INTESA SANPAOLO
INNOVATION CENTER

# INDUSTRY TRENDS REPORT
# INDUSTRIALS & MECHANICS

## *PROCESS AUTOMATION AND DIGITIZATION*

FROST & SULLIVAN

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# EXECUTIVE SUMMARY

In 2020 and 2021, sales of **industrial and mechanics** solutions were delayed as key end-user verticals such as oil and gas were impacted by COVID-19. Frost & Sullivan nonetheless expects the sector to recover quickly as overall economic activity returns to pre-pandemic levels and **automation and digitization** continues to play a pivotal role in ensuring that physical assets and industrial processes are managed effectively and efficiently.

By 2025, services will account for nearly two thirds of a $543 billion global market with both customers and vendors benefitting from the bundling of hardware and software and a move towards contracts which are based on the total cost across a solution's lifetime rather than just the capital or operating expenditure required.

In the long term, artificial intelligence with everything, quantum computing in manufacturing and blockchain in the supply chain will be areas of greater investment. In the short term, Covid-19 has accelerated interest in solutions such as **robotics, machine vision, imaging radars, dimensional metrology** and **additive manufacturing** all of which are shaping – and being shaped by – the growing focus on process automation and digitization.

Among a broad range of **robotics** solutions, arms, cobots and, increasingly, automated and autonomous robots are finding traction in industry.

The main role of robotic arms is to increase manufacturing throughput by performing mundane and repetitive manufacturing tasks with artificial intelligence enabling the launch of a new generation of systems. Currently, **cobots** remain relatively niche products, making up just 2% of industrial robots sales, but they have the potential to pave the way to deploying truly smart factories. Excitement about the prospects for **autonomous mobile robots** is similarly high as they bring scalability and safety to conventional industrial solutions.

**Machine vision** technology extracts information from images for inspection and analysis purposes in processing and manufacturing industries. Demand for such solutions is being

driven by end-users moving away from preventative towards predictive maintenance techniques. Technological innovations, including the advent of hyperspectral imaging, are also boosting uptake. Moving forwards, self-optimizing manufacturing offers an opportunity for machine vision systems to support in reducing waste and increasing efficiency.

In contrast to machine vision, **imaging radars** look to create images of objects or events which are often undetectable or unreachable. Synthetic Aperture Radar is currently the most widely deployed technique and acts as a key enabler of satellite imaging while overall the industry is moving from 2D and 3D solutions to 4D imaging which has the potential to accelerate the deployment of autonomous vehicles.

**Dimensional metrology** is the science of calibrating and using measurement equipment to quantify the physical size of or distance from a given object. The industry is mature but new solutions are required to slot into automated production and process environments.

In the future, the development of end-to-end digital **additive manufacturing** solutions represents an attractive opportunity for metrology companies. More generally, 3D printing markets are being driven by the advent of wire arc technology – which provides the ability to quickly and economically generate large parts – as well as convergence with artificial intelligence. AI promises to improve performance by anticipating and therefore decreasing the number of errors which occur in additive manufacturing design and production.

This paper examines each of these areas in turn with a focus on the role **automation and digitization** across process industries. More broadly, it examines how emerging enabling technologies, such as AI, and delivery mechanisms, such as services, are reshaping **industrials and mechanics** markets as participants on the supply and the demand side look to deploy new and existing solutions as part of the industrial internet of things.

# INTRODUCTION

## Globally, the industrial automation market was valued at $449.1b in 2020 and is expected to exceed $543.6b by 2025, a CAGR of 3.9%

70% of the opportunity lies in **process** industries, which are broadly defined as Oil and Gas (O&G), chemicals and petrochemicals, power, water and wastewater, with just 21% stemming from **discrete** industries, which largely include Automotive and Transportation (A&T), Aerospace and Defense (A&D), machinery, semiconductors and electronics. The remaining 9% stems from **hybrid** industries which primarily cover life sciences, metals and mining, Food and Beverages (F&B) and pulp and paper.

### Uptake of digital and other IoT solutions is driven by the continuing shift in customers' focus from CAPEX to total budget (TOTEX)

Manufacturers that sell tangible products are gradually moving towards as-a-Service (aaS) or Lifecycle Service (LCS) models which are based on Key Performance Indicators (KPIs) and facilitate this change.

This approach meets clients' expectations to move away from project-based milestones to contracts with longer term cost profiles where TOTEX will be equal to CAPEX plus the operational expenditure across a piece of equipment's lifetime.

For vendors, this also creates attractive opportunities for multi-year engagements.

LCS can be segmented into 4 levels which typically encompass:

- **Level 1** (L1), support and reactive/repair services
- **L2,** maintenance and reliability, spare parts management, replacement, calibration, educational, condition monitoring, asset health check and upgrade services
- **L3,** connected, performance, adoption and consulting services
- **L4,** managed and outcome-based services

L1 LCSs are expected to continue to dominate in the short term but L2 and L3 services are the fastest growing segments with the latter in particular finding applications across a range of field devices such as heat exchangers, flowmeters and control valves.

Overall, it is estimated that up to 45% of manufacturing applications, and even more than this in warehouse environments, will follow a LCS or aaS model by 2030.

**Emerson** (US) is the market leader in this respect. The company considers LCS to be an integral part of its digital transformation value proposition. In addition to standalone product lifecycle services, Emerson has integrated LCS into *Plantweb*, its flagship digital enterprise ecosystem. **Siemens** (Germany) is similarly looking to strengthen its position by expanding lifecycle services to its *Xcelerator* portfolio in partnership with IBM while **ABB** (Switzerland) has focused on extending the life of its products by leveraging its extensive global network and digital platform solutions.

### In addition, manufacturers and processors are increasingly appreciating the potential benefits of combining operational with enterprise data

This is sharpening their focus on adopting digital and IoT solutions which bridge this divide and streamline their integration.

There has also been a notable increase in brownfield projects aimed at plant modernization and upgrades which are accelerating the roll-out of real-time monitoring platforms and the implementation of predictive maintenance systems, particularly in process industries.

Finally, technology stack transformation is expected to facilitate a pivot from a five-layer architecture, based on the ANSI/ISA-95 standard, to a three-layer architecture. This will push computing power toward intelligent sensing and edge platforms.

Source: Frost & Sullivan

### Key industrial automation products include Distributed Control Systems, Machine Safety Systems and Programmable Logic Controllers

- A **Distributed Control System** (DCS) is a network architecture that manages processes or plants with the aid of connected digital controllers which are spread throughout a system
- A **Machine Safety System** (MSS) is a combination of electronic sensors, interlock switches, relays, machine-safeguarding panels and safety contactors
- A **Programmable Logic Controller** (PLC) is a digitally operating electronic system that is designed for use in an industrial environment and utilizes a programmable memory for the internal storage of user-oriented instructions to implement specific functions (including logic, sequencing, timing, counting and arithmetic) which control machines and processes through digital or analog inputs and outputs

Other notable systems and solutions are centered on Advanced Process Control, Asset Performance Management, Enterprise Asset Management, Manufacturing Execution Systems, Operator Training Systems, Product Lifecycle Management and Supervisory Control and Data Acquisition.

These are all enabled by the presence of **sensors and transmitters** which measure physical quantities and convert them into signals that can be read by an instrument. Key solutions include flow, level, pressure and temperature sensors.

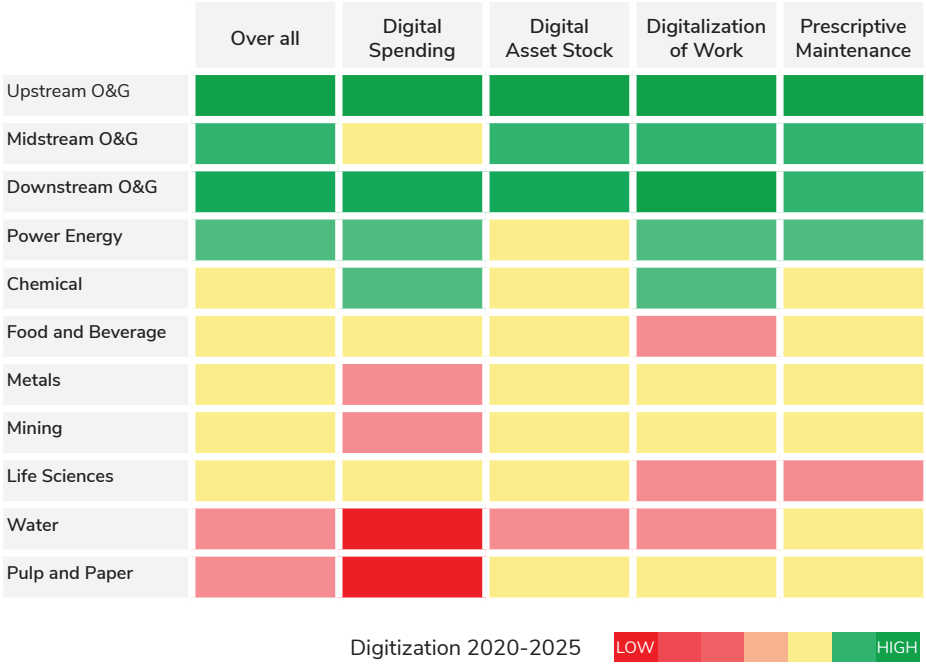
### Adoption is highest in the O&G, power and chemical sectors but there remains scope for greater digitization across a range of areas

Up-, mid- and down-stream O&G are knowledge-intensive sectors which are already highly digitized across most dimensions. Market participants here have demonstrated a willingness to partner with maintenance solution providers with strategic technology visions.

The power and chemicals sectors are capital-intensive and have the potential to further digitize their physical assets.

F&B, metals and mining and pulp and paper are also capital-intensive sectors where market participants are less interested in digital annuities due to the cost of remote monitoring and a lack of focus on Return on Investment (RoI). A minority of players is however willing to invest in cloud-based solutions if they provide them with demonstrable profitability gains.

**INDUSTRIAL AUTOMATION: USE OF DIGITAL SOLUTIONS PER END-MARKET, GLOBAL, 2021**






Source: Frost & Sullivan

### In the longer term, automated processes will be replaced by autonomous operations

There is currently a proliferation of devices in the process and manufacturing industries that can self-adjust. These have the advantage of being able to make decisions. They are also self-controlling, can take independent actions between events, offer flexibility and provide "compensation" for a workforce that is aging overall.

Technology enablers of this shift include the convergence of IT and Operational Technology (OT), the advent of open process automation standards, the availability of adequate real-time data, the emergence of Artificial Intelligence (AI) and Machine Learning (ML), the cloud and edge computing and the accessibility of smart sensors for condition monitoring.

Flawless operations are just one of the benefits of increasing automation. In addition, self-adjusting devices provide adaptive responses to any modification in demand, react to abnormal conditions and allow real-time self-diagnosis and full process optimization.

### In the short term, Covid-19 has accelerated investment in digital technologies such as robotics, machine vision and 3D printing, whilst imaging radars and dimensional metrology remain areas of intense innovation

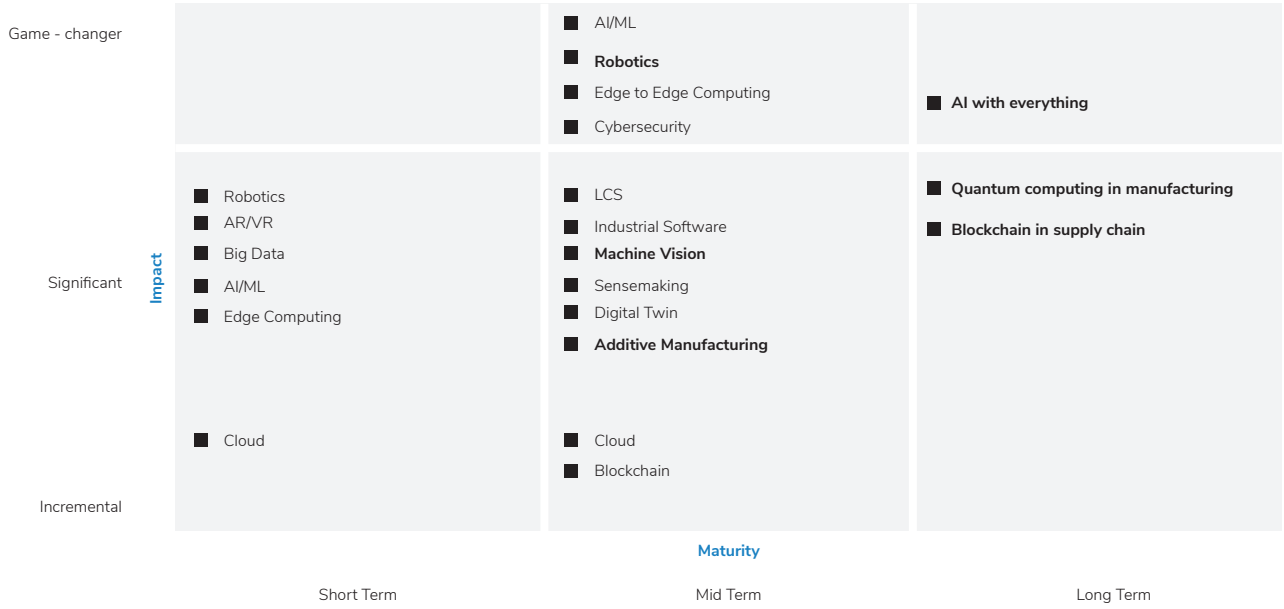
Moving forwards, AI with everything, quantum computing in manufacturing and blockchain in the supply chain will be growing areas of investment.

The application of AI across processes, from the supply chain to product line design to workforce optimization, will enable the accurate forecasting of potential problems and the selection and delivery of specific prioritized responses, including shutting or repairing manufacturing equipment and/or reducing production.

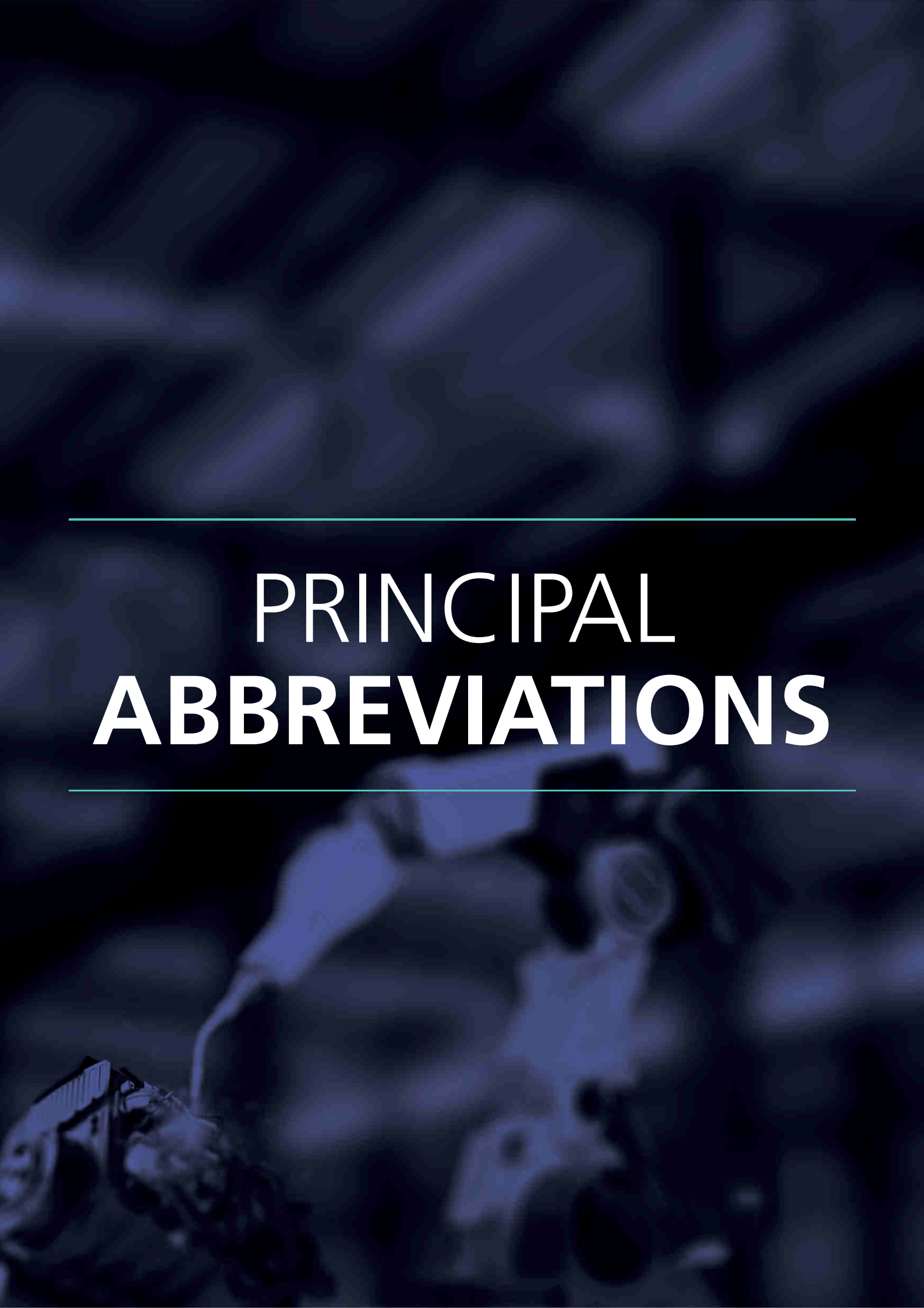
In the long term, advances in cognitive compute engines, deep learning and Natural Language Processing (NLP) will enable machines to make good use of the volume of data that is generated through plant operations to train themselves to optimize production and to provide operators with insights on their performance within and outside the enterprise.

AI-enabled continuous process improvement is expected to become a "game-changer".

**INDUSTRIAL AUTOMATION: IMPACT OF DIGITAL TECHNOLOGIES, GLOBAL, 2020-30**




Source: Frost & Sullivan



# PRINCIPAL **ABBREVIATIONS**

| | |
|---|---|
| **2D** | *Two Dimensions* |
| **3D** | *Three Dimensions* |
| **3DP** | *3D Printing* |
| **4D** | *Four Dimensions* |
| **A&D** | *Aerospace and Defense* |
| **A&T** | *Automotive and Transportation* |
| **aaS** | *As-a-Service* |
| **ADAS** | *Advanced Driver Assistance Solution* |
| **AI** | *Artificial Intelligence* |
| **AiP** | *Antenna-in-Package* |
| **AM** | *Additive Manufacturing* |
| **AMMR** | *Autonomous Mobile Manipulation Robot* |
| **AMR** | *Autonomous Mobile Robot* |
| **APAC** | *Asia Pacific* |
| **ATV** | *All-Terrain Vehicle* |
| **B** | *Billion* |
| **BJ** | *Binder Jetting* |
| **CAGR** | *Compound Annual Growth Rate* |
| **CAPEX** | *Capital Expenditure* |
| **CMM** | *Coordinate Measuring Machine* |
| **DCS** | *Distributed Control System* |
| **DED** | *Directed Energy Deposition* |
| **DSP** | *Digital Signal Processing* |
| **EV** | *Electric Vehicle* |
| **F&B** | *Food and Beverage* |
| **FDI** | *Foreign Direct Investment* |
| **FMCG** | *Fast Moving Consumer Good* |
| **GaAs** | *Gallium Arsenide* |
| **IoT** | *Internet of Things* |
| **ISAR** | *Inverse Synthetic Aperture Radar* |
| **IT** | *Information Technology* |
| **KPI** | *Key Performance Indicator* |
| **LADAR** | *Laser Radar* |
| **LAR** | *Laser Radar* |
| **LCS** | *Lifecycle Service* |
| **LWI** | *Long-Wave Infrared* |
| **M** | *Million* |
| **MIMO** | *Multiple Input Multiple Output* |
| **ML** | *Machine Learning* |
| **MSS** | *Machine Safety System* |
| **NLP** | *Natural Language Processing* |
| **O&G** | *Oil and Gas* |
| **OCR** | *Optical Character Recognition* |
| **ODS** | *Optical Digitizer and Scanner* |
| **OPEX** | *Operating Expenditure* |
| **OT** | *Operational Technology* |
| **PBF** | *Powder Bed Fusion* |
| **PC** | *Personal Computer* |
| **PCB** | *Printed Circuit Board* |
| **PLC** | *Programmable Logic Controller* |
| **R&D** | *Research & Development* |
| **RaaS** | *Robot-as-a-Service* |
| **RAR** | *Real Aperture Radar* |
| **RoI** | *Return on Investment* |
| **SAR** | *Synthetic Aperture Radar* |
| **Si CMOS** | *Silicon Complementary Metal Oxide Semiconductor* |
| **SKU** | *Stock Keeping Unit* |
| **TOTEX** | *Total Expenditure* |
| **UK** | *United Kingdom* |
| **US** | *United States* |
| **UX** | *User Experience* |
| **VGA** | *Video Graphic Array* |
| **VGR** | *Vision Guided Robotics* |
| **WAAM** | *Wire Arc Additive Manufacturing* |

Source: Frost & Sullivan

## ABOUT INTESA SANPAOLO INNOVATION CENTER:

Intesa Sanpaolo Innovation Center is the company of Intesa Sanpaolo Group dedicated to innovation: it explores and learns new business and research models and acts as a stimulus and engine for the new economy in Italy. The company invests in applied research projects and high potential start-ups, to foster the competitiveness of the Group and its customers and accelerate the development of the circular economy in Italy.

Based in the Turin skyscraper designed by Renzo Piano, with its national and international network of hubs and laboratories, the Innovation Center is an enabler of relations with other stakeholders of the innovation ecosystem - such as tech companies, start-ups, incubators, research centres and universities - and a promoter of new forms of entrepreneurship in accessing venture capital. Intesa Sanpaolo Innovation Center focuses mainly on circular economy, development of the most promising start-ups, venture capital investments of the management company Neva SGR and applied research

For further detail on Intesa Sanpaolo Innovation Center products and services, please contact
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