketing teams to refine campaigns, tailor messaging, and engage with audiences more effectively based on sentiment analysis. Customer Support Enhancement: Sentiment detection helps customer service teams prioritize urgent issues, improve response strategies, and enhance overall customer experience. Crisis Management and Risk Detection: Early identification of negative sentiment spikes allows businesses to address concerns proactively, mitigating reputational risks before they escalate. Multilingual and Cross-Cultural Analysis: The system processes sentiment data across different languages and cultural contexts, ensuring accurate insights in global markets.	
Primary actor	Brand Manager The Brand Manager is responsible for overseeing brand reputation, monitoring customer sentiment, and leveraging AI-driven insights to refine marketing strategies. This person ensures that sentiment analysis findings are integrated into day-to-day operations, enabling proactive responses to customer feedback, crisis management, and brand positioning. By analyzing sentiment trends, the Brand Manager helps maintain a positive brand image and enhances customer engagement.	
Stakeholders and Interests <involved and affected persons and groups>	**Stakeholder**	**Description**
	Brand Manager	The primary user of the system, responsible for monitoring brand reputation, analysing customer sentiment, and leveraging AI insights to adjust strategies and manage crises.
	Digital Marketing Specialist	Uses sentiment analysis to optimize marketing campaigns, tailor advertisements, and improve customer engagement.
	Customer Support Manager	Analyses customer feedback to enhance support services, identify key issues, and increase customer satisfaction.

Co-funded by the European Union

	Social Media Manager	Monitors social media discussions, responds to sentiment shifts, and uses AI-driven insights to guide communication strategies.
	Data Analyst	Processes AI-generated data, creates reports, and provides detailed analytics to management and operational teams.
	Crisis Management Team	Uses AI insights to detect early signs of negative sentiment and manage crisis situations to protect brand reputation.
	Executive Leadership (CMO, CEO)	Utilizes summarized reports and insights to make strategic decisions regarding brand positioning and business operations.
	Product Development Team	Analyses customer feedback to improve products and services based on sentiment analysis.
	Customers	Indirect stakeholders whose feedback (via reviews, social media posts, etc.) is analysed by the system. Their sentiment influences brand decisions and customer experience strategies.
	Regulatory Authorities	As AI systems are used in customer sentiment analysis, regulatory bodies may have an interest in ensuring data privacy, fairness, and compliance with regulations such as the AI Act.
Success end condition	Upon successful implementation and operation of the AI-powered sentiment analysis system, the brand manager and marketing team can rely on accurate, real-time insights into customer sentiment. The system effectively identifies shifts in sentiment, enabling the business to proactively address emerging issues, refine marketing strategies, and protect brand reputation. Customer engagement improves due to more targeted communication, and any negative sentiment is addressed swiftly, preventing potential crises. The business benefits from improved brand perception, increased customer loyalty, and higher overall satisfaction. Additionally, the AI system integrates seamlessly with existing CRM and business intelligence tools, providing continuous, actionable insights and recommendations for ongoing reputation management.	
Failure protection	If the goal of implementing the AI-powered sentiment analysis system is abandoned or encounters issues, the brand manager and marketing team will revert to traditional methods of monitoring customer sentiment. This may involve manually analysing customer feedback from social media, reviews, and surveys, relying on anecdotal evidence and historical data. While this approach will still allow the team to track customer perceptions, it will be less efficient and more	

Co-funded by the European Union

<table>
<tr><td></td><td colspan="2">time-consuming, potentially leading to delayed responses to emerging sentiment trends. The business may face challenges in proactively addressing issues, and the marketing strategies may lack precision, which could affect brand reputation and customer loyalty. Basic reputation monitoring and engagement will continue, but the brand may experience slower reactions to sentiment shifts and a reduced ability to refine strategies in real-time.</td></tr>
<tr><td>Trigger</td><td colspan="2">The use case is triggered when the Brand Manager or marketing team inputs new customer feedback data (e.g., from social media, product reviews, or surveys) into the AI system, or when the system automatically collects real-time data from various online sources. This action prompts the AI system to begin analysing the sentiment of the data, identifying trends, and classifying the feedback as positive, negative, or neutral. The system then generates insights and alerts the Brand Manager and marketing team about emerging sentiment shifts, enabling them to take proactive steps in adjusting marketing strategies, addressing customer concerns, and managing the brand's reputation.</td></tr>
<tr><td rowspan="4">Main course</td><td>Step</td><td>Action</td></tr>
<tr><td>1</td><td>Data Input (Trigger) (The use case begins when customer feedback is collected or inputted into the AI system, either manually or automatically).
Action: The Brand Manager or marketing team inputs new customer feedback data (e.g., from social media, reviews, or surveys) into the AI system, or the system automatically collects real-time customer sentiment data from online platforms.
This action triggers the sentiment analysis process. Input: New customer feedback data (social media posts, product reviews, survey results). Output: Raw sentiment data processed by the AI system.</td></tr>
<tr><td>2</td><td>Data Processing and Cleansing (The raw data is processed and cleaned).
Action: The AI system cleans and processes the raw feedback data. It ensures consistency and prepares the data for analysis by removing irrelevant information, correcting errors, and structuring the data for further processing. Input: Raw sentiment data processed by the AI system. Output: Cleaned and structured data, ready for sentiment analysis.</td></tr>
<tr><td>3</td><td>Sentiment Analysis (The raw data is analysed allowing the system to classify sentiment and identify potential risks or trends).
Action: The AI system applies Natural Language Processing</td></tr>
</table>

Co-funded by the European Union

		(NLP) and machine learning algorithms to classify the sentiment of the feedback as positive, negative, or neutral. The system analyses trends and identifies emotional tones in the feedback. Input: Cleaned and structured feedback data. Output: Classified sentiment (positive, negative, neutral) for each feedback, sentiment trend data.
	4	**Trend Detection and Risk Identification** (The system identifies emerging issues or shifts in sentiment, which are crucial for managing brand reputation proactively). Action: The system identifies shifts in sentiment or emerging issues, flagging any negative sentiment that could pose a risk to the brand's reputation. The AI also detects trends over time and compares them to historical data. Input: Classified sentiment data, historical sentiment data. Output: Alerts on negative sentiment or significant sentiment shifts, risk identification.
	5	**Sentiment Insights and Recommendations Generation** (The AI system generates insights). Action: The AI system generates actionable insights and recommendations based on the detected sentiment trends, such as suggesting improvements to customer service, adjustments in brand communication, or new marketing strategies. Input: Sentiment trends, flagged issues, historical sentiment data. Output: AI-generated insights and recommendations (e.g., refine messaging, improve customer support).
	6	**Review and Adjustment by Brand Manager** (Brand Manager reviews and makes adjustments to brand strategy, marketing, and customer engagement). Action: The Brand Manager reviews the AI-generated insights and recommendations, considering brand strategies and market context, and adjusts the recommendations if necessary. The manager may modify the actions or approve them as-is. Input: AI-generated insights and recommendations. Output: Adjusted brand strategies or confirmation of actions to implement.
	7	**Action Implementation** Action: The Brand Manager and marketing team implement the updated strategies based on the AI recommendations. This may include revising marketing content, addressing customer complaints, or improving customer engagement efforts. Input: Adjusted brand strategies, new marketing plans, updated communication tactics. Output: Implemented marketing

Co-funded by the European Union

		changes, new campaigns launched, customer engagement adjustments.
	8	**Continuous Monitoring and Feedback Loop** (The system continues to provide updates, ensuring that the brand stays responsive to ongoing customer feedback). Action: The AI system continuously monitors customer feedback in real-time, providing new recommendations and adjusting sentiment analysis as fresh data is received. The Brand Manager periodically reviews these updates to ensure the brand is responsive to customer needs. Input: Continuous customer feedback data, real-time sentiment analysis. Output: Updated recommendations and insights, ongoing adjustments.
	9	**System Update and Cleanup** (The system updates its model and data pipeline to ensure it's ready for future predictions and recommendations). Action: The AI system performs cleanup by updating its data pipeline and models based on the latest data. This ensures that the system remains effective for future sentiment analysis, predictions, and recommendations. Input: Updated sentiment data, new customer feedback. Output: Refreshed AI model and data pipelines, prepared for future analysis.
Extensions	**Step**	**Branching action**
	1a	**Stock Level Deviation (Unexpected Sales Surge)** Condition Causing Branching: An unexpected surge in sales or customer feedback (e.g., triggered by a local event, seasonal demand, or viral social media mentions).
	2	**Supplier Availability Issues (Stock Shortage from Supplier)** Condition Causing Branching: A shortage in stock from suppliers, possibly due to delays or product unavailability, which may also affect customer sentiment if negative feedback on product availability surfaces.
	3	**Data Inaccuracy (Data Mismatch or Missing Data)** Condition Causing Branching: The system detects missing, inconsistent, or inaccurate data (e.g., incomplete customer feedback, errors in sentiment classification, or feedback from unreliable sources).
	4	**Low Stock Warning (Critical Inventory Level Reached)** Condition Causing Branching: If sentiment analysis reveals that

Co-funded by the European Union

		customers are commenting on a popular product that is running low or out of stock, the system raises an alert about stock issues, potentially affecting customer sentiment.
	5	**Unpredictable Market Conditions (Shifts in Customer Sentiment or Market Trends)** Condition Causing Branching: A shift in market trends or changes in customer behaviours (e.g., an emerging preference for a new product type or a social issue affecting brand perception).
Open Issues		**Bias and Fairness in Sentiment Analysis** Issue: The system may inherit biases from training data, affecting its predictions. Potential Misuse: The system could favor certain sentiments or products over others based on biased data. **Sarcasm and Irony Detection** Issue: The system may misinterpret sarcasm or irony, affecting sentiment accuracy. Potential Misuse: Malicious actors could leave sarcastic reviews that are misclassified. **Privacy and Data Security** Issue: Sensitive data, such as customer feedback, could be at risk if not properly protected. Potential Misuse: Unauthorized access to or misuse of personal data. **System Reliability and Downtime** Issue: System failures or downtimes could disrupt sentiment analysis and decision-making. Potential Misuse: Over-relying on the system without backup plans could cause operational issues during downtimes. **Misuse for Fake Reviews** Issue: Competitors might exploit the system by submitting fake negative reviews. Potential Misuse: Malicious reviews could harm the brand's reputation if misclassified. **Over-Reliance on AI Recommendations** Issue: The system may not account for all contextual factors or sudden changes. Potential Misuse: Users may over-rely on AI, ignoring their own expertise and situational factors. **Inadequate User Training**

Co-funded by the European Union

	Issue: Users may misinterpret AI outputs if not properly trained. Potential Misuse: Incorrect decisions could be made due to misunderstanding the system's recommendations.

AI-Based Consumer Privacy Protection in Market Research				
Intended purpose	**Context of use**	The AI-driven consumer privacy system is deployed within a global market research firm, "Insightful Data Solutions," handling diverse consumer datasets. The system is designed to process data from various sources like surveys, behavioural data, and demographic information. It runs on cloud-based software integrated with the firm's existing data processing pipelines, accessible via secure web portals for the firm's analysts. The AI models will be processed on the cloud servers to ensure scalable and real-time data anonymization.		
	Scope	The AI-driven consumer privacy protection system is designed to empower market research by enabling the secure and ethical analysis of consumer data. It leverages advanced AI techniques to anonymize personal information, ensuring compliance with privacy regulations while maintaining data utility for valuable insights. The system aims to facilitate responsible market research practices, fostering consumer trust and enabling data-driven decision-making without compromising individual privacy.		
	SDGs	**SDG 9 – Industry, Innovation, and Infrastructure**: AI systems for consumer privacy protection drive innovation in market research while ensuring secure and ethical data handling. **SDG 12 – Responsible Consumption and Production**: Ethical and transparent data processing supports responsible use of consumer information in market analysis. **SDG 17 – Partnerships for the Goals**: Collaboration between technology companies, regulators, and consumer protection organizations can help establish global standards for AI-driven privacy protection.		
Type of product		AI software system for data anonymization and privacy protection.	**Is it a safety component?**	yes
Application area(s)		**Anonymization of Sensitive Consumer Data**: AI is used to anonymize sensitive consumer data (e.g., name, address, phone number) in market research datasets, transforming personal identifiers into aggregated or pseudonymized data while maintaining analytical value. **Survey Data Privacy Compliance**: The AI system ensures that all survey responses are anonymized before being processed for analysis, protecting participants' privacy and ensuring compliance with privacy regulations like GDPR. **Behavioural Data Encryption:** AI applies advanced encryption techniques to behavioural data (e.g., clicks, searches, website activity) collected through digital channels, making it secure and anonymized while still usable for market research insights. **Consumer Data Consent Management**: The AI system automates the management of consumer consent for data usage, tracking and reviewing consent statuses, ensuring all research remains compliant with privacy laws.		

Co-funded by the European Union

<table>
<tr><td></td><td colspan="2">Real-Time Privacy Anomaly Detection: AI continuously monitors and analyses data access in real time, identifying potential privacy breaches or unauthorized access to personal data, enabling quick corrective actions to maintain compliance.</td></tr>
<tr><td>Primary actor</td><td colspan="2">Data Privacy Officer (DPO) is the Primary Actor because they are responsible for ensuring that AI-based privacy protection measures are effectively integrated and continuously maintained to safeguard consumer privacy and meet legal obligations.</td></tr>
<tr><td rowspan="8">Stakeholders and Interests <involved and affected persons and groups></td><td>Stakeholder</td><td>Description</td></tr>
<tr><td>Data Privacy Officers</td><td>Privacy officers ensure compliance with data privacy regulations (such as GDPR, CCPA), overseeing the protection of consumer data.</td></tr>
<tr><td>Market Researchers</td><td>Market researchers are the end-users who need data for conducting market research studies, analysing consumer behaviour, and generating insights for businesses.</td></tr>
<tr><td>Consumers</td><td>Consumers are the individuals whose data is collected and used in market research. They are the primary stakeholders whose privacy is being protected.</td></tr>
<tr><td>Market Research Agencies</td><td>Market research agencies are the organizations that conduct market research on behalf of clients, aggregating and analysing consumer data.</td></tr>
<tr><td>Regulatory Authorities</td><td>Regulatory authorities are responsible for enforcing privacy laws and guidelines that govern how consumer data should be handled (e.g., GDPR in Europe, CCPA in California).</td></tr>
<tr><td>Legal Teams</td><td>Legal teams provide guidance on data privacy laws and ensure that the company complies with both internal policies and external regulations.</td></tr>
<tr><td>Data Scientists</td><td>Data scientists analyse the anonymized data and build predictive models that help derive insights for the business.</td></tr>
<tr><td>Success end condition</td><td colspan="2">Success:
Upon successful implementation, the AI-driven consumer privacy protection system ensures accurate market insights from anonymized data while maintaining compliance with privacy regulations. The system boosts consumer trust by ethically handling personal data, enabling seamless market research without compromising privacy. It integrates smoothly with existing data pipelines, ensuring efficient, real-time processing and data analysis. This fosters consumer participation and loyalty, supporting data-driven decision-making while upholding privacy standards.
Condition:</td></tr>
</table>

Co-funded by the European Union

	The system's success relies on continuous updates to AI models to meet evolving privacy laws and research needs, a robust consent management process, and regular audits to ensure compliance. Real-time monitoring is essential for quick detection and resolution of privacy breaches.	
Failure protection	Without the AI system's automated privacy measures, the organization risks inefficiencies in data processing, higher costs, and potential delays in obtaining insights. The company may face increased legal risks due to human error in data anonymization or failure to comply with privacy regulations. Consumer trust could also diminish as privacy concerns remain unresolved, leading to lower participation in studies and reduced data quality. Overall, the ability to conduct ethical, efficient, and timely market research would be significantly compromised, with a potential negative impact on consumer engagement, data accuracy, and compliance.	
Trigger	The use case is triggered when the Market Research Analyst or Data Privacy Officer inputs new consumer data (e.g., survey responses, behavioural data, or demographic information) into the AI system, or when the system automatically collects new data from various sources. This action prompts the AI system to begin processing the data, applying anonymization techniques, and ensuring compliance with privacy regulations. The system then generates anonymized data sets that maintain their analytical value and notifies the research team when the data is ready for analysis, ensuring both privacy protection and the delivery of actionable market insights.	
Main course	**Step**	**Action**
	1	Data Input (Trigger): The use case begins when new consumer data (e.g., survey responses, behavioural data, demographic information) is inputted into the AI system, either manually or automatically. This triggers the anonymization and privacy protection process. Input: New consumer data. Output: Raw data ready for processing.
	2	Data Processing and Anonymization: The AI system processes the raw consumer data, anonymizing personal identifiers while preparing it for analysis. The system applies privacy protection techniques that comply with regulations like GDPR and CCPA. Input: Raw consumer data. Output: Anonymized data, ready for further analysis.
	3	Privacy Compliance Check: The system checks that the anonymized data meets all privacy regulations (e.g., GDPR, CCPA). If any non-compliance is detected, alerts are triggered to inform the team. Input: Anonymized data. Output: Compliance report (compliant or non-compliant).
	4	Data Analysis and Insight Generation: The AI system analyses the anonymized data to extract market research insights,

Co-funded by the European Union

		trends, and patterns, while ensuring that privacy is maintained. This process generates valuable insights for decision-making. Input: Anonymized data. Output: Market research insights (e.g., trends, behavioural patterns).
	5	Risk Identification and Privacy Monitoring: The system monitors the anonymized data for anomalies or potential privacy risks. If a breach or data exposure is detected, alerts are triggered to notify the team. Input: Anonymized data, system logs. Output: Risk alerts and anomaly reports.
	6	Privacy-Enhanced Recommendations: Based on the analysis, the AI generates actionable insights and recommendations for the market research team, ensuring that privacy is maintained and all data is handled ethically. Input: Anonymized data detected trends. Output: Insights and recommendations (e.g., target markets, new strategies).
	7	Review and Adjustments by Privacy Officer: The Data Privacy Officer reviews the AI-generated insights and compliance reports to ensure alignment with privacy regulations. Any necessary adjustments are made to maintain compliance and data protection. Input: AI insights, compliance reports. Output: Adjusted privacy protection strategies or confirmation of compliance.
	8	Implementation and Continuous Monitoring: The market research team implements the insights and recommendations, ensuring all data usage remains compliant with privacy standards. The AI system continues monitoring data and provides ongoing updates to ensure continuous privacy protection. Input: Adjusted strategies, new insights. Output: Implemented research strategies, ongoing privacy compliance updates.
Extensions	**Step**	**Branching action**
	1a	Incomplete Data (Condition: Missing or Corrupted Entries) Condition Causing Branching: If some consumer data entries are missing, incomplete, or corrupted during input, the system detects inconsistencies and flags them.
	2	Non-Compliant Anonymization (Condition: Privacy Compliance Check Fails) Condition Causing Branching: If the anonymization process

Co-funded by the European Union

		does not meet GDPR, CCPA, or other privacy regulations, an alert is triggered.
	3	Anomalous Data Patterns (Condition: Privacy Risk Detected) Condition Causing Branching: If unusual data patterns indicate potential privacy breaches (e.g., re-identifiable data), the system raises an alert.
	4	Data Sensitivity Adjustment (Condition: Higher Privacy Risk Identified) Condition Causing Branching: If specific data points are deemed too sensitive for analysis (e.g., high re-identification risk), the system flags them.
	5	Market Trends Shift (Condition: Unusual Consumer Behaviour Detected) Condition Causing Branching: If the analysis identifies unexpected market shifts or anomalies, an alert is triggered for further review.
	6	Privacy Officer Intervention (Condition: Discrepancy in Compliance Review) Condition Causing Branching: If the Data Privacy Officer finds discrepancies in AI-generated compliance reports, adjustments must be made.
	7	Automated Risk Mitigation (Condition: Continuous Monitoring Flags New Risks) Condition Causing Branching: If ongoing monitoring detects a new privacy risk post-implementation, an alert is triggered.
	8	Real-Time Policy Update (Condition: New Privacy Regulations Introduced) Condition Causing Branching: If privacy laws change or new regulations emerge, the system detects policy misalignment.
Open Issues	**De-Anonymization Risks** Issue: Although data is anonymized, advanced techniques such as re-identification attacks could potentially link anonymized data back to individuals. Potential Misuse: Malicious actors or even internal users with access to large datasets could cross-reference anonymized data with external information to uncover identities. **Compliance Drift Over Time** Issue: Privacy regulations like GDPR and CCPA constantly evolve, and the AI system may become non-compliant if updates are not properly tracked.	

Co-funded by the European Union

	Potential Misuse: Organizations relying on outdated compliance checks may unknowingly violate regulations and face legal consequences. **Bias in Data Anonymization** Issue: Anonymization techniques may disproportionately impact certain demographic groups, reducing the accuracy of insights. Potential Misuse: If anonymization reduces data granularity for specific populations, business decisions may become biased or inaccurate. **False Positives in Privacy Risk Alerts** Issue: The AI system may incorrectly flag certain anonymized datasets as high-risk, causing unnecessary workflow disruptions. Potential Misuse: An excessive number of false positives could lead to alert fatigue, causing teams to overlook real threats. **Over-Reliance on Automated Compliance Checks** Issue: Users might blindly trust the AI system's compliance verification without additional manual validation. Potential Misuse: If the system fails to detect a compliance issue, organizations could unknowingly mishandle sensitive data.

Personalized Marketing Campaigns with Ethical AI	
Context of use	Personalized marketing campaigns powered by AI-driven consumer segmentation are implemented within a multinational digital marketing agency, "TargetSmart Solutions." The system processes consumer data from various sources, including website interactions, purchase history, social media engagement, and demographic insights. It operates on a cloud-based platform that integrates seamlessly with existing customer relationship management (CRM) tools and digital advertising systems. The AI models run on secure, scalable cloud infrastructure, enabling real-time audience segmentation and automated content personalization while ensuring compliance with ethical marketing standards and data protection regulations.
Scope	The AI-driven personalized marketing campaign system is designed to enhance customer engagement by enabling precise audience segmentation and tailored content delivery. It leverages machine learning algorithms to analyse consumer behaviour and preferences, optimizing marketing strategies while adhering to ethical AI principles. The system ensures transparency, fairness, and compliance with data privacy regulations, preventing bias and intrusive targeting. By fostering responsible marketing practices, it empowers businesses to deliver relevant and personalized experiences while maintaining consumer trust.

Co-funded by the European Union

	SDGs	**Goal 9: Industry, Innovation, and Infrastructure** – Enhances digital marketing infrastructure with AI-driven consumer segmentation, promoting innovation in targeted advertising and customer engagement. **Goal 12: Responsible Consumption and Production** – Encourages ethical AI use in marketing, ensuring fair, transparent, and sustainable advertising practices. **Goal 16: Peace, Justice, and Strong Institutions** – Supports compliance with data protection regulations and ethical AI standards, fostering trust and accountability in digital marketing.		
Type of product	AI-powered digital marketing system for personalized consumer engagement and ethical audience segmentation.	**Is it a safety component?**	yes/no	
Application area(s)	Personalized Digital Marketing: AI-driven audience segmentation and content customization enhance the effectiveness of marketing campaigns, ensuring targeted and relevant messaging. Consumer Behaviour Analysis: Machine learning algorithms process consumer interactions, purchase history, and engagement data to identify trends and preferences. Ethical AI in Advertising: Ensures compliance with data privacy regulations, preventing bias, intrusive targeting, and unethical marketing practices. Customer Relationship Management (CRM) Integration: AI-powered insights help businesses optimize CRM strategies by delivering personalized recommendations and automated customer interactions. Marketing Performance Optimization: AI evaluates campaign effectiveness in real time, enabling marketers to adjust strategies for better engagement and conversion rates. Regulatory Compliance and Fairness Monitoring: The system enforces transparency in AI-driven marketing, ensuring adherence to ethical guidelines and regulatory requirements. Cross-Channel Consumer Engagement: AI personalizes marketing across multiple digital channels, including email, social media, and e-commerce platforms, for a seamless customer experience.			
Primary actor	The Marketing Data Analyst is responsible for leveraging AI-driven consumer segmentation and personalized marketing insights to optimize campaign performance. They analyse data from various sources—such as website interactions, purchase history, and social media engagement—to identify trends and refine marketing strategies. By ensuring that AI-generated recommendations align with ethical marketing principles and regulatory compliance, they help create targeted, transparent, and consumer-friendly campaigns while avoiding biases and intrusive targeting.			
Stakeholders and Interest	**Stakeholder**	**Description**		
	Marketing Teams	Use AI-driven insights to create personalized campaigns, optimize targeting strategies, and improve customer engagement.		

Co-funded by the European Union

s <involved and affected persons and groups >	Consumers	The individuals whose data is analysed for personalized marketing; their privacy, trust, and user experience are directly impacted.
	Data Privacy Officers (DPOs)	Ensure compliance with data protection laws (e.g., GDPR, CCPA), overseeing ethical AI practices and consumer data protection.
	Digital Advertising Specialists	Utilize AI-driven segmentation to improve ad placements, increase conversions, and maximize marketing ROI.
	Customer Relationship Management (CRM) Specialists	Leverage AI-powered insights to enhance customer interactions and strengthen brand loyalty.
	Regulatory Authorities	Oversee compliance with data privacy and AI ethics regulations to ensure fair and responsible AI-driven marketing practices.
	AI/ML Engineers	Develop and maintain AI models that process consumer data while ensuring transparency, fairness, and compliance with ethical standards.
	Legal Teams	Provide guidance on regulatory compliance, risk mitigation, and the responsible use of AI in marketing.
Success end condition	Upon successful implementation and operation of the AI-driven personalized marketing campaign system, TargetSmart Solutions achieves enhanced customer engagement through precise audience segmentation and tailored content delivery. The marketing team can rely on real-time, data-driven insights to optimize campaign performance while ensuring transparency, fairness, and compliance with ethical AI and data privacy regulations. Consumers benefit from relevant and non-intrusive marketing, fostering trust and improving brand perception. The system seamlessly integrates with CRM and digital advertising platforms, enabling automated, scalable, and responsible marketing practices. Businesses experience increased conversion rates, customer loyalty, and overall marketing efficiency, ensuring a competitive edge in the digital landscape. Long-term success is maintained through continuous monitoring, model updates, and compliance audits, ensuring that AI-driven personalization remains fair, unbiased, and aligned with evolving data protection regulations.	
Failure protection	If the goal of implementing the AI-driven personalized marketing campaign system is abandoned or encounters issues, TargetSmart Solutions will revert to traditional marketing methods. Marketing teams will continue relying on manual data analysis, rule-based audience segmentation, and generalized content strategies, which may result in less precise targeting and lower engagement rates. While the company can still run campaigns using existing CRM and digital advertising tools, the	

Co-funded by the European Union

<table>
<tr><td></td><td colspan="2">absence of AI-driven insights may lead to inefficiencies, increased marketing costs, and reduced personalization, potentially impacting conversion rates and customer satisfaction. Additionally, compliance with ethical AI and data privacy regulations will require more manual oversight, increasing the risk of human error in maintaining responsible marketing practices.</td></tr>
<tr><td>Trigger</td><td colspan="2">The use case is triggered when the marketing team initiates a new campaign by inputting consumer data into the AI system or when the system automatically collects and processes real-time data from various sources (e.g., website interactions, purchase history, social media engagement, and demographic insights).
This action prompts the AI system to analyse consumer behaviours, segment audiences, and generate personalized content recommendations. The system then provides insights and automated content delivery options, enabling the marketing team to launch tailored, data-driven campaigns while ensuring compliance with ethical AI and data privacy regulations.</td></tr>
<tr><td rowspan="4">Main course</td><td>Step</td><td>Action</td></tr>
<tr><td>1</td><td>Data Collection (Trigger):
The use case begins when consumer data is collected from multiple sources, including website interactions, purchase history, social media engagement, and demographic insights. This data may be gathered automatically through integrations with CRM and digital advertising platforms or entered manually by the marketing team.
Input: Consumer data from CRM, digital platforms, and customer interactions.
Output: Raw consumer data ready for processing.</td></tr>
<tr><td>2</td><td>Data Processing and Segmentation:
The AI system processes the raw data by cleaning, merging, and structuring it to remove inconsistencies and ensure accuracy. Machine learning algorithms then analyse the data to segment consumers into groups based on their behaviour, preferences, and demographic profiles.
Input: Raw consumer data.
Output: Structured and segmented customer profiles.</td></tr>
<tr><td>3</td><td>Personalized Content Generation:
Using the segmented profiles, the AI system generates personalized marketing content, including targeted advertisements, product recommendations, and email campaigns. The content is tailored to match consumer interests and maximize engagement.
Input: Customer segmentation insights.
Output: AI-generated personalized marketing messages.</td></tr>
</table>

Co-funded by the European Union

	4	**Ethical and Compliance Check:** Before deployment, the AI system evaluates the personalized marketing content to ensure compliance with data privacy regulations (e.g., GDPR, CCPA) and ethical AI principles. It detects potential biases and unfair targeting practices, triggering alerts for human review if necessary. Input: AI-generated marketing content. Output: Compliance verification report and necessary adjustments.
	5	**Campaign Launch and Optimization:** The marketing team reviews and approves the AI-generated content. Once finalized, the campaign is launched across multiple digital channels, including email, social media, and programmatic advertising networks. Input: Approved marketing materials. Output: Live personalized marketing campaign.
	6	**Real-Time Performance Monitoring:** The AI system continuously tracks campaign performance by analyzing key engagement metrics such as click-through rates, conversion rates, and customer interactions. Based on these insights, it automatically refines audience targeting and optimizes content delivery for better results. Input: Campaign engagement data. Output: AI-driven performance insights and automated optimizations.
	7	**Consumer Feedback and Adaptation:** The AI system collects consumer feedback and sentiment data to assess campaign effectiveness. It helps the marketing team refine messaging, improve targeting, and ensure a positive consumer experience. Input: Consumer feedback and campaign performance data. Output: Adaptive content and refined targeting strategies.
	8	**Continuous Improvement and Compliance Updates:** The AI system updates its models based on new consumer data and regulatory changes to maintain relevance, fairness, and compliance. The marketing team periodically reviews AI-generated insights and ethical guidelines to ensure responsible marketing practices. Input: Updated consumer behavior trends and regulatory changes. Output: Refined AI models and optimized marketing strategies.
	9	**Cleanup and System Update:** After the campaign concludes, the AI system finalizes the data, removing outdated information and updating the marketing database. Insights gained from the campaign are stored for future learning, ensuring continuous improvement in future campaigns.

Co-funded by the European Union

		Input: Finalized campaign data, performance reports. Output: Clean database and improved AI model for future marketing efforts.
Extensions	**Step**	**Branching action**
	1a	**Incomplete or Corrupted Data** (Condition: Missing or Inaccurate Consumer Information) Condition Causing Branching: If consumer data is incomplete, missing, or contains errors, the system flags the issue.
	2	**Privacy Compliance Issue** (Condition: Non-Compliance with GDPR, CCPA, or Other Regulations) Condition Causing Branching: If AI-generated marketing content does not meet privacy regulations, an alert is triggered.
	3	**Unexpected Consumer Behavior** (Condition: Market Trends Shift Rapidly) Condition Causing Branching: If real-time consumer engagement differs significantly from predictions, the system detects a deviation.
	4	**Low Engagement Performance** (Condition: Campaign Underperforms in Real-Time) Condition Causing Branching: If click-through rates or conversions are below expectations, the system flags the issue.
	5	**Consumer Opt-Out or Data Deletion Request** (Condition: Privacy Preferences Change) Condition Causing Branching: If a consumer opts out of data tracking or requests data deletion, the system detects and updates records.

Co-funded by the European Union

Open Issues	**AI Model Overfitting to Consumer Data** Issue: The AI system may overfit its models to historical consumer data, resulting in poor generalization to new or unseen data. Potential Misuse: Overfitting could lead to overly tailored content based on past consumer behavior, missing opportunities to engage with emerging trends or new consumer segments. **Inadequate Transparency in AI Decisions** Issue: Consumers or stakeholders may not fully understand how AI-generated content decisions are made, leading to concerns about algorithmic transparency. Potential Misuse: Lack of transparency could result in public distrust, potentially causing backlash against the brand or regulatory scrutiny. **Consumer Data Inaccuracy and Fragmentation** Issue: Inaccurate or fragmented consumer data can lead to ineffective personalization, as the AI system may use incomplete profiles to generate content. Potential Misuse: If inaccurate data is used, consumers may receive irrelevant offers, reducing engagement and trust. **Data Retention and Deletion Challenges** Issue: Managing consumer data in accordance with data retention policies can be difficult, particularly when handling requests for data deletion or modification. Potential Misuse: Non-compliance with consumer requests to delete or modify their data could result in legal consequences and damage to brand reputation. **Over-Personalization and Consumer Fatigue** Issue: Over-personalization may overwhelm consumers, leading to a feeling of manipulation or invasion of privacy. Potential Misuse: Consumers may opt-out or feel discomforted by invasive targeting, resulting in lower engagement and negative brand perception. **Campaign Effectiveness vs. Ethical Boundaries** Issue: AI-driven personalization might push ethical boundaries by using consumer data in ways that feel manipulative or overly persuasive. Potential Misuse: The system could create hyper-targeted content that exploits consumer vulnerabilities, leading to accusations of unethical manipulation.

Co-funded by the European Union

4.9 AI in Customer Service - use of chatbots / virtual assistants and personalised suggestions

<table>
<tr><td colspan="5">Customer emotion detection for beauty brands</td></tr>
<tr><td rowspan="3">Intended purpose</td><td>Context of use</td><td colspan="3">The AI system is deployed in various settings, including online and in-store virtual makeup applications, automotive environments, and embedded systems. It operates on multiple hardware platforms such as Windows, macOS, Linux, Android, iOS, HTML5, Xilinx, Raspberry Pi, and Ambarella. The system is optimized for real-time performance with low computational requirements. It functions effectively both online and offline, ensuring privacy and broad applicability across different geographical and functional contexts.</td></tr>
<tr><td>Scope</td><td colspan="3">The intended use case is to enhance customer engagement and personalization in the beauty industry through real-time emotion recognition. By analyzing facial expressions during virtual makeup, the system provides immediate feedback on customer preferences, allowing brands to tailor product recommendations and marketing strategies accordingly. The technology is designed for integration into various platforms, ensuring broad applicability across different retail environments.</td></tr>
<tr><td>SDGs</td><td colspan="3">SDG 9: Industry, Innovation and Infrastructure
SDG 12: Responsible Consumption and Production - reducing overproduction and waste by aligning offerings with actual consumer preferences</td></tr>
<tr><td colspan="2">Type of product</td><td>AI emotion recognition system integrated into virtual makeup applications. Visage|SDK FaceAnalysis</td><td>Is it a safety component?</td><td>no</td></tr>
<tr><td colspan="2">Application area(s)</td><td colspan="3">Retail and marketing
Automotive industry
Healthcare
Banking and financial services
Gaming and entertainment
Social robotics</td></tr>
<tr><td colspan="2">Primary actor</td><td colspan="3">Customer - know what your customers truly feel</td></tr>
</table>

Co-funded by the European Union

Stakeholders and Interests <involved and affected persons and groups>	**Stakeholder**	**Description**
	Customers	Individuals using virtual makeup applications who interact with the AI system
	Beauty brands	Companies implementing emotion recognition technology to enhance customer engagement
	Retailers	Stores that integrate emotion recognition systems
	Marketing teams	Professionals utilizing emotional data to assess the effectiveness of marketing materials and campaigns
	Product developers	Teams analyzing emotional responses to refine product features
	Technology providers	Companies like Visage Technologies that develop and supply the emotion recognition software
	Data analysts	Experts interpreting the emotional data collected for business strategies
	Regulatory bodies	Organizations ensuring that the implementation of emotion recognition technology complies with privacy laws and ethical standards
Success end condition	Beauty brands can achieve a more personalized and engaging customer experience. Also, brands can tailor product recommendations and marketing strategies to align with individual customer preferences. This leads to increased customer satisfaction, improved conversion rates, and valuable insights into consumer behavior, ultimately enhancing brand loyalty and driving business growth.	
Failure protection	The system is designed to ensure that no sensitive personal data is stored or processed. FaceTrack processes images with human faces without storing them or sending them to the server. It does not extract, compute, or analyze any descriptors that could be used for identification purposes. It does not collect data anonymously, or transmit data to any third parties. This approach maintains user privacy and complies with data protection regulations, such as GDPR.	
Trigger	The trigger for initiating the customer emotion detection use case is the customer's engagement with a virtual makeup application. When a customer accesses the application and begins a virtual try-on session, the system's camera detects their face. This action activates the emotion recognition process, enabling real-time analysis of the customer's facial expressions to assess their emotional responses to different makeup products.	
Main course	**Step**	**Action**

Co-funded by the European Union

	1	**Customer Initiates Virtual Try-On Session** Input: Customer accesses the virtual makeup application and activates the camera. Output: Live video feed capturing the customer's face.
	2	**Face detection** Input: Live video feed from the customer's camera. Process: When detecting the face, the algorithm extracts meaningful features from it, capturing essential information about its structure and expression. Output: Continuous tracking data of facial landmarks
	3	**Emotion classification** Input: Facial tracking data from the previous step. Process: Using a pre-trained model, it immediately classifies the face into one of several emotional categories (e.g., happy, sad, surprised). The model has learned from tens of thousands of examples with various facial expressions, allowing it to recognize emotions without first having to specify which AUs are active. Output: Identified emotional states with corresponding confidence levels.
	4	**Personalized product recommendations** Input: Detected emotional responses and customer interaction data. Process: Provided personalized product recommendations based on emotional responses. The system correlates positive emotional reactions with specific makeup products tried during the session. Output: Tailored product suggestions that align with the customer's preferences.
	5	**Data collection for business insights** Input: Anonymized data on customer interactions and emotional responses Process: Aggregation and analysis of data to identify trends and inform product development and marketing strategies. Output: Actionable insights for business decision-making.
	6	**Session completion and cleanup** Input: End of the customer's virtual try-on session. Process: The system ensures that no personal images or identifiable information are stored, maintaining user privacy and complying with data protection regulations. Output: Secure termination of the session with preserved user privacy.
Extensions	**Step**	**Branching action**
	2a	**Face not detected** Condition: The system fails to detect a face due to factors like poor lighting,

Co-funded by the European Union

		obstructions, or camera issues. **Branching action**: The application prompts the user to adjust their environment or device (e.g., improve lighting, remove obstructions, or reposition the camera) to enable face detection. Outcome: Once adjustments are made, the system attempts face detection again.
	2b	**Bias in facial recognition systems** Condition: Facial recognition algorithms may exhibit racial and gender biases when trained on datasets lacking diversity. This can lead to decreased accuracy in recognizing individuals from underrepresented demographic groups. **Branching action**: To address this, developers are incorporating more diverse training datasets and refining machine learning models. Human annotators play a crucial role by labeling data across various demographics, ensuring cultural sensitivity and balanced representation. Outcome: These efforts enhance the system's ability to accurately recognize a wide range of facial features and skin tones, thereby reducing bias and improving overall performance.
	2c	**Multiple faces detected** Condition: The camera captures more than one face, such as when another person enters the frame. **Branching action**: The system notifies the user and requests that only one face be present in the frame to ensure accurate analysis. Outcome: After ensuring only one face is visible, the system resumes the emotion detection process.
	3a	**Facial spoofing and impersonation** Condition: Facial recognition systems can be vulnerable to spoofing attacks, where an unauthorized individual attempts to deceive the system using photos, videos, or 3D masks to impersonate someone else. **Branching action**: To counteract these threats, Visage Technologies' FaceRecognition solution incorporates Liveness Detection. This feature prompts users to perform simple facial actions, such as blinking or smiling, and verifies these actions to confirm the presence of a live person rather than a static image or mask. Outcome: By implementing Liveness Detection, the system significantly reduces the risk of unauthorized access through spoofing, ensuring that only genuine, live users can be authenticated.
	3b	**Inconsistent emotion labeling** Condition: Due to the subjective nature of human expressions, annotators may label the same facial expression differently, leading to inconsistent emotion labels in the training dataset.

Co-funded by the European Union

		Branching action: The system aggregates multiple annotations to determine a consensus label or employs probabilistic models to handle label uncertainty. Outcome: Enhanced model robustness to labeling inconsistencies, improving generalization to diverse emotional expressions.
	3c	**Differentiating mood from emotion** Condition: The system confuses long-term mood states with short-term emotional expressions, leading to misclassification. **Branching action**: Integrated temporal analysis and context-aware models to distinguish between transient emotions and enduring moods. Outcome: Enhanced ability to accurately identify and differentiate between moods and emotions.
	3d	**Age-related recognition challenges** Condition: The model's performance varies across age groups due to differences in facial features and expressions associated with aging. **Branching action**: Incorporated age-diverse training data and, if necessary, develop age-specific sub-models to account for these differences. Outcome: Consistent emotion recognition performance across various age demographics.
Open Issues	User privacy -> how will the system ensure that emotional data is collected, stored, and processed in compliance with GDPR and other data protection regulations? Ethical use of emotion detection -> is it ethically acceptable to analyze users' emotions without their full understanding of the purpose and implications of such analysis? Potential data misuse -> is there a risk that emotional data could be exploited for manipulative marketing or profiling? Limited user awareness -> do users truly understand what it means to have their emotions read? Should there be a mechanism for transparency and informed consent?	

Try Makeup Virtually with AR		
Intended purpose	**Context of use**	E-commerce and in-store digital mirror experiences in the beauty and cosmetics sector.
	Scope	Enable users to virtually try on makeup products using AR, improving confidence in purchase decisions and reducing need for physical product testing.

Co-funded by the European Union

	SDGs	**SDG 3: Good Health and Well-being** **SDG 9: Industry, Innovation and Infrastructure** **SDG 12: Responsible Consumption and Production**		
Type of product		AR-enhanced mobile and web application for cosmetics testing.	**Is it a safety component?**	No
Application area(s)		Retail and E-commerce Customer Experience Beauty and Cosmetics Industry Digital Marketing		
Primary actor		Consumer (makeup user/shopper)		
Stakeholders and Interests <involved and affected persons and groups>		**Stakeholder**	**Description**	
		Sephora (Business owner)	Increases customer satisfaction, brand loyalty, and reduces returns	
		Makeup brands	their interest lies in boosting product sales by enabling more potential customers to virtually try on products, thereby expanding their reach, enhancing brand visibility, and engaging a broader audience online.	
		AR/AI Tech Providers	Provide facial recognition and AR rendering software	
		Regulators (Data Protection)	Ensure privacy and ethical use biometric data	
		Influencers & Social Media Users	Share AR-based looks, promoting products and generating organic reach	
		Store Associates	Assist in digital try-on setup or integration in physical locations	
		Consumers	Can try makeup virtually, improving hygiene and personalization	
Success end condition		Consumers confidently purchase products based on realistic virtual try-on experience, leading to reduced return rates and improved brand engagement.		

Co-funded by the European Union

Failure protection	Fallback to manual product recommendation or store testing; user can disable facial recognition; clear privacy notices ensure data protection compliance.	
Trigger	The user opens the Sephora app or AR mirror in-store and selects the "Virtual Artist" feature to try makeup digitally.	
Main course	**Step**	**Action**
	1	**User Engagement and Entry Point** - User opens the Sephora mobile app or approaches an in-store digital AR mirror. - The "Virtual Artist" feature is promoted through the homepage, product pages, or QR codes in-store.
	2	**Facial Recognition & AR Setup: -**The app/mirror activates the user's camera and detects facial landmarks using AR and AI. -Users grant camera permissions and receive a clear privacy notice (biometric data, storage, etc.).
	3	**Product Selection:** -User browses or searches for makeup products (lipsticks, eyeshadows, foundation, etc.). -They can select individual items or curated looks for virtual application.
	4	**Real Time Virtual Try-on:** - Selected products are applied digitally to the user's face in real time via AR. - Users can adjust colors, angles, or combinations to see how various products look.
	5	**Comparison and Customization:** - Users can compare before/after looks or try different shades. - It allows skin tone detection or personalized reccomendations based on facial analysis.
	6	**Social Sharing (optional) -**Users may share their virtual look on social media directly

Co-funded by the European Union

		from the app. -Promotes viral marketing and encourages peer recommendations.
	7	**Purchase Integrations:** Users can add items to cart if they like the products.
	8	**Post engagement:** Users receive follow up emails or personalized ads based on the product they tried on. - Data is used for improving recommendations systems and marketing.
Extensions	**Step**	**Branching action**
	1	User skips camera access
	2	User uploads a photo instead of using real-time AR
	3	User dislikes the suggested shade
	4	User denies data permissions
Open Issues	**list of any open issues and foreseeable misuses of the system that should be taken into account, if any**	
	1	Privacy and data protection: Users' facial data may be collected and stored without clear consent or transparency. This raises concerns about compliance with privacy regulations like GDPR.
	2	Technology limitations: Poor lighting or low-resolution cameras can reduce the accuracy of the virtual try-on. This may lead to unrealistic expectations or frustration.
	3	Impact on self-image: Excessive use of AR filters can contribute to unrealistic beauty standards. This may negatively affect users' mental health, especially among teens
	4	Inaccurate feedback: Users might leave negative or overly positive reviews based solely on virtual try-ons. This could distort

Co-funded by the European Union

		product ratings and affect other shoppers' decisions.
	5	Bias in AR rendering: The system may not accurately represent makeup on diverse skin tones. This could result in exclusion or dissatisfaction among certain user groups.
	6	Limited geographical availability: The Sephora Virtual Assistant and AR try-on feature are not available in all countries, limiting global access and excluding potential users based on location. This creates inequality in user experience and reduces the reach of the technology.

USE CASE - Amazon Just Walk Out Technology		
Intended purpose	**Context of use**	Amazon Just Walk Out Technology is deployed in retail environments such as Amazon Go stores, grocery stores, and third-party retail partners. It allows customers to enter a store, pick the items they want, and leave without stopping at a checkout. The system uses a combination of computer vision, sensor fusion, and deep learning to track items selected by customers. The data is processed in real time through cloud-based infrastructure, with seamless interaction via smartphones or store-provided entry codes. This technology enables a frictionless shopping experience and is transforming retail operations worldwide.
	Scope	Amazon Just Walk Out Technology aims to eliminate checkout lines and redefine the in-store shopping experience. It uses advanced AI and sensor technologies to detect when products are taken or returned to shelves and maintains a virtual cart for each customer. The technology automatically charges customers upon exit, based on their digital payment method. This innovation improves customer satisfaction by reducing wait times, streamlining operations for retailers, and providing valuable shopping behavior data.
	SDGs	**Goal 9:** Industry, Innovation, and Infrastructure – The technology fosters innovation in the retail sector, improving operational efficiency and enabling data-driven inventory and

Co-funded by the European Union

		staffing decisions. **Goal 12:** Responsible Consumption and Production – It helps optimize supply chains and reduce waste by tracking product movement and consumer preferences, allowing for smarter restocking and sustainable inventory management.		
Type of product		AI-based retail automation system with real-time object detection and payment processing	**Is it a safety component?**	No
Application area(s)		**Retail Automation:** Enables autonomous shopping experiences by eliminating the need for traditional checkout processes. **Customer Experience Optimization:** Offers a seamless shopping journey with no checkout queues, enhancing convenience and satisfaction. **Inventory Management:** Real-time tracking of items improves accuracy and efficiency in stock management. **Operational Efficiency**: Reduces labor costs and speeds up the shopping process, freeing staff to focus on customer service. **Data Analytics**: Provides retailers with insights into customer behavior, helping them improve store layouts, promotions, and product offerings. **Loss Prevention:** Reduces shrinkage through precise monitoring and item tracking technologies.		
Primary actor		Store Operations Manager The Store Operations Manager is responsible for ensuring the smooth functioning of the Just Walk Out system. This includes managing technical performance, responding to system alerts, monitoring customer flow, and leveraging usage insights for operational improvements. The manager ensures that the technology is integrated into daily store operations and delivers a consistent, seamless experience for customers.		
Stakeholders and Interests <involved and affected persons and groups>		**Stakeholder**	**Description**	
		Store Operations Manager	Oversees technology performance, ensures customer satisfaction, and handles system alerts or escalations.	
		IT Support Specialist	Maintains the hardware and software components of the	

Co-funded by the European Union

		system, resolves technical issues.
	Retail Staff	Supports customer needs and addresses any confusion or technical issues in-store.
	Product Managers	Use insights to improve store layout and inventory placement based on shopping behavior.
	Data Analysts	Analyze customer flow, item selection, and dwell time for strategic decisions.
	Retail Customers	Experience convenient, line-free shopping; their satisfaction is key to adoption.
	Payment System Provider	Ensures secure and seamless transactions upon customer exit.
	Third-party Retail Partners	Adopt the technology to improve customer experience and streamline operations.
	Privacy and Security Officers	Ensure compliance with data protection regulations and manage customer consent and transparency.
	Local Authorities	Monitor compliance with public safety and retail operation regulations.
Success end condition	The technology functions without interruption, enabling customers to shop and exit without delays. The system accurately identifies and bills all items taken, customers receive correct receipts, and the store gains valuable insights for inventory and layout optimization. Customer satisfaction increases due to reduced wait times and a modern shopping	

Co-funded by the European Union

	experience, while the store benefits from operational efficiency and competitive advantage.	
Failure protection	If the system fails (e.g., due to hardware malfunction or inaccurate billing), staff intervene to assist customers manually, using purchase logs and camera data to verify transactions. Traditional checkout is available as a backup, and the system logs errors for IT review. In the event of consistent failure, operations may revert to traditional models temporarily while issues are addressed.	
Trigger	The use case is triggered when a customer enters a store using a QR code, app, or credit card to gain access. The system activates sensors and cameras to begin tracking customer movements and item interactions throughout the store.	
Main course	**Step**	**Action**
	1	**Customer Entry –** Customer enters using the store's access method (QR code, app, or payment card). System initializes tracking.
	2	**Item Detection –** Cameras and sensors monitor when items are taken or returned to shelves. AI updates the customer's virtual cart.
	3	**Product Identification –** The system uses computer vision to recognize products with high accuracy.
	4	**Real-Time Cart Management –** The virtual cart is updated instantly with every item interaction.
	5	**Exit and Payment –** Customer exits store; the system finalizes the cart and charges the linked payment method automatically.

Co-funded by the European Union

	6	**Receipt Delivery –** A digital receipt is sent to the customer's email or app with a list of purchased items.
	7	**System Monitoring –** Staff monitor the system for issues or alerts via dashboards and intervene if anomalies are detected.
	8	**Operational Insights –** Usage data is analyzed to improve store layout, product stocking, and staffing decisions.
	9	**System Maintenance –** IT teams update models, perform diagnostics, and address technical issues as needed.
Extensions	**Step**	**Branching action**
	2a	**Unrecognized Item Picked –** Item lacks proper label or is obscured; system alerts staff for assistance.
	3a	**Customer Changes Mind –** Returned item is misclassified; system reanalyses shelf activity for accuracy.
	5a	**Payment Failure –** Linked card is declined; customer is notified and prompted to update payment method.
	6a	**Receipt Discrepancy –** Customer reports incorrect receipt; staff reviews logs and camera footage to verify.

Co-funded by the European Union

	7a	**Hardware Malfunction –** Sensor or camera fails; system initiates failover and alerts IT support.
	9a	**Model Drift Detected –** Item recognition performance drops; retraining or recalibration is initiated.
Open Issues	**Privacy and Data Use** Issue: Concerns over tracking and personal data collection. Potential Misuse: Data used beyond stated purposes without user consent. **System Accuracy and Bias** Issue: Potential errors in product identification or tracking. Potential Misuse: Misclassification leading to false charges or loss of customer trust. **Network Reliability** Issue: System depends on continuous internet connectivity. Potential Misuse: Network outages could disrupt store operations. **Customer Trust and Transparency** Issue: Customers may not understand how the system works. Potential Misuse: Lack of transparency could reduce adoption or create legal challenges. **Accessibility and Inclusion** Issue: Some customers (e.g., elderly, those without smartphones) may find the system difficult to use. Potential Misuse: Risk of excluding segments of the population from easy access to services. **Scalability and Maintenance** Issue: Managing updates and troubleshooting across multiple locations. Potential Misuse: Inconsistent performance could damage brand image or customer experience.	

Co-funded by the European Union

4.10 AI-Driven Inventory and Logistics Automation

<table>
<tr><td colspan="5">USE CASE (AI-Powered Inventory Forecasting for Retail Stores)</td></tr>
<tr><td rowspan="3">Intended purpose</td><td>Context of use</td><td colspan="3">AI-driven inventory forecasting system for retail stores to optimize stock levels, reduce overstock and stockouts, and improve supply chain efficiency. The system will be deployed in big retail chains and small businesses, utilizing cloud-based AI models and edge computing hardware integrated into point-of-sale (POS) systems and warehouse management software.</td></tr>
<tr><td>Scope</td><td colspan="3">The use case is designed to enhance inventory forecasting using machine learning models. Drawing on historical sales history, seasonal cycles, and live demand fluctuations, the system provides automated stock level recommendations to prevent waste, prevent lost sales, and maximize cash flow management.</td></tr>
<tr><td>SDGs</td><td colspan="3">- SDG 8: Decent Work and Economic Growth
- SDG 9: Industry, Innovation, and Infrastructure
- SDG 12: Responsible Consumption and Production
- SDG 17: Partnerships for the goals</td></tr>
<tr><td colspan="2">Type of product</td><td>AI-driven inventory management system</td><td>Is it a safety component?</td><td>no</td></tr>
<tr><td colspan="2">Application area(s)</td><td colspan="3">- Retail inventory management
- Wholesale distribution
- Supply chain optimization</td></tr>
<tr><td colspan="2">Primary actor</td><td colspan="3">Retail Inventory Manager</td></tr>
<tr><td colspan="2" rowspan="5">Stakeholders and Interests <involved and affected persons and groups></td><td>Stakeholder</td><td colspan="2">Description</td></tr>
<tr><td>Retailers</td><td colspan="2">Benefit from reduced stockouts and overstock, improving profitability</td></tr>
<tr><td>Warehouse Managers</td><td colspan="2">Improve stock planning and reduce unnecessary storage costs</td></tr>
<tr><td>Customers</td><td colspan="2">Experience better product availability and fewer out-of-stock issues</td></tr>
<tr><td>AI System Providers</td><td colspan="2">Gain insights to improve forecasting models and services</td></tr>
<tr><td colspan="2">Success end condition</td><td colspan="3">Retailers maintain optimal inventory levels with minimal overstock and stockouts, improving revenue and operational efficiency.</td></tr>
</table>

Co-funded by the European Union

Failure protection	In case of AI system failure, retailers can manually adjust stock levels based on historical data and predefined safety stock policies.	
Trigger	The AI system analyses real-time sales data and triggers inventory restocking recommendations when predicted stock levels fall below optimal thresholds.	
Main course	**Step**	**Action**
	1	AI system collects historical sales data and real-time sales trends from POS systems and warehouses.
	2	Machine learning models process data to identify demand patterns and predict future inventory needs.
	3	AI generates automated stock recommendations and alerts for inventory managers.
	4	Inventory managers review recommendations and approve automated restocking orders.
	5	Orders are placed with suppliers or warehouses based on AI-driven insights.
	6	The system continuously updates based on new data and refines future predictions.
Extensions	**Step**	**Branching action**
	3a	If an unexpected demand spike occurs, AI suggests urgent replenishment options.
	5a	If a supplier delay is detected, the system proposes alternative suppliers or adjusts forecasts accordingly.
Open Issues	- Potential biases in AI forecasts due to incomplete or outdated data. - Resistance from inventory managers who may be hesitant to rely on AI-driven decision-making. - Integration challenges with existing ERP and POS systems in different retail businesses.	

USE CASE - AI in SME inventory management

Co-funded by the European Union

Intended purpose	**Context of use**	The AI-driven inventory management system is deployed in a small, local flower shop, "Petals & Blooms," located in an urban area with a fluctuating demand based on seasons and local holidays. The system is designed to handle data from various sources like sales reports, market trends, and supplier information. It runs on cloud-based software integrated with the shop's existing inventory management software, accessible via desktop and mobile devices for the store's managers. The AI models will be processed on the cloud servers to ensure quick, scalable, and real-time data analysis.		
	Scope	The AI-driven inventory management system is designed to optimize stock levels for a local flower shop by predicting demand and automating stock replenishment. The system leverages machine learning models to forecast stock needs based on historical sales data, seasonal trends, and market insights. It integrates seamlessly with existing inventory systems, providing real-time recommendations for stock orders, thereby reducing waste and avoiding stockouts. The primary aim is to improve inventory efficiency and minimize operational costs while enhancing customer satisfaction through timely product availability.		
	SDGs	Decent Work and Economic Growth: By optimizing inventory, the system helps the flower shop reduce waste and improve efficiency, ultimately leading to cost savings, business growth, and the creation of sustainable jobs. Industry, Innovation, and Infrastructure: The integration of AI into inventory management encourages innovation in the shop's operations, enhancing business processes through technology and improving the overall infrastructure of small retail businesses. Responsible Consumption and Production: By minimizing waste through better stock management and demand forecasting, the AI system supports more responsible consumption and production, ensuring flowers and other products are used efficiently. Climate Action: Efficient inventory management reduces overproduction and waste, contributing to a reduction in carbon footprints and fostering more sustainable practices in the flower industry.		
Type of product		The system is an AI-powered software that integrates machine learning models to optimize inventory levels, predict stock requirements, and automate	**Is it a safety component?**	no

Co-funded by the European Union

	ordering processes for businesses like flower shops. It can be deployed in small to medium-sized retail businesses and is designed to work with both proprietary and open-source inventory management systems to enhance efficiency and reduce operational costs.		
Application area(s)	Retail Inventory Management: AI system applied to optimize stock levels, automate ordering processes, and reduce waste in retail environments, such as flower shops and other small businesses. Supply Chain Management: AI tools used to enhance the flow of products, ensuring timely procurement and efficient distribution based on demand forecasting. Predictive Analytics for Sales: Machine learning models to analyze historical data and predict future sales, helping businesses plan for seasonal variations and market trends. Sustainability in Retail: The system supports sustainable business practices by reducing overstock and minimizing product waste, contributing to environmentally responsible retail operations.		
Primary actor	Inventory Manager The Inventory Manager is responsible for overseeing stock levels, reviewing AI-driven recommendations, and making decisions about inventory replenishment. This person ensures that the system's insights are applied in the shop's day-to-day operations to optimize stock management, reduce waste, and maintain sufficient stock for customer demand.		
	Stakeholder	**Description**	

Co-funded by the European Union

Stakeholders and Interests	Inventory Manager	Inventory Manager Description: The primary user who manages the shop's inventory. Interested in using AI-driven recommendations to optimize stock levels, reduce waste, and improve profitability. They rely on accurate predictions to ensure they have enough stock without overordering. Flower Shop Owner Description: The shop owner has a vested interest in the profitability and efficiency of the business. They are interested in the AI system for its potential to reduce costs, improve operational efficiency, and increase customer satisfaction by ensuring timely availability of products. Suppliers Description: Flower and supplies vendors who provide inventory to the shop. They are interested in accurate forecasts of demand to ensure timely deliveries and reduce the risk of overstocking or understocking, which can affect their relationship with the shop. Customers Description: The end customers of the flower shop who are interested in having a wide variety of fresh flowers available for purchase. They benefit from better stock availability due to optimized inventory management and improved customer service. AI System Provider/Developer Description: The developers or companies providing the AI technology. They are interested in ensuring that their system works seamlessly and delivers value to the flower shop, while also gathering feedback for further improvements to the product. Data Scientists/Analysts Description: The professionals who help build, maintain, and optimize the machine learning models. Their interest lies in ensuring that the AI models are accurately predicting stock levels and adapting to changing trends.
		Upon successful implementation and operation of the AI-driven inventory management system, the flower shop experiences optimized stock levels, minimizing both overstock and stockouts. The Inventory Manager is able to rely on accurate, data-driven predictions for stock replenishment, ensuring the shop always has the right amount of flowers and supplies for customer demand. Waste is reduced, costs are lowered, and the business achieves higher profitability and customer satisfaction due to better product availability. Additionally, the AI system integrates seamlessly

Co-funded by the European Union

	with the existing inventory software, providing continuous, real-time insights and recommendations.		
Success end condition	If the goal of implementing the AI-driven inventory management system is abandoned or encounters issues, the flower shop will revert to its previous inventory management processes. The Inventory Manager will continue to manually track stock levels, relying on historical sales data and intuition for stock replenishment. While this process may result in some inefficiencies, overstocking, or stockouts, it ensures that the shop can continue operations without the AI system. Basic inventory tracking and ordering will still be maintained, though the shop may face higher operational costs and reduced ability to predict future demand accurately.		
Failure protection	The use case is triggered when the Inventory Manager inputs a new sales data set into the AI system, or when the system automatically collects real-time sales data and market trends. This action prompts the AI system to begin analyzing the data, forecast demand, and provide inventory recommendations based on the shop's historical sales, seasonal trends, and upcoming market conditions. The system then generates stock optimization suggestions and alerts the Inventory Manager to take action for replenishment or adjustments.		
Trigger	**Step**	**Action**	
Main course	1	Data Input (Trigger) Action: The Inventory Manager inputs new sales data into the AI system, or the system automatically collects real-time sales data, market trends, and supplier information. Input: New sales data, current stock levels, historical sales data, market trend reports, supplier data. Output: Raw data processed by the AI system.	
	2	Data Processing and Analysis Action: The AI System cleans, merges, and processes the collected data. It ensures data consistency and readiness for machine learning models. Input: Raw sales data, market trends, historical sales, and supplier data. Output: Cleaned and structured data ready for analysis.	

Co-funded by the European Union

	3	Machine Learning Model Application Action: The AI System applies machine learning models (classification and regression) to predict future stock requirements based on sales trends and market patterns. Input: Processed data (historical sales, current inventory, market trends). Output: Predicted stock requirements, demand forecasts, recommended order quantities.	
	4	Stock Optimization and Recommendation Generation Action: The AI System generates real-time recommendations for the Inventory Manager on stock replenishment based on predicted demand. This may include suggestions for adjusting inventory levels for specific flowers or other supplies. Input: Predicted stock levels, demand forecasts, historical sales data. Output: Recommendations for stock replenishment or reduction, alerts for low or overstocked items.	
	5	Review and Adjustment by Inventory Manager Action: The Inventory Manager reviews the AI system's recommendations. They adjust orders or inventory decisions based on their experience and specific shop needs. The manager may confirm or modify the AI-generated suggestions. Input: AI-generated stock recommendations, real-time inventory information. Output: Approved stock orders, adjusted inventory levels.	
	6	Stock Replenishment and Order Placement Action: The Inventory Manager places orders with suppliers based on the AI system's suggestions and their adjustments. The system may automatically generate order requests to suppliers if integrated. Input: Approved stock orders, supplier details. Output: Order confirmation sent to suppliers, updated inventory.	
	7	Continuous Monitoring and Adjustment Action: The AI system continues to monitor sales and stock data in real-time, making ongoing adjustments to recommendations as new data is collected. The Inventory Manager can review these updates periodically.	

Co-funded by the European Union

		Input: New sales data, stock level updates. Output: Real-time updated recommendations.
	8	Cleanup and System Update Action: The AI system updates its data pipeline to reflect the new inventory levels, ensuring the system remains up-to-date for future predictions and recommendations. Input: Updated inventory levels, stock orders placed. Output: A fully updated AI model, refreshed data pipelines.
	Step	**Branching action**
Extensions	1a	Stock Level Deviation (Condition: Unexpected Sales Surge) Condition Causing Branching: If there is an unexpected surge in sales (e.g., due to a local event or seasonal demand), the AI system detects a discrepancy between the predicted and actual sales. This triggers an alert and prompts the system to re-evaluate stock recommendations. Action: The AI System re-processes the data and updates demand predictions in real-time. It suggests an immediate stock replenishment order based on the new sales pattern, adjusting the previous recommendation. Outcome: The Inventory Manager receives an updated recommendation to place a larger order or expedite delivery from suppliers.
	2	upplier Availability Issues (Condition: Stock Shortage from Supplier) Condition Causing Branching: If a supplier is unable to fulfill a stock order due to availability issues (e.g., out of stock, delivery delays), the AI system detects the change in supplier status and triggers an alternative recommendation. Action: The AI System searches for alternate suppliers or suggests adjusting the stock levels to compensate for the delay. It may recommend a smaller order or different flowers based on available stock. Outcome: The Inventory Manager reviews and approves alternative supplier options or modifies the order to meet customer demand.

Co-funded by the European Union

	3	Data Inaccuracy (Condition: Data Mismatch or Missing Data) Condition Causing Branching: If the system detects missing or inconsistent data (e.g., incomplete sales data or erroneous inventory levels), it triggers a warning to the Inventory Manager to verify the data before proceeding with stock recommendations. Action: The Inventory Manager manually checks the data for inconsistencies, either correcting the errors or requesting additional information from the data sources. Outcome: Once the data is corrected, the AI system can resume normal operation and provide accurate recommendations based on the updated information.	
	4	Low Stock Warning (Condition: Critical Inventory Level Reached) Condition Causing Branching: If a critical inventory level is reached for a popular product (e.g., roses are running low just before Valentine's Day), the system will trigger a high-priority alert. Action: The AI System automatically triggers an urgent stock replenishment action, recommending a fast-track order process. If integrated, the system may place an order directly with the supplier to prevent stockouts. Outcome: The Inventory Manager receives an urgent notification and reviews the replenishment recommendation, expediting the process to avoid running out of stock.	
	5	Unpredictable Market Conditions (Condition: Market Trend Shifts) Condition Causing Branching: If there is a sudden shift in market trends (e.g., a new flower trend emerges, or customer preferences change), the system detects these changes and adjusts the forecast for future demand. Action: The AI System recalculates demand forecasts and updates stock recommendations accordingly. It may suggest ordering a different variety of flowers based on emerging trends. Outcome: The Inventory Manager is alerted to the market change and adjusts stock orders to align with the new trend.	
	1. Data Quality and Integrity - Issue: The system's performance heavily depends on the quality and accuracy of the input data. Incomplete, inconsistent, or incorrect data can lead to inaccurate predictions, resulting in stock shortages or overstocking. - Potential Misuse: If data is entered manually without validation or if external data		

Co-funded by the European Union

	sources (e.g., supplier or sales data) are unreliable, the system's recommendations could be flawed. - Mitigation: Implement automatic data validation and cross-checking procedures, ensuring that data used for predictions is accurate and consistent. 2. Supplier Dependencies and Stock Shortages - Issue: The system relies on suppliers to fulfill stock orders, but unforeseen supply chain disruptions or stock shortages could hinder the system's ability to optimize inventory. - Potential Misuse: Over-reliance on automated stock replenishment without considering real-time supplier availability could lead to stockouts if suppliers cannot fulfill orders. - Mitigation: Incorporate real-time supplier status monitoring and develop contingency plans for sourcing from alternate suppliers. 3. Over-Reliance on AI Recommendations - Issue: The AI system provides recommendations based on data patterns, but it may not account for sudden market shifts, local events, or changes in consumer behavior that are outside the model's scope. - Potential Misuse: The Inventory Manager might over-rely on AI recommendations, potentially ignoring personal experience or situational factors that the AI cannot predict. - Mitigation: Ensure the Inventory Manager is trained to critically assess AI recommendations and combine them with their knowledge of local trends and customer behavior. 4. Algorithm Bias and Fairness - Issue: Machine learning models can inadvertently develop biases based on the data they are trained on. If historical sales data includes bias (e.g., seasonal fluctuations or demographic patterns), the AI may perpetuate this bias in its predictions. - Potential Misuse: The system could recommend stock orders that favor certain products or flower types over others, skewing the inventory toward a limited selection and potentially leading to customer dissatisfaction. - Mitigation: Regularly audit and update the AI models to ensure fairness and that recommendations are diverse and not based on biased or outdated data. 5. Privacy and Data Security - Issue: Since the system processes sensitive sales data and potentially customer information, there could be privacy concerns regarding how this data is handled and stored. - Potential Misuse: Unauthorized access to sales data or mismanagement of sensitive information could lead to privacy violations. - Mitigation: Implement strong data encryption, access controls, and privacy protection measures to ensure compliance with data protection regulations (e.g., GDPR). 6. System Reliability and Downtime - Issue: If the AI system experiences technical failures, downtimes, or slow performance, the flower shop may not receive timely stock recommendations,

Co-funded by the European Union

	potentially leading to inventory mismanagement. - Potential Misuse: Reliance on an automated system without manual backup plans could leave the shop vulnerable during system outages or disruptions. - Mitigation: Establish backup protocols and ensure the system has redundancy features to maintain reliability even during technical failures. 7. Inadequate User Training - Issue: If the Inventory Manager is not adequately trained in using the AI system or understanding its outputs, they might misinterpret the recommendations or fail to take full advantage of the system. - Potential Misuse: Inaccurate decision-making due to improper use of the system, such as ignoring certain inputs or misinterpreting AI-driven suggestions. - Mitigation: Provide comprehensive user training and regular refresher courses to ensure the Inventory Manager understands how to interact with the system and interpret recommendations effectively.
Open Issues	

USE CASE (AI-Optimized Perishable Goods Management in Grocery Retail Chains)				
Intended purpose	**Context of use**	Artificial intelligence-based system that optimizes inventory and reduces wastage of perishable goods in grocery retail chains. It analyzes real-time sales trends, best-before dates, weather forecasts, and demand from consumers to adjust stock levels dynamically. It is deployed at grocery stores and supermarkets, as well as POS systems, IoT smart shelves, and warehouse management systems.		
	Scope	This software is based on utilizing AI to prevent overstocking and wastage of perishable items like fruits, vegetables, dairy, and bakery items. The system provides demand forecasting, dynamic pricing in real-time, and automatic restocking recommendations based on real-time data. It assists grocery stores in maintaining the best inventory levels while reducing spoilage and losses.		
	SDGs	- SDG 2: Zero Hunger - SDG 9: Industry, Innovation, and Infrastructure - SDG 12: Responsible Consumption and Production		
Type of product		AI-driven perishable goods inventory management system	**Is it a safety component?**	no

Co-funded by the European Union

Application area(s)	- Grocery retail supply chain - Inventory and stock optimization - Waste reduction and sustainability initiatives	
Primary actor	Grocery Store Inventory Manager	
Stakeholders and Interests <involved and affected persons and groups>	**Stakeholder**	**Description**
	Grocery Retail Chains	Reduce waste and improve profitability by optimizing perishable inventory
	Store Managers	Ensure product availability while minimizing expired stock
	Customers	Access fresher products and benefit from dynamic pricing on soon-to-expire items
	Food Banks & Charities	Receive unsold but still consumable food before expiration
	AI System Providers	Improve demand prediction algorithms through real-world grocery data
Success end condition	Perishable goods are optimally stocked and sold before expiration, reducing food waste and maximizing revenue.	
Failure protection	If the AI system malfunctions, inventory managers can rely on historical sales trends and manual stock adjustments. An emergency alert system can notify managers if perishable stock is at risk of expiring soon.	
Trigger	The AI system detects changes in demand, weather conditions, or approaching expiration dates and suggests stock adjustments, discounts, or donations.	
Main course	**Step**	**Action**
	1	AI system collects data from sales, weather forecasts, and consumer behavior patterns.

Co-funded by the European Union

	2	Machine learning models analyze trends and predict optimal stock levels for perishable items.
	3	AI system alerts inventory managers about slow-moving or soon-to-expire products.
	4	Dynamic pricing adjustments are applied (e.g., discounting near-expiry products).
	5	If surplus perishable goods are detected, AI suggests redistribution to food banks or charities.
	6	Automated restocking recommendations are sent to warehouse managers based on real-time sales data.
Extensions	**Step**	**Branching action**
	3a	If unexpected weather changes occur (e.g., heatwave), AI adjusts inventory recommendations for high-demand items (e.g., cold beverages, fresh produce).
	5a	If a food bank cannot accept a donation, the system suggests alternative redistribution options or discounts for bulk purchases.
Open Issues	- Accuracy of AI predictions for perishable demand during seasonal fluctuations. - Potential reluctance from store managers to rely on automated dynamic pricing. - Need for regulatory compliance when redistributing food to charities.	

Co-funded by the European Union

Co-funded by
the European Union