CITADELS

TESTBED DESCRIPTION

	Cultivating Industry 5.0 Talents: Academia-industry collaboration and empowerment through accessible DEep technoLogieS
Project acronym:	CITADELS
Project topic:	HORIZON-WIDERA-2024-TALENTS-03-01
Project number:	101217281
Type of action:	HORIZON-CSA
Project starting date:	1 September 2025
Project duration:	48 months
Dissemination level	PU

Disclaimer: *CITADELS is a project funded by the European Union under the Horizon Europe call HORIZON-WIDERA-2024-TALENTS-03-01 under Grant Agreement nº 101217281.*

- *Have followed the required conventions in referencing the thoughts, ideas and texts made outside the Project.*

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Testbed description
Version

Work package:	WP2
Start date of project:	01/09/2025
Duration of project:	48 months
Lead beneficiary:	
Version:	
Status:	
Author name(s):	
Reviewer(s):	
Nature:	Report
Dissemination level:	Public

Document history			
Version	Date	Modified by (author/partner)	Comments

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Table of contents

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Introduction

Include a short introduction for the document, listing as titles the testbeds that will be described in the document and from which organization.

1 Automation & Robotics Testbed

TestBed title	Automation & Robotics Testbed

1.1 Short summary

Please provide a short summary of what the TestBed offers, its key technology focus, and relevance to DeepTech or Industry 5.0 applications. (approximately 150 words)

Automation & Robotics Testbed is an advanced industrial TestBed designed for the research and development of automated manufacturing and logistics processes. The system architecture features a multi-vendor industrial cell cointaining three industrial arms integrated within a securely enclosed zone. These robotic units are synchronized via a dedicated track conveyor to facilitate complex material handling workflows. Centralized control and process supervision are provide through a robust PLC controller and HMI interface ecosystem, providing a realistic industrial environment for testing multi-vendor interoperability.

The TestBed serves as a bridge for DeepTech innovations, focusing on AI-driven autonomous material handling, Industrial IoT and advanced Human-Machine Interface. It enables The TestBed supports high Technology Readiness Levels (TRL 5-8), making it and ideal environment for talent secondments and student theses.

In aligning with Industry 5.0 principles, Automation & Robotics Testbed emphasizes human-centric automation and high manufacturing flexibility, enabling intuitive collaboration through advanced visualization solutions and reducing programming complexity. Within the CITADELS framework, the TestBed offers accessible infrastructure for research organizations, SMEs, and industry stakeholders to develop and validate intelligent, sustainable automation solutions.

Principal Investigator Name	Ahmed Korlatović, B.Sc. EE
Position / institutional role	Technical coordinator
Email	a.korlatovic@dkr.ba
Phone No.	/
ORCID persistent identifier (PID)	
TestBed Responsible Name (if different from PI)	/
Funding source(s) for TestBed's acquisition	Existing infrastructure of Industrial Automation.
Relevant Keywords	Industrial Manipulators, Multi-Vendor Integration, Human-Machine interaction, Industry 5.0, Industrial IoT, Autonomous Material Handling, Distributed Control Systems, Industrial Automation, PLC Integration

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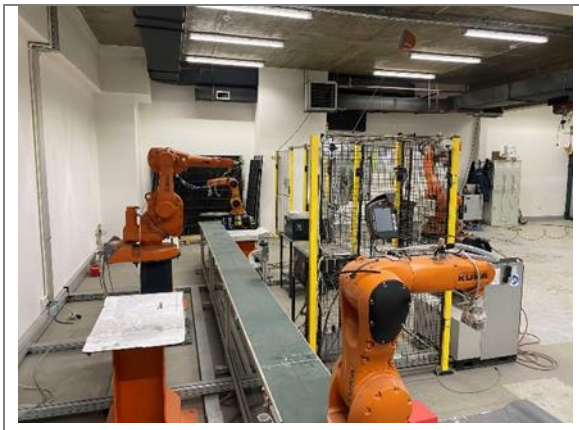
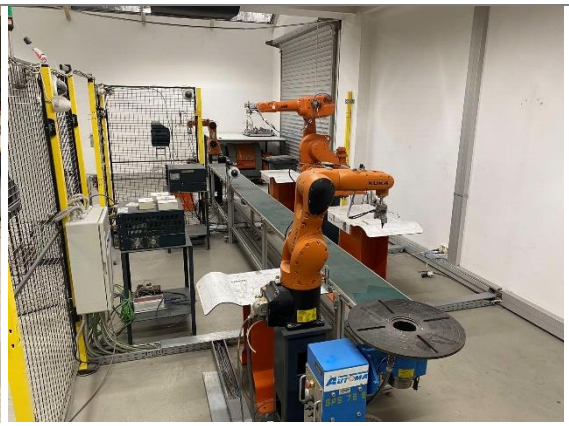
1.2 Hosting Institution

Please provide institutional details of the location of the TestBed.

Name of Host Organization	Industrial Automation d.o.o Tuzla
Department or Lab	Industrial Hub
Name of Building	Sports-Cultural-Economic Center (SKPC) Mejdan
Physical Address	Bosne Srebrene bb, 75000 Tuzla, Bosnia and Herzegovina
Website Links	https://www.dkr.ba/ https://industrialhub.ba/ https://industrialhub.ba/testbeds/automation-robotics-testbed/
Institutional contact name	Ahmed Korlatović
Institutional contact email	a.korlatovic@dkr.ba

1.3 Photos/videos

Main photo: Please embed the most illustrative photo of your testbed.

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Video Link: **Automation & Robotics Testbed I**

Automation & Robotics Testbed II

You may add additional photos and/or video links related to the TestBed (links to external providers, i.e. google photos, Flickr, YouTube, Vimeo, are acceptable)

1.4 DeepTech Area and Application Domain

Check the main technology fields covered by your TestBed:

DeepTech Area	Check all that apply	Check ONE main area
Extended Reality	☐	
Robotics	☒	
Artificial Intelligence	☒	
Human Machine Interfaces	☒	
Biotechnology	☐	
Other (Industrial IoT)	☒	

Provide short explanation of how this area is covered:

i.e. the TestBed covers the XR domain because it consists of a VR application that runs on the Meta Quest headset and aims to support the operator perform training activities in the manufacturing. (no more then 150 words)

Robotics: The testbed uses high-performance industrial arms and conveyor for assembly and material handling. It provides a standardized environment to test mechanical precision, safety protocols and complex physical workflows.

Artificial Intelligence (AI): AI enhances the robots capabilities by enabling autonomus decision-making. It allows the system to identify products using 3D vision, calculate optimal stacking patterns and adapt to varying packaging formats without needing constant manual reprogramming.

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Industrial IoT (IIOT): This area focuses on connectivity and data exchange. This testbed uses Siemens TIA Portal and industrial protocols to collect real-time telemetry from sensors and controllers. This data is used for process optimization and predictive maintenance, identifying potential failures before they cause downtime.

Human Machine Interfaces (HMI): In this testbed, advanced HMIs reduce complexity, allowing for faster setup and easier interaction between human talents and the machines.

Check the main application domains that apply to your TestBed:

Application Domain	Check all that apply
Manufacturing 	☐
Healthcare 	☐
Logistics 	☒
Agriculture 	☐
Maintenance & inspection 	☐
Other	☐

1.5 Potential Stakeholders and Exploitation Scenarios

Choose the potential target audience of your TestBed:

Non-academic stakeholders	
Industrial Partners	Manufacturing companies, automation system integrators, robotics vendors, logistics companies
SMEs	SMEs in manufacturing automation, machine builders, robotics integration companies
Startups	Robotics startups, AI for manufacturing startups, Industrial IoT startups
Government Bodies	Ministries of industry and technology, regional innovation agencies, digitalization agencies

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Professional Associations	Robotics and automation associations, industry clusters, chambers of commerce
Community	Maker communities, robotics clubs, open innovation communities
Others 1 (comma-separated)	Production managers, plant directors
Academic stakeholders	
Undergraduate students	Electrical engineering students, mechatronics students, industrial engineering students
MSc students	Robotics and automation MSc students, AI and mechatronics MSc students
PhD students	PhD researchers in robotics, AI, manufacturing systems
Researchers	Academic researchers in robotics, AI, industrial automation, human-robot collaboration
Others 2 (comma-separated)	Industrial engineering students, Early-Stage Researches, Research organizations
Other types of stakeholders	
Others 3 (comma-separated)	Workforce Development Agencies, Funding Agencies

*Add as many fields as you see fit

Define the type of exploitation that is available for the testbed.

	Check all that apply	Short notes (optional)
Internal academic research only	☐	
Collaborative research with external academic partners	☒	
Contract research / Proof-of-Concept for industry	☒	
Pilot / DeepTech Deployment in operational environment	☒	
Training services (courses, workshops, certification)	☒	
Service provision (testing, benchmarking, validation)	☒	
Open access for walk-in users (e.g. open days / hackathons)	☒	
Other (specify): _____	☐	

1.6 Formal Access Conditions

Define the type of contractual relationship that needs to exist between the TestBed provider (legal entity) and the TestBed user (legal entity), before someone can work on it.

Type of partner asking for access	Type of contractual relationship	Check all that apply
	No contract (direct access)	☐

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Academic partners	Direct contract between parties (e.g., research agreement)	⊟
	Indirect contract between parties (e.g., project framework)	⊟
	Other / Describe	☐
Industrial	No contract (direct access)	☐
	Direct contract between parties (e.g., research agreement)	⊟
	Indirect contract between parties (e.g., project framework)	⊟
	Other / Describe	☐

Define additional prerequisites agreements that an individual user needs to meet before accessing the TestBed and working on it.

Type of prerequisites	Description of prerequisites	Check all that apply
Agreements	Confidentiality agreement for proprietary algorithms	☐
	Data sharing agreement for datasets generated	⊟
	IP agreements	⊟
	Other / Describe	☐
Insurance	Users must have appropriate liability coverage through their home institution	☐
	Other / Describe:	☐

1.7 Training and Safety

Also define the training and safety preconditions that fits for accessing and working with the TestBed.

Mandatory technical training (comma-separated)	PLC Fundamentals (TIA Portal), Robot Programming Basics, Control System Logic
Recommended technical training (comma-separated)	Advanced TIA Portal, Advanced Robot Programming, Fail-Safe Programming (TIA Safety), Industrial Communication (Fieldbus), Virtual Commissioning (Kuka.Sim, RobotStudio)
Mandatory safety requirements (comma-separated)	Safety Training Session, Expert Supervision, Laboratory safety protocols, Safety Zone Boundaries

1.8 Technical description

Provide details on the technical components of the TestBed.

- Hardware – list all physical equipment available in this TestBed (e.g., robots, machines, sensors, actuators, computing and network equipment, measurement devices, safety systems).
- Software needed to run the TestBed – list all software components required to run and develop on this TestBed (e.g., OS, drivers, middleware, frameworks, libraries and tools).
- Standards that apply – list all standards and regulations that are relevant for the safe and compliant operation of this TestBed (e.g., ISO, IEC, EN, IEEE, national standards).

Refer to the technical specs of this equipment and the relevant standards that should be followed.

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Hardware (provide list of hardware components with their brief descriptions)	**KUKA KR 6 R700 sixx Robot:** Maximum reach: 706.7 mm | Maximum payload: 6 kg | Number of axes: 6 | Position repeatability: ± 0.03 mm | Cycle time: 138 cycles per minute (25 mm / 305 mm / 25 mm, 1 kg) | Weight: approx. 50 kg | Axis data (Movement range: A1: ±170 °, A2: -190 ° / 45 ° , A3: -120 ° / 156 °, A4: ±185 °, A5: ±120 °, A6: ±350 °) | Protection rating: IP54	**KUKA KR 6 R700 sixx**
	KUKA KR C4 Compact controller: Dimensions: 271 x 483 x 460 mm | Processor: Multi-core technology | Hard drive: SSD | Interface: USB3.0, GbE, DVI-D, Display Port | Number of axes: 6+2 (with add. axis box) | Mains frequency: 50/60 Hz ± 1 Hz | Rated supply voltage: AC 200 V to 230 V | Ambient temperature: +5 °C to + 45 °C | Weight: 33 kg | Protection rating: IP20	**KUKA KR C4 Compact**
	KUKA smartPAD: scratch-resistant industrial touch display (8.4'') | Dimensions 240 x 290 x 50 mm | Weight: 1,100 g	**KUKA smartPAD**
	ABB Foundry IRB 1600 Robot: Maximum reach: 1.2 m | Maximum payload 6 kg | Number of axes: 6 | Position repeatability: ± 0.05 mm | Mounting: floor, wall, inverted, titled | Weight: 250 kg | Axis data (Movement range: A1: ±180 °, A2: -63 ° / +136 ° , A3: -235 ° / 55 °, A4: ±185 °, A5: ±115 °, A6: ±400 °) | Supply voltage: 200 – 600 V W | Mains frequency: 50/60 Hz | Power consumption: ISO-Cube at max speed 0.58 kW | Rated power: supply transformer 4 kVA/7.8 kVA with external axis | Ambient temperature: +5 °C to +45 °C | Relative humidity: Max. 95 % | Protection: IP54, IP67 FoundryPlus	**ABB Foundry IRB 1600 Robot**
	ABB IRC5 Single Controller: Supply voltage: 3 phase, 200 – 600 V | Mains frequency: 50/60 Hz | Single cabinet dimension: 970 x 725 x 710 mm | Weight: 150 kg | Ambient temperature: 0 - 45 °C, optional: 0 -	**ABB IRC5 Single Controller**

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	52 °C | Relative humidity: Max. 95 % | Safety: SafeMove: Supervision of stand-still, speed, position and orientation (robot and additional axes): 8 safe inputs for function activation, 8 safe monitoring outputs | Extended safety: Electronic Position Switches: 5 safe outputs monitoring axis 1-7 | Protection: IP54 (cooling ducts IP33)	
	ABB TPU4: Functions: Graphical multi-touch 8"color screenLED status diods Joystick Hot-swapable-add/remove during operation IP65 Membrane keyboard with 12 buttons USB 3.0 support | Safety functions: Emergency stop 3-position enabling switch (dual circuit) Hold-to-run 100% manual speed button	
	SCHRUNK PGN-plus 64-2-AS 2-Finger Parallel Gripper: Stroke per jaw: 3 mm | Closing- / opening force: 710/- N | Min. spring force: 190 N | Weight: 0.37 kg | Recommended workpiece weight: 2.6 kg | Fluid consumption per double stroke: 17 cm^3 | min. / max. operating pressure: 4/6.5 bar | Nominal operating pressure: 6 bar | Closing- / opening time: 0.02/0.04 s | Closing- / opening time only with spring: 0.08 s | Max. permitted finger length: 80 mm | Max. permitted weight per finger: 0.35 kg | IP class: 40 | min. / max. ambient temperature: 5/90 °C | Repeat accuracy: 0.01 mm	**SCHRUNK PGN-plus 62**
	MINITEC Belt Conveyor D50: Track dimension: 5500 x 300 mm | Standard Belt Speed: ~8 m/min | Conveyor Belt Type: PVC or PU belt | Electric Motor: 3-phase 380 V	**MINITEC BELT CONVEYOR D50**
	Yaskawa AC Drive J1000: Max. Motor Output: 0.1 - 2.2 kW | Applicable Motor: Induction motor | Control: V/f Control | Max. Output Frequency: 400 Hz | Fieldbus interfaces: RS-232C, RS-422/485 | IP 20	**Yaskawa AC Drive J1000**

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	Countant Lambda DRP 240-1 Power supply: Output voltage: 24 V DC | Output power: 240 W | Output current: 10 A | Input voltage: 110/230 V universal input | Dimensions: 125.5 x 125.2 x 100 mm	**Countant Lambda DRP 240-1 Power supply**
	Siemens SIMATIC S7-1500 PLC: Work Memory (Program/Data): Ranges from 300 KB/1.5 MB (CPU 1513) to 3 MB/8 MB (CPU 1517) or higher, providing extensive capacity for complex applications | Performance: Bit performance in the nanosecond range (e.g., 0.01 ms/instruction for CPU 1516-3 PN/DP) | Interfaces: PROFINET IRT (Isochronous Real-Time) is standard, with multiple interfaces (up to 3) supporting web server, OPC UA server, and TCP/IP communication | I/O Capacity: Up to 32 modules (centralized) with 32/32 KB I/O address area, and support for high-density 32-channel modules | Functionality: Built-in Motion Control (positioning axes, cam tracks), integrated diagnostics for plain text messages, and enhanced security (password protection, TLS 1.3) | Power supply: 24 V DC | Environment: IP20 protection class, designed for DIN rail mounting in cabinets | Equiped with: 2 digital input modules DI 32x24VDC HF; 2 digital output modules DQ 32x24VDC/0.5A HF; 1 fail-safe digital module ET 200MP, F-DI 16X24VDC; 1 communication module CM 1542-5	**Siemens SIMATIC S7-1500 PLC**
	Siemens SCALANCE X005: 5 x RJ45 sockets with MDI-X assignment 10/100 Mbit/s (half / full duplex) | 1 x 2-pole plug-in terminal block | Supply voltage: 24 V DC | Current consumption at rated voltage: 80 mA | Operating temperature: 0°C to +65°C | IP 30	**Siemens SCALANCE X005**

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	Siemens SIMATIC ST-80 HMI Touch Panel: Display: 7" TFT widescreen display with 64,000 colors | Resolution: 800 x 480 pixels (WVGA) | Operation: Touch screen combined with 8 freely configurable tactile function keys | Interfaces: PROFINET (Ethernet) interface for communication with SIMATIC S7 controllers and USB port | Visualization: Configurable via WinCC Basic (TIA Portal) | Mounting: Portrait and landscape orientation supported | Power Supply: 24 V DC	**Siemens SIMATIC ST-80 HMI Touch Panel**
Software needed to run the TestBed (provide list of	**Siemens TIA Portal** – Central software for programming, configuration and diagnostics of Siemens S7-1500 PLC and SIMATIC ST-80 HMI Panel	**Siemens TIA Portal**
	ABB Online/Offline Programming (RobotStudio) – Software for programming and simulation of ABB Foundry IRB 1600 robot.	**ABB RobotStudio**
	KUKA Online/Offline Programming (Kuka.Sim): Software for programming and simulation of KUKA KR 6 R700 sixx robots with KRC4 controllers.	**Kuka.Sim**
Standards that apply (provide list of standards that apply with their short descriptions)	**ISO 10218-1/2** – Industrial robot safety	**ISO 10218-1** **ISO 10218-2**
	ISO 13849-1 – Safety performance levels	**ISO 13489-1**
	ISO 12100/ISO 13857 – Machine safety	**ISO 12100** **ISO 13857**
	IEC 61158/IEC 61784 (PROFINET) – Real-time communication standard	**IEC 61158** **IEC 61784**
	IEC 61131-3 – PLC programming standard	**IEC 61131-3**
	ISO 9241 – Human-system interaction ergonomy	**ISO 9241**
	IEC 60447 – Standard for control principles	**IEC 60447**
	IEC 60204-1 – Electrical equipment of machines	**IEC 60204-1**

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1.9 Existing Software Assets (i.e. in GitHub)

Software already built *using* this TestBed (demos, PoCs, deployment code, services, scripts, APIs, etc.). This will help the TestBed user and any other interested party gain background knowledge required to use the TestBed efficiently.

Link:	Short description:
/	/
/	/

1.10 TestBed documentation

Documentation in the form of technical documentation, teaching materials, publications, datasets. Similar to the above, optionally, refer if there are available technical specifications, teaching materials, publications, datasets available on Zenodo or in institutional repositories, related to the data used/generated by the TestBed.

Type	Short description:	Name and source (link):
Dataset	/	/
Scientific article	/	/
Technical documentation	Technical documentation for TestBed parts	KUKA KR 6 R700 sixx KUKA KR C4 Compact Controller & KUKA smartPAD ABB Foundry IRB 1600 Robot ABB IRC5 Single Controller & ABB TPU4 SCHRUNK PGN-plus 64-2-AS 2-Finger Parallel Gripper MINITEC Belt Conveyor D50 Siemens SIMATIC S7-1500 PLC Siemens SIMATIC ST 80 HMI Touch Panel

1.11 Application cases

Describe typical use cases and example experiments that make use of your TestBed. Show how the TestBed has been (or can be) applied in Proof-of-Concept or DeepTech Deployment actions to support the secondment activities, preferably with visuals or case summaries from past or current projects. Also, optionally, you may describe, beyond the actions, how your TestBed contributes to educational, research and innovation activities in your organization, i.e. if it is used in teaching and/or student projects, support SMEs, startups and/or spin-offs etc. You may describe previous application cases. Add as many inputs (rows) as needed.

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Application case:	Short description:	Photo of the Application case
Industrial autonomous palletizing & material handling	Engineers and students can develop autonomous palletizing solutions with using the robots synhcronized via the conveyor and PLC. This solutions are focused on automated pick-and-place, adaptive stacking patterns and interoperability between multi-vendor robots. 3D vision and rule-based logic are used to optimize pallet layouts for varying box sizes. This case has already been used in SME demonstrations and student theses, with typical cell reconfiguration times of ~30 minutes and more than 100 users trained on the testbed.	
Virtual Commissioning & Offline Robot Programming	Seconded staff and MSc/PhD students employ ABB RobotStudio and KUKA.Sim together with Siemens TIA Portal to design, simulate and validate robotic workflows before deployment on real hardware. Typical experiments include trajectory optimization, collision checking, PLC-robot handshake testing and HMI flow validation.	
PLC/SCADA integration	Participants develop PLC logic, HMI screens and PROFINET-based communication to collect real-time data from robots, conveyors and sensors. Experiments include production monitoring dashboards, fault diagnostics and basic predictive maintenance indicators.	
Education, Workforce upskilling & SME demonstrators	Used for undergraduate and MSc student projects, professional workshops and SME demonstrations. Activities include robot programming fundamentals, safety training, multi-vendor integration exercises, and rapid prototyping of automation concepts for small manufacturing companies.	

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Include information on the TRL range of possible TestBed applications as well as the related standards and safety certifications.

Possible TRL application range	TRL4	☐
	TRL5	⊟
	TRL6	⊟
	TRL7	⊟
	TRL8	⊟

1.12 Funding source

Include all relevant funding sources, links to past projects, related to the creation of the TestBed and related materials. Add as many inputs (rows) as needed.

Funding source acknowledgements
This Testbed belongs to existing infrastructure of Industrial Automation.

1.13 Ethical and societal aspects

Describe how your TestBed's value is connected to broader societal challenges. For example, describe concrete societal benefits to non-technical audiences by explaining how your TestBed contributes to accident prevention at work, ergonomics, or human–robot task allocation. Also, describe any ethical or legal issues such as data collection or AI-related aspects referring to the respective regulation such as DPIA alignment, GDPR measures, AI Act, user consent measures etc. Add as many inputs (rows) as needed.

Ethical and societal aspect:	Short description:
Accident prevention in industrial automation cell	Improving workplace safety by transferring hazardous and repetitive operations, robots operate inside fenced safety zones equipped with emergency-stop circuits and PLC-based safety logic, preventing unintended human access during operataion, validated workflows through offline programming and controlled testing.
Ergonomics and reduction of physical workload	Reducing physical strain on workers and helps prevent injuries by automating heavy lifting and repetitive handling tasks, human operators transition from manual material handling to supervisory and quality-control roles.
Human-centered task allocation and workforce upskilling	Clearly separating robot-intensive tasks from human-centered activities, used for student projects, professional training, and SME demonstrations, enabling participants to gain practical skills in PLC programming, robot operation, and system integration.
Responsible industrial data usage and GDPR alignment	Data collected within the industrial cell is strictly technical and process-oriented. No personal data is collected by default. When training activities involve identifiable participants, GDPR principles are applied, including data

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	minimization, purpose limitation, and restricted access. Any shared datasets are anonymized, and user consent is obtained where required.
Transparent and supervised AI-supported automation	Where AI is applied (e.g., for vision-based product recognition or palletizing optimization), it operates under human supervision. Operators retain final control through PLC/HMI interfaces, and system behavior is observable via diagnostic screens and logs.
Equal access to industrial DeepTech for SMEs	Providing SMEs and educational institutions access to multi-vendor industrial robotics infrastructure that would otherwise be costly to acquire. Through Proof-of-Concept projects, demonstrations, and secondments, companies can validate automation concepts before large investments.
Resource efficiency and environmental impact	By optimizing robot trajectories, material flow, and process timing, the TestBed helps reduce scrap, rework, and energy consumption. Virtual commissioning minimizes physical trial runs, lowering material waste during setup phases.

2 Collaborative Robotics Testbed

TestBed title	Collaborative Robotics Testbed

2.1 Short summary

Please provide a short summary of what the TestBed offers, its key technology focus, and relevance to DeepTech or Industry 5.0 applications. (approximately 150 words)

The Collaborative Robotics Testbed provides an advanced human–robot collaboration (HRC) environment designed for hands-on training, experimentation, and Proof-of-Concept validation in industrial automation. Based on collaborative robotic platforms, the TestBed enables safe, flexible interaction between operators and robots in shared workspaces.

It supports applications such as collaborative assembly, intelligent sorting, AI-based perception, and neuroergonomic workstation integration.

The key technology focus lies in DeepTech domains including collaborative robotics, artificial intelligence, computer vision, and human-centered system design. The integration of advanced

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sensors, safety systems, and data-driven control frameworks allows experimentation across TRL 4–6, bridging academic research and industrial deployment. The TestBed is highly relevant to Industry 5.0, promoting human-centric, safe, and sustainable manufacturing systems. It fosters co-creation between academia and industry, supports talent development in widening countries, and enables validation of responsible, AI-enabled automation solutions aligned with European Industry 5.0 priorities.	
Principal Investigator Name	Ahmed Korlatović, B.Sc. EE
Position / institutional role	Technical coordinator
Email	a.korlatovic@dkr.ba
Phone No.	/
ORCID persistent identifier (PID)	
TestBed Responsible Name (if different from PI)	/
Funding source(s) for TestBed's acquisition	Existing infrastructure of company Industrial Automation.
Relevant Keywords	Collaborative Robotics, Industry 5.0, Human – Robot Collaboration, Smart Manufacturing, Artificial Intelligence, Human – Centric Automation

2.2 Hosting Institution

Please provide institutional details of the location of the TestBed.

Name of Host Organization	Industrial Automation d.o.o Tuzla
Department or Lab	Industrial Hub
Name of Building	Sports-Cultural-Economic Center (SKPC) Mejdan
Physical Address	Bosne Srebrene bb, 75000 Tuzla, Bosnia and Herzegovina
Website Links	https://www.dkr.ba/ https://industrialhub.ba/ https://industrialhub.ba/testbeds/collaborative-robotics-testbed/
Institutional contact name	Ahmed Korlatović
Institutional contact email	a.korlatovic@dkr.ba

2.3 Photos/videos

Main photo: Please embed the most illustrative photo of your testbed.

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Video Link:

You may add additional photos and/or video links related to the TestBed (links to external providers, i.e. google photos, Flickr, YouTube, Vimeo, are acceptable)

2.4 DeepTech Area and Application Domain

Check the main technology fields covered by your TestBed:

DeepTech Area	Check all that apply	Check ONE main area
Extended Reality	☐	
Robotics	☒	
Artificial Intelligence	☒	
Human Machine Interfaces	☒	
Biotechnology	☐	
Other	☐	

Provide short explanation of how this area is covered:

i.e. the TestBed covers the XR domain because it consists of a VR application that runs on the Meta Quest headset and aims to support the operator perform training activities in the manufacturing. (no more then 150 words)

Robotics - The TestBed is built around a collaborative robotic cell equipped with a 7-DoF cobot, torque sensors, and integrated safety systems . It enables human–robot collaboration in shared workspaces for tasks such as assembly, sorting, and manipulation. The setup supports experimentation with motion control, impedance control, and safe interaction strategies aligned with Industry 5.0 principles.

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Artificial Intelligence - AI is integrated through computer vision systems, intelligent object detection, and data-driven control algorithms. The TestBed allows testing of AI-based perception, adaptive task planning, and monitoring of human–robot interaction, supporting development from research validation to applied industrial scenarios.

Human–Machine Interaction - The TestBed supports intuitive and safe interaction between operators and robots via sensor-based safety monitoring, ergonomic assessment, and user-centered workstation design. It promotes human-centric automation in line with the CITADELS Industry 5.0 focus.

Check the main application domains that apply to your TestBed:

Application Domain	Check all that apply
Manufacturing 	☐
Healthcare 	☐
Logistics 	☐
Agriculture 	☐
Maintenance & inspection 	☐
Other	☐

2.5 Potential Stakeholders and Exploitation Scenarios

Choose the potential target audience of your TestBed:

Non-academic stakeholders	
Industrial Partners	Manufacturing companies deploying collaborative robots, robotics integrators, automation solution providers

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SMEs	SMEs in smart manufacturing, robotics integration SMEs, automation consulting companies
Startups	Collaborative robotics startups, AI perception startups, human–robot interaction technology startups
Government Bodies	Ministries of industry and digitalization, regional innovation authorities, smart manufacturing initiatives
Professional Associations	Robotics and automation associations, Industry 5.0 networks, manufacturing clusters
Community	Robotics communities, maker spaces, STEM education communities
Others 1 (comma-separated)	Innovation Agencies, Technology transfer offices, Technology clusters
Academic stakeholders	
Undergraduate students	Mechatronics students, robotics engineering students, computer engineering students
MSc students	Robotics and AI MSc students, automation engineering MSc students
PhD students	PhD candidates in robotics, human–robot interaction, AI for manufacturing
Researchers	Researchers in collaborative robotics, AI perception systems, human–machine interaction
Others 2 (comma-separated)	Visiting researchers, Academic innovation labs, Research assistants
Other types of stakeholders	
Others 3 (comma-separated)	Standardization bodies, Regional development agencies

*Add as many fields as you see fit

Define the type of exploitation that is available for the testbed.

	Check all that apply	Short notes (optional)
Internal academic research only	☐	
Collaborative research with external academic partners	⊟—	
Contract research / Proof-of-Concept for industry	⊟—	
Pilot / DeepTech Deployment in operational environment	⊟—	
Training services (courses, workshops, certification)	⊟—	
Service provision (testing, benchmarking, validation)	⊟—	
Open access for walk-in users (e.g. open days / hackathons)	⊟—	

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Other (specify): _____	☐	

2.6 Formal Access Conditions

Define the type of contractual relationship that needs to exist between the TestBed provider (legal entity) and the TestBed user (legal entity), before someone can work on it.

Type of partner asking for access	Type of contractual relationship	Check all that apply
Academic partners	No contract (direct access)	☐
	Direct contract between parties (e.g., research agreement)	☒
	Indirect contract between parties (e.g., project framework)	☒
	Other / Describe	☐
Industrial	No contract (direct access)	☐
	Direct contract between parties (e.g., research agreement)	☒
	Indirect contract between parties (e.g., project framework)	☒
	Other / Describe	☐

Define additional prerequisites agreements that an individual user needs to meet before accessing the TestBed and working on it.

Type of prerequisites	Description of prerequisites	Check all that apply
Agreements	Confidentiality agreement for proprietary algorithms	☐
	Data sharing agreement for datasets generated	☒
	IP agreements	☒
	Other / Describe	☐
Insurance	Users must have appropriate liability coverage through their home institution	☐
	Other / Describe: Necessary security training and working under constant monitoring by engineers	☐

2.7 Training and Safety

Also define the training and safety preconditions that fits for accessing and working with the TestBed.

Mandatory technical training (comma-separated)	Elite Robots CS Series basic operation training, CS620 teach pendant operation training, Robot startup and shutdown procedures training, Basic programming and jogging training, Payload and TCP configuration training, Emergency stop and recovery training
Recommended technical training (comma-separated)	Advanced Elite Robots CS programming and motion control training, Safety parameter configuration training, Risk assessment and application design training, End-effector integration training, Safety I/O and fieldbus configuration

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	training, Preventive maintenance and troubleshooting training
Mandatory safety requirements (comma-separated)	Completed and documented risk assessment, Verification of all safety functions, Functional emergency stop tested and accessible, Correct payload and TCP configuration verified, Secure mechanical mounting of robot and tooling, Validated collaborative operation limits, Clear and marked robot workspace, Operator training completed and documented, No loose clothing or accessories during operation, Compliance with ISO 10218-1 and ISO 13849-1

2.8 Technical description

Provide details on the technical components of the TestBed.

- Hardware – list all physical equipment available in this TestBed (e.g., robots, machines, sensors, actuators, computing and network equipment, measurement devices, safety systems).
- Software needed to run the TestBed – list all software components required to run and develop on this TestBed (e.g., OS, drivers, middleware, frameworks, libraries and tools).
- Standards that apply – list all standards and regulations that are relevant for the safe and compliant operation of this TestBed (e.g., ISO, IEC, EN, IEEE, national standards).

Refer to the technical specs of this equipment and the relevant standards that should be followed.

Hardware (provide list of hardware components with their brief descriptions)	**Elite Robot CS620 Robotic Arm:** Payload: 20 kg | Radius: 1800 mm | Repeatability: ± 0.1 mm | Axis: 6 | Joints rotation; J1-J6: ± 360° | Joints speed; J1-J2: 125°/s, J3: 150°/s, J4-J6: 210°/s | Max TCP Speed: 3.9m/s | IP rating: IP65 (IP68 upgradable) | Operating Temperature range: 0-50 °C | Relative humidity: <90% (non-condensing) | Typical power usage: 625 W | Mounting: Any angle | Tool I/O connectors; T1: M8, 8pin; T2: Ø 12.8mm, 4pin | Tool I/O ports: 4 config. DI, 4 config. DO; 1 AI, 1 AO | Tool I/O power supply; T1: 12V / 24V, 3A, 2A, 1A; T2: 24 V, 5A | Tool I/O communication: RS485, CAN | Footprint: Ø240mm | Weight: 60 kg | Material: Aluminum, Steel | Cable length: 5.5 m	Elite Robot CS620 Robotic Arm
	Elite Robot CS620 Controller: Size: 505mm x 432mm x 257mm | Material: Aluminum, Steel | IP rating: IP54 | I/O ports: 24 DI (8 config.), 24 DO (8 config.); 2 AI, 2 AO | I/O power supply: 24V; 3A (internal), 6A (external) |	

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	Communication ports: 3 Ethernet ports, 1 RS485, 1 MiniDP, 1 USB 2.0, 1 USB 3.0 | Communication protocols: TCP/IP, MODBUS TCP/RTU, EtherNet/IP, Profinet, OPCUA | Power source: 100-240 VAC, 50-60 Hz	
	Elite Robot CS620 Teach-Pendant: Size: 301mm x 232mm x 54mm | Screen display size: 12.1" | Resolution: 1280 x 800 pixels | Material: Aluminum, Plastic | Weight: 2,1 kg | Cable length: 5.5 m | IP rating: IP 54 | Input method: Capacitive touch-screen	
Software needed to run the TestBed (provide list of	**Elite Robot Control Software (EliteStudio):** Primary programming and control platform. Provides a graphical interface for: Robot teching and motion control, path programming, I/O configuration and tool setup.	
	Elite SDK / APIs: Supports multiple languages like: Python, C++, Java and Modbus TCP / RTDE for communication with external systems	
	Elite Robot Simulator: Allows simulation and offline programming of robot tasks. Used for planning cell layouts	
Standards that apply (provide list of standards that apply with their short descriptions)	**ISO 10218-1** – Industrial robot safety	**ISO 10218-1**
	ISO 13849-1 – Control system safety integrity	**ISO 13849-1**
	UL / CE-MD – Safety certification / machinery directive	**UL / CE - MD**
	RoHS – Restriction of hazardous substances	**RoHS**

2.9 Existing Software Assets (i.e. in GitHub)

Software already built *using* this TestBed (demos, PoCs, deployment code, services, scripts, APIs, etc.). This will help the TestBed user and any other interested party gain background knowledge required to use the TestBed efficiently.

Link:	Short description:

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/	/

2.10 TestBed documentation

Documentation in the form of technical documentation, teaching materials, publications, datasets. Similar to the above, optionally, refer if there are available technical specifications, teaching materials, publications, datasets available on Zenodo or in institutional repositories, related to the data used/generated by the TestBed.

Type	Short description:	Name and source (link):
Dataset	/	/
Scientific article	/	/
Technical documentation	Technical documentation for TestBed parts	ELITE ROBOT CS620

2.11 Application cases

Describe typical use cases and example experiments that make use of your TestBed. Show how the TestBed has been (or can be) applied in Proof-of-Concept or DeepTech Deployment actions to support the secondment activities, preferably with visuals or case summaries from past or current projects. Also, optionally, you may describe, beyond the actions, how your TestBed contributes to educational, research and innovation activities in your organization, i.e. if it is used in teaching and/or student projects, support SMEs, startups and/or spin-offs etc. You may describe previous application cases. Add as many inputs (rows) as needed.

Application case:	Short description:	Photo of the Application case
Human–Robot Collaborative Assembly	The cobot cell supports shared assembly tasks where the robot handles positioning, screwing, or component transfer, while the operator performs fine manipulation. The TestBed enables validation of safe interaction modes, cycle time optimization, and ergonomic assessment before deployment in SME production lines.	
AI-Based Vision Sorting	The TestBed integrates AI-driven vision systems for object detection, classification, and robotic sorting. It is used to validate perception	

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	algorithms in semi-structured industrial environments, supporting Proof-of-Concept development for smart manufacturing and circular-economy applications.	
Neuroergonomic Workstation Optimization	The cobot cell is used to evaluate human workload and adapt robotic assistance accordingly. By combining motion tracking and operator monitoring, the TestBed enables development of human-centric automation solutions aligned with Industry 5.0 principles.	
SME Automation Feasibility Pilot	The TestBed serves as a pre-deployment validation environment for SMEs considering collaborative robotics. Companies can simulate real production tasks, measure performance indicators, and assess return-on-investment before investing in full-scale automation.	
Adaptive Impedance Control for Safe Interaction	The platform allows experimentation with task-specific stiffness shaping and compliant motion control. This supports validation of safe contact-based operations such as insertion, polishing, or precision handling in collaborative environments.	

Include information on the TRL range of possible TestBed applications as well as the related standards and safety certifications.

Possible TRL application range	TRL4	☐
	TRL5	⊟
	TRL6	⊟
	TRL7	⊟
	TRL8	⊟

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2.12 Funding source

Include all relevant funding sources, links to past projects, related to the creation of the TestBed and related materials. Add as many inputs (rows) as needed.

Funding source acknowledgements
This testbed belongs to existing infrastructure of Industrial Automation.

2.13 Ethical and societal aspects

Describe how your TestBed's value is connected to broader societal challenges. For example, describe concrete societal benefits to non-technical audiences by explaining how your TestBed contributes to accident prevention at work, ergonomics, or human–robot task allocation. Also, describe any ethical or legal issues such as data collection or AI-related aspects referring to the respective regulation such as DPIA alignment, GDPR measures, AI Act, user consent measures etc. Add as many inputs (rows) as needed.

Ethical and societal aspect:	Short description:
Accident Prevention at Work	The TestBed develops and validates collaborative robots equipped with force/torque sensing and safety monitoring systems. These technologies reduce workplace injuries by automatically limiting robot speed and force when humans are nearby, preventing collisions and unsafe contact.
Improved Ergonomics	By assigning physically demanding, repetitive, or heavy tasks to the robot, the system reduces strain on workers' backs, shoulders, and joints. This helps prevent long-term musculoskeletal disorders, one of the most common workplace health issues in manufacturing.
Human - Centered Task Allocation	The TestBed supports balanced human–robot cooperation, where robots handle precision or heavy tasks and humans focus on supervision, creativity, and decision-making. This promotes safer, more meaningful work rather than full automation replacement.
Worker Well-Being & Fatigue Monitoring	In neuroergonomic scenarios, operator workload can be monitored (e.g., movement patterns, posture). This allows adaptive assistance to reduce fatigue and stress, contributing to healthier working conditions.
Support for Aging Workforce	Collaborative robots can assist older workers in physically demanding industries, extending employability and reducing early retirement due to physical strain.
Data Protection (GDPR Compliance)	Any collection of operator-related data (e.g., motion tracking or performance metrics) follows GDPR principles: data minimization, purpose limitation, secure storage, and anonymization/pseudonymization where possible. Personal

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	data processing is documented and limited to research purposes with informed consent.
Responsible Innovation (RRI)	The TestBed follows Responsible Research and Innovation principles, ensuring that technological development aligns with societal needs, worker safety, inclusiveness, and sustainability goals under Industry 5.0.

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Conclusion

Include a short conclusion for the document, providing a summary of the described testbeds

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List of tables

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Bibliography

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Abbreviations and terminology[1]

Abbreviations	

Terminology	

[1] abbreviations are letter combinations which summarise/abbreviate a longer set of words; terminology is not limited to abbreviations, but goes beyond and captures words/terms which are specific to the project and the project context

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Annexes

Optionally include any information as you see relevant, with a reference in the main body of the documents. This could include other documents or sections such as detailed specifications, maintenance schedules, or risk management plans for complex infrastructures.

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