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Advanced Technologies for Industry – B2B Platforms

Highlighting the Relevance of B2B Industrial Digital Platforms in Europe

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Section 1

1. Introduction

1.1 B2B industrial digital platforms in manufacturing

This report has been prepared within the framework of the Advanced Technologies for Industry (ATI) project, initiated by the European Commission, Directorate General for Internal Market, Industry, Entrepreneurship and SMEs (DG GROW) and the European Innovation Council and Small and Medium-sized Enterprises Executive Agency (EISMEA).

The report follows and expands on some of the key elements that were analysed in the previous report 'Monitoring B2B Industrial Digital Platforms in Europe'[1], which investigated the status of B2B industrial digital platforms and underlined their relevance in fostering the process of digital transformation across industries, as well as their role as a fundamental enabler of the data economy in Europe and beyond. More specifically, the previous report pointed to the central role of digital platforms and of B2B industrial digital platforms in particular, in bringing about a composite business ecosystem that is conducive of innovative products, solutions and business processes. It also emphasised how an ever-increasing number of leading organisations in Europe across all industry sectors is shifting to 'platform thinking' with remarkable impacts on their business models and technology architecture. It further found that the supply-side of the European B2B platform market is fragmented and that, in contrast, the demand for B2B industrial digital platforms is quite solid with a vast majority of European companies perceiving clear advantages in the adoption of B2B platforms, such as the potential to access significantly larger markets and increase revenues as a result.

With this in mind, the present report builds on these findings and aims to expand them by:

- providing an overview of the relevance of these platforms in the context of post COVID-19 economy 'next normal';
- highlighting the potential impact of these technologies on the industrial ecosystems, in particular when it comes to the potential amplification of the digital divide;
- introducing a classification for the different B2B ecosystem models and provide an organised summary of the key initiatives that are being deployed in Europe and elsewhere.

1.2 B2B industrial digital platforms definitions

B2B Industrial Digital Platforms are software applications designed to manage data coming from products, assets and processes and facilitating seamless collaboration within different functions inside business organisations and across their ecosystem partners to create business value. The key elements or layers that are present in most of the commercially available products are:

- Data-capture process and data analysis layer;
- Data management and access services layer;
- Collaboration and application platform layer.

One important differentiating point is whether the cloud is 'multi company' i.e. driven by a group of users companies, and often decentralised and distributed in its architectures (an example could be the International Data Space), or whether it is 'single company', i.e. driven by a single, centralised supplier (such as Siemens or GE Digital).

Multi-company-led open data platforms and single-company-led proprietary data platforms represent the two ends of a theoretical continuum, whereas the reality is clearly characterised by a much higher degree of complexity. As shown in the previous report[2], the actual landscape of industrial data platforms presents a more variegated picture, with features pertaining to each of the two extremes often distributed along the full length of the continuum.

[1] The report 'Monitoring B2B Industrial Digital Platforms in Europe' is available online: Monitoring B2B Industrial Digital Platforms in Europe | Advanced Technologies for Industry (europa.eu)

[2] ibidem

1.3 Methodology approach

This report draws from extensive secondary research conducted on external sources as well as on existing research previously carried out by the Consortium partners. In particular, various IDC sources from research carried out by IDC Manufacturing Insights[3] and other IDC units have been used as the basis for the content developed in the following pages.

1.4 Structure of the report

The report is structured along the following sections:

- After the introductory section, Section 2 examines in detail the current economic situation in relation to the COVID-19 pandemic and how B2B industrial digital platforms could play a role in defining and implementing a recovery strategy.
- Section 3 deals in detail with the micro-economic aspects of B2B platforms and provides an overview of the principal ecosystem and business models currently unfolding thanks to the application of platforms in the industry.
- Section 4 presents the conclusive remarks and explains the link between industry/company maturity levels and the levels of platform take up and deployment.

[3] https://www.idc.com/getdoc.jsp?containerId=TEA002928

Section 2

2. Towards the 'next normal'

The recent COVID-19 pandemic has redefined the very concept of disruption. Consensus economic forecasts[4] converge to an 8.1% decrease in Y-o-Y GPD by 2020 for the euro area. Already visible signs of an uptick in economic activities may suggest a partial recovery in 2021, with GDP growth for the region forecast at 5.9% in the course of this year

In this context, where a sudden downturn impacts all economic activities, survival of the fittest is linked not to size or strength but to resilience and the ability to change — to move quickly, adapt, seize opportunities, and be ready for the next disruption. Economic uncertainty, political instability, climate change and disruptive innovations continue to persist, but these challenges are overshadowed by the immediate impacts of the global pandemic. A sense of urgency pervades companies, and distressed businesses have to make rapid pivots towards new models and viable markets or quickly adjust their supply chains. The immediate imperative is to manage costs, balanced with strategic investments.

2.1 An analysis of existing situation

When looking at COVID-19 impacts, 73% of European organisations state that current transformation projects will be revaluated to deliver more efficiency and return on investments. 60% report that they will focus their organisations on new business and operating models. Worldwide IT spending is now expected to decline 5.1% in constant currency terms this year to approximately €1.9 trillion. Organisations are expecting the slowdown and recession phases to last into 2021. At the same time seizing advantage in a downturn is being considered as a strategy. 67% of industrial European companies are trying to take advantage of their competitors' weakness and capture market share and 56% are planning to introduce innovative new business offerings or models[5]. Executives expect to increase spending across nearly all technology areas in the next 12 months, with more than 80%of companies investing or planning to invest in emerging technologies[6].

These results confirm that the COVID-19 crisis has not stopped digital initiatives. Actually, it has accelerated the shift to digital and fundamentally changed the business landscape. As organisations are rethinking what the future will look like and what it will take to thrive in the new business landscape, innovation is an urgent imperative for overcoming the disruptions, both tactically and strategically. With increased awareness, there is now a strong focus on applying digital technologies to address the future of work, engagement, intelligence, operations and leadership. Global spending on digital transformation technologies and services is forecast to grow 10.4% in 2020 to slightly more than €1 trillion despite the challenges presented by the COVID-19 pandemic[7]. Europe follows this trend quite closely, and in fact 70% of European manufacturers plan to adjust their 2020 technology roadmap to respond to the COVID-19 pandemic[8].

2.2 The recovery trajectory

The main strategies that industry organisations are likely to adopt to embark upon a recovery path may be summarised in three main phases (see also Figure 1).

Phase 1- Quick reaction. COVID-19 forced many organisations to adopt digital technologies and change business approaches as they sought to maintain business continuity. Anecdotal evidence suggests that some companies had to crush two years of digital transformation in two months (for example, to guarantee working from home). The main purpose of these initiatives was to ensure business continuity. Initiatives of this kind entail for example embedding hygiene rules in core process, trying to decentralise work by enabling UC&C (Unified Communications and Collaboration), assessing the risk of their more strategic suppliers and invest in extra resources to model the cash flow impact of the crisis.

Phase 2- The resilient organisation. Over the next phases, organisations will seek ways to manage the economic downturn and to seed investments for the ''next normal''. More conservative organisations will focus on ROI, cost savings and essential capabilities only. Some organisations will seek to short circuit the impacts of the recession (flatten the curve) using technology. Some organisations will

[4] Consensus Forecasts, July 2020
[5] IDC EMEA, COVID-19 Impact Survey Europe, Internal, Wave 5: 18-25 May 2020 , manufacturing = 160
[6] KPMG, 2020 Global Emerging Technology Survey Report
[7] IDC's Worldwide Digital Transformation Spending Guide
[8] IDC EMEA, COVID-19 Impact Survey Europe, Internal, Wave 6: 8-12 June 2020 , manufacturing = 156

redouble their investments on technology to obtain a competitive advantage during the 'next normal'. 46% of industrial companies are planning to be leaders and early adopters of new technology or to even aggressively seek out emerging technology to create advantage even if it means some products may sometimes not work. A slightly lower number of companies (38%) will be pragmatic and look for proven, but not necessarily innovative solutions. Only a fraction of companies will refrain from new investments and will avoid new technologies[9].

Phase 3 - The 'next normal'. When industrial organisations in every sector such as machinery, electronics, automotive and chemicals come out of the recession, they will be operating in a new type of economy – 'the next normal'. In the post-COVID economy, expected changes in behaviour, consumption and supply will force companies to adopt digital-led business and operating models that can survive lockdowns, movement restrictions, social distancing, supply disruptions, and more. The following key transformational drivers are at the core of the 'next normal':

- New realities and customer expectations will redefine product and service expectations.
- Economies of scale will be challenged by the need for mass customisation and social distancing.
- Products, services and relationships shift from face-to-face to digital.
- Work-from-home, scalability, security, throughput and redefining internal processes for remote access and communications require immediate attention but will have lasting effects.
- Resiliency in supply will be balanced against efficiencies as automations are applied to operations.
- Adaptability will take greater importance in business and operating strategies.

A core element of this phase will be for industrial companies to learn so-called 'long lasting behaviours' and be able to create the foundation for solid, long term growth by leveraging:

- Operational resilience, efficiency and agility
- New customer experience models
- Integrated ecosystem collaboration

Companies will have to re-build new capabilities to change their way of working in accordance with the new market needs that will arise. For example, the need to rapidly adapt to a mutating demand, to buffer the bullwhip effect[10], to maintain a minimum level of production considering social distancing. In this scenario, where we expect the pandemic to heavily disrupt both the demand behaviour as well as the supply and capability of companies to deliver goods to the market, this will require a complete new set of skills which are all centred around having higher operational agility and leveraging real-time demand intelligence and process visibility. Manufacturing will possibly be based on smaller 'market pockets' and shorter value chains. In this environment, companies will have to reconsider their supply chain footprint and transform their operations to make them fit for purpose and prepared for the next disruption.

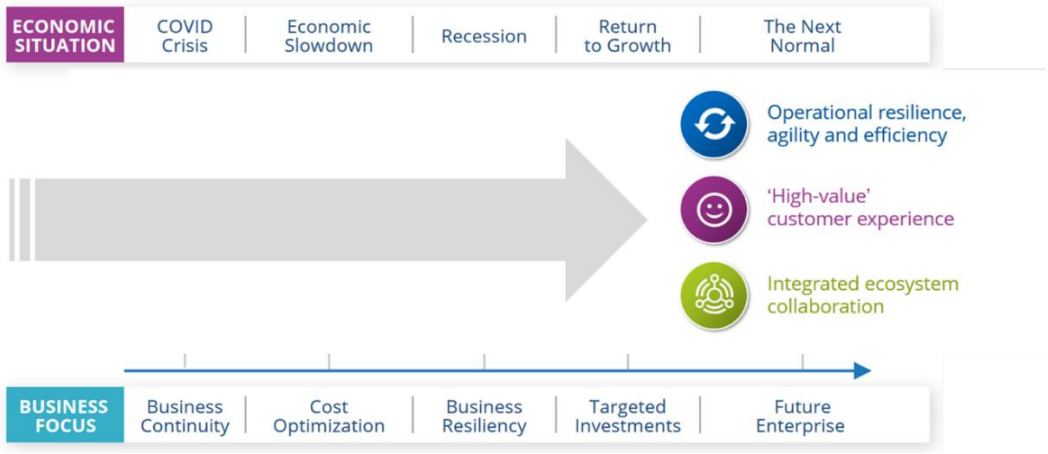
Examples of key strategic initiatives include:

- Digital sales channels / salesforce
- Augmented reality for remote operator assistance
- Factory network redesign
- Supply chain footprint redesign
- Real-time sales & operational planning
- Remote monitoring & operation control
- New production scheduling to enable staggered shifts
- Data-driven market intelligence
- Transportation & logistics agility
- Collaborative B2B networks / ecosystems
- Product portfolio assessment
- Sensorisation & Automation

[9] IDC European IT Buyer Sentiment Survey — Wave 6, June 8-12 2020 – Manufacturing Sample, N=156

[10] The bullwhip effect is a supply chain phenomenon describing how small fluctuations in demand at the retail level can cause progressively larger fluctuations in demand at the wholesale, distributor, manufacturer and raw material supplier levels. The effect is named after the physics involved in cracking a whip. When the person holding the whip snaps their wrist, the relatively small movement causes the whip's wave patterns to increasingly amplify in a chain reaction.

Figure 1: Build resiliency to thrive in the 'next normal'



Source: IDC, 2020

2.3 The role of IT in overcoming the disruption

In order to thrive in this phase, the European industry will not only adapt to shifting customer needs and market conditions, but also proactively shape the needs and the market to match their strengths, innovations and business models, with the help of IT.

In the 'next normal' a continuum of applications and data that stretches from machines, assets, processes, up to the boardroom — combined with historical data, enterprise systems and global information — will continually detect the environment and put it into a new context. In this context, competitiveness is determined by how data is transformed into insight to create high-value differentiators for products, customers and markets; and how effectively organisations deliver meaningful, value-added learning, predictions and actions that improve engagement, processes, enterprise decision making, resilience competitive advantage.

Understanding and provisioning the platforms that will sustain, advance, and scale business and operations, and exert strategic control is essential for every business. A digital platform is the assembly of technologies, capabilities and data, upon which digitally enabled businesses run. The data exchanges, intelligence and network effect within digital ecosystems generate new value beyond the platform itself (Figure 2). For users and competitors, the value of digital platforms introduces high switching costs and barriers to entry that cannot be easily replicated through the introduction of new products and services alone. A key example are the Volkswagen Industrial Cloud[11] and the Open Manufacturing Platform (OMP) that are designed to create a 'closed' ecosystem of certified partners that can collaborate to implement data-driven operational improvement activities[12].

[11] https://www.volkswagen-newsroom.com/en/press-releases/volkswagen-steps-up-development-of-industrial-cloud-5996
[12] Please see IDC's The Open Manufacturing Platform: A Collaborative Initiative to Accelerate Innovations in Industrial Production - Jul 2020, Doc # EUR146713020 and The VW Industrial Cloud: An Ambitious Project with Challenges to Overcome Oct 2020 -Doc # EUR146921920.

Figure 2: The ecosystem business model, enabled by shared data

Source: IDC, 2020

To be successful, the industrial digital platform will have to be built upon state-of-the art architecture that incorporates the latest technologies including:

- **Cloud & DevOps**[13] – These technologies are essential to enable collaboration and execution across a wide range of stakeholders with multiple and diversified requirements. In particular, low-code applications are essential to allow users to tailor the functionalities to the specific needs of their industry and the process they are looking after, in a bottom-like approach to solution delivery.
- **Artificial Intelligence and Analytics** – When it comes to enabling decision making across the vast amount of ecosystem participants, the about of information produced and generated often supersedes the capabilities of human decision makers to effectively take optimal decisions. In this context, technology such as AI are central to operationalise analytics and assist business leaders in taking optimised decisions.
- **Security and Blockchain** – In a digital world companies need to trust their business partners in managing data well and to be compliant with agreed policies and with global regulations. In this regard, it is essential to integrate different information sources effectively. In particular, it is important to manage who can access the data and for which purpose, and under which conditions, without an excessive amount of bureaucratic control (to allow for an agile and business-relevant collaboration). Cyber security and blockchain are key technologies in enabling this.
- **IoT and Edge Computing**– Industrial companies have the opportunity to generate and share real-time data and information coming from any machine, device and process that is under their control. Edge technologies and IoT become particularly relevant as they pertain to privacy-neutral, operational data that can be easily shared, pooled and analysed to maximise the value for the whole ecosystem.

2.4 The relevance of B2B digital platforms in the industrial sector

When it comes to B2B Industrial Digital platforms, the industrial sector holds a particularly relevant role. On the one hand, the majority of industrial platform applications apply to the management of data coming from cyber-physical systems that are deployed in production plants, mining and energy facilities, global warehouses and transportation networks. Most of these systems are deployed or at least enabled within the manufacturing industry. On the other hand, the industrial sector is a key contributor to the wellbeing of European economies for its size and its capability to drive innovation and thus to contribute, create and distribute these platforms. A significant example lies in the pivotal role that advanced machines and products have in enabling next generation business models in every industry. For each of these use cases, from smart manufacturing to smart agriculture, to connected logistics and smart

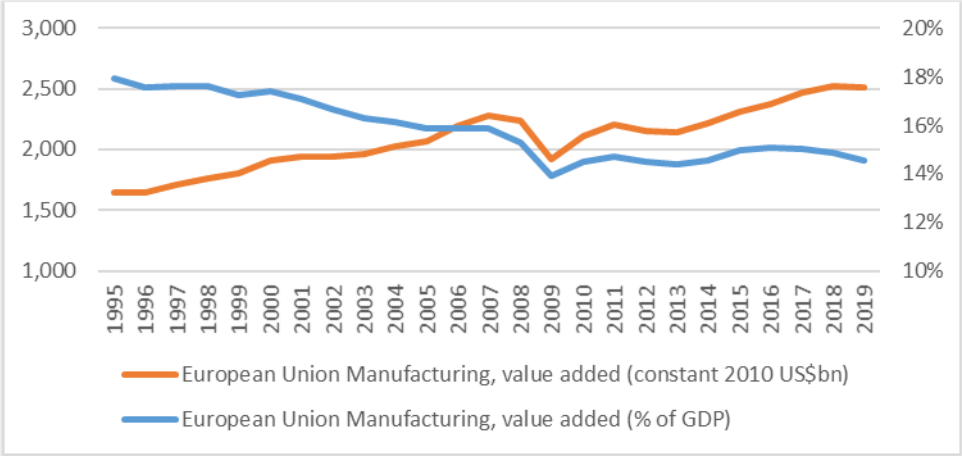
[13] DevOps is a set of practices that works to automate and integrate the processes between software development and IT teams, so they can build, test and release software faster and more reliably. The term DevOps was formed by combining the words 'development' and 'operations' and signifies a cultural shift that bridges the gap between development and operation teams, which historically functioned in siloes. (https://www.atlassian.com/devops/what-is-devops)

medicine, we can find a machine (be it a machine tool, agricultural equipment, smart truck or a connected medical device) that has been designed and developed with the embedded technology to deliver value in new forms to the user.

But another important point is the significance that B2B Industrial Digital Platforms may have in ensuring the long-term productivity and sustainability of the whole sector.

Ensuring productivity and innovation are central to the long-term prospect of the European industrial sector. For example, looking at the manufacturing industry, the analysis of OECD and World Bank data[14] highlights that, while the manufacturing industry in Europe has been able to constantly grow their value added – with the exception of the 2009 crisis – the relative importance of the industry for the European economy has decreased, and that can be summarised by the declining line of value added as a share of total GDP. This signals that, while the industry has certainly moved forward in innovation and achieved more productivity, other industries – especially in the services – have performed better and have become gradually more competitive.

Figure 3 : Value added evolution in European manufacturing, 1995-2019



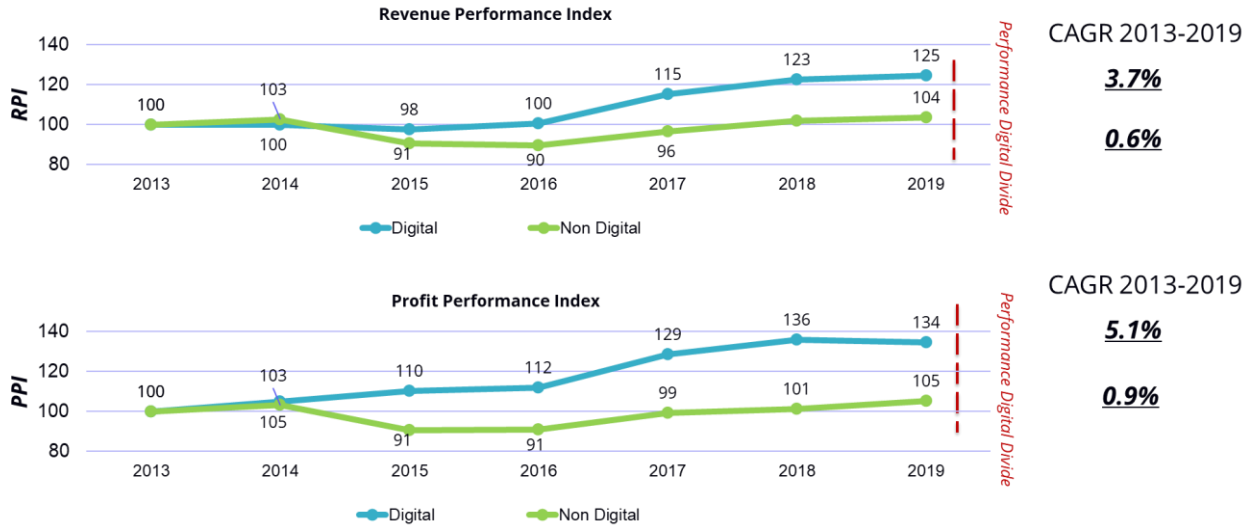
Source: World Bank national accounts data, and OECD National Accounts data files

The competitiveness factor is central here. Innovation and technology have been a constant source of competitive advantage. Companies that have consistently shown a better and more extensive advancements on digital transformation and deployment of digital technologies such as IoT, 5G, Big Data, Mobility, Connectivity, AI show a better business performance than their non-digital counterparts. It is very likely that this is due to the fact that investing in digital is an essential element to move towards the creation of sustainable long-term competitive advantage[15].

[14] Manufacturing, value added (% of GDP) - European Union | Data (worldbank.org)

[15] IDC, GPI Global Performance Index

Figure 4: IDC GPI Index for the manufacturing industry



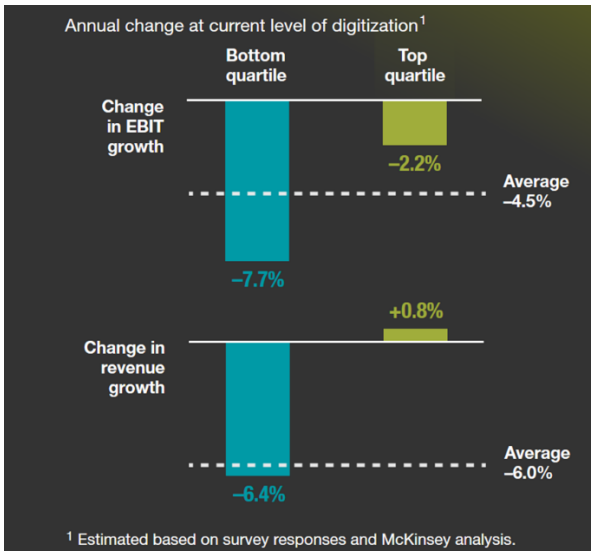
Source: IDC Manufacturing Insights' Global Performance Index analysis 2013-2019

The Manufacturing Insights Global Performance Index (GPI) tracks growth metrics from more than 800 publicly traded global firms in the manufacturing and retail industries. The GPI tracks general trends in manufacturing and retail subindustries based on the performance of a sample of companies from those subindustries. Historical data in the index may be adjusted between quarters based on the addition or subtraction of companies in the index or company restatements of historical filings.

Within this index, a total of 402 companies were selected from the Capital IQ database and a detailed secondary research was performed to categorise the companies as Digital and Non-Digital. Category 1 (300 companies): companies which are digitally transformed or are on the verge of getting digitally transformed are categorised as Digital companies. Category 2 (102 companies): companies that have not undertaken any digital initiatives are categorised as Non-Digital Companies. For each category, the financials (Revenue and Gross Profit) were obtained and the Revenue Performance Index (RPI) and Profit Performance Index (PPI) was calculated to illustrate the performance of companies over the years 2013-2019.

The average and bottom performing quartiles in digital transformation maturity were expected to suffer more in terms of financial performance with respect to their more digital peers. This can lead to a growing divide between digital winners and losers[16].

Figure 5: Growing digital divide between digital and non-digital companies



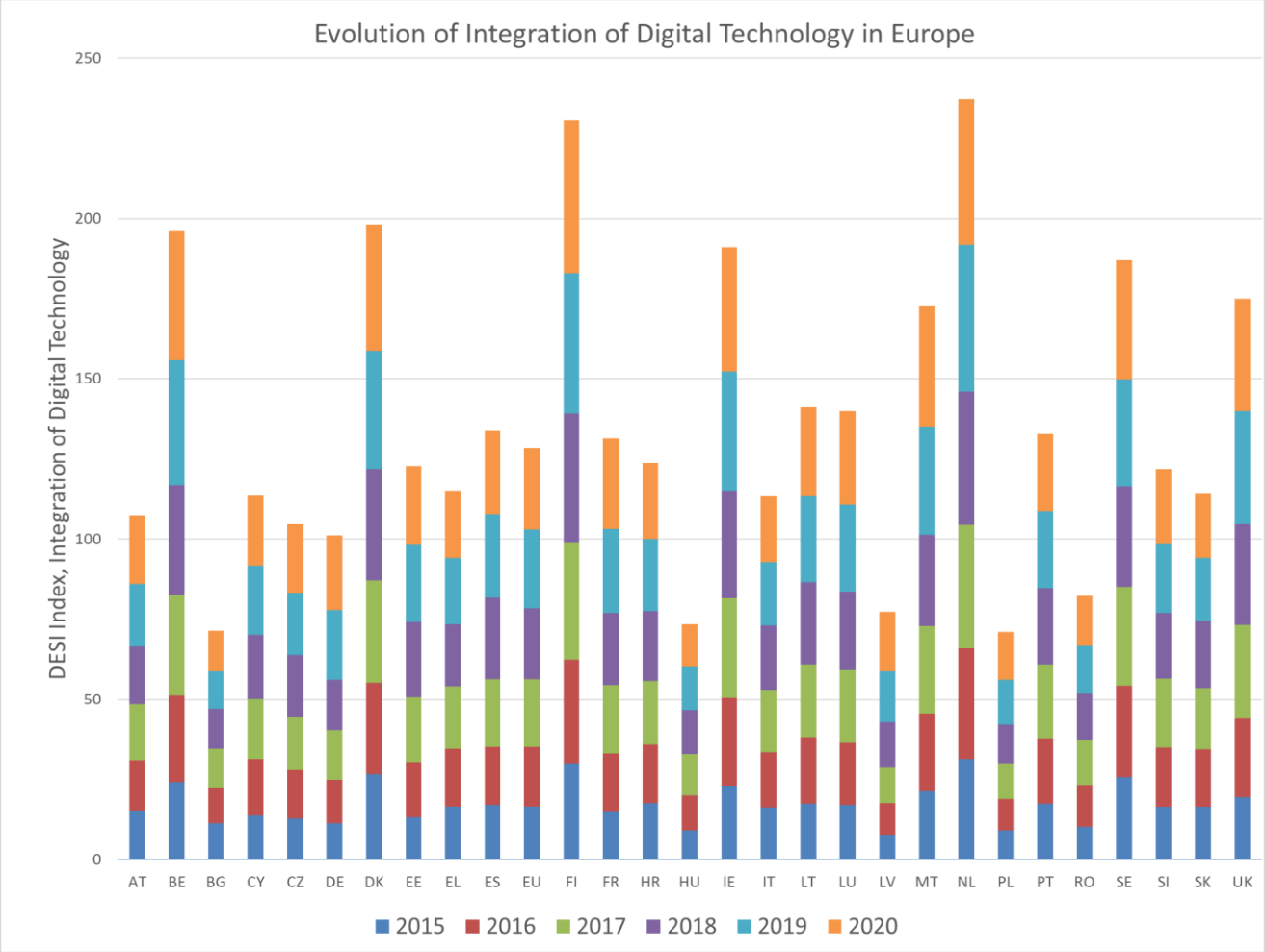
Source: McKinsey, 2020

[16] McKinsey, Five Fifty: The digital effect, available at https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/five-fifty-the-digital-effect

It is therefore very important that European industrial companies understand that without innovating today they risk missing key opportunities in transforming their business and prepare for the world of tomorrow.

This is a key point, considering that many companies in Europe seem not to have advanced enough on their way to digital transformation. The European Commission's recent publication of Digital Economy and Society Index (DESI) 2020[17] has highlighted an increased variability among European countries in the Integration of Digital Technologies over the years, in particular when it comes to the difference between the top of and lowest performing ones. The report also highlights that one of the essential reasons behind this divide is linked to companies' scale and size. Therefore, this variability can be explained both with the capability of each country's digital infrastructures and provisioning of support to digital technology adoption, but also in relation to each country's industry demography.

Figure 6: Evolution of integration of digital technologies in Europe



Source: IDC elaboration on European Commission, Digital Scoreboard Data, 2020

As we have seen, the role of the digital economy to drive long-term business results is uncontested. In order to thrive and seize new business opportunities, companies will have to move beyond the traditional business practices that were geared around product differentiation and pricing policy and focus instead on ecosystem-based value creation. In this context, platform thinking represents a long-term, sustainable response to the new reality of the digital economy, in which organisations and companies from all industry sectors can evolve into digital-native enterprises.

Indeed, in the 'next normal', platform thinking (and the ensuing uptake of B2B industrial digital platforms) will be underpinned by the need to achieve and accommodate for operational resilience, efficiency and agility, new customer experience models and integrated ecosystem collaboration. Within this setting, industrial digital platforms can play a significant role by:

[17] The DESI 2020 reports are based on 2019 data. The United Kingdom is still included in the 2020 DESI, and EU averages are calculated for 28 Member States. https://ec.europa.eu/digital-single-market/en/digital-economy-and-society-index-desi

- Increasing customer value through joint, collaborative product development and delivery involving relevant stakeholders (e.g. customers, partners, suppliers, service providers)
- Enhancing customer experience through seamless integration of all relevant stakeholders during entire product lifecycle (e.g. closer customer engagement, better integration of service and maintenance)
- Reducing time to market for product innovations
- Developing of new business models and revenue streams
- Optimising product cost structures
- Improving product quality
- Increase efficiency of shop-floor operations (incl. warehouse operations)
- Increase efficiency of B2B operations (incl. sell-side/sales and buy-side/procurement)
- Scaling up IT solutions for process innovations faster (if IT solutions are being tested in a broader ecosystem before)
- Exploiting existing IT solutions for common industry challenges (utilising apps from digital platforms and marketplaces)
- Leveraging data from ecosystem stakeholders for process improvements or innovations
- Leveraging data from ecosystem stakeholders for new data-driven services and business models

As a result, it is key to assess the main characteristic of the platform economy that are behind this new competitive pressure in order to understand the nature of the risk companies may face if they fail to adapt.

Section 3

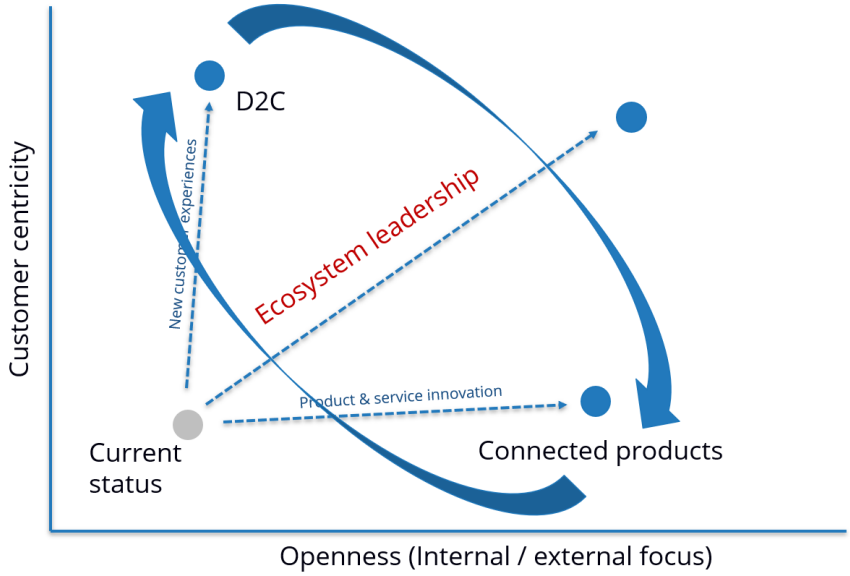
3. The platform is the new business battleground

3.1 The risk of a 'Winner takes all' approach

Figure 7 shows the nature of the transformation currently brought about by platform thinking, where actors who can create added value by using data from connected products and processes in open ecosystems. As underlined in the previous report 'Advanced Technologies for Industry – B2B Platforms. Monitoring B2B Industrial Digital Platforms in Europe'[18] these ecosystems encompass a growing number of companies and are increasingly becoming a strategic element of business success. A relatively small number of organisations will ultimately be able to manage these ecosystems using their innovation strategies in terms of benefit, such as market size gains and opportunity to be first movers. Other companies, most of them indeed, will at some point take a follower position or a position that is of a mere compliant platform member. As a result, while high-performing companies move away from the rest, a polarised and uneven landscape may emerge, where some organisations achieve high productivity and profits, and a wider galaxy of organisations with minimal returns falls behind.

In this respect, digital platforms may play a role in creating and amplifying the digital divide. In 2023, 20% of worldwide discrete manufacturing ecosystem participants will lead and shape ecosystems through technology innovation and vision, resulting in polarised gains within value chains[19] .

Figure 7: The role of platforms to sustain businesses and operations



Source: Advanced Technologies for Industry – B2B Platforms. Monitoring B2B Industrial Digital Platforms in Europe, March 2020

3.2 Different ecosystem models

Considering the market perspective described in section 3.1 above, the role of technology today and in the coming years exceeds the one of a simple enabler. It is a key contributor to, and differentiator of, the core value proposition of an industry and, ultimately, it determines the success of an ecosystem. Indeed, many technologies contribute to the success of ecosystem-based value propositions. Each layer type constitutes a technological and collaborative setup that addresses specific business issues. In each case, the success of business ecosystems depends on collaboration within and across enterprises; hence, the seamless exchange of information and inter-enterprise collaboration lead to transparency in decision making and trust among participants.

[18] Monitoring B2B Industrial Digital Platforms in Europe | Advanced Technologies for Industry (europa.eu)
[19] IDC FutureScape: Worldwide Manufacturing Business Ecosystems 2019 Predictions

Driven by consumer demand, the need to create service-based business models and competition from platform economy, many industrial companies are thus adopting this ecosystem approach to grow their business.

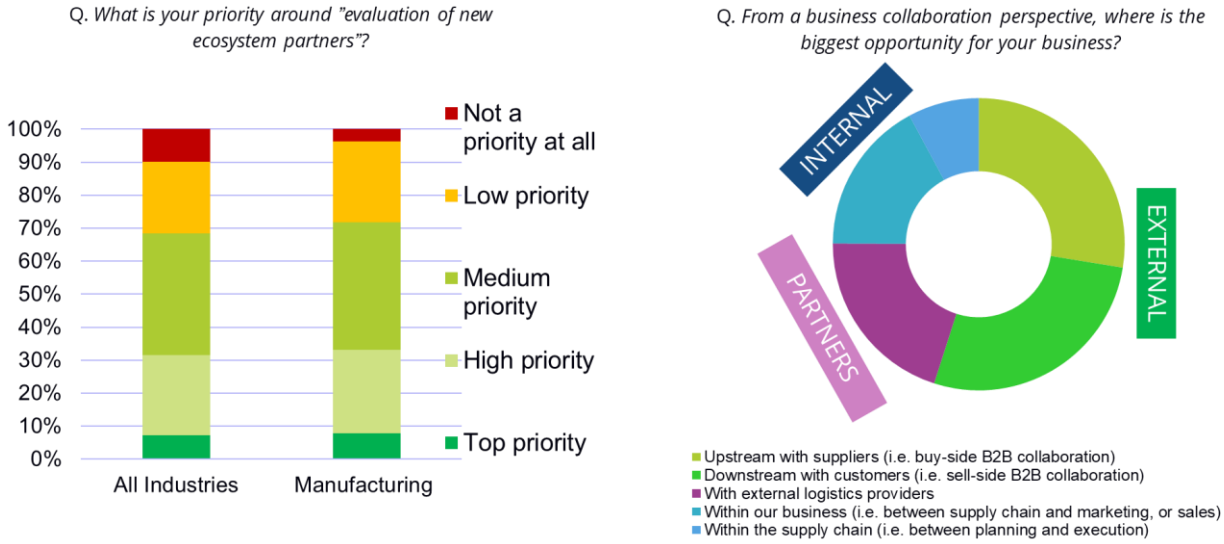
Figure 8 highlights how today manufacturers' propensity of collaborating with external companies is growing and it is now on par, if not superior, to other industries such as banking, utilities, retail and transportation. Most manufacturing companies are seeing today their main competitive advantage and biggest business opportunity in the partnership with ecosystem players such as suppliers, customers and trading partners. In fact, collaborative models - also known as coordination models - are rapidly being deployed throughout manufacturing value chain product design, development, production, after sales, and a series of other processes. The key common objective among these processes is gaining rapid scale[20].

There are many collaborative ecosystem initiatives in the manufacturing industry, for example:

- Combient AB involves a group of global enterprises in a variety of industries in the Nordics. Founded in January 2015, Combient today is the leading cross-industry collaboration network in the Nordics. It includes 30 large enterprises supported by an ecosystem of top universities and start-ups. Major partners in the manufacturing domain include Scania, KONE, Stora Enso and Saab. The vision of Combient is to develop digitalised industrial innovations to the industry by means of collaboration and knowledge sharing.
- Platform Industry 4.0 was launched in 2013. It is an ecosystem of companies, trade unions, associations, scientific institutions and political bodies that aim to promote the digital transformation of manufacturing in Germany. As of May 2020, this initiative has over 350 stakeholders from over 150 organisations.
- The Open Industry 4.0 Alliance aims to accelerate the development of Industry 4.0 solutions by supporting common standards. This initiative has about 53 supporting companies, including founding members Beckhoff, Endress+Hauser, Hilscher, ifm, KUKA, MULTIVAC, SAP and Voith.
- The Open Platform Communications (OPC) Foundation was founded to develop and maintain the interoperability standard for the secure and reliable exchange of data between industrial automation devices from multiple vendors. In 2008, it released the OPC Unified Architecture (UA), a platform-independent, service-oriented architecture that integrates all the functionality of individual OPC Classic specifications into one extensible framework. There are currently over 750 OPC foundation members globally and thousands of OPC-compliant products.
- The Industrial Internet Consortium (IIC) brings together organisations and the necessary technologies to accelerate the growth of Industrial Internet by identifying, assembling, testing and promoting best practices. Members work collaboratively to speed up the commercial use of advanced technologies.
- The International Data Space (IDS) aims at defining data standards and data governance frameworks for collaborative data sharing environments.
- The SmartFactoryKL initiative aims at jointly implementing Industry 4.0 projects regarding the factory of the future. Its members include Festo, HARTING, Pilz, proALPHA and IBM.

[20] IDC, Finally Boosting Business Cases for DX: How Manufacturers Approach the "Next Normal" with Digital Industrial Platforms and Collaboration Strategies Oct 2020 - Doc # EUR146919320

Figure 8: The role of ecosystem in manufacturing industry in Europe



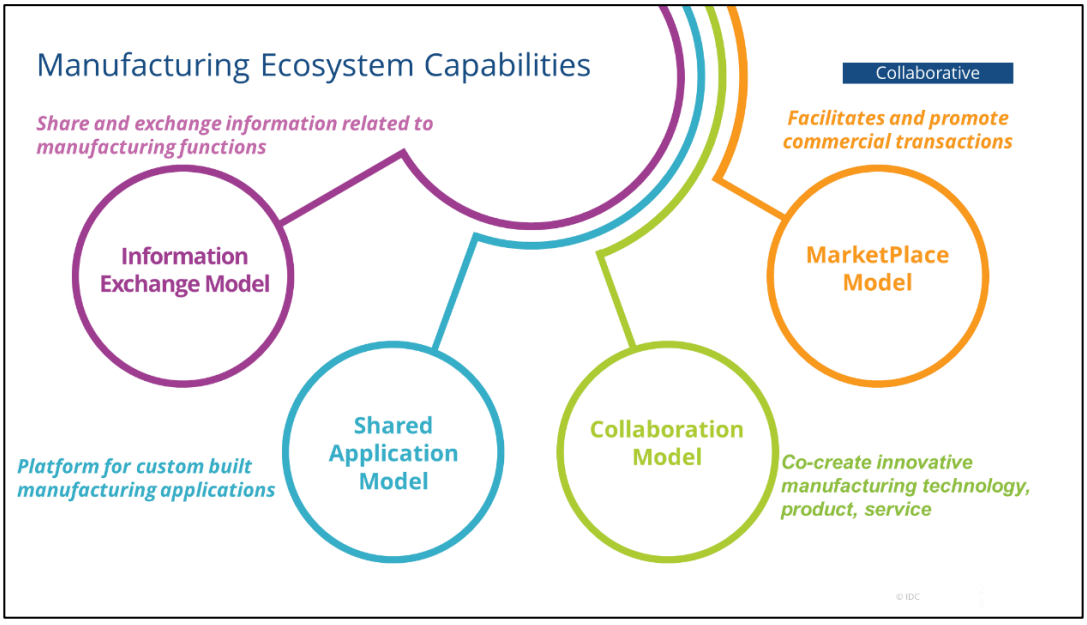
Source 1: IDC EMEA, COVID-19 Impact Survey Europe, Internal, Wave 3: 20-27 April 2020. Manufacturing answers, N=111

Source 2: IDC Supply Chain Survey, April 2020 - European manufacturing N = 256

When looking at the landscape of the existing manufacturing business ecosystems, their function and use-cases, the following categories can be identified. These categories are a valuable asset for decision-makers and policy-makers in classifying and mapping industry transformation paths so to support companies and organisations (especially SMEs) to enter and thrive in the ecosystem business.

1. Information Exchange Model
2. Shared Application Model
3. Collaboration Model
4. MarketPlace Model

Figure 9: Manufacturing ecosystem capabilities



Source: IDC, 2020

Figure 9 illustrates the key characteristics of different manufacturing ecosystems. It is worth looking into the definition and detail description for each ecosystem type.

3.2.1 Information exchange ecosystem model

The Information Exchange Model is as an ecosystem whose main purpose revolves around **data and information sharing**.

Goal

The goal is to enable participants in such an ecosystem to turn data from other participants in that ecosystem into information that enables them to generate some value.

Key Characteristics

The key characteristics of the Information Exchange Model:

- Participants in such ecosystems can be any entity that can generate value from data which is not their own. Typically, these are companies from adjacent or related industry sectors.
- Participants in information exchange ecosystems need to be properly registered. There are access and coordination mechanisms in place.
- Data is only shared between agreed parties. This is important, because all participants need to agree to mutual data sharing agreements and need to comply with GDPR.
- The participation in such information exchange models can be free of charge or subject to a fee:
    - Free of charge models do not pay money to providers of data and do not charge consumers of this data. Those type of free of charge models are often called 'open data initiatives'.
    - Information exchange models can also be based on commercial interest, where providers of data typically get money and consumers typically pay money for data consumption.
- Typically, only data is shared. There is no or only minimal additional services offered.

Technology Role

Technology in this ecosystem plays an important role, mainly:

- There needs to be a data repository which enables to store and manage data, typically this is a scalable cloud-based data platform.
- Data exchange requires that there is a common pre-agreed format (incl. semantics) for data exchange.
- There have to be a defined interface for data provisioning, upload and consumption. Data platforms typically provide APIs to inject data into applications for specific purposes (see examples below).
- In cases where there are no third party platforms involved for data collection and data consumption, blockchain technology can be used to verify and validate data transactions.

A non-exhaustive list of Information Exchange Ecosystems that are active in Europe and elsewhere is offered in the table below.

Table 1: List of Information Exchange Ecosystems

Information Exchange Ecosystems Examples	Country	Description
Caruso	Germany	Provides third parties (e.g. workshops, insurance companies) access to data from major automotive vehicle manufacturers in Europe. Harmonised multi-brand in-vehicle data of different vehicle manufacturers in one location.
SAP Asset Intelligence Network	Germany	The application is designed to optimise asset performance by collecting and tracking equipment usage information in a central repository.
Tracelink platform	USA	Provides information coordination and access through a network of operators in the pharma industry (pharma companies, distributors, packagers, Third Party Logistics (3PL), governments, etc.)
Know4Car	Germany	Internet-based collaborative platform for managing Manufacturing Knowledge. The Know4Car project attempts to make collaboration and knowledge management more effective throughout the product lifecycle
SAP Ariba	Germany	Integrates organisational buying process by connecting to millions of suppliers across direct and indirect expense categories
Voith's Supplier's Ecosystem	Germany	Voith's extranet as a central entry point for external, registered suppliers. The aim is to improve competitiveness of Voith and their parts suppliers and logistics partners through efficient exchange of data
Maglis BASF	Germany	Helps farmers manage fields and supports them in making better decisions in collaboration of farm equipment manufacturers, weather data, etc.
Monsanto's Climate Corporation	USA	Industry-wide digital agri technology development. Cloud platform aggregates in-field sensor data, equipment, field management practices
Trumpf's AXOOM	Germany	Axoom’s open platform brings suppliers and users together and makes them partners
MONET - Technologies Corporation	Japan	Toyota & Softbank owned MONET's goal is to roll out Autono-MaaS (autonomous mobility as a service) businesses using Toyota's e-Palette electric vehicle
John Deere - agriculture management solutions	USA	Digital ecosystem that integrates software, connectivity and sensors into tractors to collect, transmit and analyse data on behalf of farmers.
TradeLens- IBM Mersk logistics ecosystem	Denmark	Share real-time, end-to-end supply chain information among cargo owners, transportation providers, 3PLs and beyond
Fictiv	USA	Providing a platform both to design components and help get them produced by linking together makers and machines with companies needing rapid execution

Source: IDC research, 2020

3.2.2 Shared application ecosystem model

The Shared Application Model is an ecosystem whose main function is about sharing custom-built applications for specific purposes.

Goal

The main goal of the model is to enable participants in such an ecosystem to make use of custom-built applications that have already been developed for specific purposes by other stakeholders, often IT companies, and that can enable participant with similar needs to benefit from existing application without the need to re-invent an ad hoc solution. Typically, applications shared in such ecosystems help to address common challenges within an industry or domain.

Key Characteristics

These are the main Shared Application Ecosystem Model's features:

- Participants in shared application ecosystems need to be registered in such, or even be part of a specific alliance or working group.
- Participants in such ecosystems typically are companies from adjacent or related industry sectors that have similar needs or challenges to address.
- Common challenges can relate to gaining insights from own data. Shared applications could be heavily analytics-driven, where data dashboards allow other users of this application to better utilise the data in order to optimise the efficiency of owned operations, for example.
- Typically, the usage of such shared applications is subject to license fees for accessing the platform or for benefitting from the applications and data models created by other participants.

Role of Technology

Technology is essential in this use case:

- Typically, such shared application ecosystems are cloud-based IoT platforms that also provide developer tools that help to develop new applications to be shared with the ecosystem members.
- Applications are pre-validated by the application provider and are available for download from so-called app marketplaces.
- Those platforms can be hosted by industry players themselves (e.g. manufacturing companies) or by third party non-manufacturing companies (e.g. software, hardware or automation providers)
- Platforms typically provide APIs to inject data into applications for specific purposes (see examples below).

Concrete examples of Shared Application Ecosystems are included in the table below.

Table 2 : Examples of Shared Application Ecosystems

Shared Application Ecosystems Examples	Country	Illustrative Use Cases
MindSphere World	Germany	MindSphere World offers a forum participant wishing to MindSphere's cloud-based IoT operating system
GE - Predix	USA	Platform for the collection and analysis of data from industrial machines – supports IIOT, cloud servers, app store
RIO – MAN Logistics Cloud	Germany	Open, cloud-based platform, for global supply chain – from the consigner via the forwarding agent and transport, shipper, dispatcher and driver to the recipient. RIO bundles digital solutions with complete transport and logistic ecosystems

Shared Ecosystems Application Examples	Country	Illustrative Use Cases
Evrythng.com	UK	IoT platform for consumer product brands. The EVRYTHNG Platform Operates the Knowledge Network Driven by CPG (consumer packaged goods)
Skywise	France/ Germany	Skywise will provide all users with one single access point to their enriched data by bringing together aviation data from multiple sources across the industry into one secure cloud-based platform
Philips Healthsuite digital platform	Netherlands	An open, cloud-based platform that collects, compiles and analyses clinical and other data from a wide range of devices and sources. Applications can be built for health systems, care providers and individuals to access data on personal health, specific patient conditions and entire populations
HOMAG Tapio	Germany	An open system, which means that tapio's business partners – manufacturers of machinery, tools and materials – are able to use the tapio technology platform to offer their services and digital solutions to anyone operating in the woodworking industry.
VW Automotive Cloud	Germany	The Groups' technology backbone upon which the company runs most of their digital ecosystem services.
Continental Remote Vehicle Data (RVD)	Germany	Enables the ecosystem of providers of connected car services, by offering a consistent access to vehicle data unified across models. Continental announced a partnership with HPE to enable Blockchain-powered data monetisation

Source: IDC research, 2020

3.2.3 Collaboration ecosystem model

The Collaboration Ecosystem Model as an ecosystem whose main purpose is to foster joint initiatives driving product and service innovations in the industry.

Goal

The main goal is to enable participants in such an ecosystem to speed up the development of new, innovative industrial solutions and gaining rapid scale by enabling knowledge exchange and the utilisation of a joint pool of talents.

Key characteristics

These are the key characteristics of Collaboration Ecosystems:

- The ecosystem involves personal interaction between member companies to align interests, goals, measures and working groups to enable of coordination among the community members.
- Collaboration can take place throughout the entire spectrum of business processes. For example, in manufacturing, product design, development, production and after-sales.
- Initiatives can focus on the development of certain technologies or on industry-specific solutions. (See examples). Jointly developed solutions will be shared in the ecosystem.
- Participants in such ecosystems typically are companies from adjacent or related industry sectors that have similar needs or challenges to address.
- Usually, the participation in such ecosystem require some membership fees.

Role of Technology

Technology is important to enable these ecosystems although it does not play a central role:

- Typically, infrastructure is provided and organised by the community in order to be able to develop and test joint solutions, which will then be applied in own technology infrastructure environments.
- Such infrastructure includes for example cloud-based industrial IoT platforms

A few real-life examples of Collaboration Ecosystems are displayed in the table below.

Table 3: Examples of Collaboration Ecosystems

Collaboration Ecosystems Examples	Country	Use Cases
International Data Space (IDS)	Germany	Aims at defining data standards and data governance frameworks to be used in collaborative data sharing environments.
Industrial Internet Consortium	USA	Brings together organisations and technologies necessary to accelerate the growth of the industrial internet by identifying, assembling, testing and promoting best practices. Members work collaboratively to speed the commercial use of advanced technologies.
Combient AB	Sweden	Involves a select group of global enterprises in a variety of industries in the Nordics. Founded in January 2015, Combient today is the leading cross industry collaboration network in the Nordics.
Platform Industry 4.0	Germany	It was already launched back in 2013 and where companies, trade unions, associations, science and politics have joined forces to promote the digital transformation of manufacturing in Germany. As of May 2020, this initiative has over 350 stakeholders engaged from over 150 organisations.
Open Industry 4.0 Alliance	Germany	It has the goal to accelerate the development of industry 4.0 solutions by supporting common standards.
OPC-Foundation	USA	It was founded to develop and maintain the interoperability standard for the secure and reliable exchange of data between industrial automation devices from multiple vendors. OPC stands for Open Platform Communications and the so called OPC Unified Architecture (UA), which was released in 2008, is a platform independent service-oriented architecture that integrates all the functionality of the individual OPC Classic specifications into one extensible framework.
SmartFactoryKL	Germany	It is about jointly implementing Industry 4.0 projects regarding the factory of the future and with members such as Festo, Harting, Pilz, ProAlpha and IBM
BMW Open Manufacturing Platform	Germany	An open industrial IoT platform to accelerate production and logistics optimisation efforts. It allows industrial manufacturers to work together to break down data silos and overcome the challenges of complex, propriety systems that slow down production optimisation.

Source: IDC research, 2020

3.2.4 MarketPlace ecosystem model

The MarketPlace Ecosystem Model as an ecosystem which brings together demand- and supply-side players to discover, promote, purchase and partner for specific manufacturing products or related services.

Goal

The main goal and purpose of B2B marketplaces is to enable and optimise commercial transactions between corporate buyers and sellers thereby increasing efficiency of B2B procurement or sales operations.

Key Characteristics

The key characteristics of this ecosystem model are as follows:

- B2B marketplace providers can either be driven by IT vendors or by manufacturing companies themselves.
- Industrial B2B marketplaces can either serve generic needs of the manufacturing industry or serve specific needs of very specialised manufacturing sub-sectors such as steel, recovered paper or timber (see examples)
- Platform participants enjoy the main benefits and challenges of the 'network effect' through referral, rating and also potentially being banned from accessing the ecosystem.
- There are various pricing models to use these B2B marketplaces: it can range from free to time-based subscriptions, and even include commercial models based on percentage or commission for awarded jobs, orders or sales.

Role of Technology

In this ecosystem, the importance and role of technology is high:

- B2B marketplaces are cloud-based and (or) mobile-enabled platform that can be accessed in a very simple way.
- In order to differentiate from other similar propositions, B2B marketplaces offer additional capabilities such as data analytics, to enable their customers to make better data-driven decisions.

A non-exhaustive list of MarketPlace ecosystems is summarised in the table below.

Table 4: List of MarketPlace ecosystems

MarketPlace Ecosystems Examples	Country	Use Cases
MerQbiz - by Voith	Germany	An online marketplace designed to improve the way buyers and sellers of recovered paper do business
MFG.com	USA	Contract manufacturing marketplace to source manufacturing processes (CNC Machining Services) through an online platform.
247 Tailor Steel	Netherland	The company provides an Amazon-like platform for the steel trading, where upon upload of the 3-D model of parts or products customers receive within seconds a quote and estimated delivery time
Klöckner's XOM Materials	Germany	A cloud platform that connects operators, buyers and sellers in the steel industry. They expect that by 2022 50% of their revenue will come from the services offered in the platform
Forstify	Germany	A marketplace for the trading of raw wood, where traders, producers and providers of wood can contract and run business
SAP Hybris and Commerce Platform	Germany	Although not a proper marketplace, these solutions allow businesses to provide superior commerce experiences to customers across the globe and can act as marketplaces in certain implementations.

Source: IDC research, 2020

Section 4

4. Conclusion and overview of maturity levels

The path towards the actual deployment and success of one or more of the Ecosystem Models introduced in the previous paragraph is driven by a multitude of factors and, at the same time, can be hindered by several barriers. There are many reasons that can drive a company towards one of the Ecosystems models highlighted above:

- The need for stable, diversified revenue streams. Companies cannot rely only on revenues from the selling of their physical products anymore, thus they create new services and digitally enhanced products leveraging the power of a multi-partner ecosystem aimed directly at consumers.
- The need for leveraging insights from customer and operational data to identify efficiencies and new business opportunities.
- The need to react faster to customer needs and time-to-market reduction. Depending on the type of industry and product, the go-to-market of a new product or service can take one to three years, as market needs are changing more rapidly.
- The inability to cover niche areas. Especially in the manufacturing environment, there are different types of production, number of machine and production line brands, complex supply chains and a wide range of different stakeholders, thus the development of in-house, state-of-the-art solutions covering all customer needs do not deliver business potential. On the other hand, the ecosystem is an enabler for providing a service for very niche customer needs as some participants or service providers can use their scale and offer a service or solution addressing a specific area.
- The lack of suitable infrastructure and little experience. For many companies, digitalising their businesses could be a very long journey as they lack the right IT and logistics infrastructure, experienced workforce and digital and business skills.

However, regardless of the reasons, many companies still face significant barriers to the investment, for example, technology challenges and lack of technical knowledge; data monetisation challenges; innovation aversion; lack of a level-playing field for data.

It is worth noting that the nature of ecosystem interaction – and the consequent barriers to its adoption when present - are heavily dependent on the maturity of a company on this matter. The following analysis[21] about maturity level could be of use for policymakers when considering measures of support to the European industry across sectors.

4.1 Low maturity

There is no collaborative business culture or mindset, and no responsibility or organisational structure for ecosystem management. Collaboration with suppliers and trading partners and connections between customers and channel partners are on a one-off basis, and B2B processes are often handled manually and are not structured. Only simple spreadsheets are used to create supplier reports, channel sales performance, customer reports, and so forth. Products and services are sold individually, not as part of a joint solution.

There are inefficient, highly manual B2B processes that result in steep administrative costs and time delays that impact customer experience. There are missed business opportunities and undiscovered risks arising in the ecosystem (for example, from the supplier side, competitors or channels). There is a lack of understanding of customer and market needs, innovation is not responsive to ecosystem changes, and there is no intention to engage in any ecosystem or create new ones. Not being open to collaboration might lead to potential partners approaching other manufacturers that are more open to collaboration, leading to missed opportunities.

4.2 Medium maturity

A dedicated, formal 'special project' team drives efforts to engage in ecosystems or to leverage ecosystem pulses for innovation. In some instances, a dedicated, formal office exists that is responsible for establishing governance and priorities for ecosystem collaboration. Leadership understands

[21] This analysis is drawn from recent IDC report MaturityScape: Manufacturing Business Ecosystem Strategies 2.0 (February 2020).

synergies among all players in the ecosystem and is enabled to identify both risks and business opportunities. Ecosystem pulses are captured and engagement in ecosystems drives consistent innovation ideation and execution. The integration of all ecosystem stakeholders is via cloud-based platforms and can be done easily for all relevant B2B processes.

Dedicated leadership for ecosystem strategies increases business opportunities from the ecosystem, but there is a limited capacity to understand synergies among players in the ecosystem to react to changing market needs quickly and to expand business accordingly. Well-structured commercial B2B processes provide a good foundation to scale B2B processes to a broader ecosystem including B2B platforms and marketplaces.

4.3 High maturity

The ecosystem strategy is a top priority at the corporate level. Corporate and business metrics motivate leadership to continuously identify risks and new opportunities within their existing ecosystems as well as from outside their existing ecosystems.

Cloud platforms enable easy integration of all stakeholders for all relevant B2B processes, and a large share of automated B2B processes helps to create efficient ecosystem processes. Organisations automatically adapt to changing ecosystem needs and opportunities in real time and have ecosystem strategies in place that enable continuous business model innovation and world-class customer experience through flexible, scalable, automated, smart and fully integrated B2B and B2B2C processes to maintain a long-term competitive advantage. The ecosystem generates sustainable and significant revenue to the founding organisation and ecosystem participants.

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About the 'Advanced Technologies for Industry' project

The EU's industrial policy strategy promotes the creation of a competitive European industry. In order to properly support the implementation of policies and initiatives, a systematic monitoring of technological trends and reliable, up-to-date data on advanced technologies is needed. To this end, the Advanced Technologies for Industry (ATI) project has been set up. The project provides policymakers, industry representatives and academia with:

- Statistical data on the production and use of advanced technologies including enabling conditions such as skills, investment or entrepreneurship;
- Analytical reports such as on technological trends, sectoral insights and products;
- Analyses of policy measures and policy tools related to the uptake of advanced technologies;
- Analysis of technological trends in competing economies such as in the US, China or Japan;
- Access to technology centres and innovation hubs across EU countries.

You may find more information about the 16 technologies here: https://ati.ec.europa.eu.

The project is undertaken on behalf of the European Commission, Directorate General for Internal Market, Industry, Entrepreneurship and SMEs and the European Innovation Council and Small and Medium-sized Enterprises Executive Agency (EISMEA) by IDC, Technopolis Group, Capgemini, Fraunhofer, IDEA Consult and NESTA.

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