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TECHNICAL REPORT

colour inside

Industrial-process measurement, control and automation – Smart manufacturing – Part 5: Market and innovation trends analysis

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IEC Secretariat
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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INDUSTRIAL-PROCESS MEASUREMENT, CONTROL AND AUTOMATION – SMART MANUFACTURING –

Part 5: Market and innovation trends analysis

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The text of this Technical Report is based on the following documents:

Draft	Report on voting
65/1008/DTR	65/1028/RVDTR

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Report is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 63283 series, published under the general title *Industrial-process measurement, control and automation – Smart manufacturing*, can be found on the IEC website

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

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INTRODUCTION

The IEC TR 63283 series describes the framework for smart manufacturing concepts and in particular, terms and definitions, use cases, cyber security, market and innovation trends and new technologies.

This document describes the market and innovation trends and analyses their impediments and impacts to smart manufacturing.

The market trends are based on the tendency that the smart manufacturing markets move into a particular direction potentially using technologies described in other parts of the series. These market trends have the time prospective of 3 years to 5 years to become common smart manufacturing concepts.

The innovation trends describe those technology innovations that are considered to have an impact on or to influence the smart manufacturing concepts. These innovation trends have the time prospective of 5 years to 10 years.

This document also describes how the market and technology trends are influencing the current business models. Some examples of the forthcoming business models are described.

This document has no intention to describe an exhaustive list of market, innovation or the business model trends. It also forecasts how standards will be influenced by these market, innovation and business model trends.

INDUSTRIAL-PROCESS MEASUREMENT, CONTROL AND AUTOMATION – SMART MANUFACTURING –

Part 5: Market and innovation trends analysis

1 Scope

This part of IEC 63283 describes the market and innovation trends analysis affecting smart manufacturing (SM). The market and innovation trends will influence the evolution of smart manufacturing and it will be important to have good insights on these trends. Specific aspects of the market trends are the evolution of the business cases that is assumed to highlight new supplier chain models, new revenue streams, new customer services, and/or new customer segments.

The document will address the following topics:

- Market watch: Identify the important, likely, and/or disruptive market trends (e.g. mass customization) from an end-to-end perspective, which impact smart manufacturing topics/aspects. This includes the end-user, producers, supply chain, regulators, etc.
- Business model watch: Identify the new business model trends from an end-to-end perspective, which impact smart manufacturing.
- Technological watch: Identify the important, likely, and/or disruptive innovations (AI chipsets, 6G, quantum computing, etc.) describing the impacted smart manufacturing topics/aspects; this topic will focus on those technologies that are still under development but is assumed to influence (or is assumed to be influenced by) smart manufacturing.

There are many more new trends which are used in SM. In this document, only some frequently discussed trends are presented. Some technologies are considered to have priority according to their maturity.

This work will focus on how they can be used in SM.

2 Normative references

There are no normative references in this document.

3 Terms, definitions, abbreviated terms and acronyms

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

NOTE Numbers in square brackets refer to the Bibliography.

3.1 Terms and definitions

3.1.1
market trend
perceived tendency of a particular sector to move in a particular direction over time

Note 1 to entry: These trends are classified as secular for long time frames, primary for medium time frames, and secondary for short time frames.

Note 2 to entry: This report attempts to identify market trends using technical analysis, a framework which characterizes market trends as predictable tendencies within the market when the trend reaches support and resistance levels, varying over time.

Note 3 to entry: A trend can only be confirmed in hindsight, since at any time the future is not known.

Note 4 to entry: In this document, market trend also includes tendency of technology innovations and behaviour of the stakeholders around such innovations.

3.1.2
innovation
new idea, creative thoughts, new imaginations in form of device or method

Note 1 to entry: Innovation is often also viewed as the application of better solutions that meet new requirements, unarticulated needs, or existing market needs. Such innovation takes place through the provision of more-effective products, processes, services, technologies, or business models that are made available to markets, governments and society.

Note 2 to entry: An innovation is something original and more effective and, as a consequence, new, that "breaks into" the market or society. Innovation is related to, but not the same as, invention, as innovation is more apt to involve the practical implementation of an invention (i.e. new/improved ability) to make a meaningful impact in the market or society and not all innovations require an invention. Innovation often manifests itself via the engineering process, when the problem being solved is of a technical or scientific nature.

Note 3 to entry: While a novel device is often described as an innovation, in economics, management science, and other fields of practice and analysis, innovation is generally considered to be the result of a process that brings together various novel ideas in such a way that they affect society. In industrial economics, innovations are created and found empirically from services to meet growing consumer demand.

[SOURCE: Wikipedia article on Innovation, https://en.wikipedia.org/wiki/Innovation. This work is licensed under the Creative Commons Attribution-ShareAlike 4.0 International License. To view a copy of this license, visit http://creativecommons.org/licenses/by-sa/4.0/]

3.1.3
innovation trend
assumed innovation in the future that will have a long-term and lasting effect on and change something

EXAMPLE Current developments are moving in a different direction or intensifying even more.

3.1.4
zero-defect manufacturing
ZDM
holistic approach for ensuring both process and product quality by reducing defects

Note 1 to entry: Defect reduction is achieved through corrective, preventive and predictive techniques using mainly data-driven technologies and guaranteeing that no defective products leave the production site and reach the customer aiming at higher manufacturing sustainability.

Note 2 to entry: ZDM improves process efficiency and product quality.

3.1.5
asset
entity owned by or under the custodial duties of an organization, which has either a perceived or actual value to the organization

[SOURCE: IEC TR 63283-1:2022 [1], 3.1.26]

3.1.6
production system
system intended for production of goods

Note 1 to entry: The concept of production system includes spare parts.

Note 2 to entry: The concept of production system does not encompass the whole manufacturing facility. It excludes in particular the supporting infrastructure (such as building, power distribution, lighting, ventilation). It also excludes financial assets, human resources, raw process materials, energy, work pieces in process, end products.

Note 3 to entry: Production systems can support different types of production processes (continuous, batch, or discrete).

[SOURCE: IEC TR 63283-1:2022 [1], 3.1.350]

3.2 Abbreviated terms and acronyms

4G	4th generation cellular system
5G	5th generation cellular system
5G-PPP	5th Generation – Public Private Partnership
6G	6th generation cellular system
6G-PPP	6th Generation – Public Private Partnership
AAS	asset administration shell
ADSL	asymmetric digital subscriber line
AI	artificial intelligence
AIOTI	Alliance for the Internet of Things Innovation
API	application programming interface
App	application
B2B	business to business
B2C	business to consumer
BIS	building information system
CAD	computer aided design
CAM	computer aided manufacturing
CCPA	California Consumer Privacy Act
CDD	common data dictionary
CPU	central processing unit
CSA	coordination and support action
CWA	CEN Workshop Agreement
DevOps	SW development and IT operations
DF	digital factory
DMP	digital manufacturing platform
DSP	digital signal processor
E/W	East/West
ECN	edge control node
EPON	Ethernet Passive Optical Network
ERP	enterprise resource planning

EU-OSHA	European Agency for Safety & Health at Work
F6G	6th generation fixed network
FCC	Federal Communications Commission
GDPR	General Data Protection Regulation
GHz	giga hertz
GPON	gigabit passive optical network
GPU	graphics processor unit
HAP	high-altitude platform
HPC	high performance computing
I4.0	Industry 4.0
IACS	industrial automation and control systems
ICT	information communication technology
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IIoT	industrial Internet of things
IoT	Internet of things
ISDN	Integrated Services Digital Network
ISP	image signal processor
IT	information technology
ITU-T	International Telecommunication Union – Telecommunication Standardization Sector
LCA	life cycle assessment
LGPD	Lei Geral de Proteção de Dados or General Data Protection Law
LTE	long term evolution
M2M	machine to machine
MES	manufacturing execution system
MIIT	China Ministry of Industry and Information Technology
MIMO	multiple input multiple output
ML	machine learning
mmWave	millimeter wave
MQTT	Message Queuing Telemetry Transport
N/S	North/South
NB-IoT	narrowband – Internet of things
NISQ	noisy intermediate-scale quantum
O&M	operations and maintenance
OCI	open container initiative
oneM2M	Standards for M2M and the Internet of Things
OPC	Open Platform Communications
OPC-UA	OPC Unified Architecture
OPE	operational excellence
OPEX	operational expenses
OS	operating system
OTD	open technical dictionary

OWL	web ontology language
PC	personal computer
PON	passive optical network
PSTN	public switched telephone network
QKD	quantum key distribution
QoS	quality of service
Qubits	quantum bits
RDF	resource description framework
R&D	research and development
SaaS	software as a service
SG	study group
SM	smart manufacturing
SME	small medium enterprise
SW	software
TCG	Trust Computing Group
THz	tera hertz
TRL	technology readiness level
TSN	Time Sensitive Networking
VDSL	very high-speed digital subscriber line
WFA	Wi-Fi Alliance
WIA-PA	Wireless Networks for Industrial Automation/Process Automation
Wi-Fi	Wireless Fidelity
XML	eXtended Markup Language
ZDM	Zero-Defect Manufacturing

4 Smart manufacturing trend analysis

4.1 Trend analysis template

Each trend is described by the following template introducing the following aspects of the trend:

- Description

This subclause describes the trend textually, how the trend is used in reality (use case), and the stakeholders in order to clarify the referenced market, market expectations, business model or the technology trend.

- Impediments to market acceptance

This subclause describes what the market obstacles are to realise the market trends, e.g. restrictions, uncertainty, competitive technologies, regulatory restrictions.

- Impacts to smart manufacturing

This subclause analyses the trend and describes the impacts to smart manufacturing. Potential impacts, if addressed, could be specified to the smart manufacturing use cases, architecture, information models, lifecycle, interfaces, security and safety.

- Standardization needs

This subclause describes the standardization needs internally and externally of IEC TC 65. If there are standardization needs identified for IEC TC 65, then the suggested respective working group and/or subcommittee are identified where such standardization ought to take place.

4.2 Market watch

4.2.1 General

Some of the common smart manufacturing market trends are listed within the following subclauses. They are based on the technologies as described in other parts of this series, which describe new innovative technologies expected in the coming years. It is understood that these innovative technologies are already available and have been proven useful to the domain of smart manufacturing. Therefore, the required technologies are ready to realise the described market trends below and it is assumed that these market trends will be common within smart manufacturing in 3 years to 5 years.

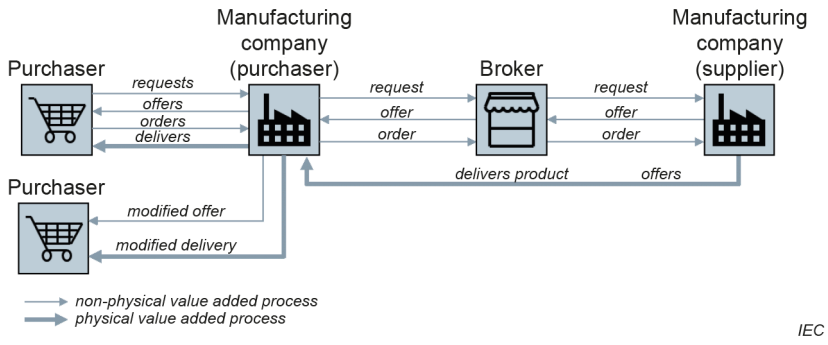
What is being described is not intended to produce an exhaustive list of market trends.

4.2.2 Mass customization

4.2.2.1 Description

The customer demands have evolved from standard mass market products towards personalised products based on the customer needs. This market trend can be realised by benefiting from the capabilities that smart manufacturing provides, like the flexible production systems.

The manufacturing market is evolving towards an individualised market that will require a manufacturing company to offer a flexible product/service portfolio. Therefore, a manufacturing company will require a strategy addressing such individualised market, while still being profitable from its operational perspective. Examples of such strategies are Manufacturing of Individualised Products, Flexible Scheduling and Resource Allocation and Outsourcing of Production, collectively named order-controlled production. Figure 1 illustrates a combined business context of the separate business contexts of Manufacturing of Individualised Products, Flexible Scheduling and Resource Allocation and Outsourcing of Production, which are further explained within IEC TR 63283-2 [2][1].



SOURCE: IEC TR 63283-2:2022, modified combining use cases 6.1.1, 6.1.2 and 6.1.3 (Figures 6, 8, and 10).

Figure 1 – Business context of "Mass customization"

[1] Numbers in square brackets refer to the Bibliography.