

LABraDT

The Rapid Application Development Toolkit for Digital Twins

Digital Twins. Built to Reuse.

Press Kit

Institute for Control Engineering of Machine Tools and Manufacturing Units (ISW)
University of Stuttgart

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LABraDT in 30 seconds

LABraDT is an open-source framework for the rapid and reusable development of Digital Twin (DT) applications in industrial production. LABraDT is based on the Asset Administration Shell (AAS) and provides reusable software components for developing Digital Twins and the services built on top of them. Its component-based approach allows functions to be flexibly combined, reused, and assembled into new applications. This reduces development effort and enables rapid prototyping.

A key feature of LABraDT is the abstraction of connectivity to cyber-physical production systems (CPPS). Applications can therefore be developed independently of the specific integration of an industrial system and executed in a controlled environment. This is particularly valuable for AI and data-driven applications: models and services can be trained, tested, and validated before being deployed on real production systems.

LABraDT supports an end-to-end development process – from rapidly creating and testing new Digital Twin applications to integrating them into industrial production systems.

- **Open Source** enables extension, collaboration, and community involvement.
- **Modularity** enables reusable components and rapid prototyping.
- **Reusability** through the separation of connectivity and business logic.
- **AI-Readiness** supports the deployment, testing, and validation of AI agents.

Digital Twins. Built to Reuse.

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Why LABraDT?

Digital twins are becoming an increasingly important technology for understanding, designing, operating, and managing cyber-physical production systems (CPPS). By connecting directly to a physical production system, a digital twin can automatically collect and process data, perform analyses and calculations, and send instructions back to the system. This creates a digital abstraction of the physical system, standardizes interfaces, and enables services and solutions to be reused across different applications.

However, developing digital twins remains a significant engineering challenge, as there is still no systematic approach for their development. In practice, digital twin applications are often built as purpose-specific solutions, requiring substantial development effort for each individual use case. This not only increases development costs but also limits the reusability that digital twins are intended to provide.

LABraDT addresses this gap.

Instead of rebuilding application components and system integrations for every new use case, LABraDT provides a framework in which reusable components can be combined, tested and integrated. The AAS was adapted to provide a standardized, interoperable foundation for DTs, enabling consistent representation, seamless data exchange, and the reuse of digital twin components across different systems and applications. The AAS provides a standardized representation of assets, but does not define how digital twins are engineered, composed, executed, and integrated into operational applications.

- **Reuse** software components instead of starting from scratch.
- **Abstract** CPPS connectivity from application logic.
- **Validate** AI-based services before deployment.
- **Integrate** applications into industrial production systems with reduced effort.

From AAS models to reusable, executable Digital Twin applications.

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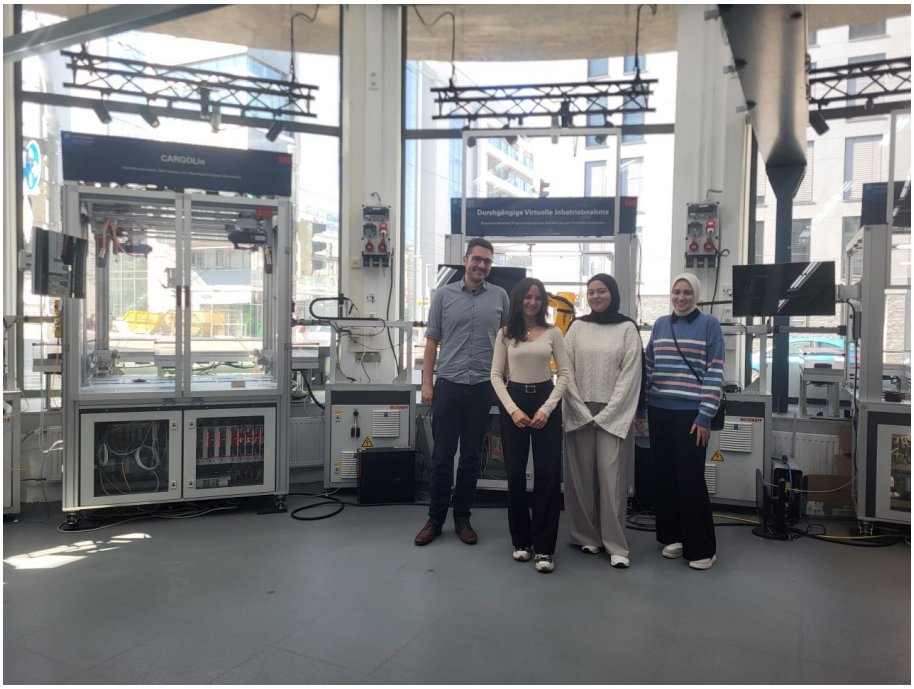
About Its Origins

LABraDT originated at the Institute for Control Engineering of Machine Tools and Manufacturing Units (ISW) at the University of Stuttgart The project began with a vision: to make the development of digital twins more accessible, flexible, and reusable.

As part of an international collaboration, students from the German University in Cairo (GUC) joined the ISW in Stuttgart to work on their theses, gain international experience and contribute to the implementation of the framework. The collaboration laid the foundation for LABraDT, bringing together different perspectives and expertise across countries and disciplines.

The project was driven by a simple observation: while digital twins are becoming increasingly important in modern industry, developing them often requires significant effort and specialized software. LABraDT was created to change this by enabling existing software components to be reused and combined rather than developed from scratch for every new application.

What began as a collaboration between students and researchers has since evolved into an open-source software framework for building modular and reusable digital twins. LABraDT reflects the ISW's commitment to developing practical approaches that bring digital twin technology from research into industrial applications, while demonstrating how innovation can emerge through collaboration across institutions, countries, and generations.



Welcoming the GUC students to ISW, April 2026.
(Photo Credit: ISW, University of Stuttgart)

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Applications & Technical Facts

From Modular Digital Twins to Industrial Applications

LABraDT provides a modular foundation for developing and deploying TD applications for cyber-physical production systems. Instead of developing each application from scratch, existing software components can be combined, reused, and adapted to new use cases. DTs can therefore be configured using the existing components without any programming effort or knowledge.

At its core, LABraDT separates the connection to the physical production system from the application logic. Data from machines, sensors, actuators, PLCs, and HMIs is represented within the digital twin, while services can be integrated through APIs, scripts, or containers. This separation allows applications to be developed independently of the underlying production system and facilitates their reuse across different environments.

A Digital Twin as an Engineering Sandbox

The modular architecture also creates a controlled environment for developing and testing advanced software services. Virtual models can be used to experiment with applications before they are deployed to a physical production system. This is particularly relevant for AI-based services and agents, which can be trained, tested, and evaluated within the digital twin environment.

LABraDT can further support the validation and plausibility checking of results returned by services. This provides an additional layer of confidence when integrating automatically generated, AI-based, or rapidly developed software components into industrial applications.

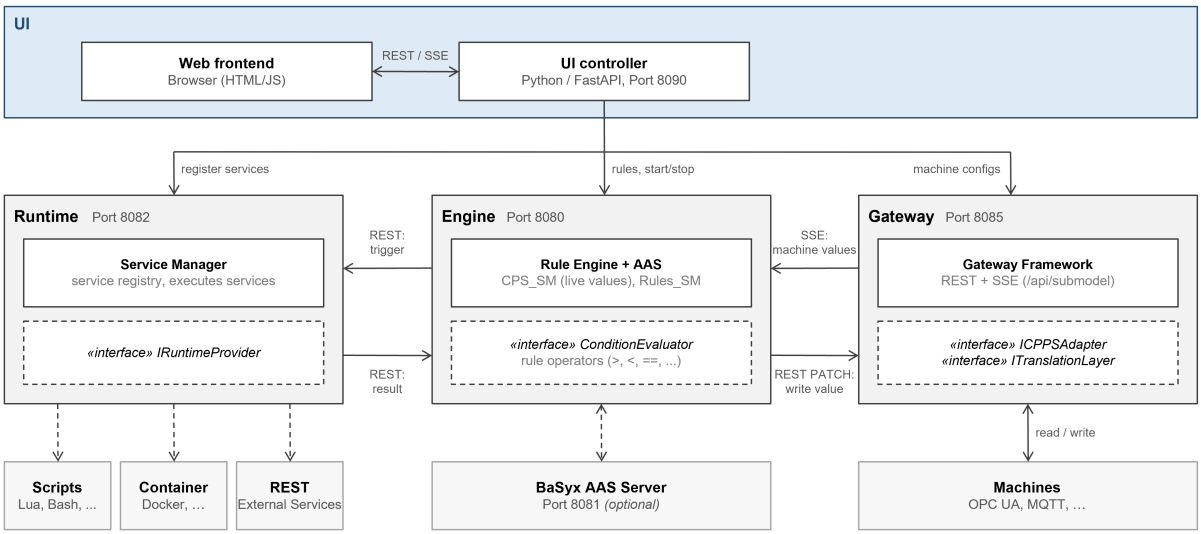
Key Technical Benefits

Component-based Development	Build applications from reusable software components rather than starting from scratch.
Separation of Concerns	Abstract CPPS connectivity from application and business logic.
Rapid Prototyping	Combine existing components and services to quickly develop new applications.
AI-Ready Environment	Provide a sandbox for training, testing, and validating AI-based services and agents.
Validation Before Deployment	Evaluate service outputs and plausibility before connecting applications to physical production systems.
Reduced Integration Effort	Reuse established components across different machines, systems, and applications.

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LABraDT Architecture

LABraDT follows a modular, service-oriented architecture. The LABraDT Core consisting of four main components: UI, Service Execution, Engine and Gateway. Each component encapsulates specific functionality and communicates with the others through defined interfaces and standardized communication mechanisms.



The LABraDT UI provides the graphical user interface for configuring and operating LABraDT. It consists of a web frontend (HTML/JavaScript), which communicates with a Python-based UI controller implemented using FastAPI. Communication is handled via REST and Server-Sent Events (SSE). The UI controller coordinates service registration, rule configuration, engine operation (start/stop) and machine configuration.

The Service Execution component manages and executes external services. Its Service Manager provides a service registry and handles service invocation. The component supports different execution environments through the IRuntimeProvider interface, including scripts, containerized applications and external services accessible. Services are triggered by the Engine and return their results through REST interfaces.

The LABraDT Engine provides the central logic for executing rules and interacting with AAS-based data models. Its Rule Engine integrates the AAS submodels CPS_SM (providing live values) and Rules_SM (containing rule definitions). The ConditionEvaluator interface enables the evaluation of rule conditions using configurable operators. The Engine communicates with the Gateway to retrieve live machine values and write updated values. An optional BaSyx AAS Server can be connected to provide AAS infrastructure.

The Gateway abstracts connectivity to physical machines and production systems. Its Gateway Framework provides REST and SSE interfaces for accessing AAS submodels and exchanging machine data. The interfaces ICPPSAdapter and ITranslationLayer decouple the framework from specific communication protocols and production system implementations. This enables connectivity to different machines and communication technologies.

Media Information

The media package, available via https://labradt.de/media, contain the following assets:

Logo	LABraDT logo in SVG and PNG formats
Technical Images	Architecture and functional diagrams
Screenshots	Application screenshots

Short Description

160 characters:

LABraDT is an open-source framework for developing modular AAS-based Digital Twin applications with reusable components and abstracted CPPS connectivity.

500 characters:

LABraDT is an open-source framework for developing modular, AAS-based Digital Twin applications. It provides reusable software components and abstracts the connectivity to cyber-physical production systems. This enables applications and services to be developed independently of specific production system integrations and tested in a controlled environment. The framework supports the development, testing and validation of Digital Twin and AI-based services before deployment to real product.

Press Release

October 1st 2026 - Exhibition Announcement:

LABraDT: Accelerating the Development and Deployment of Digital Twins

With “LABraDT – The Rapid Application Development Toolkit for Digital Twins,” the Institute of Control Engineering (ISW) at the University of Stuttgart is presenting a new open-source framework for the rapid development and integration of digital twin applications at SPS 2026. LABraDT uses the Asset Administration Shell (AAS) as a standardized digital representation and combines it with modular, reusable software components.

The component-based approach reduces development effort, enables the reuse of existing functionalities, and accelerates prototyping. At the same time, LABraDT abstracts the connection to cyber-physical production systems (CPPS). This allows, for example, AI applications and data-driven services to be trained, tested, and validated in a controlled environment. AI-generated services can also be checked for plausibility before being deployed on a real production system.

Visit ISW in Hall 6, Booth 340, at the SPS fair and experience LABraDT live.

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Contact & Licensing

Project Coordination

Organization
Institute for Control Engineering of Machine Tools and Manufacturing Units (ISW), University of Stuttgart
Seidenstraße 36
70174 Stuttgart
Germany

Contact
Carsten Ellwein
Chief Engineer
+49-711-685-82424
labradt@isw.uni-stuttgart.de

Project Links

Website https://labradt.de
GitHub https://github.com/LABraDT-Framework
LinkedIn https://www.linkedin.com/company/labradt

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