BRYAN, GARNIER & CO

Industrial IoT

AUTOMATION AND DIGITALIZATION SET TO ACCELERATE

TECHNOLOGY WHITE PAPER APRIL 2021

Contents

The pandemic is accelerating the digitalization of industry and the move to smarter factories and warehouses. Surging e-commerce is driving a need for optimized manufacturing processes and reduced supply-chain lead times.

The behavioural changes caused by the COVID-19 crisis are here to stay and digitalization is speeding up in every aspect of our lives. More importantly, we are taking giant leap towards “industry 4.0”, defined by hyper connectivity, hyper mobility, and hyper intelligence.

In this paper, we look at how the pandemic is accelerating the already bright landscape of robotics and automation in production and logistics. We explore the main technological trends such as autonomous mobile robots, collaborative robots, 5G and “untact” technologies. We highlight how the requirements and challenges of a full IoT environment go beyond hardware, demanding more interoperability and integration so operational and information technologies can be seamless.

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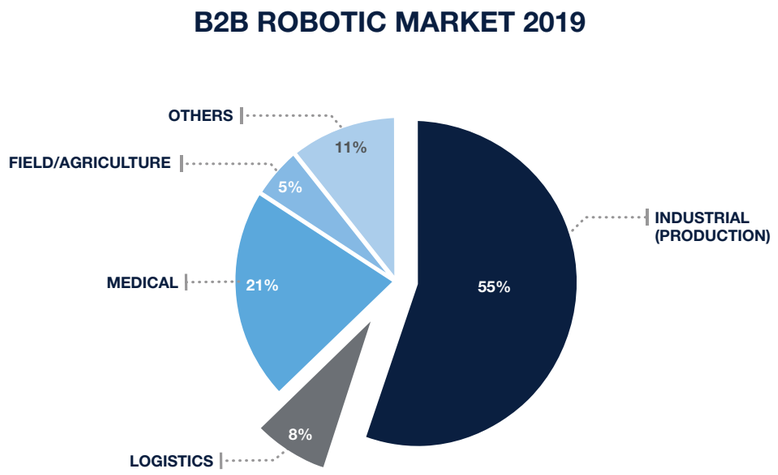
The pandemic is accelerating B2B automation

In this paper, which looks at digital transformation in the industrial space, we have excluded the personal and domestic service robot market (i.e. vacuum cleaners, entertainment robots or assistance robots for elderly or handicapped individuals), which was valued at around USD 5.7bn in 2019. We focus on the B2B market, more specifically production-related and logistic robots, the markets for which were worth USD 15.7bn in 2019, over than 60% of the B2B robotic market. (See Figure 1.)

FIG. 1: 546M PROFESSIONAL-RELATED ROBOTS WERE INSTALLED IN 2019 FOR A VALUE OF USD25BN



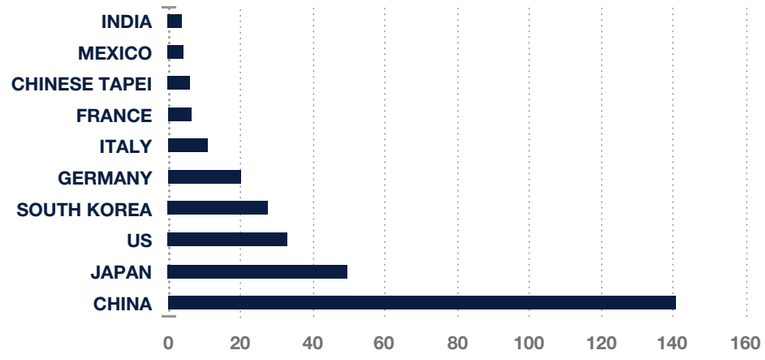
Source: World Robotics Service Robots 2020 report; Bryan, Garnier & Co

Pre-COVID, the robotic landscape was already attractive

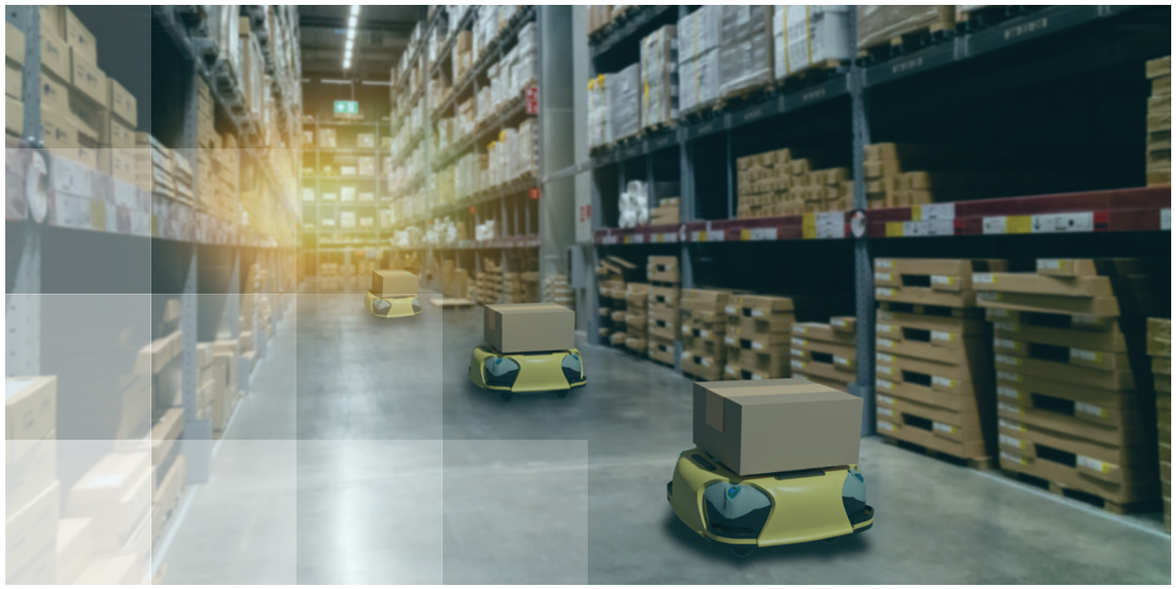
In 2019, 2.7m production robots were operating in factories worldwide, an increase of 12% from the previous year. The largest robot operators are the automotive and electronics supply chains, which hold around 30% and 25% of the global robotic installed base respectively[1]. The robotic market is highly concentrated, with the top 5 countries representing approximately 75% of annual installations, and China accounting for over one-third of robotic demand. (See Figure 2.)

[1] World Robotics Industrial Robots 2020 report, International Federation of Robotics, September 2020

FIG. 2: TOP 10 COUNTRIES BY INSTALLATIONS OF INDUSTRIAL ROBOTS 2019

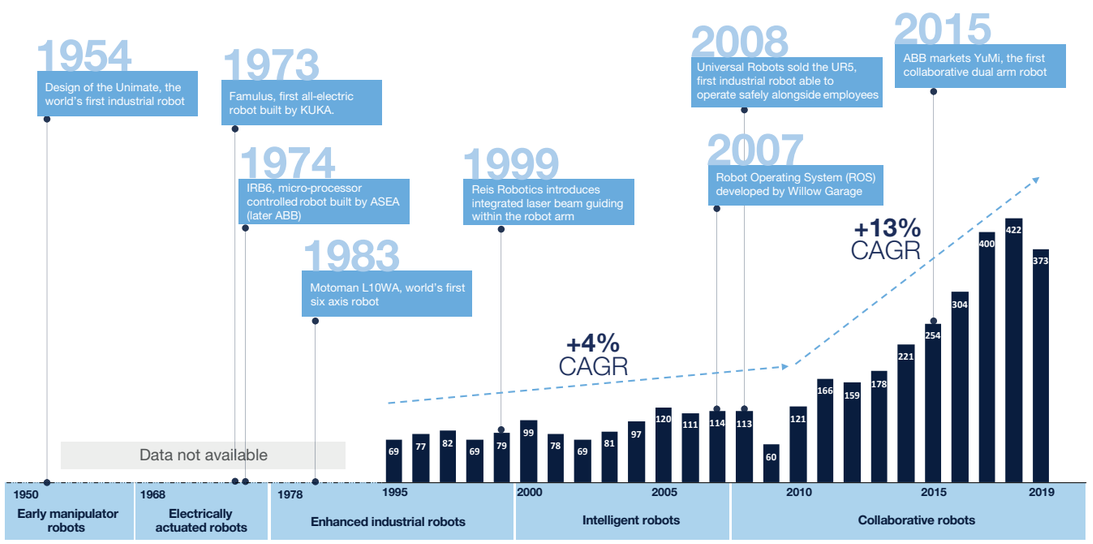


Source: World Robotics Industrial Robots 2020 report, International Federation of Robotics, September 2020



Robots for production-related tasks remain by far the most important segment of the B2B market, with estimated sales of USD 13.8bn for 373k units installed in 2019, representing an average price per unit of around USD 43k. The production robot market has experienced steady double-digit CAGR of 20% over the past ten years, although new installations have recently been hindered by the downturn in automotive and electronics markets caused by the US/China trade war and the pandemic. Both the value and number of installations were down by 16% and 12% year-on-year in 2019, respectively, and a full recovery in industrial installations is not expected before 2022-2023. (See Figure 3.)

FIG. 3: ANNUAL SHIPMENTS OF INDUSTRIAL ROBOTS AND KEY DEVELOPMENTS

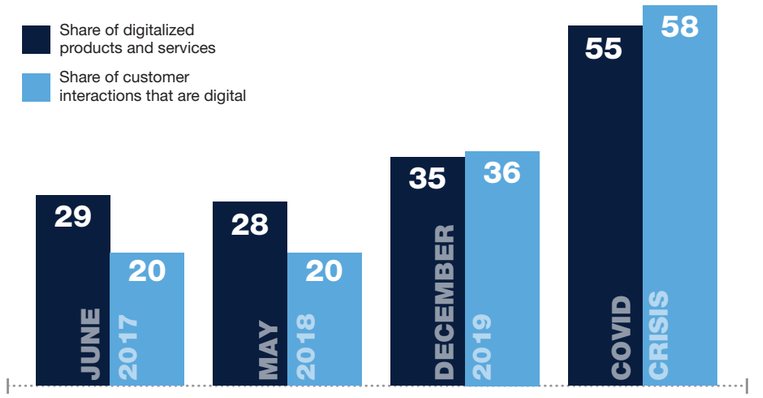


Source: International Federation of Robotics; Bryan, Garnier & Co

COVID-19 is an important catalyst for the robotic market

The robotic market can still deliver high double-digit growth.
While installations of production robots have slowed down in reaction to the pandemic, the surge in demand for electronic devices to enhance working and learning mobility – coupled with the strong shift toward electric vehicles – are likely to drive investments in more advanced automated installations.
The pandemic has dramatically accelerated the digitalization of businesses as humanity fights the virus through social distancing. A global survey from McKinsey shows that the share of both digitalized products and services and customer interactions online have soared from around 35% in 2019 to more than 50% post COVID. (See Figure 4.)

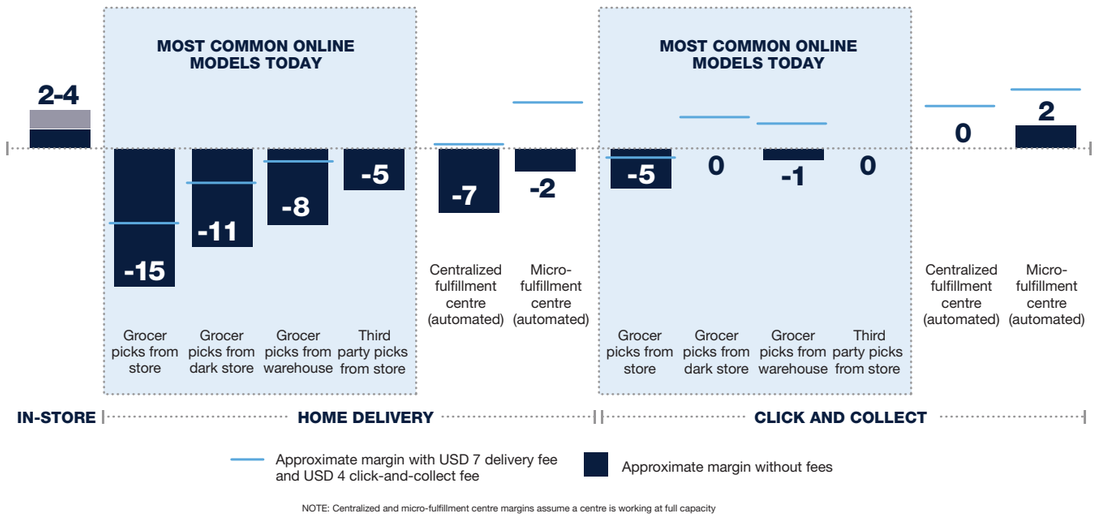
FIG. 4: THE PANDEMIC HAS ACCELERATED THE DIGITALIZATION OF BUSINESSES



Source: McKinsey global survey of executives, July 2020

Such a rapid shift is putting a great deal of stress on supply chains, requiring warehouse operators to be more efficient in their organization and deliveries. This is essential to improve the profitability of e-commerce, which is significantly lower than for physical retail. While in-store grocery businesses yield an operating margin between 2-4% on average, a study from Bain & Company shows that home delivery can reduce profitability to -15%. More automation in warehouses can deliver significant optimization gains, bringing operating margin improvements of 8-13% percent. (See Figure 5.)

FIG. 5: GROCERY EBIT MARGINS BY CHANNEL AND MODEL (%)



Source: How to Ramp Up Online Grocery—without Breaking the Bank, Bain & Company, July 2020

The impact on profitability can be mitigated by collecting delivery fees, but this hits competitiveness. As both large retailers and SMEs face even more competition from e-commerce specialists, in particular Amazon, it has become essential to increase the density of robotics in manufacturing and order fulfillment to deliver more attractive pricing, delivery time and shipping fees – without sacrificing too much from the bottom line.

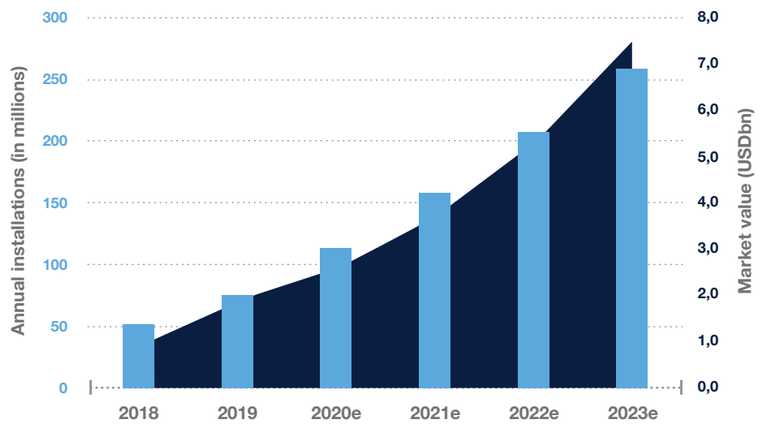
A surge in logistic robots is underway

The increase in logistic robots such as automated guided vehicles (AGVs) and automated mobile robots (AMRs) will be particularly important to meet the need for more efficiency and flexibility. These robots offer a high level of automation for fleet management and picking optimization, enabling the transportation of bigger payloads and an increase in picking throughput.

According to the International Federation of Robotics, best-in-class logistic robots can reach ROI breakeven by 2-3 years, assuming 24-hour operation and an operational availability of around 98%. This includes operating costs of around 5% of the up-front investment and a 15-year lifespan.

Compared to production robots, the market for logistic robots is less mature, which implies potential growth well above the market average in the future. The market value of logistic robots is estimated to have increased by 37% during the first year of the pandemic, to USD 3.7bn, and is expected to double again to USD 7.5bn by 2023, representing a CAGR of 42%. (See Figure 6.)

FIG. 6: LOGISTIC ROBOTS MARKET VALUE TO GROW BY A CAGR OF 42%



Source: International Federation of Robotics, October 2020

Empowering industrial IoT

A taste of the factory of tomorrow

As the pandemic has accelerated the digitalization of the industrial world, it has also shed light on the challenges to overcome on the road toward smart factories.

At Bryan, Garnier & Co, we see the factory of tomorrow as having the following attributes: hyper connectivity, hyper flexibility and hyper intelligence. We see industry with no stationary machines, allowing the plant to be customized on request to meet any type of demand. This introduces the concept of manufacturing-as-a-service or on-demand manufacturing. Technologies such as advanced AI, additive manufacturing and robotic process automation will empower the transition from mass production to mass customization. And as every step of the manufacturing process will be completely automated, human intervention will be minimal.

The first signs of factories like this are already there, for example at General Electric's multi-modal factory in India. This factory is highly automated and digitalized, and can switch between production for oil & gas, aviation, transportation, and distributed power businesses as well as building products for a range of other industries.

Building the smart factory of tomorrow requires wireless connectivity as well as seamless communication between equipment and machinery. It can also go beyond the walls of one site, thanks to the "digital twin" concept, which enables the replication of the entire value chain by generating virtual models of the physical world. This technology will allow synchronization and cloning of several remote production sites in addition to enabling predictive analysis, process planning and optimization and virtual prototyping.

We are a long way from this paradigm. But developments in robotics and the pandemic have accelerated our path towards it.

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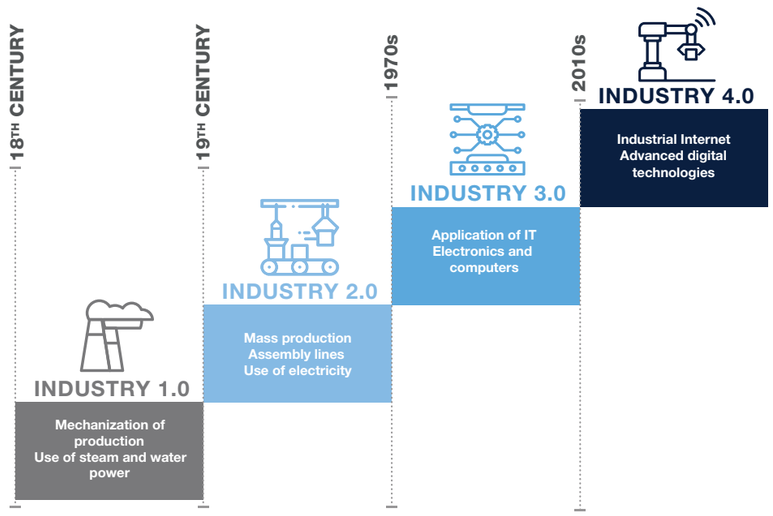
Industrial IoT is a natural and essential evolution

As advanced computing chips, sensors, and data infrastructure become mature and decrease in price, IoT applications are proliferating into a growing number of verticals. In a report published in July 2020, IDC estimates that the number of IoT-connected devices will reach 55.7 billion in 2025. Sectors such as transportation, healthcare, manufacturing and utilities are massively integrating the use of IoT in their operations and together, should account for more than 50% of the IoT market[2].

Industrial IoT (IIoT) can also be referred as Industry 4.0, the latest in a series of important industrial disruptions associated with new technologies and new business models that have led to significant gains in productivity.

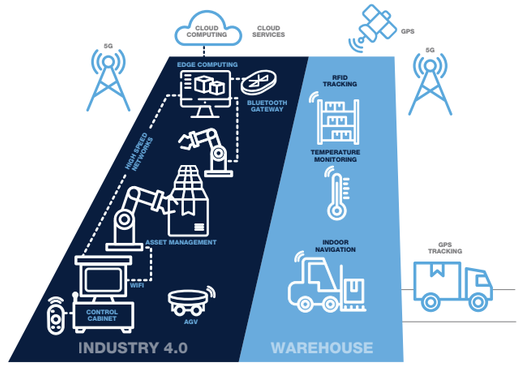
[2] IoT growth demands rethink of long-term storage strategies, ICD, July 2020

FIG. 7: INDUSTRY 4.0 IS PART OF A SERIES OF IMPORTANT INDUSTRIAL DISRUPTIONS



Source: Bryan, Garnier & Co

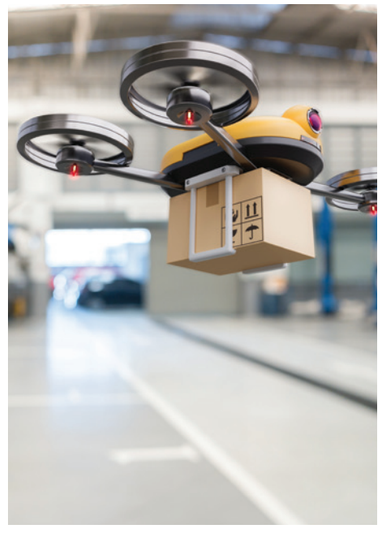
FIG. 8: INDUSTRIAL IOT ECOSYSTEM: CONNECT, COLLECT, INTEGRATE AND ACT



Source: These 8 charts will challenge your perspective on the Industrial IoT, AVNET, October 2019

Intensifying the digitalization of industrial processes has become a key challenge. It involves deploying a combination of hardware and dedicated software that uses embedded sensors and computing capabilities to collect, analyze and act in real time on large quantities of data. As well as deploying advanced hardware, IIoT's goal is to create an ecosystem that can work in concert to improve the efficiency of the whole operation in the field.

As Industry 4.0 matures, there will be an explosion of opportunities for industrial companies to unlock their growth potential. The manufacturing industry is projected to be the most IoT-intensive, with the potential to automate more than 60% of its processes. (See Figure 8).



The economic rationale is significant

The economic rationale for industrial IoT is important and likely to grow further following the pandemic, as great economic crises tend to push industries to innovate.

Research from McKinsey revealed that the application of IoT to factories could yield an economic value between USD 1.2 trillion and USD3.7 trillion by 2025, representing approximately one third of total potential economic impact of IoT.

The value for industrial comes mainly from cost reduction, higher productivity and efficiency through optimizing operations. By combining sensors and AI, industrials can leverage predictive maintenance capabilities that can reduce downtime by up to 50% and cut operating and maintenance costs by 10-40%.

We also believe industrial IoT will drive top-line growth, as improved efficiency can result in market share gains from more favorable pricing strategies as well as new business models and revenue streams.

Turn manufacturing sites into agile, scalable, and autonomous operations requires significant financial and technological efforts. According to IDC, global investment in IoT is estimated at USD 742 billion in 2020 and set to achieve a CAGR of 11.3% over the 2020-2024 period, with nearly 25% to be spent in manufacturing operations, production management and freight monitoring[3].

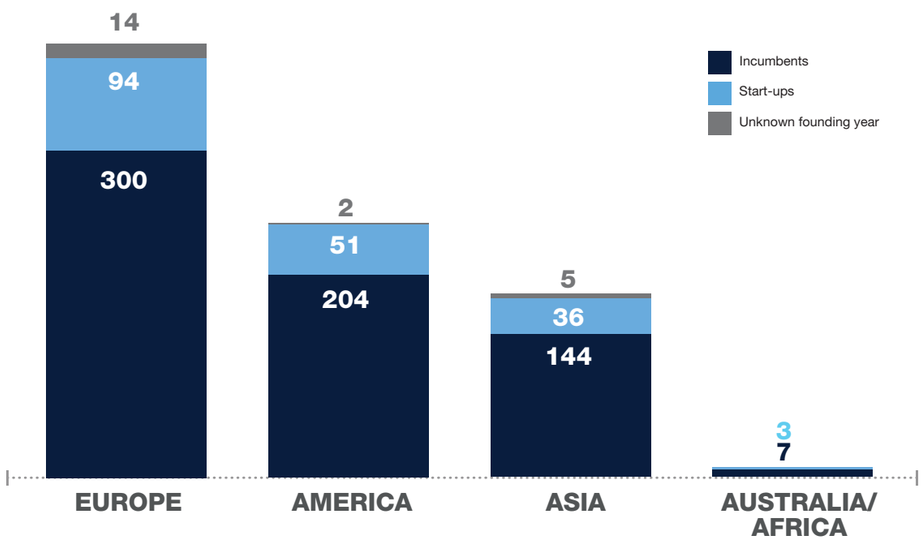
[3] Worldwide spending on the Internet of Things will slow in 2020 then return to double-digit growth, according to a new IDC spending guide, IDC, June 2020

> ***By combining sensors and AI, industrials can leverage predictive maintenance capabilities that can reduce downtime by up to 50% and cut operating and maintenance costs by 10-40%.***

Key automation trends

As industrial IoT involves many disruptive technologies, industrial digitalization is not only a way for existing players to create or strengthen their competitive advantage, it also opens door to new winners. (See Figure 9).

FIG. 9: 155 SERVICE (NON-PRODUCTION) ROBOT STARTUPS CREATED BETWEEN 2015 AND 2020



Source: International Federation of Robotics, October 2020

Europe remains an important venue for industrial innovation, with healthy fundraising activity in recent years in the field of robotics. (See Figure 10.)

FIG. 10: RECENT EUROPEAN FUNDRAISING IN ROBOTICS

	Date	Company	Country	Company description	Deal value (EURM)	Investors
Fundraising	Oct-20	Cognite	Norway	IoT Platform	63	Accel
	Oct-20	Evrythng	UK	Developer of an IoT smart products platform intend-ed to connect consumer products to the web	11	UK Future Fund, You & Mr Jones
	Sep-20	Exotec	France	Developer of an order preparation system	76	83North, Dell
	Sep-20	Magazino	Germany	Distributor of storage and dispensing robotic machines	21	Jungheinrich, European Invest-ment Bank
	Feb-20	Nomagic	Poland	Developer of robotic systems	8	Khosla Ventures, Hoxton Ventures
	Dec-19	OnRobot	Denmark	Developer of a gripper system platform designed to handle industrial robots	25	Bogh-Sorensen, Bonnesen
	Sep-19	ProGlove	Germany	Developer of wierless industrial glove designed to reduce human effort	36	Summit Partners, Bayern Kapital
	Jun-17	Balyo	France	Autonomous material handling robots	109	IPO

Source: PitchBook; Bryan, Garnier & Co

More mobility and more autonomy

"Smart" robots, characterized by much-improved sensors and advanced computing capabilities, were born in the early 2000s. The increasing use of AI has been making robots smarter and able to perform complex tasks while moving around the factory floor.

There are two types of mobile robots: autonomous guided vehicles (AGVs) and autonomous mobile robots (AMRs). AMRs are one of the most advanced robot types currently deployed on industrial shopfloors. Unlike AGVs, AMRs are fully autonomous, which means that their motion does not rely on predetermined guidance system such as beacons or magnetic tapes that are used to allow AGVs to navigate around the warehouse.

AMRs are capable of recognizing and reconstructing their environment thanks to more greater computing power and sensor fusion, which is the ability to combine cameras, radars and even lidar in the most advanced devices. The combination of simultaneous localization and mapping (SLAM) system and path planning software also makes AMRs aware of their environment.

Performance and total cost of ownership are important factors in decision making. While the purchase price for an AMR can be higher than AGVs due to the more sophisticated embedded hardware, AMRs provide several operational advantages that can lead to a lower cost of ownership. As explained earlier, AGVs need a structured environment in order to work properly, which therefore requires some rearrangement of the warehouse, leading to more infrastructure costs, slower deployment time and less scalability.

FIG. 11: LEADING COMPANIES IN AUTONOMOUS MOBILE ROBOTS

Source: IoT Analytics, January 2019, Bryan, Garnier & Co

More collaborative

Most robots still operate in a cage to protect human operators. However, the hardware and AI advances described earlier have enabled workers to execute their tasks safely alongside a robot, and vice versa. These collaborative robots, also called cobots, can be considered the most advanced piece of technologies in industrial fields.

In 2008, Danish company Universal Robots sold the first industrial robot capable of working safely alongside employees. Later in 2015, YuMi, built by ABB, was the first collaborative dual-arm robot to be commercialized. Universal Robots and ABB have been joined by other European cobot pioneers such as Germany-based Festo, with its innovative BionicCobot, and German company Hahn Group, which bought the US-based company Rethink Robotics in 2018.

There is a growing adoption of cobots worldwide. During 2019, saw cobot installations increased by 11% to 18m units, which represented nearly 5% of new installations of industrial robots. We are still at the early stage of cobot adoption, which leaves important potential for acceleration in growth. (See Figure 12.)

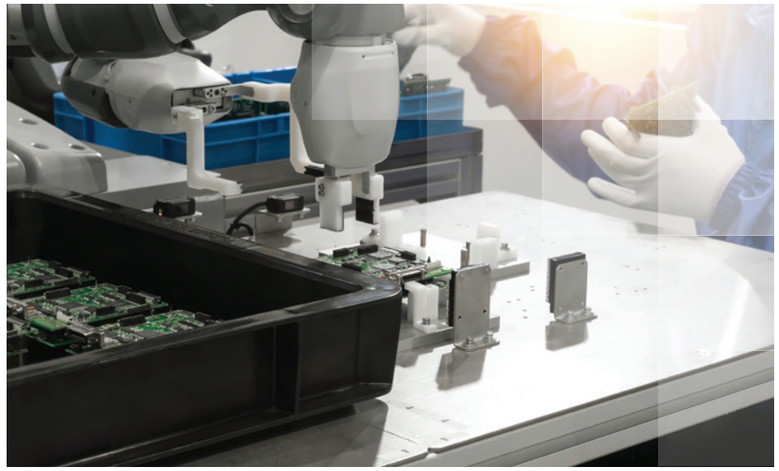
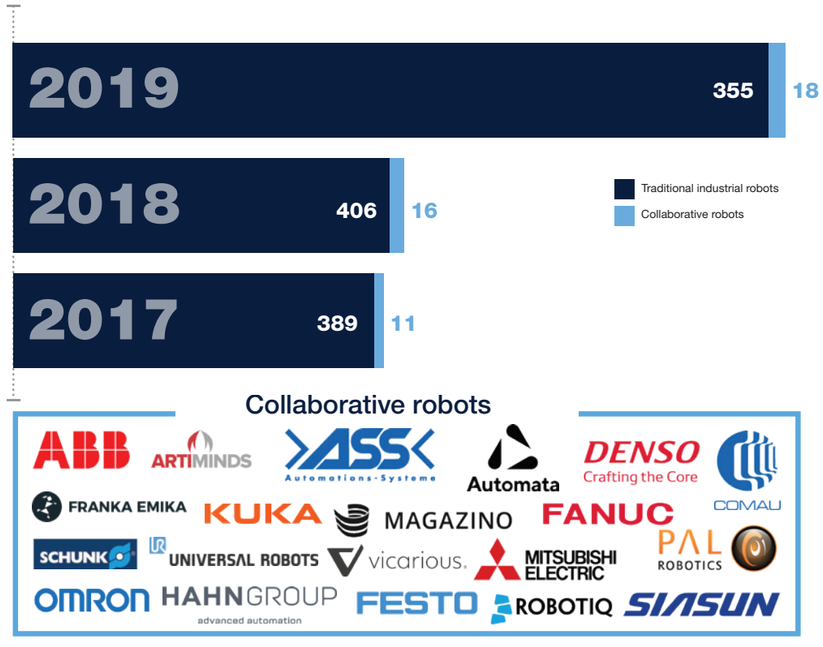


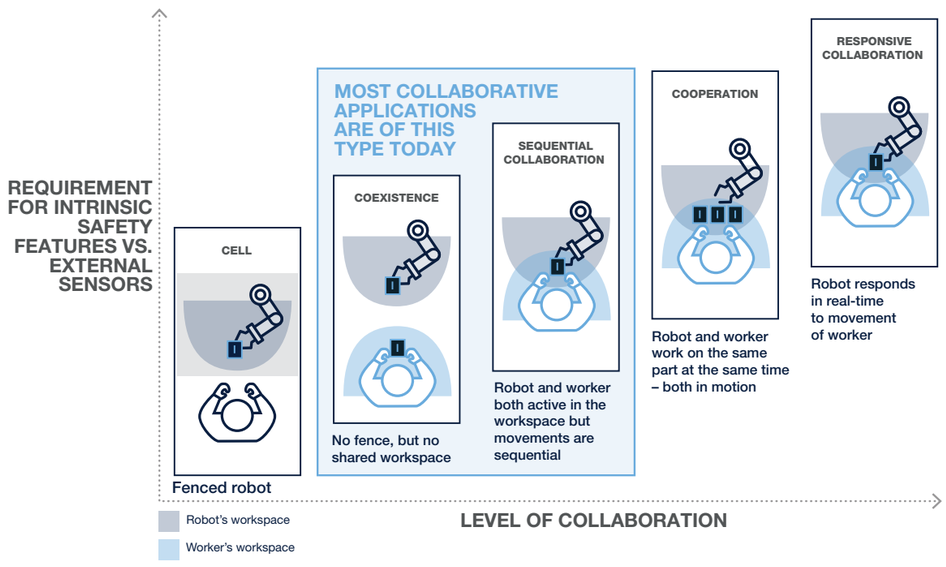
FIG. 12: PENETRATION OF COLLABORATIVE ROBOTS IS INCREASING



Source: World Robotics Industrial Robots 2020; IoT Analytics, January 2019, Bryan, Garnier & Co

AMRs can be qualified as cobots as they are capable of navigating and safely executing tasks in the same environment as humans. The most advanced cobots can perform sequential tasks with human workers. Current developments are aiming at improving collaboration by allowing robots to perform tasks at the same time as humans. This will require more advanced AI and sensing capabilities in order for the robot to analyze and recognize human motion and intention in real time. (See Figure 13.)

FIG. 13: DIFFERENT TYPES OF COLLABORATION WITH INDUSTRIAL ROBOTS



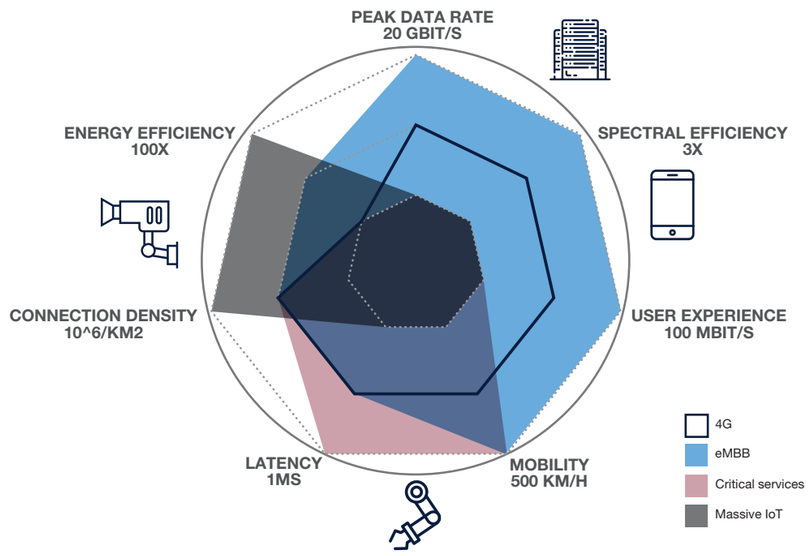
Source: Top Trends Robotics 2020, International Federation of Robotics, February 2020

5G simplifies and enhances wireless connectivity

5G applications expand well beyond the perspective of telecoms players and mobile users, as the new network is set to play a significant role the industrial revolution.

Thanks to its software-controlled "network slicing", 5G is the most versatile wireless technology out to date. Users can choose between three network services depending on the underlying applications. Enhanced Mobile BroadBand (eMBB) delivers peak data rates; ultra-Reliable and Low Latency Communications (uRLLC) considerably improves the reliability of connections and their latency, and massive Machine Type Communications (mMTC) drastically reduces power consumption and increases network density. Each of these features can efficiently serve all aspects of the future of industrial production from augmented reality/ virtual reality, to precise motion controls, and battery-operated low-power devices. (See Figure 14.)

FIG. 14: THREE 5G TECHNOLOGIES FOR A MULTITUDE OF APPLICATIONS



Source: Bryan, Garnier & Co

As a wireless network, 5G provides additional flexibility to the factory, even though the most demanding time- sensitive applications will remain on wired connections. Another advantage of the 5G network is the ability to set up private networks. This makes it possible to license or sublicense a spectrum, and to further secure the network and optimize interference and power.

The 5G network can therefore significantly accelerate the automation of some demanding industrial processes while bringing flexibility and reducing their heterogeneity. However, the deployment of 5G in industrial operations will take time. Global telecommunications standards body 3GPP only expects to finalize the specifications of uRLLC for industrial IoT in June 2022 with the Release 17 update. And most current industrial ethernet protocols are not compatible with 5G, as only TCP/IP (Modbus/TCP and Ethernet/IP) supports cellular standards. Other industrial ethernet protocols are being updated to work on 5G. (See Figure 15.)

FIG. 15: INDUSTRIAL ETHERNET PROTOCOLS AND TYPICALLY ACHIEVABLE CYCLE TIMES

Network	Market share	Layer	Cycle time	Real-time extensions
EtherNet/IP	33%	UDP/IP	~1 ms	No
PROFINET IO	26%	Ethernet	~1 ms	No
PROFINET IRT		Ethernet	250 µs (31,25 µs)	Yes
EtherCAT	15%	Ethernet	12,5 µs	Yes
Modbus/TCP	9%	TCP/IP	~10 ms	No
POWERLINK	9%	Ethernet	100 µs	Yes
SERCOS III	< 9%	Ethernet	62 µs	Yes
CC-Link IE Field	< 9%	Ethernet	~20 µs	Yes

* Highlighted in purple, industrial ethernet protocols natively compatible with cellular connectivity

Source: The Benefit of 5G in the factory, HMS Networks, 2019

Going "Untact"

COVID-19 social distancing is accelerating the "contactless" economy: driving more working and learning at home, increasing online shopping and cashless payments in-store. These changes in human interactions were essential to fight the virus, but we believe that these new behaviours will remain, albeit at a reduced level.

Contactless technologies will also bring further productivity and safety to the manufacturing and supply chain economy. South Korea in particular has emphasized the need to develop "untact" (contactless) technologies as part of its USD 62bn "New Deal" programme with further investments in robots, drones, and self-driving vehicles to enhance productivity and to prevent pandemic disruption. We believe other countries and regions, especially Europe, will follow suit, with ambitious investment programmes.

All the advanced technologies we have discussed – autonomous mobile robots, collaborative robots and 5G – will play an important role in a world of contactless manufacturing and logistics. However, more sophisticated human-machine interface through gesture and face recognition and augmented/virtual reality is necessary to complete the picture of an "untact" industrial world. Delivery drones will also require further developments in sensors.

> ***COVID-19 social distancing is accelerating the "contactless" economy: driving more working and learning at home, increasing online shopping and cashless payments in-store.***

A need for interoperability and integration

A complex ecosystem

The organizational structure of an industrial site is complex, with several interactions between hardware and software layers that can be represented by four main areas:

- **Automation shopfloor:** this is where manufacturing or warehousing operations take place. This layer consists of machines, sensors, and actuators that are connected and controlled by hardware and middleware such as programmable logic controllers (PLCs) or gateways. This also collects related data from the activity, which is then transferred to Supervisory Control and Data Acquisition (SCADA) software.
- **Manufacturing Operation Management (MOM):** alongside the SCADA software, MOM refers a set of Manufacturing Execution Systems (MES) solutions that plan, monitor and improve day-to-day operations performance.
- **Product Lifecycle Management (PLM):** this is the software layer suite that handles the engineering and the process lifecycle of a product, from design to manufacturing and data management. It includes Computer Aided Design (CAD), Computer Aided Engineering (CAE), Computer Aided Manufacturing (CAM) and Product Data Management (PDM).
- **Enterprise Resource Planning (ERP):** this includes the software suite that will support the essential processes for running a company, from supply chain management, to inventory management, procurement and distribution and human resource management. (See Figure 16.)

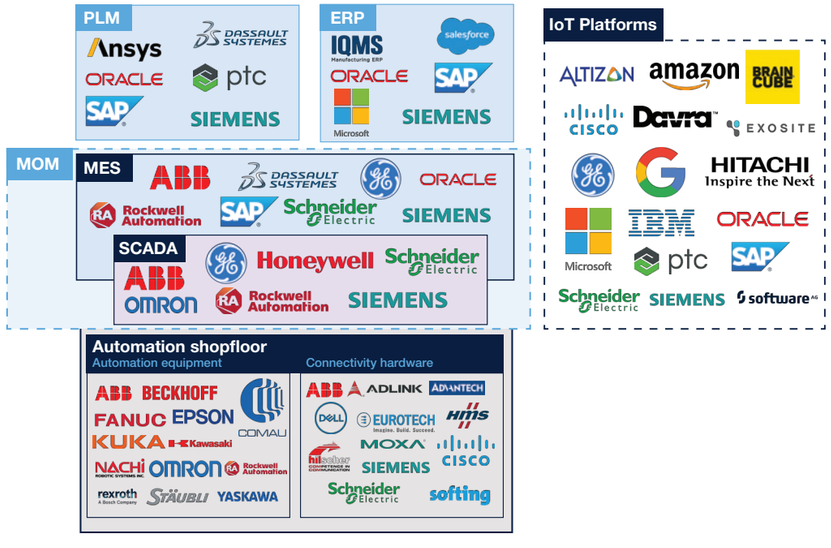
As we previously illustrated, Industry 4.0 aims for a seamless ecosystem to collect, analyse, coordinate and act on large-scale data in real time. It requires more integration of hardware and software layers and it is made more complex by the fact that the bulk of industrial IoT implementations will be in brownfield factories. So, there is not only a need to connect existing devices and equipment more tightly, but also to ensure all new technologies co-exist with legacy architecture. On the software side, the lack of a dominant and fully integrated solution is driving a number of M&A transactions.

Still a need for device middleware

The industrial hardware space is very complex, with a wide range of machine types and devices, and a lack of standards and uniformity in the communication protocols, control systems and application frameworks that are essential to operate, monitor and manage the equipment.

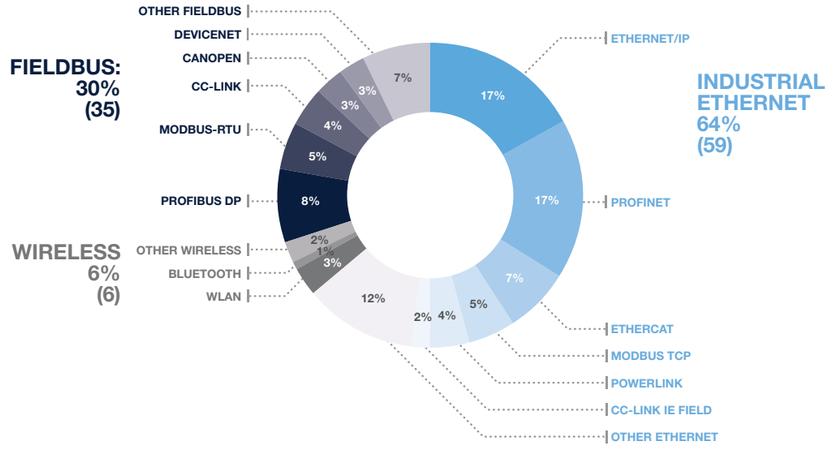
We can illustrate this complexity with the multitude of communication protocols available in the industrial world, some of which are proprietary and often not interoperable. This fragmentation makes the transition from legacy Fieldbus protocols to the industrial ethernet and wireless protocols that are needed for IoT more difficult and slower. (See Figure 17.)

FIG. 16: INDUSTRIAL ECOSYSTEM ARCHITECTURE



Source: Bryan, Garnier & Co

FIG. 17: INDUSTRIAL NETWORK PROTOCOLS



Source: HMS industrial network market study, May 2020

Both equipment OEMs and industrials need integrator companies to solve the interoperability issues between devices and machines, especially in brownfield operations. Companies like HMS Networks, Hilscher, Moxa and Softing offer discrete programmable logic controllers (PLCs) and gateways that act as device middleware and help to solve interoperability issues.

A PLC controls the manufacturing process of equipment and handles the communication with the OT and IT ecosystem. By installing a more modern PLC, data can be communicated to the network using standard protocols like MQTT, OPC-UA or HTTP (ethernet protocols). Elsewhere, a gateway can aggregate, compute and convey the information from a group of connected devices to the field IT system or any remote server.

Modern discrete PLCs or gateways are essential investments especially in a brownfield factory to provide not only more integration but also more efficiency and computing performance for AI-related applications. Enhancing data collection through more efficient data filtering and bringing more computing power to the edge are key criteria for industrial IoT. They improve data storage costs and privacy while creating the low latency that is essential for predictive maintenance or real-time robotic applications.

Large robotic manufacturers often supply discrete PLCs as well, but integrators are essential partners to OEMs because they usually support a wider range of protocols, and they help in reducing time-to-market and penetrating different geographies and typologies of customers. Integrators are also essential to the factory or warehouse operators as they help in dealing with interoperability issues.

Consolidation and "platformization"…

As we have seen, hardware standardization is complex and global and regional integrators will continue to play an important role in the future. On the software front, consolidation and integration is already much more advanced thanks to a less cumbersome ecosystem and a greater M&A activity.

The integration of the different software layers is essential for seamless automation. In envisioning a completely modular and customizable factory and the concept of manufacturing-as-a-service, all the software layers down to hardware need to be perfectly integrated.

Industrial and logistic-related companies have been active in M&As to broaden their software suite and offer more integrated and connected services. (See Figure 18.)

FIG. 18: LIST OF M&A TRANSACTIONS IN INDUSTRIAL IOT

M&A transactions

Date	Target	Country	Target description	Deal value (EURM)	Acquirer	Acquirer Description	EV/Sales
Jan-21	Arena Solutions	USA	SaaS PLM	589	PTC	PLM	14.3x
Dec-20	Boston Dynamics	USA	Legged robots	726	Hyundai	Automotive manufacter	550.0x
Aug-20	OSIsoft	USA	SCADA	4230	Schneider Electric	Industrial conglomerate	10.7x
Jul-20	Hydroid	USA	Subsea robotics	317	Huntington Ingalls	Industrial conglomerate	3.6x
Jun-20	Zoox	USA	Autonomous mobility	1070	Amazon	Online retailer	-
Nov-19	AutoGuide Mobile Robots	USA	High-payload industrial autonomous mobile robots	148	Teradyne	Industrial robots	14.5x
Oct-19	Onshape	USA	SaaS CAD	422	PTC	PLM	-
Sep-19	6River Systems	USA	Robots for warehouse	408	Shopify	Online retailer	15.0x
Dec-18	IQMS	USA	ERP software	374	Dassault	PLM	6.7x
Sep-18	Gimatic	Italy	Robotics arms	370	Bames Group	Private Equity	4.4x
Aug-18	Mendix	USA	Industrial IoT Platform	600	Siemens	Industrial conglomerate	13.1x
Apr-18	Mobile Industrial Robots	Denmark	Collaborative mobile robots	222	Teradyne	Industrial robots	21.3x
Jan-18	Piab	Sweden	Automation and robotics parts focus on gripping solutions	661	Patricia Industries PE	Private Equity	11.4x
Nov-17	IGE+XAO	France	CAD and PLM	188	Schneider Electric	Industrial conglomerate	5.4x
Sep-17	Aveva	UK	Engineering software	2034	Schneider Electric	Industrial conglomerate	13.2x
Sep-16	Meridium	USA	Asset performance management	326	GE	Industrial conglomerate	-
Dec-15	Kepware	USA	Edge data collection	108	PTC	PLM	5.9x
Oct-15	Vuforia	USA	Augmented Reality platform	57	PTC	PLM	-
Jun-15	Universal Robots	Denmark	Robotics arms	314	Teradyne	Industrial robots	8.0x
May-15	Coldlight	USA	Machine learning & Predictive analysis	94	PTC	PLM	13.1x
Dec-13	Thingworx	USA	IoT software platform	94	PTC	PLM	11.8x
Jul-13	Axeda	USA	Cloud-based IoT service and software	129	PTC	PLM	6.8x

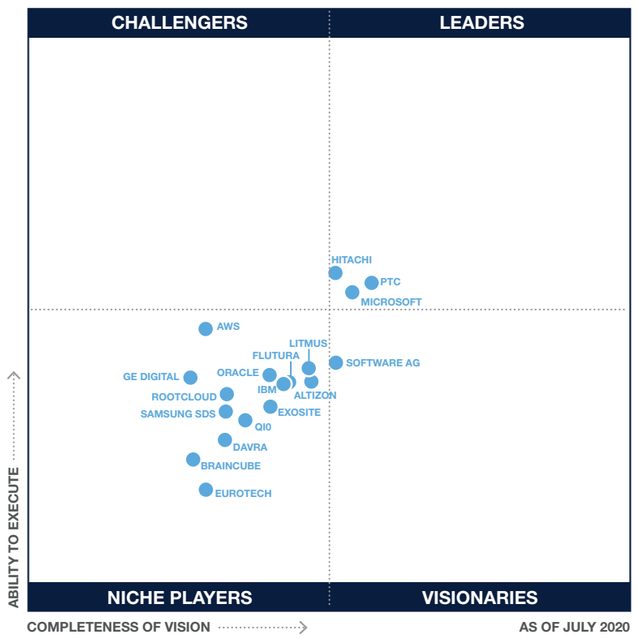
Source: PitchBook; Bryan, Garnier & Co

Despite consolidation and the fact that many major players like Siemens, Dassault, and Schneider have acquired several software layers, the historical leaders remain largely dominant in their field of expertise. This is especially the case in the PLM market, which is very fragmented, with Siemens leading in CAM, Dassault in CAD, PTC in PDM and Ansys in CAE.

The market is also witnessing a wave of integration through cloud-based IoT platforms (platform-as-a-service) that are designed to support and combine multiple business applications into one platform. Ideally, these platforms are agnostic to the end device model and connectivity protocol. Their key features are the ability to manage and monitor underlying connected devices, but also to collect, consolidate and efficiently analyse a high volume and velocity of data.

In reality, the scalability of IoT platforms will depend on the nature of the provider, as vertically integrated players such as industrial conglomerates tend to only push their in-house developments. Microsoft, GE Digital and PTC are often cited as the leading companies in this space. We see infrastructure providers and IoT-focused software companies as natural leaders in this space going forward. Microsoft from the dominant market share of Windows and Azure, while PTC is an IoT-focused company with a large breadth of software and hardware partners. (See Figure 19).

FIG. 19: MAGIC QUADRANT FOR INDUSTRIAL IOT PLATFORMS



Source: Gartner Magic Quadrant for Industrial IoT Platforms, October 2020

Gartner predicts that by 2025, 50% of industrial enterprises will use industrial IoT platforms, up from 10% in 2020, and 25% of large global industrial enterprises will acquire or invest in an industrial IoT platform company, up from 5% in 2020.

… enabling robotics-as-a-service

The list of M&A transactions on page 23 shows that hardware specialists are going vertical, mostly to add data acquisition and IoT platforms to their offering. The digitalization and the vertical integration of the industry actually enables new business model such as “robotics-as-a-service”, which will help the robotic market to further penetrate small and medium-size companies.

The upfront cost of advanced robots has always been a challenge for SMEs, but the access to robots is helped by the decreasing cost of advanced hardware components as well as the increasing penetration of robotics-as-a-service. This business model is based on a monthly fee, which not only includes the rent of the robot but usually also includes additional cloud-related services and the maintenance.

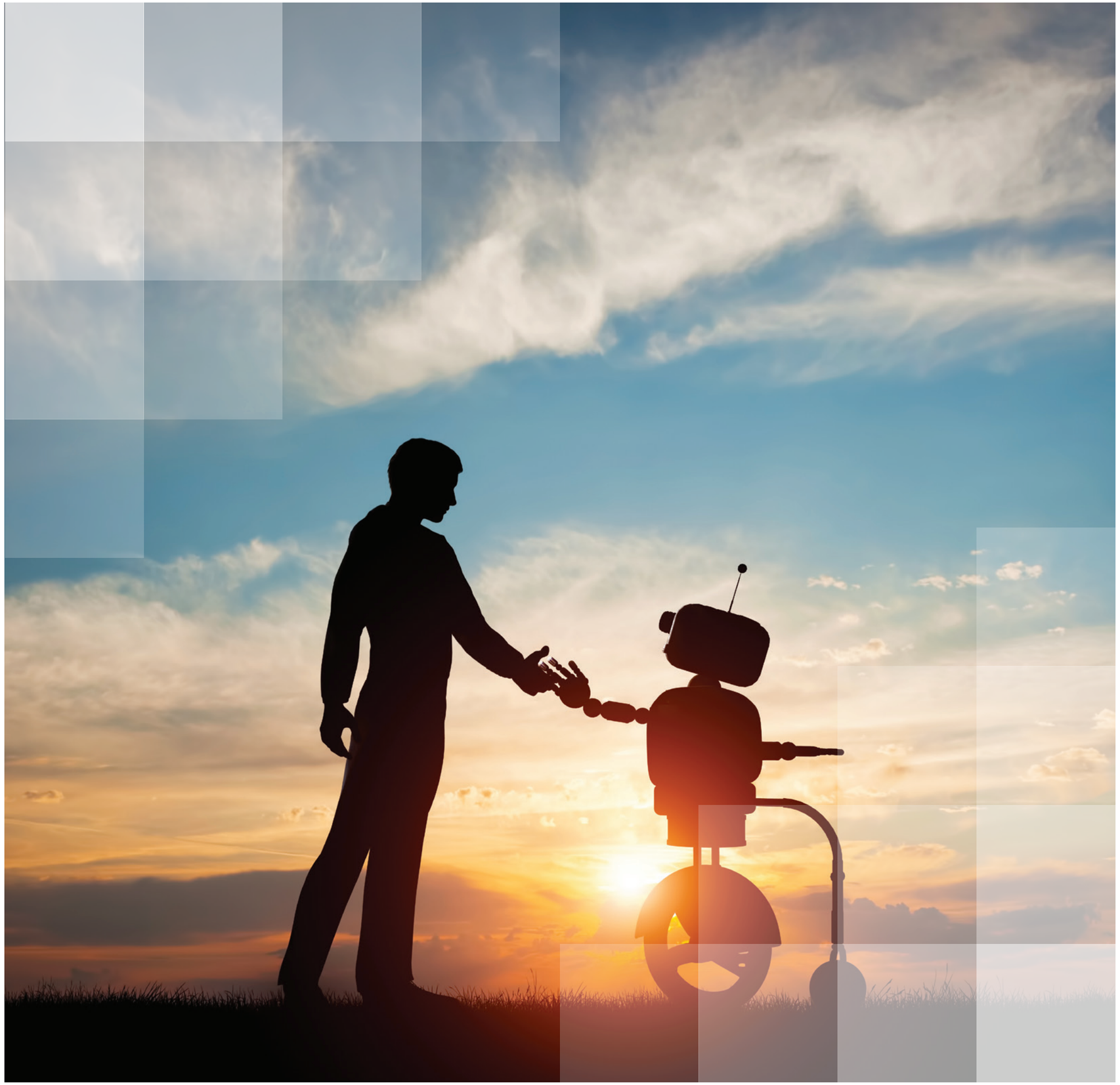
Generally speaking, digitalization strengthens the monetization of the robotic installed base, in particular with logistic robots. The International Federation of Robotics estimates that over the lifespan of professional service robots (logistic, medical and field/agriculture robots), the price of the robot only represents around 30% of the total economic value for the OEM, with 45% coming from the associated services (auxiliary hardware, installation, software and programing), and other accessories making up the remaining 25%[4].

[4] Industrial robotics: insights into the sector’s future growth dynamics, McKinsey, July 2019

So, beyond the growth in unit sales, building a strong installed base is particularly important for OEMs, as it drives more recurring revenue streams throughout the equipment’s typical 15-year lifespan and makes business models more resilient. Bearing in mind the increasing complexity of robots, the intrinsic value of services is likely to increase and provide strong potential growth in services-related revenue.

Conclusion

We are still a long way from the paradigm shift toward totally automated factories. But the pandemic has triggered unprecedented awareness around the need for further digitalization of the industrial ecosystem and the need to make automation accessible to SMEs. The robotic market and its related automation and data processing services are about to see significant acceleration. On the hardware front, the complexity of the underlying technologies, mainly sensing and AI, will continue to give birth to new and disruptive players. In the world of software layers, the market will continue to consolidate, with both industrial conglomerates and pure players looking to offer more integrated IoT solutions.



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