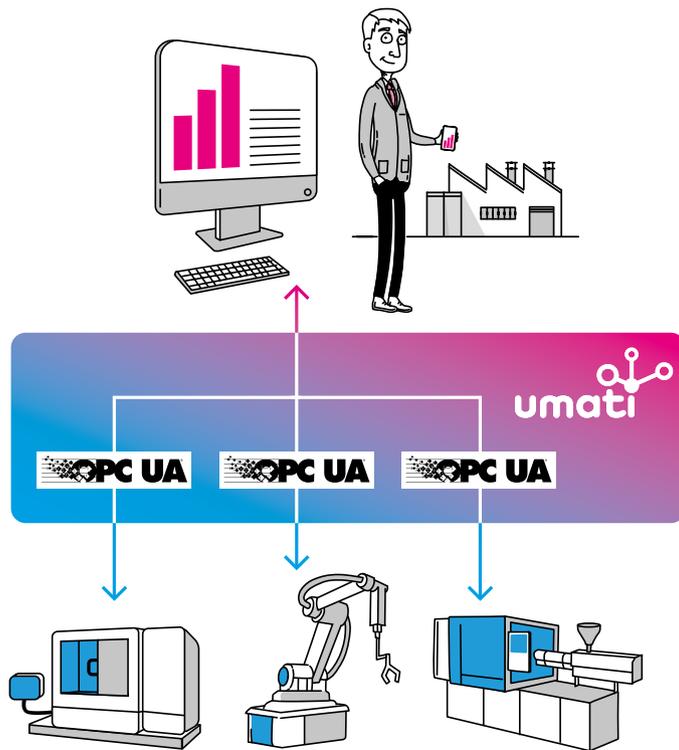


connecting the world
of machinery

the universal machine technology interface

Our promise: Make connectivity between machinery and software easy, secure and seamless – to help customers exploit added value from data.



How umati works: several machines with OPC UA servers using Companion Specifications endorsed by umati, implemented according to umati guidelines, are connected to one IT system with an OPC UA client.

Connectivity is key for all machinery in the 21st century. It means getting data in and out of devices and software systems – preferably via open, standardized interfaces.

umati is a global initiative for the promotion of open communication interface standards for machinery and production equipment.

Our mission is to provide true "plug and play" functionality in the field of machinery, so it becomes easier for users to participate in a data driven economy.

umati supports users and machine builders by building a strong international community; raising market awareness by joint marketing; ensuring identical implementation of the endorsed OPC UA specifications; and proving the power of an open, standardized data exchange ecosystems through live demonstrations.

umati relies on **OPC UA as the global interoperability standard**. Standardization work takes place in multiple "Joint Working Groups" with various sectors of the machine building industries and the OPC Foundation. This guarantees that the individual needs of different technologies are taken into consideration and ensures maximum transparency and the support of a strong global community.

OPC UA and the OPC Foundation:

- provide a **framework for standardized communication** (**HOW** to communicate)
- **support standardization** of specific needs for various technologies (**WHAT** is to be communicated)
- make the standards **available worldwide with no license fee**.



data flow as a user experience

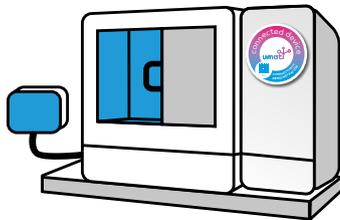
The umati live demonstration proves that connectivity across different machine technologies is a promise come true.

The umati live demonstration:

- provides a **"user experience"** for data flow
- has an **open, common set-up** to which participants can connect
- realizes **"criss-cross connectivity"** between machinery and multiple software applications even under trade show conditions

The umati community benefits from:

-  a common infrastructure for **secure connection** during a trade show and beyond
-  a vendor-independent **dashboard** to display data for a "machine status monitoring" use case
-  **guidelines** on getting connected – also applicable for testing and plug fests
-  comprehensive **marketing** (including design and templates) for all partners to increase market impact for customers and suppliers

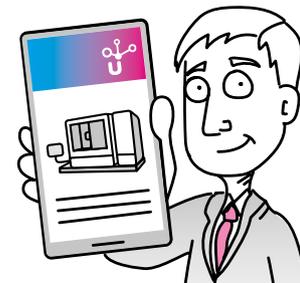


How the umati live demonstration works:

1. Connected machines feature an umati sticker.



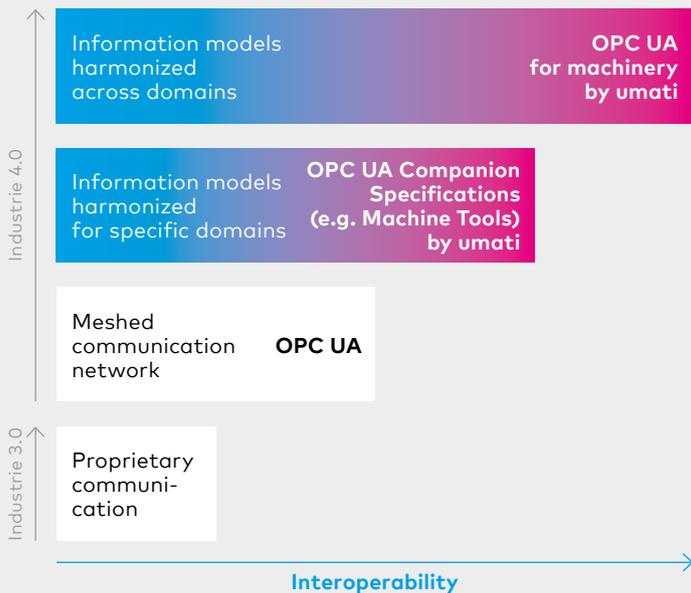
2. Scan the QR code or type the shortcut link to access the umati dashboard and see the live data stream from the machine.



3. Get an overview of all the connected machines at <https://umati.app>

OPC 40001 UA for Machinery

The **OPC 40001** series is applicable for the entire machine building industry.



The highest level of interoperability is achieved through cross-domain information models. One such information model is the OPC UA Companion Specification OPC UA for Machinery.

It contains various building blocks for machinery that allow use cases across different types of machines and machine components. These building blocks can either be used in other companion specifications or directly in an information model.

The first version was published in 09/2020 and was one of the first OPC UA companion specifications to be fully endorsed by the umati community. Recently, the version was updated to address additional use cases and will continue to be updated in the future.

The implemented use cases for the identification of machines and components form the basis for the "Plug & Work" target image, as aggregates from a wide range of industries can be identified in the same way and enable machine- and manufacturer-independent recognition between diverse network participants.

Part 1 covers these use cases:



Machine Identification and Nameplate



Finding all Machines in a Server



Component Identification and Nameplate



Finding all Components of a Machine

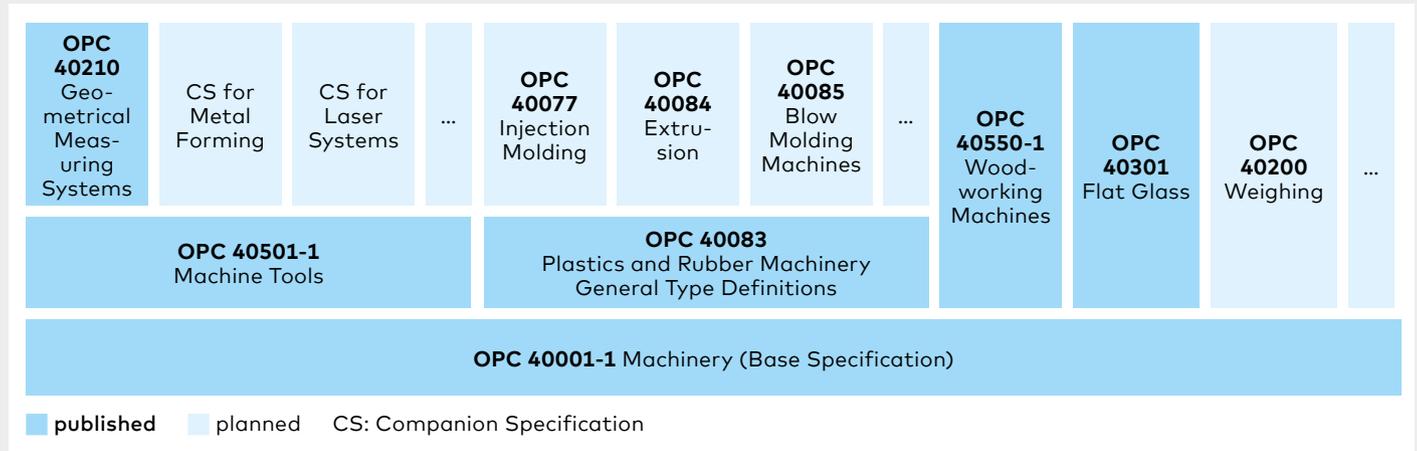


Machinery State



**Currently ongoing:
Job Management and Process Values**

Harmonized Interfaces based on OPC UA for Machinery



The "Machinery State" module paves the way for various use cases like Machine Monitoring and KPI Calculations. Machine availability can easily be determined, resulting in high added value – especially in production where machines from different industries are used.

The first practical implementation is shown in the umati showcase with the umati.app. To see how this is done, visit <https://showcase.umati.org>

OPC 40001-1 / VDMA 40001-1 was developed under the umbrella of VDMA, the Mechanical Engineering Industry Association, in a Joint Working Group with the OPC Foundation. It followed an initiative by a number of technology-specific first-mover standardization groups from different sectors of the machine building industries.

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The specification is available for free at the following repository: umati.org/ua4m



Supported by:



on the basis of a decision
by the German Bundestag

OPC 40010 UA for Robotics

The **OPC 40010** series provides standardized OPC UA information models for industrial robots.

The VDMA OPC Robotics Initiative was established in 2017 to bring together robot manufacturers with the aim of discussing and developing a common, usable, future-proof interface for industrial robots. OPC UA was identified as the obvious choice for the creation of such a standard since it provides feature-rich standardized mechanisms to describe vendor-independent interfaces supported by a strong information model.

As a joint working group, the initiative is organized by VDMA Robotics + Automation and supported by the OPC Foundation. Over the last years, the core working group of this initiative, a group of experts from 14 companies, have developed Part 1 of the VDMA OPC Robotics Companion Specification. Part 1 is the first step in the gradual design-in towards a fully connected Industrial Internet of Things (IIoT). It enables vertical provisioning of information from the lower (Sensor/ Actuator) to the higher (Control, SCADA, MES, Cloud) levels of the automation pyramid.

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The specification is available for free here:
umati.org/ua4robotics

The **OPC Robotics Information Model** can be used to describe all current and future robotics systems:

- **industrial robots**
- **mobile robots**
- **additional axes**
- **control units**
- **peripheral devices**, which do not have their own OPC UA server

Part 1 covers these use cases:

- **Structuring of an integrated robot system** into its constituent components
- **Vendor-independent access** to asset information of all integrated robot systems and their components
- **Representation of motion devices** containing one or more axes.
- **Representation of controllers** including their software and task controls.
- **Representation of common safety states** of a motion device system.
- **Common condition monitoring parameters** of the components of an integrated robot system
- **Identification of anomalies** based on the condition monitoring parameters

Ongoing work to extend Part 1 with:

- addIns for **remote operation** i.e. loading, unloading, starting, stopping programs.
- addIns to **provide the single point of control mechanism**.
- a **dialog mechanism** to handle system notifications that need to be accepted by the operator.

OPC 40083 UA for Plastic and Rubber Machinery

The **OPC 40083** specification provides standardized OPC UA information models for the plastic and rubber machinery industry.

This collection of specifications is jointly developed with the OPC Foundation and the European umbrella association of the plastics and rubber machinery industry called EUROMAP. The initiative was launched in May 2014 and aims to define OPC UA information models for various plastic and rubber machines.



EUROMAP provides technical recommendations for plastics and rubber machines. In addition to standards for machine descriptions, dimensions and energy measurement, interfaces between machines feature prominently.

The primary goal of this initiative is to increase the quality and efficiency of the production, which is only possible with standardized interfaces. Plastics and rubber machines are usually integrated in a production line and/or connected to superordinate systems like Manufacturing Execution Systems (MES). Therefore, the joint working group OPC UA Plastics and Rubber Machinery develops Companion Specifications for both horizontal and vertical communication.

OPC 40083 is a Companion Specification for general information related to plastics and rubber machinery. The idea is that object types used for different machines and applications are defined in OPC 40083 and only once. There are specific Companion Specifications for the concrete applications (**OPC 40077, 40079, 40082, 40084, 40086**). Their generally valid results are then summarized in EUROMAP 83.

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The specification is available for free here:
<https://euromap.org/euromap83>



OPC 40077 UA and OPC 40079 UA for Injection Molding Machines

The **OPC 40077** and **OPC 40079** specifications provide standardized OPC UA information models for vertical and horizontal communication of injection molding machines.

OPC 40077

OPC 40077 focuses on data exchange between injection molding machines (IMM) and a higher-level manufacturing execution system (MES). The aim is to provide a vendor independent interface for easier quality assurance, order and data set management.

The following functionalities are covered:

- **General information** about the IMM (manufacturer, model, serial number etc.), current configuration and status of the IMM
- **Job management:** Information on the jobs running on the machine and the parameters of the production cycles and methods to send and start jobs from the MES to the IMM
- **Dataset management:** Allows transferring datasets between IMM and MES for building a central repository of datasets. These include information on nominal process parameters related to the IMM but also to installed handling systems.

OPC 40079

The interface for data exchange between injection molding machines and robots is elaborated in OPC 40079. The target of OPC 40079 is to provide a unique interface for IMM and robots independent of manufacturer to ensure compatibility. The next versions are going to add further Facets allowing unlimited equipment and other topics for higher level of integration on the production floor.

The following functionalities are covered:

- **Realtime exchange of signals** via PubSub to prevent mechanical collisions
- **Position signals** from the IMM: 1 mould, 2 ejectors, 10 cores and 1 additional axis
- **Enabling signals from the robot** to the IMM to enable/disable movements of the IMM depending on the robot position
- **Multiple pub sub connections**
- **Part tracking**
- **Signals from the IMM** representing the availability of parts in each mould
- **Signals from the robot** on inserting and removing of parts
- **Exchange of production and quality datasets** between machine and robot

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The specifications are available for free here:

<https://euomap.org/euomap77>
<https://euomap.org/euomap79>



OPC 40084 UA for Extrusion Lines

The **OPC 40084** series specifications provide standardized OPC UA information models for whole extrusion lines and individual components.

The working group on OPC 40084 develops information models for rubber and plastics extrusion. The intention is to ensure interoperability between the different machines in an extrusion line. In particular, the monitoring of the overall production and the management of production orders are possible use cases.

OPC 40084-1 provides general types that are used for extrusion. Together with OPC 40083, which defines general type definitions for the complete sector plastics and rubber machinery, it is the basis for all other parts of OPC 40084.

OPC 40084-2 describes the interface between extrusion lines and manufacturing execution systems (MES) for data exchange. MES are used for collecting the information generated by extrusion lines at a central point for easier quality assurance and job and dataset management. The target of OPC 40084-2 is to provide a unique interface for extrusion lines and MES from different manufacturers to ensure compatibility.

The following functionalities are covered:

- **General information** about the extrusion lines, current configuration and status of the extruder line.
- **Job management**
- **Recipe management** including temperatures, dosing volumes etc.

OPC 40084-3 describes the interface between extruders as part of an extrusion line and MES for data exchange. The target of OPC 40084-3 is to provide a unique interface for extruders and MES from different manufacturers to ensure compatibility.

The following functionalities are covered:

- **General information** about the extruder (manufacturer, model, serial number etc. etc.), current configuration and status of the extruder.
- **Recipe management:** Extruders store their configurations in so-called recipes. These include information on nominal process parameters (temperatures, dosing volumes etc.).

OPC 40084-4 to OPC 40084-12 describe the data exchange interface for various components as part of an extrusion line. The components include:

- Part 4: **Haul-off**
- Part 5: **Melt pump**
- Part 6: **Filter**
- Part 7: **Die**
- Part 8: **Pelletizer**
- Part 9: **Cutter**
- Part 10: **Calibrator**
- Part 11: **Corrugator**
- Part 12: **Calendar**

The interfaces are used by

- **MES** for collecting the information generated by extrusion lines at a central point for easier quality assurance and job and dataset management.
- **Line controllers** to monitor and set process parameters.

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The specification is available for free here:
<https://euomap.org/euomap84>



OPC 40082 UA and OPC 40086 UA for Interfacing Plastic and Rubber Machinery

The **OPC 40082** and **OPC 40086** specifications provide standardized OPC UA information models for interfacing plastic and rubber machinery with material supply systems and other periphery.

OPC 40082

OPC 40082 defines OPC UA interfaces to peripheral devices for plastics and rubber machines. The Companion Specification consists of several parts, focusing on different device types.

OPC 40082-1 to 40082-3 describe the OPC UA interfaces for:

- Part 1: **Temperature control devices**
- Part 2: **Hot runner devices**
- Part 3: **Liquid silicone and rubber dosing systems**

The target of OPC 40082-1 to OPC 40082-3 is to provide a standardized interface for these devices from different manufacturers to ensure compatibility.

The following functionalities are covered:

- **General information** about the device
- **Status information**
- **Process data**

OPC 40086

OPC 40086 defines information models for material supply systems in the plastics sector. The entire path of the material from silo to the processing machine is to be covered.

The specification deals with the handling of granules, powder or liquids in a material supply system and addresses systems of arbitrary complexity. Furthermore, all process data generated during the process in the material supply system should be recorded and made available to other systems.

OPC 40086 covers the following functionalities:

- **General information** about the Material Supply System and its materials: e.g. filling level, temperature, etc. Each of the devices has a material input (incl. condition) and a material output.
- **Job management**: The delivery of material by the MSS is organized by jobs. With a job a target machine or the MES orders material according to a defined recipe which shall be provided at a specified transfer point.
- **Traceability**: An event is generated for each batch part that leaves the MSS. This contains a unique identifier, which can later be used to determine the history of supplied materials.

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The specifications are available for free here:

<https://euomap.org/euomap82-1>
<https://euomap.org/euomap82-2>
<https://euomap.org/euomap82-3>
<https://euomap.org/euomap86-1>

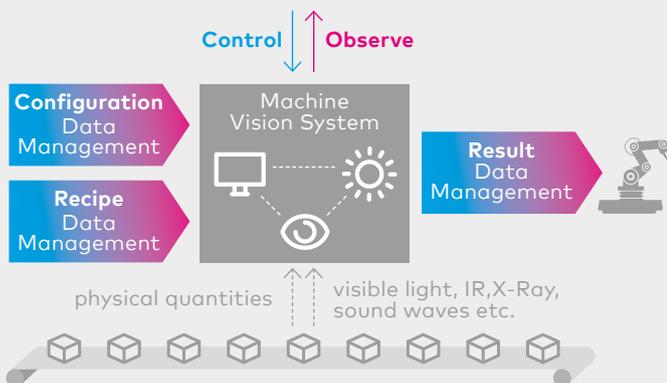


OPC 40100 UA for Machine Vision

The OPC 40100 series provides standardized OPC UA information models for Machine Vision systems.

The VDMA OPC Machine Vision Initiative, launched in January 2016, released Part 1 of the OPC Machine Vision Companion Specification in 2019, and Part 2 will be released in 2022. As a joint working group, the initiative is organized by VDMA Robotics + Automation and supported by the OPC Foundation.

The core working group that is developing the specification consists of 17 experts from 10 companies. Due to the enormous variations in machine vision systems all over the world, it is very hard to generalize vision system data. Therefore Part 1 focuses on data management methods without restricting the content of the same. Behavior control and observation of a vision system are the key objectives solved in Part 1. The generic state machine approach introduced in Part 1 of the specification enables monitoring and control of system behavior.



The initiative is currently concluding the development of Part 2 of the specification which aims to define a generic structure and the components of a machine vision system. It describes the relationship between the components and their condition monitoring parameters.

Part 1 describes the **functionality of a machine vision system** and covers these use cases:

- **Configuration Management**
- **Recipe Management**
- **Result Management**
- **Safety State Management**
- **Machine vision system state with State Machines**

Part 2 describes **the structure of a machine vision system**, its components and the relationships between them and covers these use cases:

- **Identification of the system and its components**
- **Condition Monitoring**
- **Relationship between components**
- **Future proof information model** to allow integration of future detailed companion specifications for the components of a machine vision system

The members of the initiative are:

- **Asentics**
- **Basler**
- **Bosch**
- **EVT**
- **Isra Vision**
- **Kuka**
- **MVTec**
- **PeerGroup**
- **SAC**
- **Scanware**
- **Stemmer**
- **Vitronic**

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The specification is available for free here:
umati.org/ua4mv

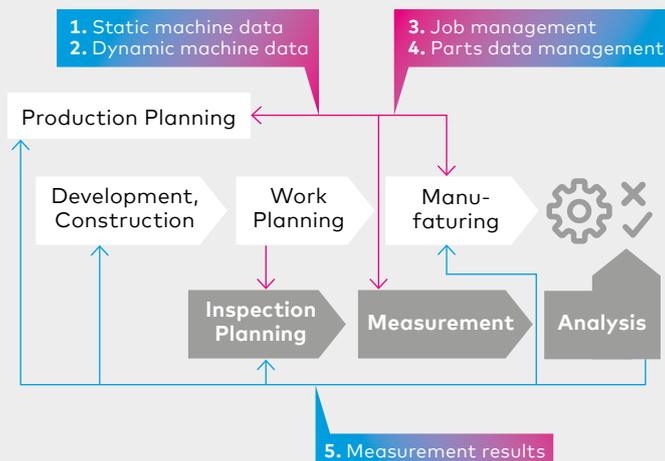


OPC 40210 UA for Geometrical Measuring Systems

The **OPC 40210** provides information for data transfer to and from geometrical measuring systems.

For geometrical measuring systems (GMS), such as coordinate measuring systems, form and surface measuring machines as well as multi-point measuring machines, a VDMA working group is defining OPC 40210 UA for Geometrical Measuring Systems in coordination with the OPC Foundation. The aim is to provide information for data transfer to and from geometrical measuring systems via a uniform interface that can be used by digital data processing systems such as MES systems.

For geometrical measurement technology, as the "information supplier" on the quality of production, digitalization has a special significance in the interaction with other production systems. This interaction, which



is also referred to as interoperability of machines and systems, enables companies to participate in new digital structures and is a basic prerequisite for new digital business models. Through interoperable interfaces, machines from different manufacturers can be efficiently integrated into existing and new production landscapes.

The Companion Specification considers the following use cases:

- 1. static machine data** (identification of the GMS)
- 2. dynamic machine data** (current state/status of the GMS)
- 3. job management** (monitoring of measurement routines)
- 4. parts data management** (identification of parts and related information)
- 5. measurement results** (management of the provision of measurement results)

The Companion Specification was jointly developed by:

- **Hexagon Manufacturing Intelligence**
- **Jenoptik**
- **Mahr**
- **MARPOSS**
- **Mitutoyo**
- **OGP Messtechnik**
- **Wenzel Metrology**
- **ZEISS Industrial Quality Solutions**

The Companion Specification developed by the industry will be presented at CONTROL 2022 where its practical applicability will be demonstrated on a dashboard. This dashboard (**umati.app**) is provided by the umati community, which promotes the dissemination and use of open interface standards based on OPC UA.

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The specification is available for free here:
umati.org/ua4gms



OPC 40451 UA for Industrial Joining Technologies

The **OPC 40451** for Industrial Joining Technologies is an initiative to create common OPC UA interface for joining technologies.

The VDMA Industrial Joining Technologies initiative, launched in May 2019, released Part 1 of the OPC 40451-1 Tightening Companion Specification in 2021, and Part 2 will be released in 2022/2023. As a joint working group, the initiative is organized by VDMA Integrated Assembly Solutions and supported by the OPC Foundation.

The aim of the initiative is to create standard interfaces for joining technologies such as Tightening, Riveting, Gluing, Pressing etc. The first release of the initiative was to cover the specific Tightening use cases along with common elements at the joining level.

The core working group that is developing the specification consists of 15+ experts from 9 companies.

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The specification is available for free here:
umati.org/ua4ijt

The following are the use cases covered in Release 1, published in October 2021:

Asset Management

- Overview and identification of the asset

Result Management

- Standard definition of Result which is common for various joining technologies.
- Tightening Result containing Steps, Traces and Errors.
- Standard interface to access Results using Event, Methods, AddressSpace.

Basic Events

- Generic event with customized message and Result event with payload.

Upcoming Releases:

- Create a joining specification to harmonize various joining technologies.
- Cover additional use cases such as
 - Consolidated Result
 - Harmonization of Asset and Result models
 - Comprehensive Event Model
 - Joints
 - Future-proof information model
 - Program, Process, Parts
 - Integration of harmonized location model
 - Future-proof information model through use of flexible modeling approach with required semantics and rules.

The members of the initiative are:

- **Atlas Copco**
- **Cleco**
- **CSP**
- **Deprag**
- **Desoutter**
- **Rexroth**
- **SCS Concept Group**
- **Weber**
- **Xitaso**

OPC 40501 UA for Machine Tools

The **OPC 40501** series addresses use cases and parameters specifically for machine tools.

The aim is to create a common interface among machine tools of different technologies, manufacturers and model series.

The first part of the OPC UA Companion Specification for Machine Tools aims to provide the basics for such an interface. These allow for monitoring the machine tool and providing an overview of the jobs on it. Most of this information is not specific to a particular technology. The OPC UA for Machine Tools interface facilitates the exchange of information between a machine tool and software systems like MES, SCADA, ERP or data analytics systems.

The Machine Tool Specification was recently updated with Use Cases provided by OPC UA for Machinery, especially the Machine States Use Cases. They serve as the basis for further KPI Monitoring facets to enable calculations based on ISO 22400 KPI definitions.

umati provides resources on how to implement UA4MT uniformly at umati.org/dev

OPC 40501-1 and **VDMA 40501-1** was initiated by VDW, the German Machine Tool Builders' Association. It was created by a **Joint Working Group** between **VDW** and the **OPC Foundation**, comprising over 90 companies and almost 200 participants from all around the world.

Part 1 covers these use cases:



Identify machines of **different manufacturers**



Overview of whether **production is running**



Overview of **parts** in a job



Overview of **runtimes** for a job



Overview of machine tool **state**



Overview of upcoming **manual activities**



Overview of **errors and warnings**



Providing information for **KPI calculations**



Providing an overview of **tool data**



Providing OPC UA for Machinery **Use Cases**

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The specification is available for free at
the following repository: umati.org/ua4mt



OPC 40701 UA for Surface Technology

The **OPC 40701** is an initiative to create common OPC UA interfaces for surface technology machinery.

The aim of the initiative is to create common OPC UA interfaces for surface technology machinery such as

- **paint application technology**
- **shot blasting technology**
- **plasma surface treatment technology**
- **cleaning and pretreatment technology**

Current activities focus on the interface of material supply systems for coating material. The use-cases considered cover the provision of raw data of

- **all quality-relevant parameters with time stamp to higher-level systems**
- **all process-relevant parameters with time stamp to other components/machines**

The information model aims to provide the basis for detailed monitoring of the material supply system and its components. The model defines parameters for all relevant system components including pumps, tanks, valves, pipelines, filters and measuring devices for monitoring physical quantities such as temperature, pressure, flow, etc.

On the basis of the information model developed for material supply systems, the OPC UA surface technology community teamed up with umati for demonstration of a complete paint application plant consisting of

- **pretreatment plant**
- **material supply system**
- **dosing system**
- **application system**
- **conveyor**
- **spray booth**
- **dryer**

The paint application plant model has been developed jointly by the **companies**

- **AFOTEK Anlagen für Oberflächentechnik GmbH**
- **b+m surface systems GmbH**
- **Dürr Systems AG**
- **J. Wagner GmbH**
- **Konzeptpark GmbH**
- **WIWA Wilhelm Wagner GmbH & Co. KG**



The umati implementation is a prototype tested in parallel to the development of the information model by the community. The umati demonstrator infrastructure is used to display the current state of work.

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a network of strong partners



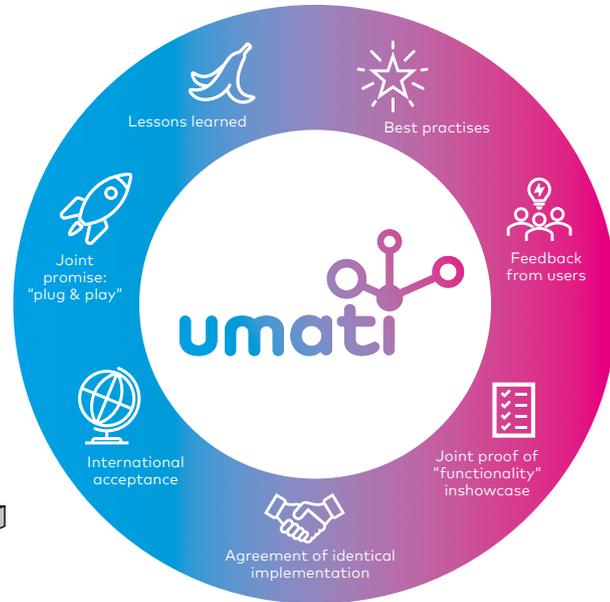
umati partners:

- advertize the connectivity of their products through the **umati logo**
- have **easier access to their customers**
- benefit from **market stimulation** through strong marketing with high visibility
- demonstrate the **"plug and play"** user experience e.g. by taking part in demonstrations at trade fairs
- are part of a **global community** – for the industry by the industry
- have access to **exclusive** information and tools

The number of umati partners is growing continuously. To see who has already endorsed umati, visit www.umati.org/partners

Machine builders

Associations, working groups



Users

Various sectors, multiple machinery



umati brings together machine builders, software producers and users in a strong community. They share their experience to benefit from identical implementation of OPC UA standards.

umati is operated by



VDMA – Mechanical Engineering Industry Association
www.vdma.org



VDW – German Machine Tool Builders' Association
www.vdw.de

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