PLATTFORM INDUSTRIE4.0

GUIDELINE

Which criteria do Industrie 4.0 products need to fulfil?

Guideline 2020

Created in collaboration with

ZVEI: Die Elektroindustrie

Imprint

Published by
Federal Ministry for Economic Affairs and Energy (BMWi)
Public Relations
10119 Berlin
www.bmwi.de

Text and editing
The Plattform Industrie 4.0 secretariat
Bülowstraße 78
10783 Berlin

Design
PRpetuum GmbH, Munich

Status
July 2020

Illustrations
zhu difeng – istock; Alexander Limbach – fotolia (title and p. 5), arrow – fotolia (p. 3), zoranm – gettyimages (p. 5), rost9 – fotolia (p. 6), nd3000 – fotolia (p. 9), yewkeo – fotolia (p. 10), MH – fotolia (p. 12), elen31 – fotolia (p. 15)

This publication as well as further publications can be obtained from:
Federal Ministry for Economic Affairs and Energy (BMWi)
Public Relations
E-mail: publikationen@bundesregierung.de
www.bmwi.de

Central procurement service
Tel.: +49 30 182722721
Fax: +49 30 18102722721

This brochure is published as part of the public relations work of the Federal Ministry for Economic Affairs and Energy. It is distributed free of charge and is not intended for sale. The distribution of this brochure at campaign events or at information stands run by political parties is prohibited, and political party-related information or advertising shall not be inserted in, printed on, or affixed to this publication.

Table of contents

1. Introduction 3

2. Principles for defining criteria for Industrie 4.0 products 4
2.1 Self-examination 4
2.2 Simplicity 4
2.3 Own identifier instead of a general label 4
2.4 Free usage 4
2.5 Free of charge and for everyone 4
2.6 Implementing entity 4

3. Product characteristics 2020 5
3.1 Migration 5
3.2 Product labelling 5

4. Selecting the criteria 6
4.1 Identification 6
4.2 Industrie 4.0 communication 7
4.3 Industrie 4.0 semantics 7
4.4 Virtual description 7
4.5 Industrie 4.0 services and states 8
4.6 Standard functions 8
4.7 Security 8

5. Procedure for criteria and product characteristics 9
5.1 Milestone plan 9

6. Criteria for Industrie 4.0 products and their product characteristics 2020 10

7. Further development of the criteria for Industrie 4.0 products 12
7.1 Probable criteria and product characteristics – mid-term 12
7.2 Outlook for criteria and product characteristics – long-term 12

8. Product examples 15
8.1 Nexo industrial cordless Wi-Fi nutrunner 15
8.2 Energy efficiency module 18
8.3 FDI-based software for device management 20
8.4 S7-1500 Advanced Controller 22
8.5 Modicon M251 Logic Controller 25
8.6 LiDAR Sensor R2000 27
8.7 Power Supply Quint Power 29

Appendix 31

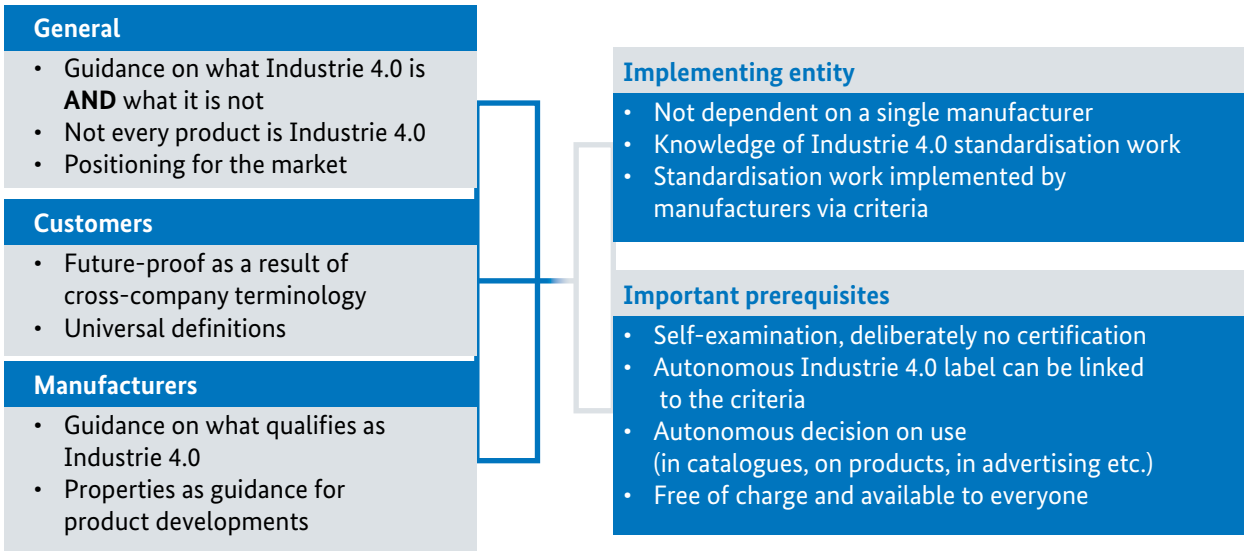
1. Introduction

Industrie 4.0 is the fully digitalised and networked production approach of the future and it is relentlessly moving into the factories. There is an almost inflationary use of terms such as “IoT Ready”, “RAMI 4.0-compliant” and “Industrie 4.0 seal”. Moreover, consulting companies are offering to test products and entire enterprises for their Industrie 4.0 fitness. All too often, the services offered define Industrie 4.0 in completely different ways, causing far more confusion than clarity. How can we shed some light onto this mix of terms and offers? What does the customer gain and what is behind the terms and consulting services? ZVEI has developed general and universal criteria for Industrie 4.0 products.They are described in this guideline. The guideline was created in collaboration with the working group 1 on reference architectures, standards and norms of Plattform Industrie 4.0.

These criteria help providers in the market to decide which products can already be labelled as Industrie 4.0-capable today. At the same time, companies can use these criteria as a guide for product development. For customers, the ZVEI definition provides clarity about the performance and features that Industrie 4.0 products[1] should provide. This ensures more transparency and security for the market as a whole. Indirectly, it also becomes clear what is not Industrie 4.0-compliant.

This guideline continues and supersedes the yearly updated guidelines since 2015.

Figure 1: Why criteria for Industrie 4.0 products are important: initial universal guidance for customers and manufacturers



Source: ZVEI Leaderchip circle Industrie 4.0, Martin Hankel, Bosch Rexroth AG

1 This guideline deals with criteria for products, whereby the term ‘products’ can refer to devices, systems, machines or software. It does not describe criteria for Industrie 4.0 complete solutions (hardware, software, service, application etc. as a complete package). Industrie 4.0 complete solutions should contain at least one Industrie 4.0 product that complies with the criteria for Industrie 4.0 products and thus the minimum product properties.

2. Principles for defining criteria for Industrie 4.0 products

The criteria for Industrie 4.0 products are to be established quickly and simply as far as possible. The following prerequisites have therefore been defined.

2.1 Self-examination ✔

Each company or organisation checks itself, based on the criteria for Industrie 4.0 products, whether its own products have the properties or not. They are also responsible for developing any properties lacking in their products.

Certification is explicitly not necessary for the self-examination.

2.2 Simplicity ✔

The criteria for Industrie 4.0 products and their product properties are to be presented as simply as possible so that any company or organisation can apply them independently without third party assistance.

2.3 Own identifier instead of a general label ✔

A general label is not associated with the criteria for Industrie 4.0 products and the requisite product properties. Each company or organisation can use its own label to reference the criteria and refer customers to the criteria.

Conversely, customers can also actively query whether a company label meets the criteria for Industrie 4.0 products.

2.4 Free usage ✔

Each company and organisation is free to decide whether to publicly use the criteria for Industrie 4.0 products and their product properties.

For example, they can use them in product catalogues, at trade fairs or for advertising.

Public use is explicitly requested, always contributing to the spread of the criteria for Industrie 4.0 products.

2.5 Free of charge and for everyone ✔

The use of the criteria for Industrie 4.0 products and their product properties is free of charge for companies and organisations. Anyone can use them for their products.

2.6 Implementing entity ✔

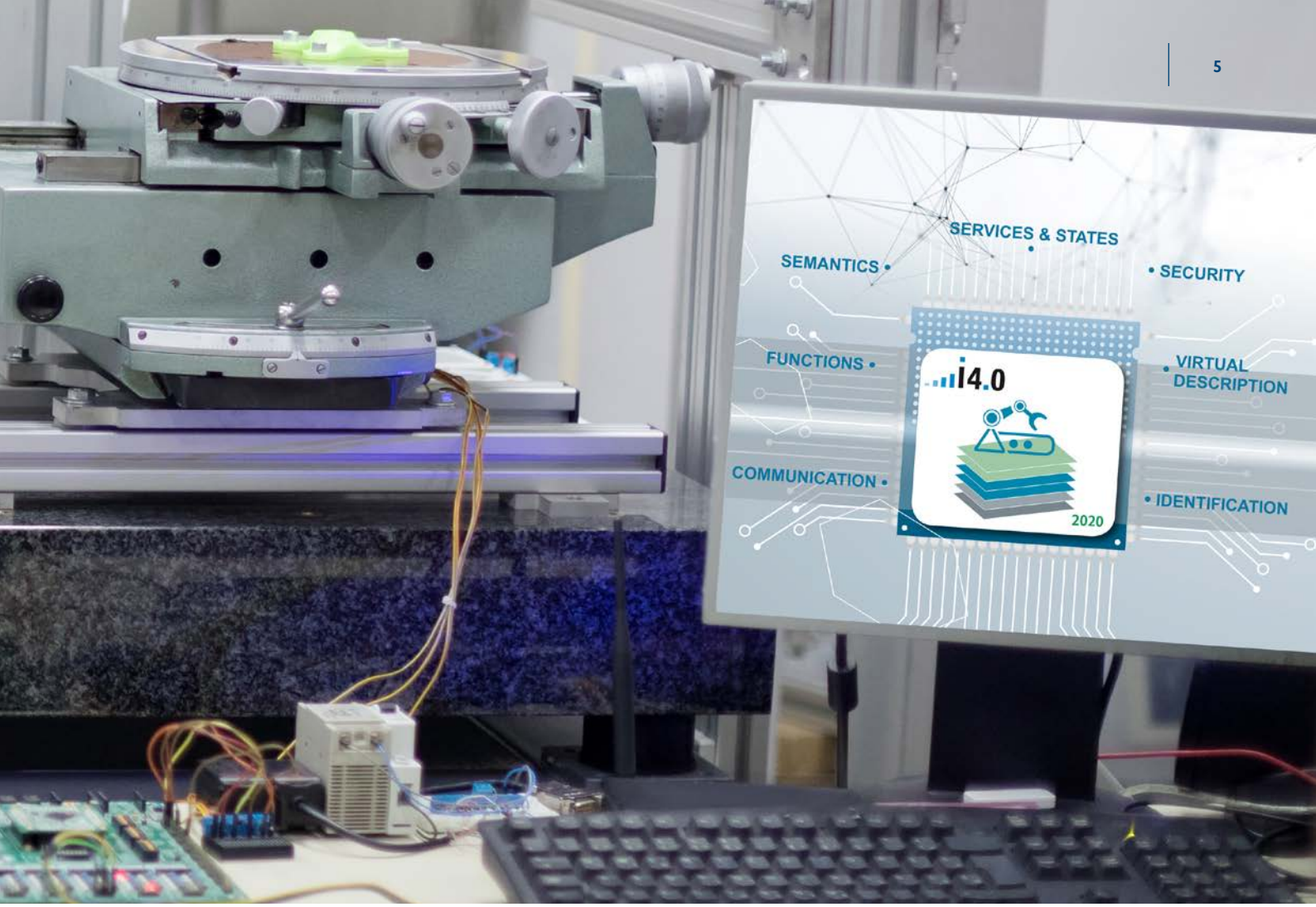
An entity which is independent of manufacturers defines and publishes the criteria for Industrie 4.0 products in a fixed and transparent process.

Specifically, the criteria are developed in the committees ‘ZVEI-SG models & standards’ and the Plattform Industrie 4.0 working group AG1 on reference architecture, norms & standards. Both committees are staffed with cross-manufacturer members from the IT industry, automation engineering, mechanical and plant engineering and process engineering. The two committees have sufficient knowledge of the ongoing standardisation work on a reference architecture for Industrie 4.0.

This ensures that the criteria for Industrie 4.0 products are generally valid and that the right and necessary technical product properties are used.

The stipulated criteria for Industrie 4.0 products can only be changed through (by) these two committees.

The aim is for the criteria and the requisite product properties to also be used in a standardisation process in the future.



3. Product characteristics 2020

"Product characteristics 2020" describe minimum features that a product on the market today must have if it is to satisfy the criteria for Industrie 4.0 products. This also includes products with features that can be loaded subsequently and with updates for future requirements.

The characteristics are primarily aimed at customers and list which products are available to be procured today for an Industrie 4.0 network. Minimum requirements for norms and standards are described here so that a product can participate in an Industrie 4.0 network. Products can of course also have features that exceed these minimum requirements. The call for specified product characteristics also supports the introduction of new business models.

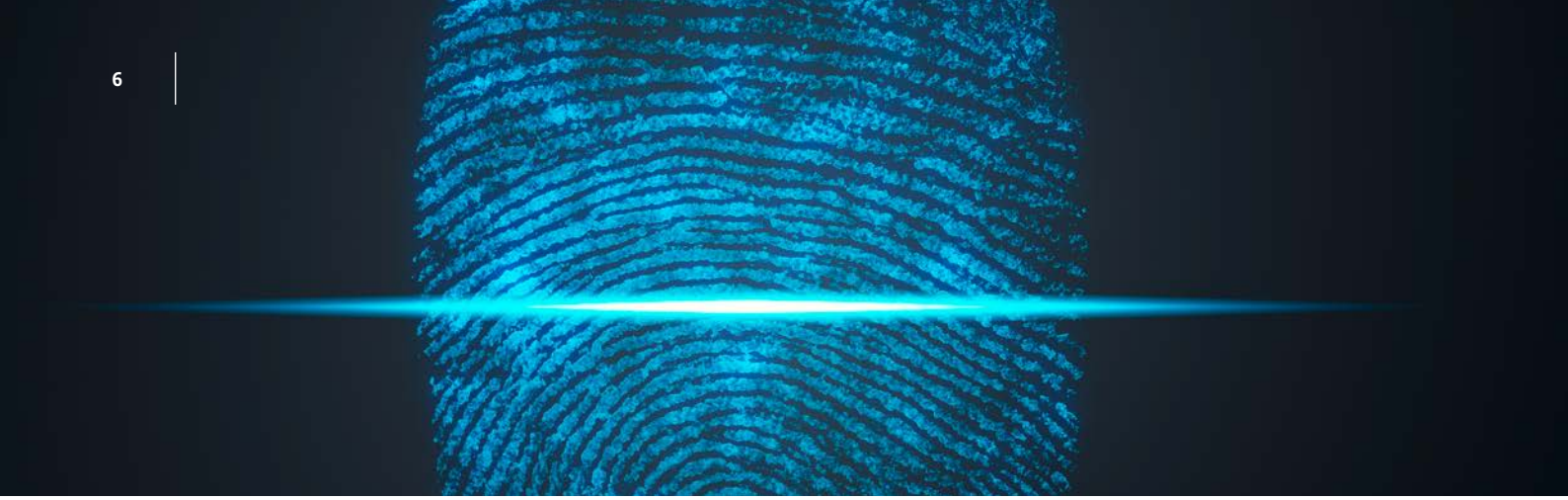
The criteria for Industrie 4.0 products and the product characteristics are checked and adjusted on an annual basis.

3.1 Migration

The description and stipulation of the minimum characteristics for the individual criteria are checked once per calendar year. Changes are made where necessary. This ensures that the characteristics of the criteria for Industrie 4.0 products are adapted in line with technical progress. New norms and standards can be added in the future and the characteristics outlined in increasing detail.

3.2 Product labelling

The criteria for Industrie 4.0 products and their respective characteristics should be used for the labelling of products. ZVEI recommends labelling the products "I4.0" or "Industrie 4.0" and adding these terms to the manufacturers' catalogues, for example. Products with this labelling satisfy the currently stipulated minimum requirement of features, and a migration to comply with future features is ensured.



4. Selecting the criteria

The Reference Architecture Model Industrie 4.0 (RAMI 4.0)[2] was created as part of the standardisation work. It represents the entire scope of solutions for Industrie 4.0.

Technical standards from the three axes “Architecture Layer”, “Lifecycle & Value Stream” and

“Functional Hierarchy” can be found in RAMI 4.0. The various Industrie 4.0 committees are currently working on activities in this area.

The second reference model is the similarly published “Industrie 4.0 Components”2. It describes how an Industrie 4.0 product is integrated into an Industrie 4.0 network. An administration shell2 with the corresponding Industrie 4.0 communication is required here.

This means that an Industrie 4.0 product is always an Industrie 4.0 component consisting of “asset”, i. e. the object, and “administration shell”.

Both reference models set requirements and are the starting point for deriving the criteria for Industrie 4.0 products.

Criteria were selected which involve major changes or are an essential requirement for Industrie 4.0.

Each criterion is divided into its product characteristics, degree of fulfilment and the phases of its lifecycle.

The minimum required product characteristics for each criterion are described in the following and must be satisfied cumulatively.

The degree of fulfilment establishes which characteristics are mandatory and which are optional (use case-dependent).

The lifecycle is roughly divided into two phases of type (development) and instance (production, service). The product characteristics for the criteria may differ depending on the lifecycle phase and must then be fulfilled cumulatively (both criteria) to achieve them.

4.1 Identification

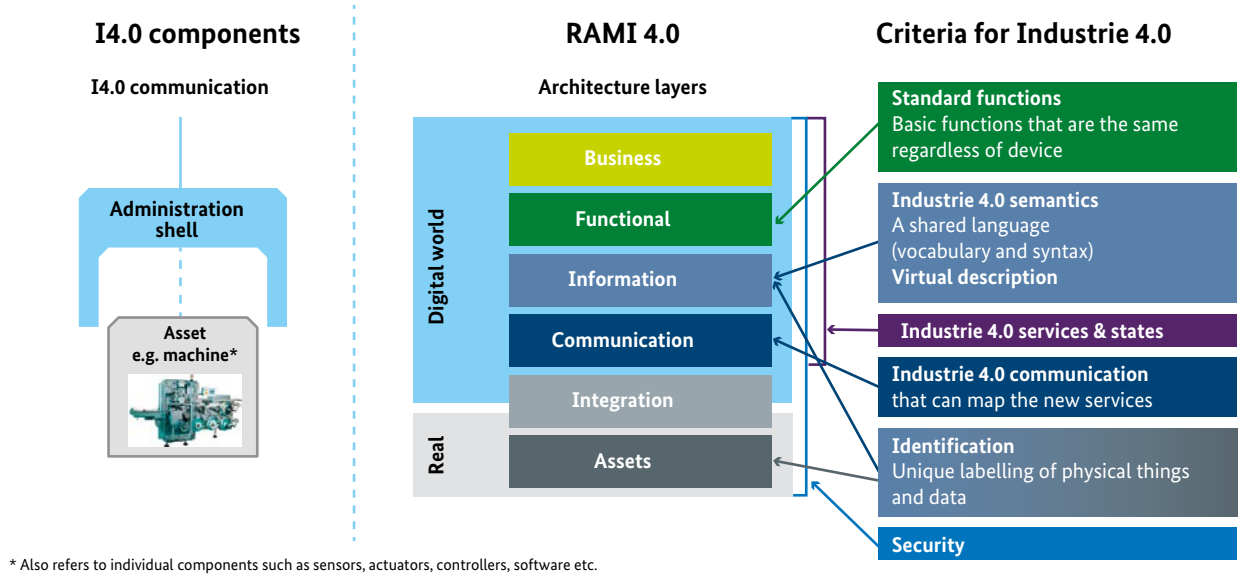
A necessary prerequisite for Industrie 4.0 is the globally unique identification of all products, i.e. assets and administration shells, in the Industrie 4.0 network. For this purpose, each product requires an identifier that can be used to clearly identify it worldwide.

The same also applies to data, standard functions, administration shells, etc ... that belong to the product. A globally unique identifier is also required so that the relationship between the data and functions can be established on a cross-manufacturer basis.

Two preferred schemes for identifiers have already been specified in the second part of the description of Industrie 4.0 components (according to ISO 29002-5 or as URI; see: “Structure of the Administration Shell”, Plattform Industrie 4.0, 2016).

2 The publications marked with a 2 can be obtained here:
www.zvei.org/presse-medien/publikationen/das-referenzarchitekturmodell-industrie-40-rami-40
www.zvei.org/presse-medien/publikationen/die-industrie-40-komponente/
www.zvei.org/presse-medien/publikationen/das-referenzarchitekturmodell-industrie-40-rami-40/
Further links: www.din.de/de/wdc-beuth:din21:250940128 und https://webstore.iec.ch/publication/30082

Figure 2: Deriving criteria for Industrie 4.0 products



* Also refers to individual components such as sensors, actuators, controllers, software etc.

Source: ZVEI Leaderchip circle Industrie 4.0, Martin Hankel, Bosch Rexroth AG

The identification is required in RAMI 4.0 in the asset, information and functional architecture layers.

4.2 Industrie 4.0 communication

Industrie 4.0 follows a service-oriented architecture in which services can be provided and data exchanged. For this purpose, requirements for message transfer between two Industrie 4.0 components have been formulated, known as Industrie 4.0 communication.

The specifications for Industrie 4.0 communication are currently being defined. To this end, preferential standards are filtered out of existing standards and standards already at the development stage which are best suited for Industrie 4.0 communication.

In RAMI 4.0, Industrie 4.0 communication is represented by the communication layer. All other communication types as well as protocols are located in the integration layer here.

4.3 Industrie 4.0 semantics

Components, machines, plant and IT systems require a common language if they are to understand each other regardless of manufacturer. This involves shared vocabulary in the form of data and functions and also a common syntax that creates the right context for the data.

Some initial good candidates for Industrie 4.0 semantics are being discussed in the ZVEI and Plattform Industrie 4.0 standardisation committees. In addition to candidates such as eCl@ss or IEC 61360 with IEC CDD, other options for the potential sorting of syntax under discussion are, for example, Automation ML. The first standardised data and file formats will be added to the criteria as necessary product characteristics.

In RAMI 4.0, the Industrie 4.0 semantics are located in the information layer. All data and functions that are not standardised according to Industrie 4.0 are located here in the integration layer.

4.4 Virtual description

The virtual description reflects the entire content of the digital product representation.

There is a digital compilation of important data in Industrie 4.0 semantics as well as other information such as product descriptions, catalogue pages, images, technical features, data sheets, security features, simulation models etc.

This information provides a digital description of the product, parts of which are also accessible for customers.

Information can be accessed on the product, made freely available on the Internet, connected with the product or retrieved online by user ID.

4.5 Industrie 4.0 services and states

Components, systems and machines should be able to find each other in an Industrie 4.0 network and conduct an initial negotiation by communicating between themselves.

This also includes exchanges on the available data, functions and capabilities. Once agreement has been reached in these negotiations, the first data can be exchanged. Basic services are necessary for these processes, and both communication partners must be able to operate them.

Accordingly, these Industrie 4.0 services must be described and implemented independently of manufacturers so that an Industrie 4.0 network can function. These Industrie 4.0 services must be open, standardised (preferably normed) and accessible to all, and must also not be dependent on a single provider. They are necessary basic services that every Industrie 4.0 product must support and provide – staggered from initial implementation to full expansion. This also includes, for example, a general interface for all loadable services and messages on the states of the Industrie 4.0 products.

4.6 Standard functions

For machine builders and end customers in particular, it is extremely helpful for certain functions to be standardised for all components and systems. A good example of functions is the PLCopen Motion modules which are standardised independently of manufacturer. Simple condition monitoring functions are also suitable for this; if the starting values are standardised across all manufacturers, it is much easier to implement cross-manufacturer condition monitoring in a machine. Such functions, which will then be located in the functional layer of the RAMI 4.0, are currently being standardised/normed and will also be a good criterion for Industrie 4.0 products in future.

4.7 Security

Security is one of the central topics for Industrie 4.0 and must be ensured throughout the entire lifecycle in all architecture layers and hierarchy levels. In the same way as a building reinforced with steel, security thus ensures the stability of RAMI 4.0 and protects against possible attacks.

Initial security capabilities should already be in place today. Which capabilities these are should typically be shown by a threat analysis and already be clearly documented. Furthermore, a suitably secure identity should already be available, at least for the product instance. In the future, the partial security model will describe the necessary capabilities (authentication of the identifiers, user and role management, secure communication, logging of security-related changes) and optional capabilities of an Industrie 4.0 component that need to be taken into account for Industrie 4.0 products. It will be possible to access the inherent security capabilities online. IEC 62443 will play a key role here.

The security capabilities of a product property will have to be evaluated, in the long term (ten years), with a measurable quality based on a scale that has yet to be determined. In addition, the security capabilities[3] alongside safety capabilities, privacy capabilities, resilience and reliability will have to be the characteristic properties of a trustworthy Industrie 4.0 component. A multi-level scale for trustworthiness will then allow estimates of an Industrie 4.0 component's usability in an overall system, and it will be possible to determine the level of trustworthiness of an added value network automatically based on the current networking of the participants in the added value network. When components are integrated into a machine, the resulting level of trustworthiness must arise from the composition of the components.

3 This goes in a similar direction to the "trustworthiness" proposed by the IIC

5. Procedure for criteria and product characteristics

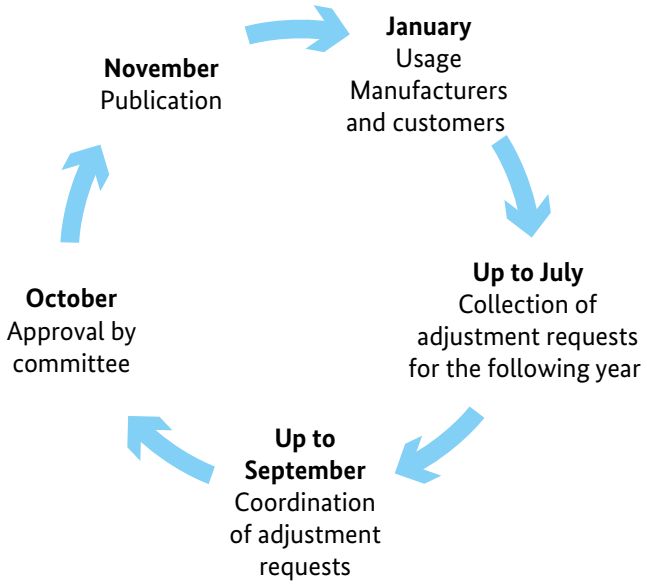
Initially, the criteria for Industrie 4.0 products and their product characteristics will be defined and stipulated in the “ZVEI-SG models and standards” and then released in the “Plattform Industrie 4.0 working group 1 on reference architecture and standards”.

The further process for the criteria and product characteristics is to be designed openly and, in the future, could also be implemented by means of a DINSPEC that performs an annual check and makes adjustments to the criteria and their product characteristics where necessary.

5.1 Milestone plan

The annual process will roughly be as follows: a publication of the criteria for Industrie 4.0 products and their product characteristics will always be made in November of each year. Manufacturers and customers will then be able to work with these specifications in the following year. By the middle of the following year, any adjustment requests will have been collected (contact: trs@zvei.org) and discussed in the committee up to September. The decisions taken by the committee will be approved in October so that the adjustments for the following year can again be published in November.

Figure 3: Generic annual cycle for checking the criteria for Industrie 4.0 products including product characteristics



Source: ZVEI Leaderchip circle Industrie 4.0, Martin Hankel, Bosch Rexroth AG

6. Criteria for Industrie 4.0 products and their product characteristics 2020

NB: In the following tables, the term Industrie 4.0 will be abbreviated to I4.0 for simplicity's sake.

Table 1: Product characteristics 2020 for the criteria for Industrie 4.0 products

Criteria	Requirements	L	C	Product characteristics 2020
1. Identification	Cross-manufacturer identification of the asset with unique identifier (ID) attached to the product[6], electronically readable. Identification in: 1) Development 2) Goods transport (logistics), production 3) Sales, service, marketing 4) Network	T	M	For 1) material number[4] (electronic) in accordance with ISO 29002-5[5] or URI
		I	M	For 2) serial number or unique ID For 3) manufacturer + serial number or unique ID With 2) and 3) electronically readable, for physical products via 2D code, RFID or NFC With 2) and 3) URI in accordance to DIN SPEC 91406 For 4) participant identification via IP network
2. I4.0 communication	Transfer of product data and data files for interpretation or simulation, for example; product data in standardised form.	T	M	Manufacturer makes data available/accessible online. The data should be relevant to customers and available/accessible with the assistance of identification/e. g. pdf via http(s) and URI
	Product[6] can be addressed via the network, supplies and accepts data, Plug & Produce via I4.0-compliant services.	I	M	Administration shell of the product[6] can be addressed (at any time) with the assistance of the identification online via TCP/UDP&IP with at least the information model from OPC-UA
3. I4.0 semantics	Standardized data with manufacturer-independent unique identification in the format of Properties with syntax for (as example): 1) Data related to business (Commercial data) 2) Catalog data 3) Technical data: Mechanics, Electric, Function, Location, Capabilities 4) Dynamic Data 5) Data describing the life cycle of the product instance.	T	M	For 2)–3) Catalog data and technical data sheet in an open standard online accessible.
		I	M	For 2)–3) Catalog data and technical data sheet in an open standard online accessible. For 4) Dynamic data via I4.0 communication online accessible.
		I	O	For 5) Data regarding the life cycle of the product instance online accessible

→

Table 1: Product characteristics 2020 for the criteria for Industrie 4.0 products (continued)

Criteria	Requirements	L	C	Product characteristics 2020
4. Virtual Description	Virtual representation in I4.0-compliant semantic. Virtual representation for the complete life cycle. Important properties of the physical component, information regarding the relation between Properties, relations relevant for production and production process-relevant relationships between Industrie 4.0 components, formal description of relevant functions of the physical component and its processes.	T	M	Customer-relevant information can be retrieved digitally based on type-identification (Product description, catalog, picture, technical features, datasheet, security properties, etc.)
		I	M	Digital contact to service and to information regarding product support (including spare parts information) possible from the field.
5. I4.0- Services and States	Standardized digital description of the asset's services, which can also access further services from the manufacturer or partners.	T	O	Digital description of device interface available
	General interface for loadable services and report of states. Necessary base services, which have to be supported and provided by an I40-product.	I	O	Information like states, error messages, warnings, etc. according to an industrial specification available via OPC-UA information model
6. Standard functions	Basic standardized functions, which can be executed manufacturer-independently and which provide same data in same functions. These basic functions serve as base for the functionality, on which every manufacturer can build their own extensions.	T	O	Functions described in Administration shell in format of I4.0 submodels.
		I	O	Functions implemented in Administration shell in format of I4.0 submodels.
7. Security	Minimum requirements for providing security functions.	T	M	A threat analysis has been executed. Appropriate security features were considered and publicly documented.
		I	M	Available security capabilities are documented. Appropriate secure identities are available.

Product characteristics for the criteria L: Lifecycle with T: Type and I: Instance
C: Coverage with M: Mandatory,
O: Optional, use-case-dependent, may be mandatory and N: Not relevant

4 Material number is used here as umbrella term for the type designation, manufacturer part number, order number, product classification etc.

5 A manufacturer-specific identification will probably be required as a rule for the above directly connected assets. ISO 29002-5 does not currently provide for this.

6 This guideline deals with criteria for products, whereby the term 'products' can refer to devices, modules, machines or software.

7. Further development of the criteria for Industrie 4.0 products

Industrie 4.0 is not fully described at present. The first stipulations were included in the criteria for Industrie 4.0 products. Which implementations and standards for Industrie 4.0 products will be relevant in the future? A timeframe is relevant for manufacturers and customers as well as for examining the product criteria and product characteristics. For the purposes of classification, the outlook has been divided into mid-term and long-term.

7.1 Probable criteria and product characteristics – mid-term

The mid-term outlook describes which further product characteristics are already being discussed today and could be implemented in the various products over the coming years.

It is directed particularly at manufacturers and shows which product characteristics regarding the criteria will have to be developed and implemented for Industrie 4.0 products over the next few years as a minimum. The time horizon here is up to five years.

7.2 Outlook for criteria and product characteristics – long-term

The long-term outlook describes the entire Industrie 4.0 spectrum with all of its norms and specifications.

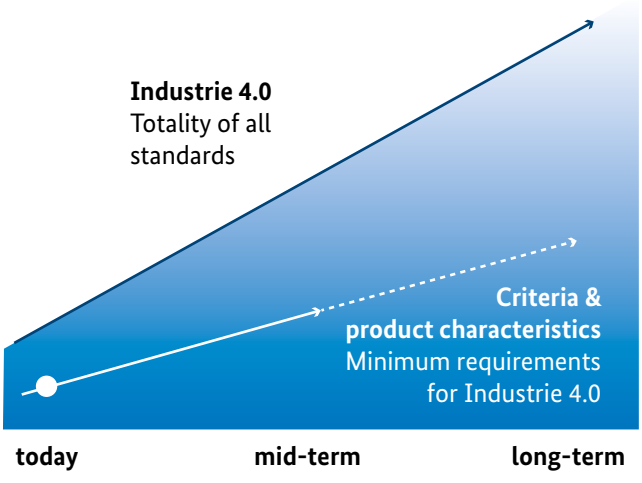
Many of these topics have not yet been conclusively defined and cannot as yet be considered in full. It is shown here what could belong to Industrie 4.0 product characteristics in the future.

This description is directed in particular at the norming and standardisation committees and highlights the fields in which standrads and norms are still to be added. A need for research can also be derived from this.

Whether and when these descriptions will become minimum product characteristics and part of criteria for Industrie 4.0 products is completely unknown at present. Potential candidates will first be included in the mid-term product characteristics as part of the annual checks.

The time horizon here is distinctly more than five years until a more precise description and definition is available.

Figure 4: Further development of the criteria and product characteristics including migration path



Source: ZVEI Leaderchip circle Industrie 4.0, Martin Hankel, Bosch Rexroth AG

Table 2: Outlook for criteria and product characteristics

Criteria	Requirements	L	C	Medium term ≤ 5 years	C	Long term ≤ 10 years
1. Identification	Manufacturerindependent identification of the asset with unique identifier (ID) attached to the product[7], electronically readable. Identification in: 1) Development 2) Supply chain (logistics), production 3) Sales, service, marketing 4) Network	T	M	As in 2020	M	As in 2020
		I	M	As in 2020, but also further wireless identification possible. More detailed identification data and de-referencing of further identifiers (e.g. GS1) possible.	M	As for medium term, but also indoor and outdoor localisation, pattern recognition, etc. possible.
2. I4.0-Communication	Transmission of product data and data files regarding the product, e.g. for planning or simulation, data regarding the product in standardised form.	T	M	As in 2020, but administration shells and its data can be communicated digitally.	M	As for medium term and new technologies such as ledger technologies (blockchain, IOTA).
	Product[7] accessible via network, provides and receives data, Plug & Produce based on I4.0-compliant services.	I	M	As in 2020, but Administration shell of the products [7] via "Details of the Asset Administration Shell" [8], OPC UA Mapping	O	As for medium term but communication can use communications standards (e.g. DDS, AMQP, Bluetooth etc.). Flexible network topologies (SDN), ledger technologies (blockchain, IOTA).
			O	Additionally MQTT and REST API for above production line level. TSN and 5G are possible in communication stack (support of pub/sub).	O	Standardised implementation of "mechanisms for bootstrap, announcement and detection of IoT components" in the asset or device.
3. I4.0-Semantic	Standardized data with manufacturer-independent unique identification in the format of Properties with syntax for (as example): 1) Data related to business (Commercial data) 2) Catalog data 3) Technical data: Mechanics, Electric, Function, Location, Capabilities 4) Dynamic data 5) Data describing the life cycle of the product instance	T	M	As in 2020, but with I4.0-compliant self-description. 1–5) structured in manufacturer-independent submodels with uniform minimum standards derived from "Details of the Asset Administration Shell" [8], 1–4) preferably ecl@ss, but also IEC CDD/W3C/IEC62832, IEC62569, IEC61360/ ISO13584 and IEC61987-compliant data 2) BMEcat or corresponding submodel 2-4) Models for simulation and virtual commissioning	M	As for medium term 1–3) + further catalogues for Property/concept descriptions Also autonomous negotiation of business relationships.
		I	M	As in 2020. 3–5) preferably ecl@ss, but also IEC CDD/ W3C/ IEC 62832-compliant data.	M	3–5) + further catalogues for Property/concept descriptions + data in public databases Also autonomous negotiation of business relationships.
4. Virtual Description	Virtual representation in I4.0-compliant semantic. Virtual representation for the complete life cycle. Important properties of the physical component, information regarding the relation between Properties, relations relevant for production and production process-relevant relationships between Industrie 4.0 components, formal description of relevant functions of the actual component and its processes.	T	M	As in 2020, but further customer-relevant data are available in I4.0-compliant formats. Data on product types can also be transferred to public or private clouds (Administration shell via a type). Documentation is available as submodel, according to VDI 2770	M	All data and descriptions available digitally in I4.0 semantics for cross-manufacturer exchange.
		I	M	Representation of all production and service documents as well as data present and available internally in a transparent manner.	M	All data and descriptions available digitally in I4.0 semantics for cross-manufacturer exchange.

→

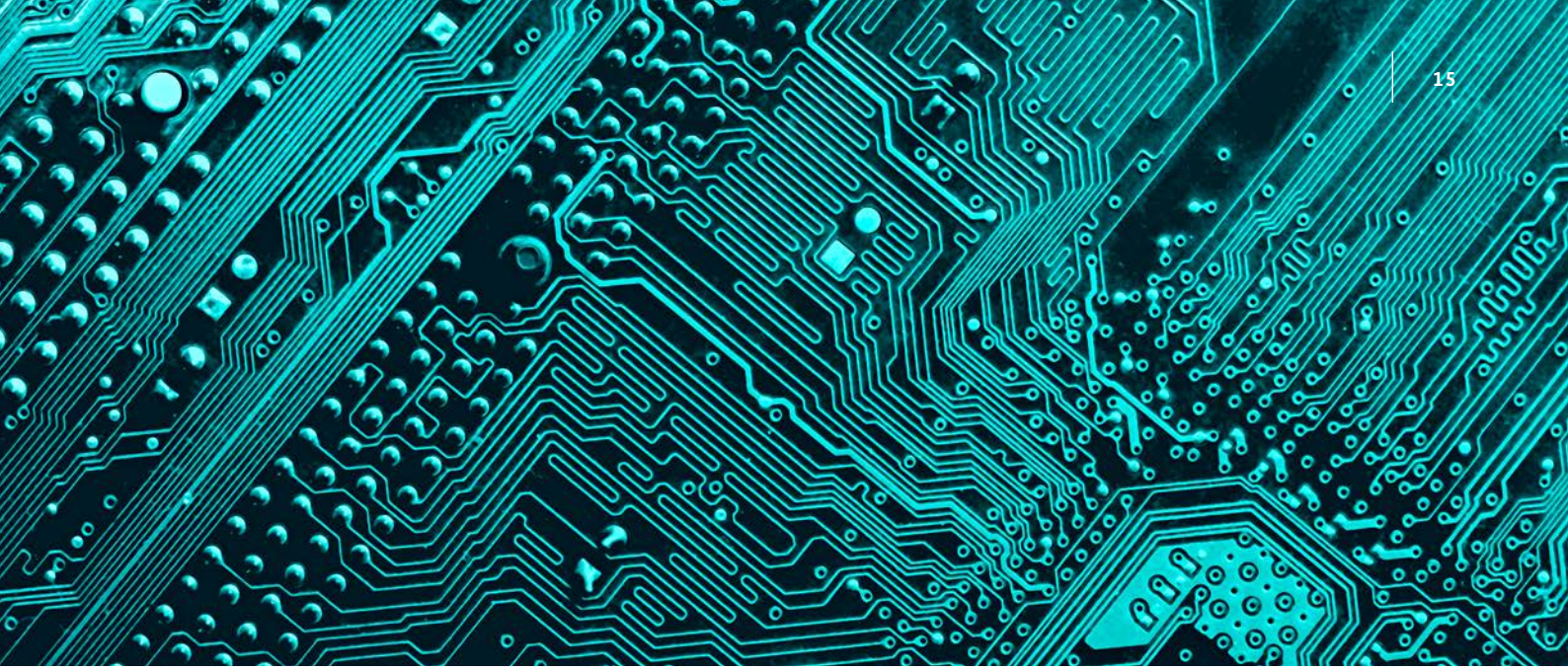
7 This guideline deals with criteria for products, whereby the term 'products' can refer to devices, modules, machines or software.

Table 2: Outlook for criteria and product characteristics (continued)

Criteria	Requirements	L	C	Medium term ≤ 5 years	C	Long term ≤ 10 years
5. I4.0-Services and States	Standardized digital description of the asset's services, which can also access further services from the supplier or partners.	T	M	Digital description of services for the asset available via specification "Details of the Asset Administration Shell"[8] (AAS for asset type). AAS for asset type can be automatically accessed via supplier's website or open platform.	M	Additional services, e.g. for simulation and design, described and available via AAS for asset type. AAS for asset type in infrastructures can be automatically accessed according to the specification "Details of the Asset Administration Shell"[8].
	General interface for loadable services and report of states. Necessary base services, which have to be supported and provided by an I40-product.	I	M	As in 2020, additionally digital description of the I40 services and states can be realized online via specification "Details of the Asset Administration Shell"[8] (AAS for asset instance). (e.g. self description, remote update capability, new loadable functions, etc.)	M	As for medium term, AAS for asset instance can be realized online and implemented with mandatory submodels.
6. Standard functions	Basic standardized functions, which can be executed manufacturer-independently and which provide same data in same functions. These basic functions serve as base for the functionality, on which every manufacturer can build their own extensions.	T	O	First mandatory submodels e.g. identification, name plate and simulation model for virtual commissioning available. Methods from machine learning and artificial intelligence.	O	All defined standard functions for development support are available. New methods from machine learning and artificial intelligence. Autonomous products.
		I	O	For example, PLCopen for Motion functions, description and access to primary user functions of the asset, condition monitoring standard according to VDMA 24582, Methods from machine learning and artificial intelligence.	O	All defined standard functions for users are available and can be executed. New methods from machine learning and artificial intelligence. Autonomous products. Generalized functionality described as capabilities.
7. Security	Minimum requirements for providing security functions	T	M	Security by design. Security capabilities are described at the respective level (Authentication of the identifiers, subject- and role management, secure communication, logging of the security-relevant changes).	M	Security by design. Additional (level of trust), Capabilities of the intended level of trust are described.
		I	M	Security capabilities are available digitally at the intended level (Authentication of the identifiers, subject- and role management, secure communication, logging of the security-relevant changes).	M	Also available digitally (level of trust), Capabilities of the intended level of trust are implemented.

Product characteristics for the criteria
L: Lifecycle with T: Type and I: Instance
C: Coverage with M: Mandatory, O: Optional, use-case-dependent, may be mandatory and N: Not relevant
Note: The criteria for "medium term" and "long term" are not yet considered mandatory. They are merely examples and reflect the current state of discussion.

8 Publication of Plattform Industrie 4.0 "Details of the Asset Administration Shell Part 1 - The exchange of information between partners in the value chain of Industrie 4.0", 25 November 2019



8. Product examples

A few product examples are shown in the following with the aim of making classification and characteristics somewhat more transparent and manageable. Alongside the following tables displaying product characteristics, an initial implementation of the Asset Administration Shell can be requested (see the specification document “Details of the Administration Shell”, format .aasx).

Overview of examples:

1 Bosch Rexroth – Nexo cordless Wi-Fi nutrunner

2 Festo – Energy efficiency module

3 ABB – Field Information Manager (software)

4 Siemens – Programmable logic controller

5 Schneider Electric – Programmable logic controller

6 Pepperl & Fuchs – Sensor

7 Phoenix Contact – Power Supply Quint Power

Figure 5: Nexo cordless Wi-Fi nutrunner

Source: Bosch Rexroth

8.1 Nexo industrial cordless Wi-Fi nutrunner

The nutrunner works fully independently. The complete control unit is integrated in the nutrunner and is accessible via open interfaces using WLAN. The parameters are configured using a web browser. Numerous sensors are integrated. Functions can be subsequently loaded and all of the nutrunner’s data can be retrieved via an open interface using WLAN. Condition monitoring and diagnostic functions are already integrated into the nutrunner. Communication to all common protocols can be adjusted by way of software

Table 3: Characteristics of the Nexo cordless WiFi nutrunner

Criteria	Requirements	L	C	Product characteristics 2020	Nexo nutrunner
1. Identification	Cross-manufacturer identification of the asset with unique identifier (ID) attached to the product[6], electronically readable. Identification in: 1) Development 2) Goods transport (logistics), production 3) Sales, service, marketing 4) Network	T	M	For 1) material number[4] (electronic) in accordance with ISO 29002-5[5] or URI	1) Material number (electronic)
		I	M	For 2) serial number or unique ID For 3) manufacturer + serial number or unique ID With 2) and 3) electronically readable, for physical products via 2D code, RFID or NFC With 2) and 3) URI in accordance to DIN SPEC 91406 For 4) participant identification via IP network	2) QR code 3) QR code 4) Participant identification via TCP/UDP and IP network
2. I4.0 communication	Transfer of product data and data files for interpretation or simulation, for example; product data in standardised form	T	M	Manufacturer makes data available/accessible online. The data should be relevant to customers and available/accessible with the assistance of identification, e.g. pdf via http(s) and URI	Step Files, CAD drawings etc.
	Product[6] can be addressed via the network, supplies and accepts data, Plug & Produce via I4.0-compliant services	I	M	Administration shell of the product[6] can be addressed (at any time) with the assistance of the identification online via TCP/UDP&IP with at least the information model from OPC-UA	Yes, torque, rotary angle, tightening curve etc. can be read online
3. I4.0 semantics	Standardised data in the form of attributes with cross-manufacturer unique identification and syntax for: 1) Commercial data 2) Catalogue data 3) Technical data: mechanics, electronics, functionality, location, performance 4) Dynamic data 5) Data on the lifecycle of the product instance	T	M	For 2)–3) Catalog data and technical data sheet in an open standard online accessible.	Yes, via QR code
		I	M	For 2)–3) Catalog data and technical data sheet in an open standard online accessible. For 4) Dynamic data via I4.0 communication online accessible.	Yes, via QR code
		I	O	For 5) Data regarding the life cycle of the product instance online accessible	
4. Virtual description	Virtual representation in I4.0-compliant semantics Virtual representation across the entire lifecycle. Characteristic attributes of the actual component, information on relationships between the attributes, production and production process-relevant relationships between Industrie 4.0 components, formal description of relevant functions of the actual component and its processes.	T	M	Relevant information for customers can be accessed digitally based on the type identification (product description, catalogue, image, technical features, data sheet, security properties etc.)	The product description, catalogue, image, technical features, datasheet etc. are available online
		I	M	Digital contact to service and information for product support including spare part information from the field possible	QR code leads directly to services and offers information on spare parts
5. I4.0 services and states	Standardised digital description of services for the asset, which can also access further services from the supplier or other partners.	T	O	Digital description of the device interface available	Interfaces are described openly
	General interface for loadable services and for the reporting of states. Necessary basic services which an I4.0 product must support.	I	O	Information such as states, error messages, warnings etc. available via OPC-UA information model in accordance with an industry standard	Data at the interface for all states are disclosed and can be requested

→

Table 3: Characteristics of the Nexo cordless WiFi nutrunner (continued)

Criteria	Requirements	L	C	Product characteristics 2020	Nexo nutrunner
6. Standard functions	Basic standardised functions that run on various products regardless of manufacturer and provide the same data in the same functions. They serve as the foundation for the functionality on which all manufacturers can build their own enhancements.	T	O	Functions described in form of I4.0 submodels in the administration shell	
		I	O	Functions realized in form of I4.0 submodels in the administration shell	First diagnosis and condition monitoring functions, also monitoring of the process with diagnosis outputs
7. Security	Minimum requirements to ensure security functionality.	T	M	A threat analysis was conducted. Appropriate security capabilities were considered and publicly documented.	Is discussed and documented in the customer projects
		I	M	The existing security capabilities are documented. Suitably secure identities exist.	Is discussed and documented in the customer projects

Product characteristics for the criteria
L: Lifecycle with T: Type and I: Instance
C: Coverage with M: Mandatory, O: Optional, use-case-dependent, may be mandatory and N: Not relevant

Conclusion: The Nexo cordless WiFi nutrunner therefore meets all stipulated product characteristics 2020. The manufacturer has thus given it the “Industrie 4.0 logo” available in this area.

Source: Bosch Rexroth

4 Material number is used here as umbrella term for the type designation, manufacturer part number, order number, product classification etc.

5 A manufacturer-specific identification will probably be required as a rule for the above directly connected assets. ISO 29002-5 does not currently provide for this.

6 This guideline deals with criteria for products, whereby the term ‘products’ can refer to devices, modules, machines or software.

8.2 Energy efficiency module

The energy efficiency module combines pressure and flow sensors, independent data processing, a 2/2 way shut-off valve and an Ethernet communication interface. The communication parameters of the interface (usual field buses, OPC-UA, Modbus/TCP) are open. Functions can be subsequently loaded through the integration of a CODESYS control unit. The module continuously monitors the air consumption of the downstream system and, thanks to machine learning, can distinguish between resting state, operating state and abnormal states. Fixed limits can also be set for the individual states. The shut-off valve allows an auto-stop function which automatically blocks the compressed air supply after a configurable amount of time in a resting state to prevent leaks. The sensor data, operating states and shut-off valve behaviour can all be accessed via the communication interface.

Figure 6: Energy efficiency module

Source: Festo

Table 4: Characteristics of the energy efficiency module

Criteria	Requirements	L	C	Product characteristics 2020	Energy efficiency module
1. Identification	Cross-manufacturer identification of the asset with unique identifier (ID) attached to the product[6], electronically readable. Identification in: 1) Development 2) Goods transport (logistics), production 3) Sales, service, marketing 4) Network	T	M	For 1) material number[4] (electronic) in accordance with ISO 29002-5[5] or URI	1) Parts number and product key of the manufacturer (electronically) readable
		I	M	For 2) serial number or unique ID For 3) manufacturer + serial number or unique ID With 2) and 3) electronically readable, for physical products via 2D code, RFID or NFC With 2) and 3) URI in accordance to DIN SPEC 91406 For 4) participant identification via IP network	2) DM code of the manufacturer 3) DM code of the manufacturer 4) Participant identification via TCP/UDP and IP network
2. I4.0 communication	Transfer of product data and data files for interpretation or simulation, for example; product data in standardised form	T	M	Manufacturer makes data available/accessible online. The data should be relevant to customers and available/accessible with the assistance of identification, e.g. pdf via http(s) and URI	CAD drawings, EPLAN macros, instructions, device description etc.
	Product[6] can be addressed via the network, supplies and accepts data, Plug & Produce via I4.0-compliant services.	I	M	Administration shell of the product[6] can be addressed (at any time) with the assistance of the identification online via TCP/UDP&IP with at least the information model from OPC-UA	Yes, sensors and states can be read out. Valve can be controlled for which purpose a control module with OPC-UA application is plugged in.

→

Table 4: Characteristics of the energy efficiency module (continued)

Criteria	Requirements	L	C	Product characteristics 2020	Energy efficiency module
3. I4.0 semantics	Standardised data in the form of features with cross-manufacturer unique identification and syntax for: 1) Commercial data 2) Catalogue data 3) Technical data: mechanics, electronics, functionality, location, performance 4) Dynamic data 5) Data on the lifecycle of the product instance	T	M	For 2)–3) Catalog data and technical data sheet in an open standard online accessible.	Yes, via link of the DM code
		I	M	For 2)–3) Catalog data and technical data sheet in an open standard online accessible. For 4) Dynamic data via I4.0 communication online accessible.	Yes, via link of the DM code
		I	O	For 5) Data regarding the life cycle of the product instance online accessible	
4. Virtual description	Virtual representation in I4.0-compliant semantics Virtual representation across the entire lifecycle. Characteristic attributes of the actual component, information on relationships between the attributes, production and production process-relevant relationships between Industrie 4.0 components, formal description of relevant functions of the actual component and its processes.	T	M	Relevant information for customers can be accessed digitally based on the type identification (product description, catalogue, image, technical features, data sheet, security properties etc.)	Product description, catalogue, image, technical features, data sheet, CAD drawings, EPLAN macros, instructions, device description etc. are available online
		I	M	Digital contact to service and information for product support including spare part information from the field possible	DM code leads directly to service and offers information on spare parts
5. I4.0 Services and states	Standardised digital description of services for the asset, which can also access further services from the manufacturer or other partners.	T	O	Digital description of the device interface available	Interfaces are described openly
	General interface for loadable services and for the reporting of states. Necessary basic services which an I4.0 product must support.	I	O	Information such as states, error messages, warnings etc. available via OPC-UA information model in accordance with an industry standard	Data at the interface for all states are open and available online
6. Standard functions	Basic standardised functions that run on various products regardless of manufacturer and provide the same data in the same functions. They serve as the foundation for the functionality on which all manufacturers can build their own enhancements.	T	O	Functions described in form of I4.0 submodels in the administration shell	First diagnosis and condition monitoring functions
		I	O	Functions realized in form of I4.0 submodels in the administration shell	Also monitoring of the process with diagnosis output
7. Security	Minimum requirements to ensure security functionality.	T	M	A threat analysis was conducted. Appropriate security capabilities were considered and publicly documented.	Documentation shows that no security capabilities exist
		I	M	The existing security capabilities are documented. Suitably secure identities exist.	Documentation shows that no security capabilities exist

Product characteristics for the criteria
L: Lifecycle with T: Type and I: Instance
C: Coverage with M: Mandatory, O: Optional, use-case-dependent, may be mandatory and N: Not relevant

Conclusion: The energy efficiency module therefore meets all stipulated product characteristics 2020. The manufacturer has not given the product a special Industrie 4.0 logo.

4 Material number is used here as umbrella term for the type designation, manufacturer part number, order number, product classification etc.

5 A manufacturer-specific identification will probably be required as a rule for the above directly connected assets. ISO 29002-5 does not currently provide for this.

6 This guideline deals with criteria for products, whereby the term ‘products’ can refer to devices, modules, machines or software.

8.3 FDI-based software for device management

The Field Information Manager (FIM) is a software solution for field-device configuration and diagnostics on handheld devices. FIM provides easy access to standardised device parameters and helps people to work securely with different device types. It is based on FDI technology (www.fieldcommgroup.org). The DeviceWindow edition of the FIM enables online parameter configuration of HART devices. The handheld edition permits offline device configuration, the use of templates and document generation. The Field Information Manager can be downloaded from: www.abb.com/fieldinfo

Figure 7: Field Information Manager with HART modem and field device

Source: ABB

Table 5: Characteristics of the Field Information Manager

Criteria	Requirements	L	C	Product characteristics 2020	Field Information Manager
1. Identification	Cross-manufacturer identification of the asset with unique identifier (ID) attached to the product[6], electronically readable. Identification in: 1) Development 2) Goods transport (logistics), production 3) Sales, service, marketing 4) Network	T	M	For 1) material number[4] (electronic) in accordance with ISO 29002-5[5] or URI	www.abb.com/fieldinfo
		I	M	For 2) serial number or unique ID For 3) manufacturer + serial number or unique ID With 2) and 3) electronically readable, for physical products via 2D code, RFID or NFC With 2) and 3) URI in accordance to DIN SPEC 91406 For 4) participant identification via IP network	Every installed version of the FIM has a unique "machine ID"
2. I4.0 communication	Transfer of product data and data files for interpretation or simulation, for example; product data in standardised form	T	M	Manufacturer makes data available/ accessible online. The data should be relevant to customers and available/accessible with the assistance of identification, e.g. pdf via http(s) and URI	Product data available online
	Product[6] can be addressed via the network, supplies and accepts data, Plug & Produce via I4.0-compliant services.	I	M	Administration shell of the product[6] can be addressed (at any time) with the assistance of the identification online via TCP/ UDP&IP with at least the information model from OPC-UA	Device data can be requested with OPC-UA clients (planned)

→

Table 5: Characteristics of the Field Information Manager (continued)

Criteria	Requirements	L	C	Product characteristics 2020	Field Information Manager
3. I4.0 semantics	Standardised data in the form of features with cross-manufacturer unique identification and syntax for: 1) Commercial data 2) Catalogue data 3) Technical data: mechanics, electronics, functionality, location, performance 4) Dynamic data 5) Data on the lifecycle of the product instance	T	M	For 2)–3) Catalog data and technical data sheet in an open standard online accessible.	Product guide available online
		I	M	For 2)–3) Catalog data and technical data sheet in an open standard online accessible. For 4) Dynamic data via I4.0 communication online accessible.	Version number is available in the software
		I	O	For 2)–3) Catalog data and technical data sheet in an open standard online accessible. For 4) Dynamic data via I4.0 communication online accessible.	Device parameters can be accessed online
4. Virtual description	Virtual representation in I4.0-compliant semantics Virtual representation across the entire lifecycle. Characteristic attributes of the actual component, information on relationships between the attributes, production and production process-relevant relationships between Industrie 4.0 components, formal description of relevant functions of the actual component and its processes.	T	M	Relevant information for customers can be accessed digitally based on the type identification (product description, catalogue, image, technical features, data sheet, security properties etc.)	Manual available online.
		I	M	Digital contact to service and information for product support including spare part information from the field possible	Service requests can be made online. ABB Knowledge Store available for contact with other end customers and ABB experts from software.
5. I4.0 Services and states	Standardised digital description of services for the asset, which can also access further services from the manufacturer or other partners.	T	O	Digital description of the device interface available	Follows FDI standard
	General interface for loadable services and for the reporting of states. Necessary basic services which an I4.0 product must support.	I	O	Information such as states, error messages, warnings etc. available via OPC-UA information model in accordance with an industry standard	Device parameters can be read out via OPC-UA (planned). States in accordance with NE 107.
6. Standard functions	Basic standardised functions that run on various products regardless of manufacturer and provide the same data in the same functions. They serve as the foundation for the functionality on which all manufacturers can build their own enhancements.	T	O	Functions described in form of I4.0 submodels in the administration shell	
		I	O	Functions described in form of I4.0 submodels in the administration shell	
7. Security	Minimum requirements to ensure security functionality.	T	M	A threat analysis was conducted. Appropriate security capabilities were considered and publicly documented.	Security capabilities are documented in the manual.
		I	M	The existing security capabilities are documented. Suitably secure identities exist.	Access to OPC-UA server only after corresponding user authentication

Product characteristics for the criteria
L: Lifecycle with T: Type and I: Instance
C: Coverage with M: Mandatory, O: Optional, use-case-dependent, may be mandatory and N: Not relevant

Conclusion: The Field Information Manager will meet the criteria in the near future.
The manufacturer will therefore issue the “IoTSPenabled” logo (Internet of Things, Service and People) for this product.

4 Material number is used here as umbrella term for the type designation, manufacturer part number, order number, product classification etc.

5 A manufacturer-specific identification will probably be required as a rule for the above directly connected assets. ISO 29002-5 does not currently provide for this.

6 This guideline deals with criteria for products, whereby the term ‘products’ can refer to devices, modules, machines or software.

8.4 S7-1500 Advanced Controller

SIMATIC S7-1500 Advanced Controllers of the SIMATIC S7 controller family are particularly suitable for medium-sized to complex applications. The controllers are long-term compatible, modular, vibration-proof, maintenance-free and scalable. In addition to machine and system communication via the field buses PROFINET and PROFIBUS, a vertical communication to the MES or cloud-based systems via OPC-UA, for example, is also possible. The controllers can be planned using the TIA Portal. Programming in the FUP contact plan, KOP contract plan, Structured Control Language SCL, process control S7-GRAPH and instruction list AWL is based on IEC 61131 and, together with the library concept and standardization, provides the foundation for digitalisation.

Motion Control is integrated and in addition to standardised modules (PLCopen) to link analogue and PROFIdrive-capable drives, offers a large number of extended motion control functions. The spectrum covers basic functions such as speed and positioning axes, and extends to the mid-range area with extensive handling functions. With “Security Integrated“, the devices have a comprehensive security concept against manipulation and know-how theft. There is easy access to technical data, lifecycle details, parameters, online data and much more online or via apps such as the “Siemens Industry Online Support” or the “S7 APP”.

Figure 8: SIMATIC S7-1500 Advanced Controllers

Source: Siemens

Table 6: Characteristics of the SIMATIC S7-1500 Advanced Controllers

Criteria	Requirements	L	C	Product characteristics 2020	Advanced Controller
1. Identification	Cross-manufacturer identification of the asset with unique identifier (ID) attached to the product[6], electronically readable. Identification in: 1) Development 2) Goods transport (logistics), production 3) Sales, service, marketing 4) Network	T	M	For 1) material number[4] (electronic) in accordance with ISO 29002-5[5] or URI	1) Parts number and product key of the manufacturer (electronically) readable
		I	M	For 2) serial number or unique ID For 3) manufacturer + serial number or unique ID With 2) and 3) electronically readable, for physical products via 2D code, RFID or NFC With 2) and 3) URI in accordance to DIN SPEC 91406 For 4) participant identification via IP network	2) Imprint of the DM code of the manufacturer 3) Imprint of the DM code of the manufacturer 4) Participant identification via IP network
2. I4.0 communication	Transfer of product data and data files for interpretation or simulation, for example; product data in standardised form.	T	M	Manufacturer makes data available/ accessible online. The data should be relevant to customers and available/ accessible with the assistance of identification, e.g. pdf via http(s) and URI	CAx data, EPLAN macros, documentation, application examples, device description etc.
	Product[6] can be addressed via the network, supplies and accepts data, Plug & Produce via I4.0-compliant services.	I	M	Administration shell of the product[6] can be addressed (at any time) with the assistance of the identification online via TCP/ UDP&IP with at least the information model from OPC-UA	Yes, online available via TIA Portal, webserver, OPC-UA or directly e.g. via TCP/IP
3. I4.0 semantics	Standardised data in the form of features with cross-manufacturer unique identification and syntax for: 1) Commercial data 2) Catalogue data 3) Technical data: mechanics, electronics, functionality, location, performance 4) Dynamic data 5) Data on the lifecycle of the product instance	T	M	For 2)–3) Catalog data and technical data sheet in an open standard online accessible.	Yes, via link of the DM code
		I	M	For 2)–3) Catalog data and technical data sheet in an open standard online accessible. For 4) Dynamic data via I4.0 communication online accessible.	Yes, via link of the DM code
		I	O	For 5) Data regarding the life cycle of the product instance online accessible	
4. Virtual description	Virtual representation in I4.0-compliant semantics Virtual representation across the entire lifecycle. Characteristic attributes of the actual component, information on relationships between the attributes, production and production process-relevant relationships between Industrie 4.0 components, formal description of relevant functions of the actual component and its processes.	T	M	Relevant information for customers can be accessed digitally based on the type identification (product description, catalogue, image, technical features, data sheet, security properties etc.)	Yes, product description, catalogue, image, technical features, data sheet, CAx data, drawings, product photos, EPLAN macros, documentation, security properties etc.
		I	M	Digital contact to service and information for product support including spare part information from the field possible	DM code leads directly to service and offer information on spare parts
5. I4.0 Services and states	Standardised digital description of services for the asset, which can also access further services from the manufacturer or other partners.	T	O	Digital description of the device interface available	Description of the access via industrial buses, OPC-UA or web server available online
	General interface for loadable services and for the reporting of states. Necessary basic services which an I4.0 product must support.	I	O	Information such as states, error messages, warnings etc. available via OPC-UA information model in accordance with an industry standard	States, error messages, warnings available online.

→

Table 6: Characteristics of the SIMATIC S7-1500 Advanced Controllers (continued)

Criteria	Requirements	L	C	Product characteristics 2020	Advanced Controller
6. Standard functions	Basic standardised functions that run on various products regardless of manufacturer and provide the same data in the same functions. They serve as the foundation for the functionality on which all manufacturers can build their own enhancements.	T	O	Functions described in form of I4.0 submodels in the administration shell	Motion control functions according to PLCopen as well as further standard functions and safety-related functions according to EN 61508 available
		I	O	Functions realized in form of I4.0 submodels in the administration shell	Motion control functions according to PLCopen as well as further standard functions and safety-related functions according to EN 61508 available
7. Security	Minimum requirements to ensure security functionality.	T	M	A threat analysis was conducted. Appropriate security capabilities were considered and publicly documented.	Security capabilities are documented in the manual.
		I	M	The existing security capabilities are documented. Suitably secure identities exist.	Access to OPC-UA server only after corresponding user authentication

Product characteristics for the criteria
L: Lifecycle with T: Type and I: Instance
C: Coverage with M: Mandatory, O: Optional, use-case-dependent, may be mandatory and N: Not relevant

Conclusion: The SIMATIC S7-1500 Advanced Controller therefore meets all stipulated product characteristics 2020. The manufacturer has not given the product a special Industrie 4.0 logo.

4 Material number is used here as umbrella term for the type designation, manufacturer part number, order number, product classification etc.

5 A manufacturer-specific identification will probably be required as a rule for the above directly connected assets. ISO 29002-5 does not currently provide for this.

6 This guideline deals with criteria for products, whereby the term ‘products’ can refer to devices, modules, machines or software.

8.5 Modicon M251 Logic Controller

Die Modicon M251 Logic Controller is suitable for modular and distributed architectures and simple machine applications. Despite its compactness and an overall width of 54 mm, a fully configurable web server, an Ethernet/IP scanner and an OPA-UA server are already integrated together with 3 Ethernet ports. Thanks to its many interfaces, the Modicon M251 therefore increases flexibility and saves on additional space in the switch cabinet. Many modern options are open based on EcoStruxureTM Machine, the uniform architecture from Schneider Electric for Industrie 4.0 applications in mechanical engineering.

Figure 9: Modicon M251 Logic Controller

Source: Schneider Electric

Programming is conducted with the EcoStruxure Machine Expert software which is uniform for all machine controllers of the Modicon series, based on Codesys V3, which will also be available in future as SaaS.

Table 7: Characteristics of the Modicon M251 Logic Controller

Criteria	Requirements	L	C	Product characteristics 2020	Modicon M251
1. Identification	Cross-manufacturer identification of the asset with unique identifier (ID) attached to the product[6], electronically readable. Identification in: 1) Development 2) Goods transport (logistics), production 3) Sales, service, marketing 4) Network	T	M	For 1) material number[4] (electronic) in accordance with ISO 29002-5[5] or URI	1) Material number (electronic) according to URI
		I	M	For 2) serial number or unique ID For 3) manufacturer + serial number or unique ID With 2) and 3) electronically readable, for physical products via 2D code, RFID or NFC With 2) and 3) URI in accordance to DIN SPEC 91406 For 4) participant identification via IP network	2) and 3) electronically readable on type plate and QR code 4) Identification via each of the 3 Ethernet ports via Modbus TCP and Ether-Net/IP
2. I4.0 communication	Transfer of product data and data files for interpretation or simulation, for example; product data in standardised form.	T	M	Manufacturer makes data available/accessible online. The data should be relevant to customers and available/accessible with the assistance of identification, e.g. pdf via http(s) and URI	CAD drawings, EPLAN macros, instructions and data sheets via www.schneider-electric.com as well as online via QR code of the instance
	Product[6] can be addressed via the network, supplies and accepts data, Plug & Produce via I4.0-compliant services.	I	M	Administration shell of the product[6] can be addressed (at any time) with the assistance of the identification online via TCP/UDP&IP with at least the information model from OPC-UA	Available via TCP/IP from latest Firmware
3. I4.0 semantics	Standardised data in the form of features with cross-manufacturer unique identification and syntax for: 1) Commercial data 2) Catalogue data 3) Technical data: mechanics, electronics, functionality, location, performance 4) Dynamic data 5) Data on the lifecycle of the product instance	T	M	For 2)–3) Catalog data and technical data sheet in an open standard online accessible.	2) Catalogue data as BMEcat 2005 with ETIM 6.0 and as Datanorm/Eldanorm available online
		I	M	For 2)–3) Catalog data and technical data sheet in an open standard online accessible. For 4) Dynamic data via I4.0 communication online accessible.	2) and 3) catalogue data available online using a QR code on the device 5) Available online via the Codesys runtime (integration in SoMachine Software)
		I	O	For 5) Data regarding the life cycle of the product instance online accessible	Accessible via the CoDeSys runtime (integration in SoMachine software)

→

Table 7: Characteristics of the Modicon M251 Logic Controller (continued)

Criteria	Requirements	L	C	Product characteristics 2020	Modicon M251
4. Virtual description	Virtual representation in I4.0-compliant semantics Virtual representation across the entire lifecycle. Characteristic attributes of the actual component, information on relationships between the attributes, production and production process-relevant relationships between Industrie 4.0 components, formal description of relevant functions of the actual component and its processes.	T	M	Relevant information for customers can be accessed digitally based on the type identification (product description, catalogue, image, technical features, data sheet, security properties etc.)	Product description, catalogue, image, technical features, data sheet etc. are available online
		I	M	Digital contact to service and information for product support including spare part information from the field possible	Access to support and service contact for location available online via QR code and MySE app
5. I4.0 services and states	Standardised digital description of services for the asset, which can also access further services from the manufacturer or other partners.	T	O	Digital description of the device interface available	Interfaces are described openly
	General interface for loadable services and for the reporting of states. Necessary basic services which an I4.0 product must support.	I	O	Information such as states, error messages, warnings etc. available via OPC-UA information model in accordance with an industry standard	Available online via OPC-UA from latest firmware
6. Standard functions	Basic standardised functions that run on various products regardless of manufacturer and provide the same data in the same functions. They serve as the foundation for the functionality on which all manufacturers can build their own enhancements.	T	O	Functions described in form of I4.0 submodels in the administration shell	N. a.
		I	O	Functions described in form of I4.0 submodels in the administration shell	N. a.
7. Security	Minimum requirements to ensure security functionality.	T	M	A threat analysis was conducted. Appropriate security capabilities were considered and publicly documented.	Achilles Certificate exists and publication of recognised vulnerables, where present (https://www.schneider-electric.com/b2b/en/support/cybersecurity/overview.jsp)
		I	M	The existing security capabilities are documented. Suitably secure identities exist.	Achilles Certificate exists

Product characteristics for the criteria
L: Lifecycle with T: Type and I: Instance
C: Coverage with M: Mandatory, O: Optional, use-case-dependent, may be mandatory and N: Not relevant

Conclusion: The Modicon M251 Controller therefore meets all stipulated product characteristics 2020. The manufacturer has thus given it the logo available in this area.

Source: Schneider Electric

4 Material number is used here as umbrella term for the type designation, manufacturer part number, order number, product classification etc.

5 A manufacturer-specific identification will probably be required as a rule for the above directly connected assets. ISO 29002-5 does not currently provide for this.

6 This guideline deals with criteria for products, whereby the term 'products' can refer to devices, modules, machines or software.

8.6 LiDAR Sensor R2000

The R2000 is a LiDAR sensor ("Light Detection And Ranging") with a radius of 360°. The device has an Ethernet interface. Parameters are configured using FDT by way of a DTM. Different switching and measurement functions are available.

Figure 10: LiDAR Sensor R2000

Source: Pepperl & Fuchs

Table 8: Characteristics of the LiDAR Sensor R2000

Criteria	Requirements	L	C	Product characteristics 2020	LiDAR-Sensor R2000
1. Identification	Cross-manufacturer identification of the asset with unique identifier (ID) attached to the product[6], electronically readable. Identification in: 1) Development 2) Goods transport (logistics), production 3) Sales, service, marketing 4) Network	T	M	For 1) material number[4] (electronic) in accordance with ISO 29002-5[5] or URI	1) Material number ("part number") of the manufacturer (electronically readable
		I	M	For 2) serial number or unique ID For 3) manufacturer + serial number or unique ID With 2) and 3) electronically readable, for physical products via 2D code, RFID or NFC With 2) and 3) URI in accordance to DIN SPEC 91406 For 4) participant identification via IP network	2)+3) Serial number electronically readable via DM code of the manufacturer 4) Participant identification via TCP/UDP and IP network
2. I4.0 Communication	Transfer of product data and data files for interpretation or simulation, for example; product data in standardised form.	T	M	Manufacturer makes data available/accessible online. The data should be relevant to customers and available/accessible with the assistance of identification, e.g. pdf via http(s) and URI	CAD drawings, DTM, instructions, device description etc. are available online
	Product[6] can be addressed via the network, supplies and accepts data, Plug & Produce via I4.0-compliant services.	I	M	Administration shell of the product[6] can be addressed (at any time) with the assistance of the identification online via TCP/UDP&IP with at least the information model from OPC-UA	Identification via TCP/UDP&IP and FDT
3. I4.0- semantics	Standardised data in the form of features with cross-manufacturer unique identification and syntax for: 1) Commercial data 2) Catalogue data 3) Technical data: mechanics, electronics, functionality, location, performance 4) Dynamic data 5) Data on the lifecycle of the product instance	T	M	For 2)–3) Catalog data and technical data sheet in an open standard online accessible.	Yes
		I	M	For 2)–3) Catalog data and technical data sheet in an open standard online accessible. For 4) Dynamic data via I4.0 communication online accessible.	Yes
		I	O	For 5) Data regarding the life cycle of the product instance online accessible	

→

Table 8: Characteristics of the LiDAR Sensor R2000 (continued)

Criteria	Requirements	L	C	Product characteristics 2020	LiDAR-Sensor R2000
4. Virtual description	Virtual representation in I4.0-compliant semantics Virtual representation across the entire lifecycle. Characteristic attributes of the actual component, information on relationships between the attributes, production and production process-relevant relationships between Industrie 4.0 components, formal description of relevant functions of the actual component and its processes.	T	M	Relevant information for customers can be accessed digitally based on the type identification (product description, catalogue, image, technical features, data sheet, security properties etc.)	Product description, catalogue, image, technical features, data sheet, CAD drawings, DTM, instructions, device description etc. are available online
		I	M	Digital contact to service and information for product support including spare part information from the field possible	Via DTM contact to service and spare part information
5. I4.0 services and states	Standardised digital description of services for the asset, which can also access further services from the manufacturer or other partners.	T	O	Digital description of the device interface available	Standards used: TCP/IP&UDP, FDT
	General interface for loadable services and for the reporting of states. Necessary basic services which an I4.0 product must support.	I	O	Information such as states, error messages, warnings etc. available via OPC-UA information model in accordance with an industry standard	Available via DTM
6. Standard functions	Basic standardised functions that run on various products regardless of manufacturer and provide the same data in the same functions. They serve as the foundation for the functionality on which all manufacturers can build their own enhancements.	T	O	Functions described in form of I4.0 submodels in the administration shell	Several service and diagnosis functions are available
		I	O	Functions described in form of I4.0 submodels in the administration shell	Several service and diagnosis functions are available
7. Security	Minimum requirements to ensure security functionality.	T	M	A threat analysis was conducted. Appropriate security capabilities were considered and publicly documented.	Derived from FDT and is explicitly addressed in customer projects
		I	M	The existing security capabilities are documented. Suitably secure identities exist.	Derived from FDT and is explicitly addressed in customer projects

Product characteristics for the criteria
L: Lifecycle with T: Type and I: Instance
C: Coverage with M: Mandatory, O: Optional, use-case-dependent, may be mandatory and N: Not relevant

Conclusion: The LiDAR Sensor R2000 therefore meets all stipulated product characteristics 2020. The manufacturer has thus given it the "Industrie 4.0 logo" available in this area.

Source: Pepperl & Fuchs

4 Material number is used here as umbrella term for the type designation, manufacturer part number, order number, product classification etc.

5 A manufacturer-specific identification will probably be required as a rule for the above directly connected assets. ISO 29002-5 does not currently provide for this.

6 This guideline deals with criteria for products, whereby the term 'products' can refer to devices, modules, machines or software.

8.7 Power Supply Quint Power

The functioning of the powerful Quint Power power supply ensures the maximum availability of the system. The power reserve enables the trouble-free start-up of high loads as well as the easy extension of your system. The combination of SFB Technology, preventive function monitoring, and long service life increases the application's availability. The range of features is rounded out with the option to make individual adjustments precisely and easily, either online or with a mobile device, or to order a preconfigured power supply after the first batch. For example, reporting thresholds and output voltages can be set up and characteristic curves adjusted individually.

Figure 11: Quint Power power supply

Source: Phoenix Contact

Table 9: Characteristics of the Power Supply Quint Power

Criteria	Requirements	L	C	Product characteristics 2020	Power Supply
1. Identification	Cross-manufacturer identification of the asset with unique identifier (ID) attached to the product[6], electronically readable. Identification in: 1) Development 2) Goods transport (logistics), production 3) Sales, service, marketing 4) Network	T	M	For 1) material number[4] (electronic) in accordance with ISO 29002-5[5] or URI	Type: Article name, article number and hardware revision available via NFC and as eCl@ss. Link to e-shop via QR Code available.
		I	M	For 2) serial number or unique ID For 3) manufacturer + serial number or unique ID With 2) and 3) electronically readable, for physical products via 2D code, RFID or NFC With 2) and 3) URI in accordance to DIN SPEC 91406 For 4) participant identification via IP network	Instance: Serial number and date of production readable via NFC.
2. I4.0 Communication	Transfer of product data and data files for interpretation or simulation, for example; product data in standardised form.	T	M	Manufacturer makes data available/accessible online. The data should be relevant to customers and available/accessible with the assistance of identification, e.g. pdf via http(s) and URI	Available on the website under the section Technical Data and Downloads for the article (e.g. CAD drawings or data sheet)
	Product[6] can be addressed via the network, supplies and accepts data, Plug & Produce via I4.0-compliant services.	I	M	Administration shell of the product[6] can be addressed (at any time) with the assistance of the identification online via TCP/UDP&IP with at least the information model from OPC-UA	Reading and writing the instance data on the device takes place over NFC. The Administration Shell of the device is available on app.
3. I4.0- semantics	Standardised data in the form of features with cross-manufacturer unique identification and syntax for: 1) Commercial data 2) Catalogue data 3) Technical data: mechanics, electronics, functionality, location, performance 4) Dynamic data 5) Data on the lifecycle of the product instance	T	M	For 2)–3) Catalog data and technical data sheet in an open standard online accessible.	eCl@ss-Properties of the Administration Shell available as BMEcat
		I	M	For 2)–3) Catalog data and technical data sheet in an open standard online accessible. For 4) Dynamic data via I4.0 communication online accessible.	2-3) eCl@ss-Properties of the Administration Shell available as BMEcat 4) Reading and writing of instance data in the device takes place over NFC
		I	O	For 5) Data regarding the life cycle of the product instance online accessible	

→

Table 9: Characteristics of the Power Supply Quint Power (continued)

Criteria	Requirements	L	C	Product characteristics 2020	Power Supply
4. Virtual description	Virtual representation in I4.0-compliant semantics Virtual representation across the entire lifecycle. Characteristic attributes of the actual component, information on relationships between the attributes, production and production process-relevant relationships between Industrie 4.0 components, formal description of relevant functions of the actual component and its processes.	T	M	Relevant information for customers can be accessed digitally based on the type identification (product description, catalogue, image, technical features, data sheet, security properties etc.)	Available on the website under the Download section of the article
		I	M	Digital contact to service and information for product support including spare part information from the field possible	Configuration data of the device are available electronically. Additional services available from aftersales@phoenixcontact.com.
5. I4.0 services and states	Standardised digital description of services for the asset, which can also access further services from the manufacturer or other partners.	T	O	Digital description of the device interface available	
	General interface for loadable services and for the reporting of states. Necessary basic services which an I4.0 product must support.	I	O	Information such as states, error messages, warnings etc. available via OPC-UA information model in accordance with an industry standard	
6. Standard functions	Basic standardised functions that run on various products regardless of manufacturer and provide the same data in the same functions. They serve as the foundation for the functionality on which all manufacturers can build their own enhancements.	T	O	Functions described in form of I4.0 submodels in the administration shell	
		I	O	Functions described in form of I4.0 submodels in the administration shell	
7. Security	Minimum requirements to ensure security functionality.	T	M	A threat analysis was carried out and security measures have been implemented.	A threat analysis was conducted and security measures are being implemented.
		I	M	The existing security capabilities are documented. Suitably secure identities exist.	A threat analysis was conducted and security measures are being implemented.

Product characteristics for the criteria
L: Lifecycle with T: Type and I: Instance
C: Coverage with M: Mandatory, O: Optional, use-case-dependent, may be mandatory and N: Not relevant

Conclusion: The Power Supply Quint Power therefore meets all stipulated product characteristics 2020. The product does not receive a separate Industrie 4.0 logo from the manufacturer.

4 Material number is used here as umbrella term for the type designation, manufacturer part number, order number, product classification etc.

5 A manufacturer-specific identification will probably be required as a rule for the above directly connected assets. ISO 29002-5 does not currently provide for this.

6 This guideline deals with criteria for products, whereby the term ‘products’ can refer to devices, modules, machines or software.

Appendix

List of figures

Figure 1: Why criteria for Industrie 4.0 products are important: initial universal guidance for customers and manufacturers 3
Figure 2: Deriving criteria for Industrie 4.0 products 7
Figure 3: Generic annual cycle for checking the criteria for Industrie 4.0 products including product characteristics 9
Figure 4: Further development of the criteria and product characteristics including migration path 12
Figure 5: Nexo cordless Wi-Fi nutrunner 15
Figure 6: Energy efficiency module 18
Figure 7: Field Information Manager with HART modem and field device 20
Figure 8: SIMATIC S7-1500 Advanced Controllers 22
Figure 9: Modicon M251 Logic Controller 25
Figure 10: LiDAR Sensor R2000 27
Figure 11: Quint Power power supply 29

Tables

Table 1: Product characteristics 2020 for the criteria for Industrie 4.0 products 10
Table 2: Outlook for criteria and product characteristics 13
Table 3: Characteristics of the Nexo cordless WiFi nutrunner 16
Table 4: Characteristics of the energy efficiency module 18
Table 5: Characteristics of the Field Information Manager 20
Table 6: Characteristics of the SIMATIC S7-1500 Advanced Controllers 23
Table 7: Characteristics of the Modicon M251 Logic Controller 25
Table 8: Characteristics of the LiDAR Sensor R2000 27
Table 9: Characteristics of the Power Supply Quint Power 29

AUTHORS

Sebastian Bader, Fraunhofer-Institut für Intelligente Analyse- und Informationssysteme IAIS | Dr. Heinz Bedenbender, VDI – Verein Deutscher Ingenieure e.V. | Artur Bondza, Pepperl+Fuchs AG | Meik Billmann, ZVEI – Zentralverband Elektrotechnik- und Elektronikindustrie e.V. | Dr. Birgit Boss, Robert Bosch GmbH | Kai Garrels, ABB STOTZ-KONTAKT GmbH | Dr. Thomas Hadlich, ROCKWELL Automation GmbH | Martin Hankel, Bosch Rexroth AG | Roland Heidel, Roland Heidel Kommunikationslösungen e.K. | Oliver Hillermeier, SAP SE | Dr. Michael Hoffmeister, Festo SE & Co. KG | Michael Jochem, Robert Bosch GmbH | Markus Kiele-Dunsche, Lenze Automation GmbH | Dr. Marco Mendes, Schneider Electric Automation GmbH | Dr. Jörg Neidig, SIEMENS AG | Andreas Orzelski, PHOENIX CONTACT GmbH & Co. KG | Florian Palm, RWTH Aachen – Lehrstuhl für Prozessleittechnik | Stefan Pollmeier, ESR Pollmeier GmbH | Benedikt Rauscher, Pepperl+Fuchs AG | Dr. Simon Stein, SICK AG | Bernd Waser, Murrelektronik GmbH | Prof. Dr. Martin Wollschlaeger, Technische Universität Dresden

This guideline was prepared in the working group “Models and Standards“ of the ZVEI in collaboration with the working group “Reference architectures, Standards and Norms” (Plattform Industrie 4.0).

www.plattform-i40.de