Digital Transformation in Manufacturing:

Creating an intelligent, connected and secure information advantage

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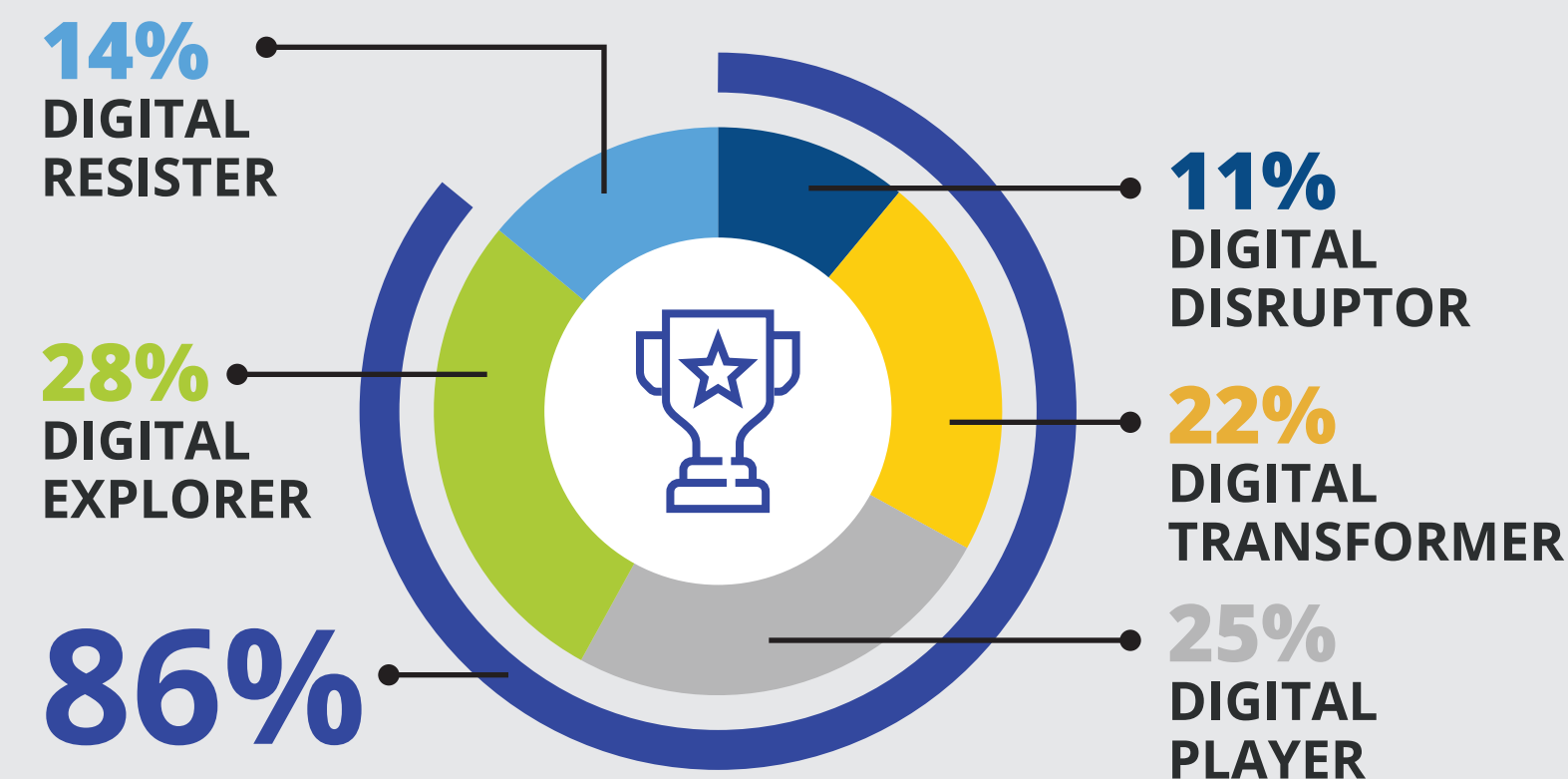An IDC InfoBrief, Sponsored by

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Manufacturing at the Heart of Digital Transformation's Perfect Storm

IDC research shows that manufacturers worldwide are rapidly embracing new technologies to transform their business models and operations to improve agility, customer engagement, profit and sustainable competitive advantage.

They are at the heart of the perfect storm, both living with and seeking to exploit, disruptive information technologies such as cloud, big data, AI-assisted analytics and the Internet of Things (IoT), while facing increasing IT security challenges, regulatory pressures and a changing workforce. In the face of new and disruptive competitors, they are changing their businesses radically to offer value-added services and leverage tightly linked ecosystems.

It should be no surprise then that a clear majority of manufacturers are actively planning bold transformation of information architecture, operating models and more. In fact, 86% of European manufacturers have already begun their digital journey. Improving customer satisfaction and achieving higher operational performance are seen to be the key goals.

Q. Which of the following 5 stages of digital transformation maturity best describe your organization?

- **14%** DIGITAL RESISTER
- **11%** DIGITAL DISRUPTOR
- **28%** DIGITAL EXPLORER
- **22%** DIGITAL TRANSFORMER
- **86%**
- **25%** DIGITAL PLAYER

- Enterprise is aggressively disruptive in the use of new digital technologies and business models to affect markets.
- Integrated, synergistic business – IT management disciplines deliver digitally enabled product/service experiences
- Business-IT goals are aligned at enterprise level around the creation of digital products and experiences
- Business has identified a need to develop a digitally enhanced, word execution is on ad-hoc basis
- Business and IT digital initiatives are disconnected and poorly aligned with enterprise strategy

Q. Where do you expect digital transformation having the biggest impact on your business?

- Improving customer satisfaction
- More efficient operations/Cost optimization
- Improving workforce satisfaction
- Faster IT innovation rates
- Expanded market share/Greater customer (patients/students) base
- Increasing revenues/margins from core businesses
- Reducing time to market
- Fostering new business models
- Faster business innovation rate
- Brand uplift
- Increasing revenues/margins from new digital businesses
- Being celebrated in media and by peers
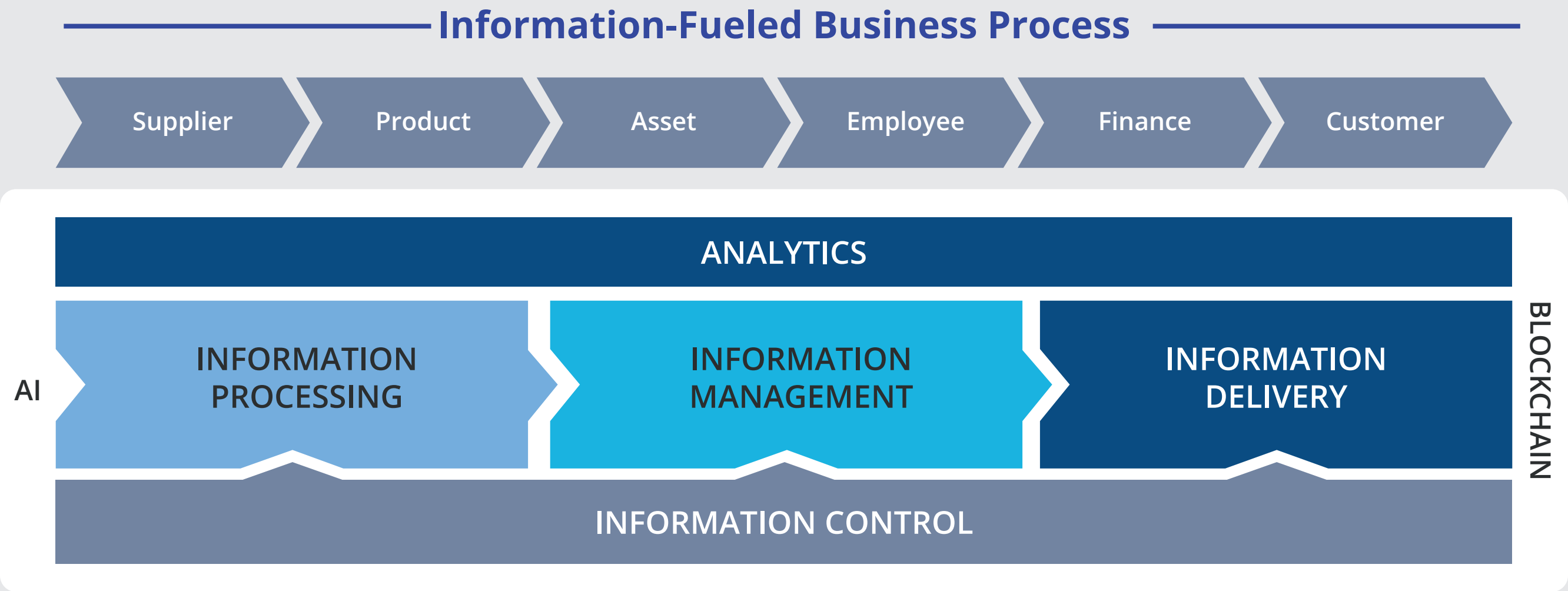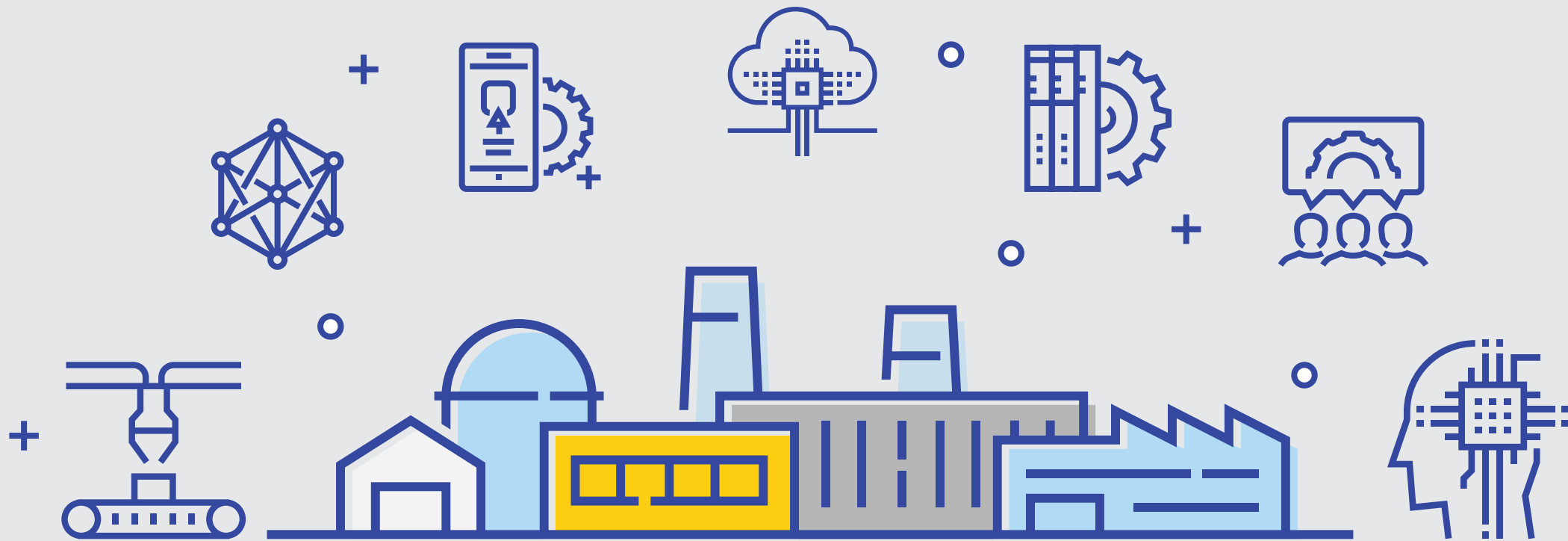- No expected impact

Source: IDC European Tech and Industry Pulse Survey 2019-2020 – Manufacturing N = 290

The Information Advantage: Information is at the Center of Business Processes – and the Key to Process Improvement

Technologies including cloud, mobile, big data and AI, as well as blockchain architectures, enable new services and models such as intelligent predictive maintenance and as-a-service, outcome-based business models. In this digital economy, information and analytics are fueling every business process. With this in mind, manufacturers are realizing the importance of employing advanced enterprise information management (IM)[1].

Information is delivered across business processes, from supplier engagement, manufacturing, logistics and asset management to HR, finance and sales and marketing, always as a part of a larger system of ecosystem applications.

[1] Information Management (IM) allows organizations to capture, govern, exchange and enhance information while keeping it secure. IM brings together key technologies to enrich information and processes from end-to-end. Both unstructured and structured information flow across the extended enterprise. Through IM, businesses can consolidate and integrate information so it can be managed transparently throughout the entire information lifecycle.

Information-Fueled Business Process

| Supplier | Product | Asset | Employee | Finance | Customer |

AI

ANALYTICS

| INFORMATION PROCESSING | INFORMATION MANAGEMENT | INFORMATION DELIVERY |

INFORMATION CONTROL

BLOCKCHAIN

Source: © Open Text 2020

Companies Need to Pursue an Integrated Information Management Approach

To be effective, information has to flow in many directions: top-down, bottom-up, from inside out and outside in, between employees, business departments and across the business network. Companies must integrate data analytics, transactional content and content-related services, and provide strong reporting on activities such as content created and received via easily-accessible dashboards.
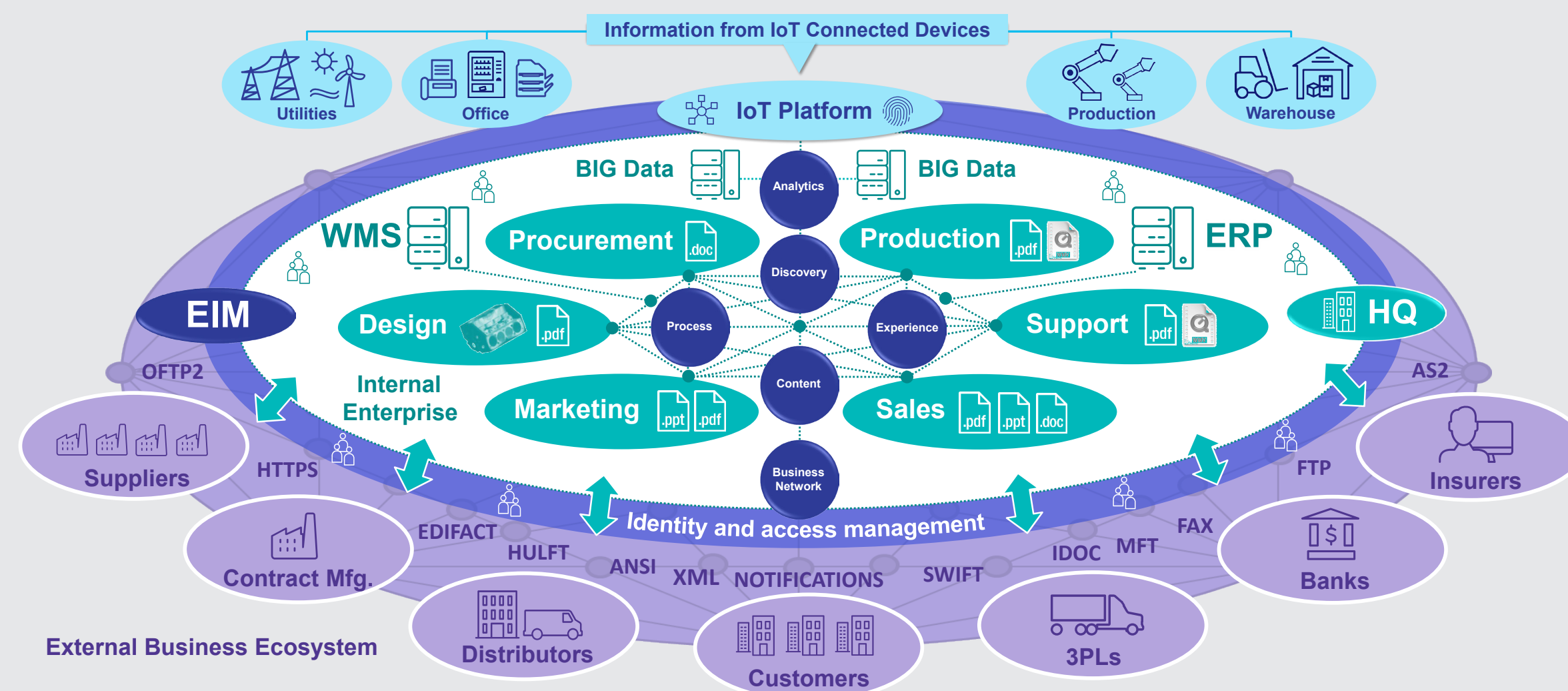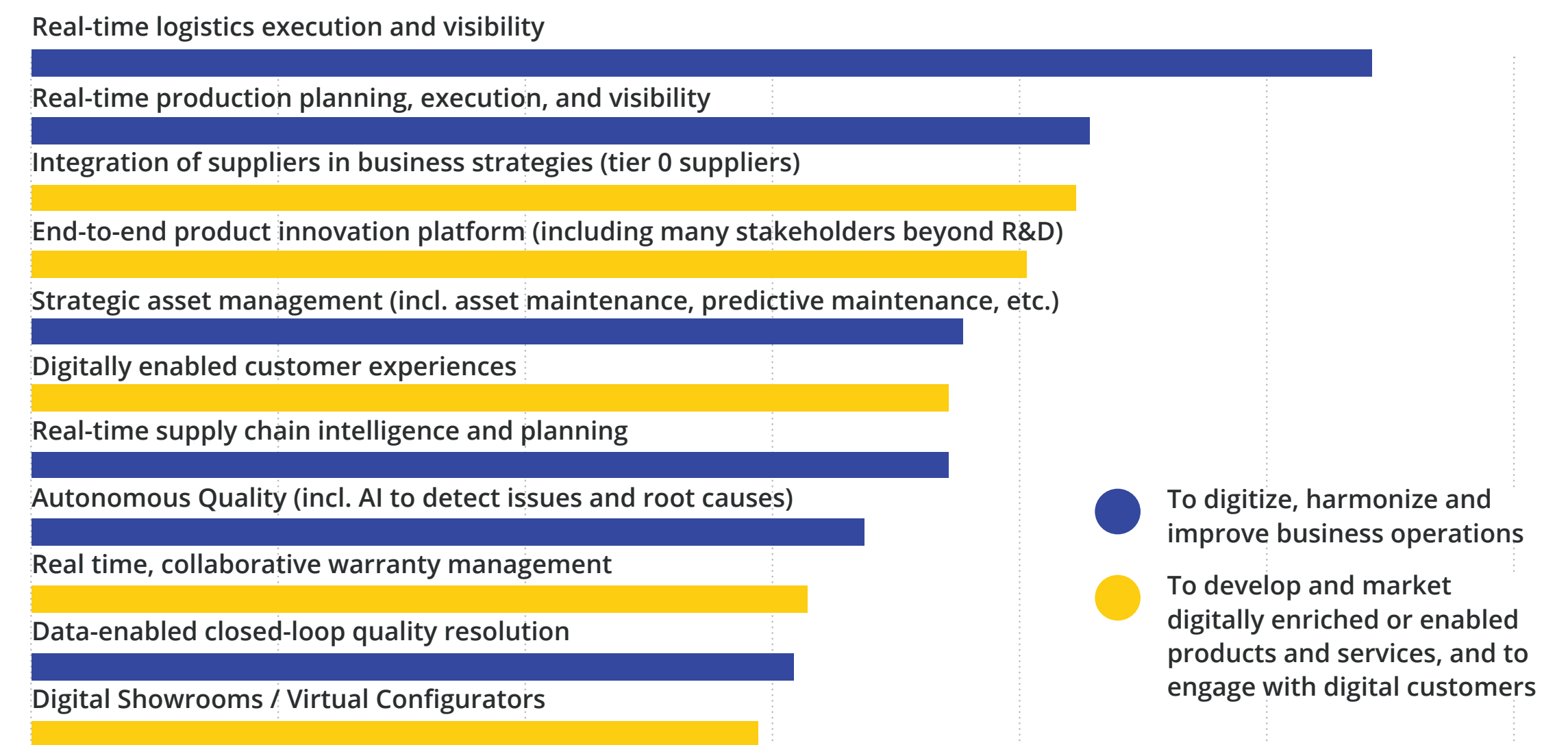
However, most business applications — as originally conceived — excel at managing silos of information, but lack the capability to seamlessly hand data and information to other business processes and applications. In order to effectively cover intra-enterprise processes, companies often need to rely on expensive and cumbersome custom applications or on error-prone manual processes.

Enabling a unified data platform is central to empowering business to work smarter with information to improve productivity, completeness and customer experience, driven by better business insight.

- To digitize, harmonize and improve business operations
- To develop and market digitally enriched or enabled products and to engage with digital customers

Q. In which of the following digital initiatives are you investing or planning to invest in the next 12 months?

- Real-time logistics execution and visibility
- Real-time production planning, execution, and visibility
- Integration of suppliers in business strategies (tier 0 suppliers)
- End-to-end product innovation platform (including many stakeholders beyond R&D)
- Strategic asset management (incl. asset maintenance, predictive maintenance, etc.)
- Digitally enabled customer experiences
- Real-time supply chain intelligence and planning
- Autonomous Quality (incl. AI to detect issues and root causes)
- Real time, collaborative warranty management
- Data-enabled closed-loop quality resolution
- Digital Showrooms / Virtual Configurators

● To digitize, harmonize and improve business operations

● To develop and market digitally enriched or enabled products and services, and to engage with digital customers

Source: IDC European Tech and Industry Pulse Survey 2019-2020 – Manufacturing N = 290

Diagram labels:

Information from IoT Connected Devices

Utilities · Office · IoT Platform · Production · Warehouse

BIG Data · BIG Data

WMS · Procurement · Analytics · Production · ERP

EIM · Design · Discovery · Process · Experience · Support · HQ

Marketing · Content · Sales

Business Network

Internal Enterprise

Identity and access management

OFTP2 · HTTPS · EDIFACT · HULFT · ANSI · XML · NOTIFICATIONS · SWIFT · IDOC · MFT · FAX · FTP · AS2

Suppliers · Contract Mfg. · Distributors · Customers · 3PLs · Banks · Insurers
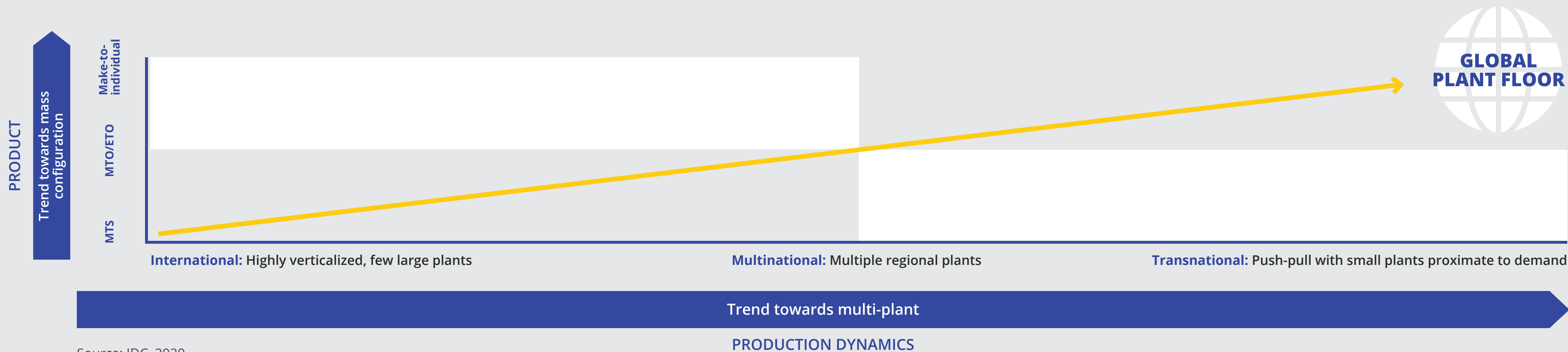
External Business Ecosystem

An Example of Enterprise Information Management: The Shop Floor

To ride the digital transformation wave, with its emphasis on innovation at scale and building new relationships within their ecosystems, companies must transform their manufacturing processes.

Indeed, they must set up a network of factories and manage them as a single, virtual factory that consolidates the number of different manufacturing plants in terms of resources, processes and products. They need the ability to harmonize, supervise and coordinate execution activities across the company's and suppliers' manufacturing operations with a greater level of real-time visibility.

In this context, business leaders must seek to couple digital technologies with organizational, operational and business model innovation to create new ways of operating, communicating and growing businesses.

Centers of Operational Excellence (COE) and shop-floor IT are essential to this transformation, and information integration is the key business enabler for creating a platform that helps businesses better share information and manage the bigger picture. The information itself — not the business applications such as ERP/PLM/MES — moves to center stage.

PRODUCT — Trend towards mass configuration

Make-to-individual / MTO/ETO / MTS

GLOBAL PLANT FLOOR

International: Highly verticalized, few large plants
Multinational: Multiple regional plants
Transnational: Push-pull with small plants proximate to demand

Trend towards multi-plant

PRODUCTION DYNAMICS

Source: IDC, 2020

IDC ANALYZE THE FUTURE

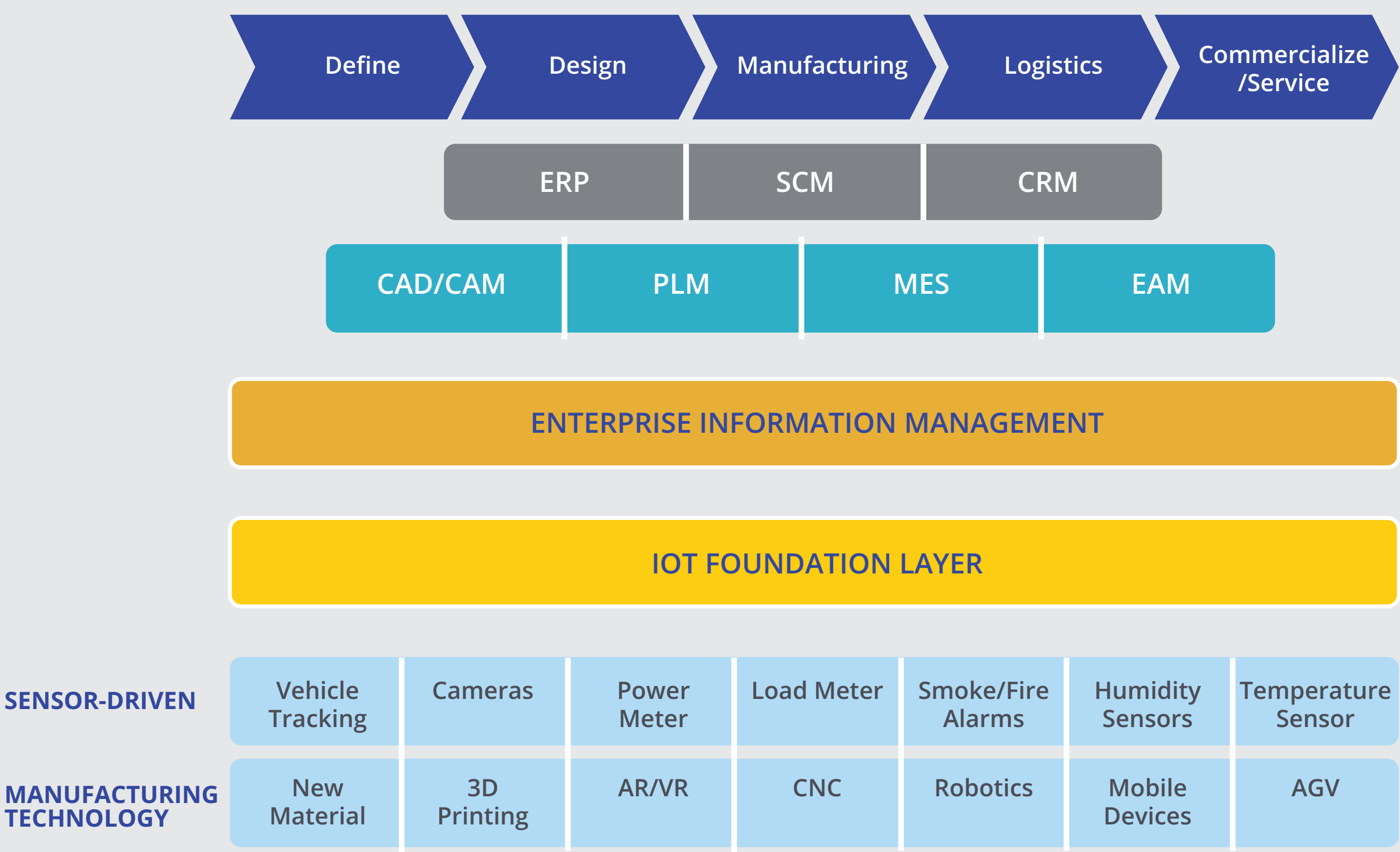# The Factory of the Future Has a Layered Approach to Information

In the Factory of the Future, the foundation layer will be automation intensive: all production processes will be highly or completely automated with few or no people involved in production operations. Digital technologies will make continuous improvement a transactional exercise, allowing people to focus on business reinvention.

This transformation will provide a further growth opportunity for companies deploying advanced automation that will cover all the processes where humans cannot bring any added value.

An IT intensive operational layer will create real-time decision-making environments. The connection between factory technology and enterprise systems is based around an IoT layer supporting the seamless transition from operation technology (OT) to IT systems. This entails dismantling the traditional organizational boundaries that have OT and IT as separated domains.

Above all it will be information-intensive to support people's decision making. People will be at the center of the Factory of the Future as they provide the degree of flexibility and decision-making capabilities that are required to deal with increasing complexity.

EIM will be the facilitator that eases the exchange of information transparently across organizational boundaries. EIM acts as the information highway assisting the transmission of data between OT and IT for better business outcomes.
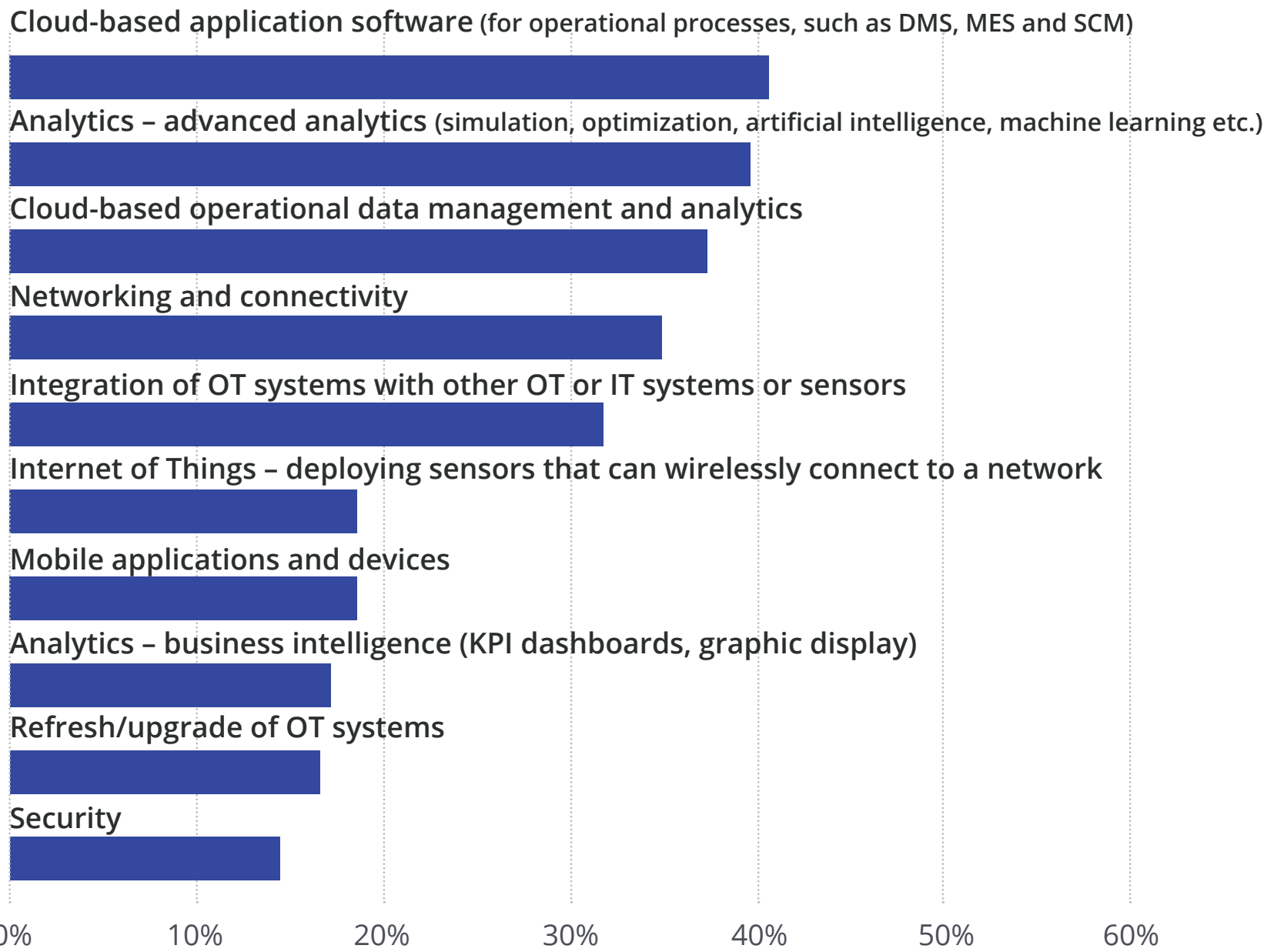
Define	Design	Manufacturing	Logistics	Commercialize/Service

ERP	SCM	CRM

CAD/CAM	PLM	MES	EAM

ENTERPRISE INFORMATION MANAGEMENT

IOT FOUNDATION LAYER

SENSOR-DRIVEN	Vehicle Tracking	Cameras	Power Meter	Load Meter	Smoke/Fire Alarms	Humidity Sensors	Temperature Sensor
MANUFACTURING TECHNOLOGY	New Material	3D Printing	AR/VR	CNC	Robotics	Mobile Devices	AGV

Source: IDC 2020

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The Factory of the Future Ecosystem will Leverage Multiple Data Sources with AI-Assisted Analytics

Digital transformation of manufacturing means a highly interconnected supply chain and increased expectations around quality, logistics and security. Digital transformation requires not just integrated processes in a factory, but a tight coupling between suppliers, customers and the manufacturing organization to give greater closeness to the customers and better control over WIP and raw materials; however, the expectations will be towards greater flexibility and agility in the ecosystem.

This implies a unified information strategy across the organization and extending across the supply chain. Information sharing will be absolutely vital to support this. Manufacturers' top priorities for operational investments are around capturing and sharing the information their processes generate by leveraging cloud and analytics

**What are your top three priorities for investment within your operational technology IT related initiatives?**

Cloud-based application software (for operational processes, such as DMS, MES and SCM)

Analytics – advanced analytics (simulation, optimization, artificial intelligence, machine learning etc.)

Cloud-based operational data management and analytics

Networking and connectivity

Integration of OT systems with other OT or IT systems or sensors

Internet of Things – deploying sensors that can wirelessly connect to a network

Mobile applications and devices

Analytics – business intelligence (KPI dashboards, graphic display)

Refresh/upgrade of OT systems

Security

0% 10% 20% 30% 40% 50% 60%

Source: WW - IT and OT Convergence Survey 2018, Manufacturing, N= 326

OLD FACTORY
Closed Environment
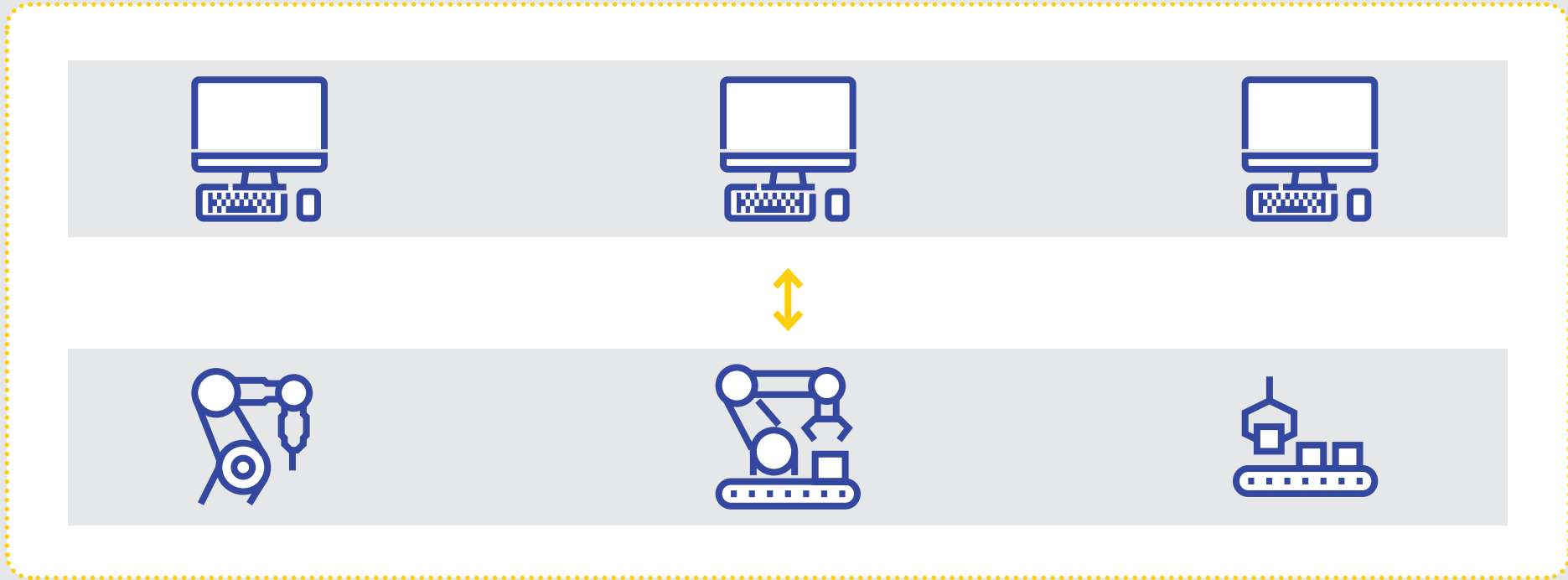
FACTORY OF THE FUTURE

Open Environment
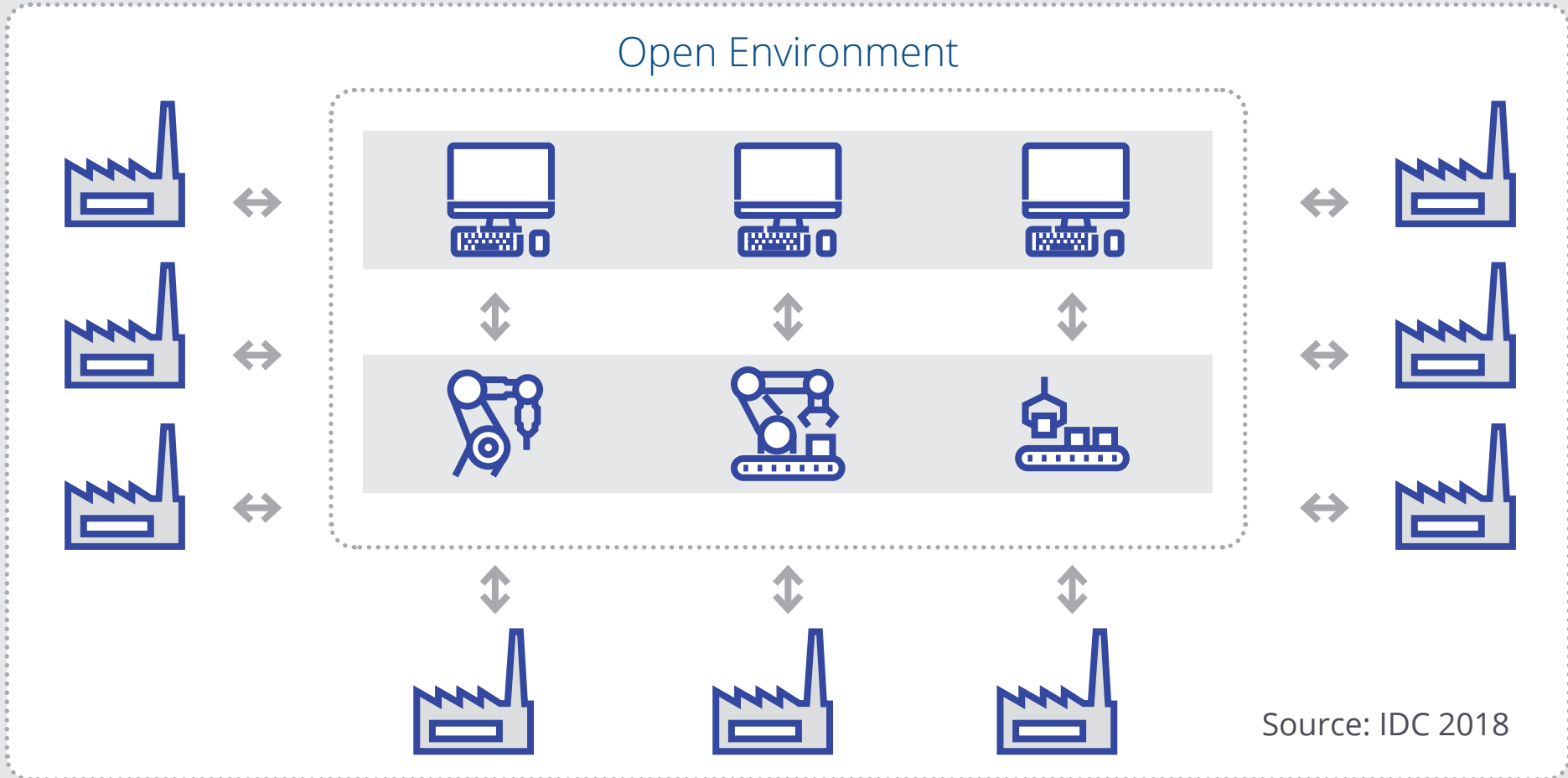
Source: IDC 2018

Once information is created, it can reach multiple audiences. Mixing advanced analytics of enterprise business data with operations technology data is central to delivering better, more powerful business applications.

Moving Information from Factories to the Supply Chain through Enterprise Information Management
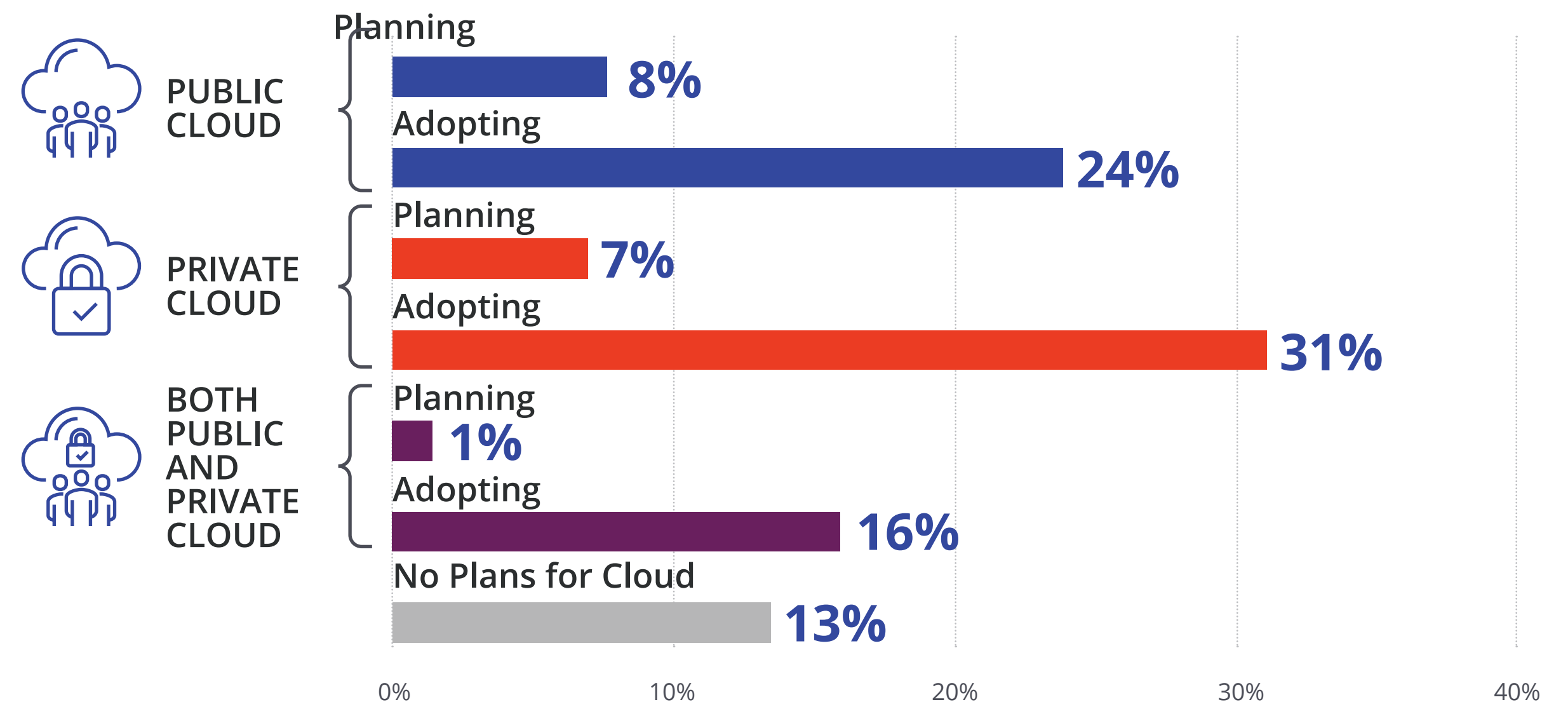
Smart manufacturing leverages innovative technologies and world-class concepts and solutions. EIM capabilities around content management, process management and transaction management, along with big data analytics, can deliver insightful productivity and governance benefits across the board.

Category	Use Case	EIM Enablemement
Connected assets/ smart manufacturing	Production optimization/ flexibility	Reading and archiving unstructured data (big data) and using analytics for better equipment managment including diagnostics, performance tuning and predictive maintenenace
Factory management	Energy management	Storing and analyzing information to support optimization initiatives and regulatory compliance
	Environment/security management	
Connected supply chain	Inventory management	Connecting shop floor to top floor: link with ERP and component/material sourcing
	Item traceability	Supporting traceability by enabling drill-down analysis on processes and B2B transactions
Connected products	Warranty service	Understanding the data journey across the life cycle assisting the customer experience. New revenue streams through value-added content in the form of information.

Cloud - No more a Taboo, but rather the Essential Underpinning for a Unified Information Management Strategy Across all Business Units

Unified information platforms across IT and OT and across industries will need to rely on hybrid approaches. While data storing will be managed on premise, there is certainly an opportunity to move APIs to a secure, cloud-based environment. Digital transformation is implicitly linked to changed relationships between manufacturers and their partners, suppliers, and customers. Cloud-based storage and processing is the natural consequence of this, while also giving agility, scalability and cost-effectiveness. Furthermore, the synergy between cloud and big data analytics, amplified by the widespread distribution of mobile tools, will prove to be key. Companies realize the short-term opportunity of using cloud to analyze information and create shop floor visibility across the organization.

Cloud Adoption and Investments

PUBLIC CLOUD
- Planning: 8%
- Adopting: 24%

PRIVATE CLOUD
- Planning: 7%
- Adopting: 31%

BOTH PUBLIC AND PRIVATE CLOUD
- Planning: 1%
- Adopting: 16%

No Plans for Cloud: 13%

0% 10% 20% 30% 40%

Source: IDC European Tech and Industry Pulse Survey 2019-2020 – Manufacturing N = 290

Artifical Intelligence is Going To Revolutionize The Way Information Is Analyzed

Manufacturers need to equip their workforce with technologies that create visibility, seamless data flow and offer real-time insights. AI and Machine Learning technologies play the role of the "brain" that are able to process in high volumes, variety and velocity the information, coming from the processes (and exponentially augmented by data produced by ubiquitous sensors).

To this end, companies should focus on acquiring a way to make sense of the corporate information by enabling the following three capabilities.

01
Decision Automation

○ **Conditional Decision Automation (Automating Decision-Making Process)** – This automation provides rapid identification and response for well-known and slow-to-change conditions across a variety of processes, including IoT and production health monitoring.

○ **Algorithmic Decision Automation (Creating Decision Support Tool)** – This automation provides the business benefit of rapidly predicting upcoming problems or immediate opportunities where conditions change continuously and data is highly variable, including IoT use cases, real-time promotions, quality controls, and inventory outage predictions.
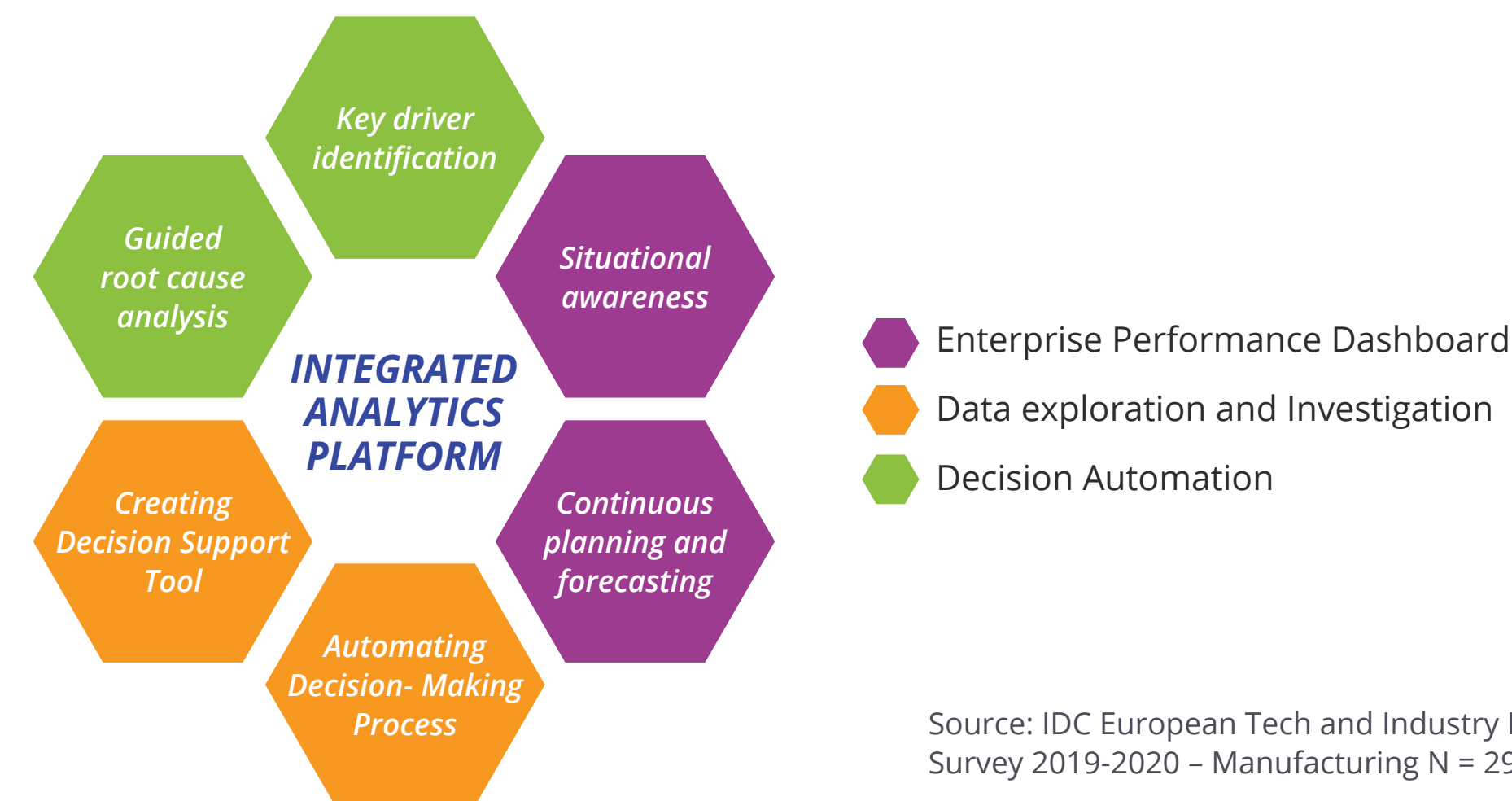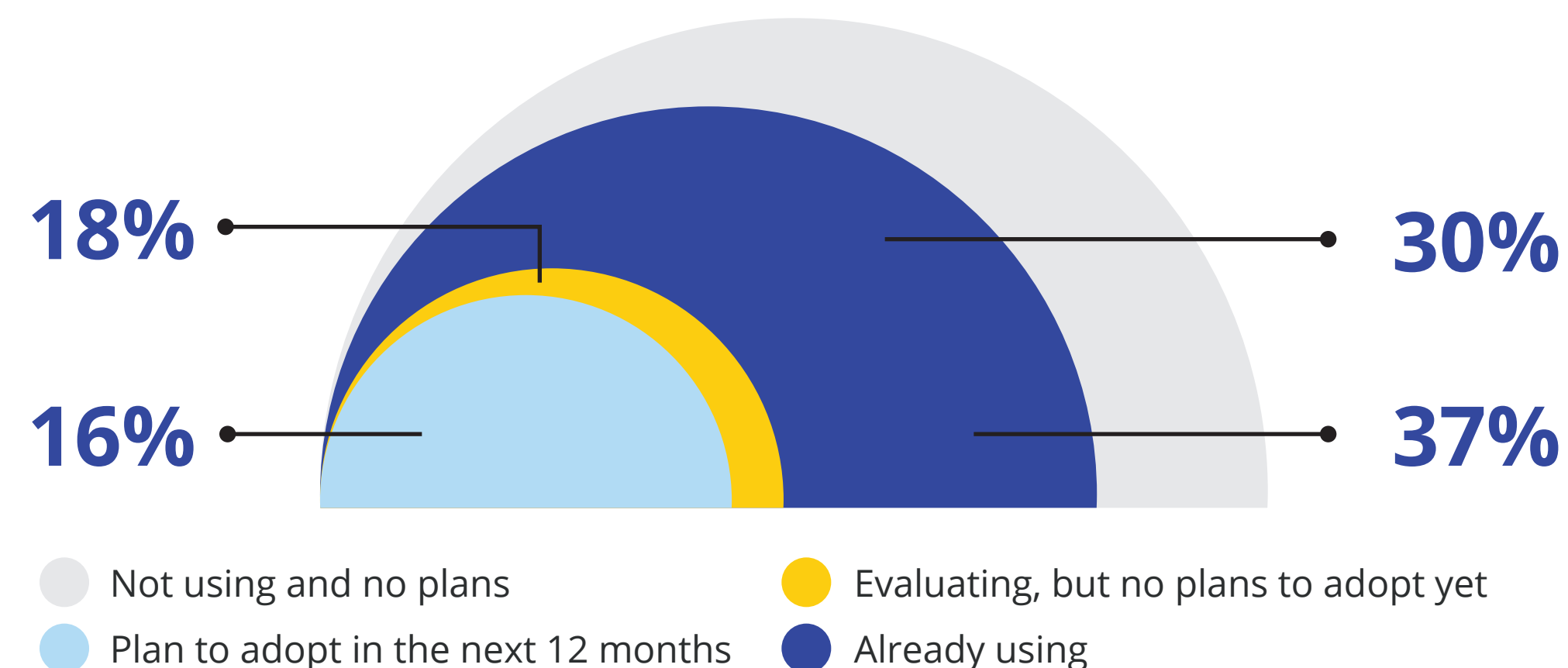
02
Enterprise Performance Dashboard

○ **Continuous planning and forecasting –** This is the ability of using the most recent available data across the organization for on-going forecasting process.

○ **Situational awareness** – It provides capabilities for instant access or notification of the current state of the enterprise based on real-time internal and external data contextualized by human expertise.

03
Data exploration and Investigation

○ **Key driver identification** – It provides decision support capabilities that not only identify what happened but also provide information on why it happened and what can be done about it.

○ **Guided root cause analysis** It provides decision support capabilities via automation to understand why something happened without requiring users to spend endless hours on manual data crunching activities.

Q. Does your organization already use or is it planning to adopt an Artificial Intelligence solution?
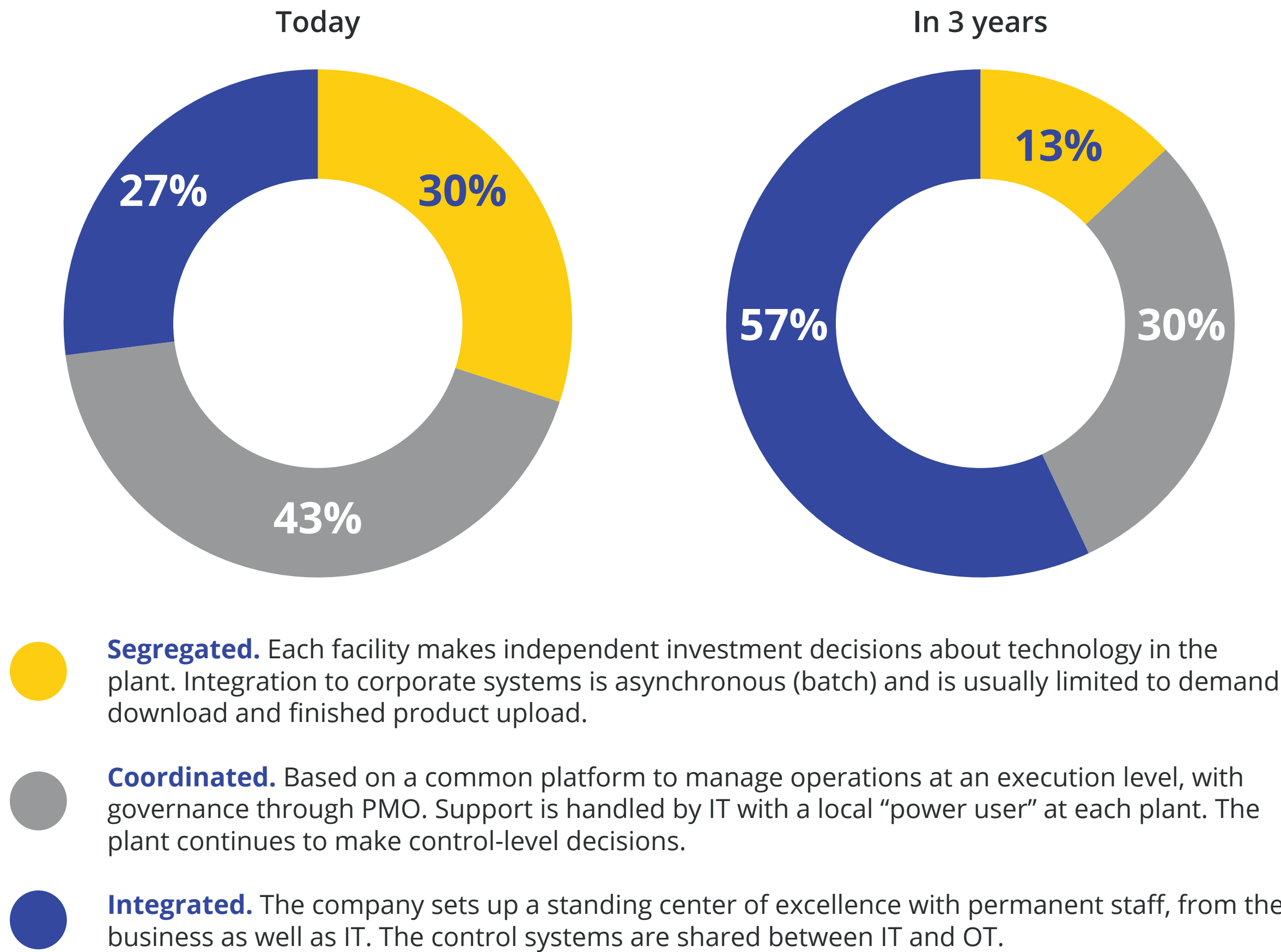
18%
16%
30%
37%

- Not using and no plans
- Evaluating, but no plans to adopt yet
- Plan to adopt in the next 12 months
- Already using

INTEGRATED ANALYTICS PLATFORM

Key driver identification

Guided root cause analysis

Situational awareness

Creating Decision Support Tool

Automating Decision- Making Process

Continuous planning and forecasting

- Enterprise Performance Dashboard
- Data exploration and Investigation
- Decision Automation

Source: IDC European Tech and Industry Pulse Survey 2019-2020 – Manufacturing N = 290

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A Drill-Down on IT/OT Integration

Too many companies have a segregated approach to IT/OT integration, where each plant makes independent investment decisions about technology in the plant through execution and plant scheduling. Integration with corporate systems is asynchronous (batch) and is usually limited to demand download and finished product upload. However, things are changing. We see more and more companies looking at coordinated integration models as they create a common platform to manage operations at an execution level. The trend will be for companies to achieve an integrated vision enabled by standing centers of operational excellence with permanent staff.

Status of OT/IT Integration

Today

- 30% (yellow)
- 43% (gray)
- 27% (blue)

In 3 years

- 13% (yellow)
- 30% (gray)
- 57% (blue)

- 🟡 **Segregated.** Each facility makes independent investment decisions about technology in the plant. Integration to corporate systems is asynchronous (batch) and is usually limited to demand download and finished product upload.

- ⚪ **Coordinated.** Based on a common platform to manage operations at an execution level, with governance through PMO. Support is handled by IT with a local "power user" at each plant. The plant continues to make control-level decisions.

- 🔵 **Integrated.** The company sets up a standing center of excellence with permanent staff, from the business as well as IT. The control systems are shared between IT and OT.

Source: IDC Research 2020

Intelligent and Connected Manufacturing Directions Enable Smart Manufacturing

Ultimately, the move to smart manufacturing requires movement along multiple dimensions and enterprise information management is tracking these to become a modern state-of-the-art digital backbone for the smart manufacturer.

Investments around the 3rd platform, which is cloud-centric, have been a business imperative in recent years. These investments now pave the way for future innovation and set the stage for a smooth transition to the 4th Platform, which is based on cognitive and AI-based operations.

FROM

Traditional IT

On Premises Architectures

Traditional Equipment

Existing Operations

TO

Innovation Accelerators

Cloud Platform

Smart Equipment

Emerging Business Models

INNOVATION ACCELERATORS

Abundance · New Buying Centers · Efficiency · Personalization · Future of Work · Immediacy

3D Printing · IOT · Cognitive Systems · Neutral Interfaces · Next Gen Security · Robotics

Cloud · Mobility · Social Business · Big Data/Analytics

3rd Platform
Millions of Apps · Billions of Users · Trillions of Things

2nd Platform

1st Platform

IDC | ANALYZE THE FUTURE

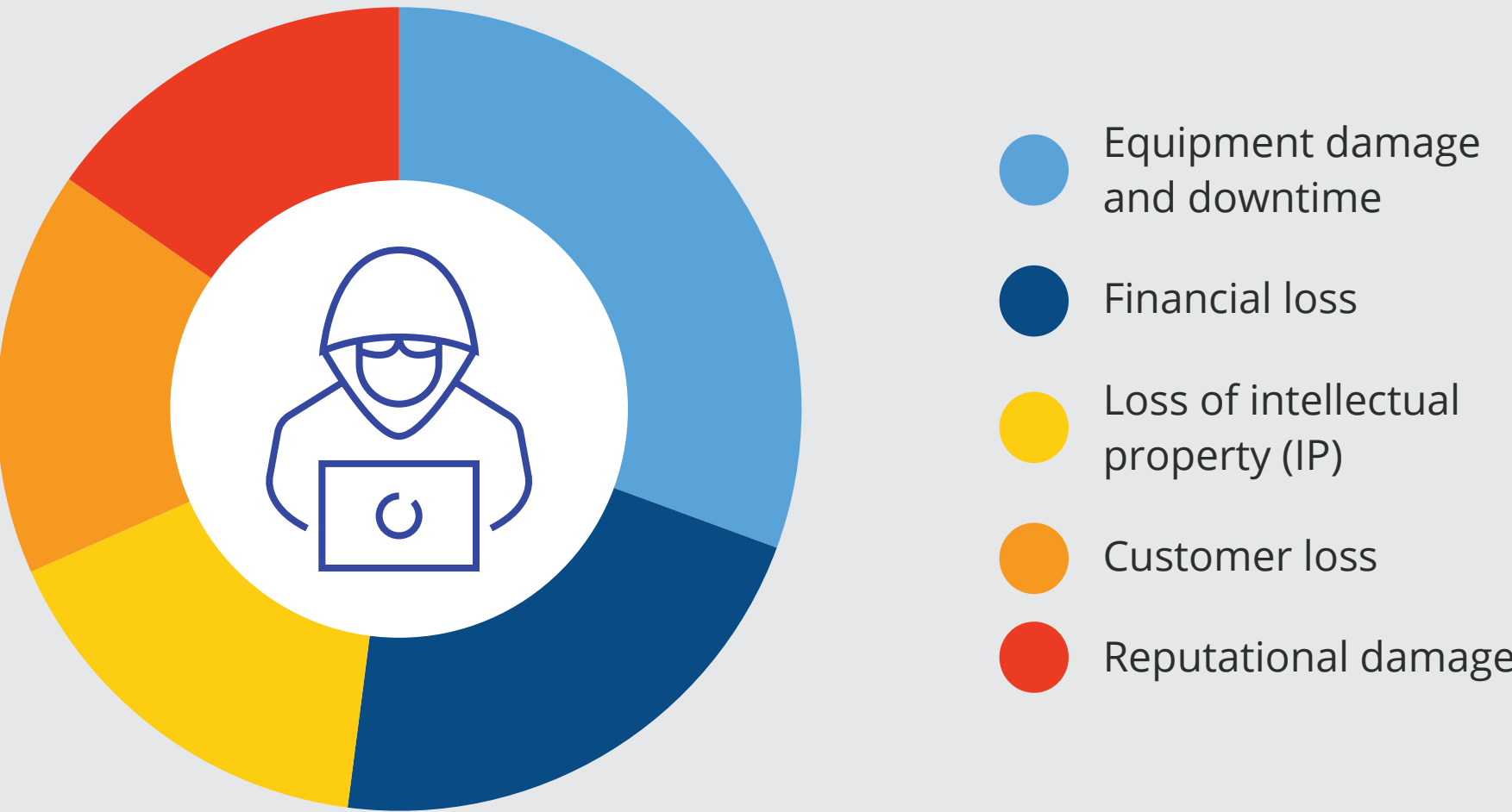# Cyber Security Has Direct Business Impact

Manufacturing companies worldwide are involved in a number of initiatives aimed at making their organizations better able to cope with the challenges of digital transformation.

Implementing compliance regulations (e.g. GDPR, NISD, Cybersecurity Act)

Data loss/leakage prevention

Mobile device security

Cloud security (public, private and hosted private cloud)

Addressing data privacy issues

Operational Technology Security

Security governance and management (e.g. reporting, metrics, risk management)

Ongoing compliance monitoring (including regulation)

Identity and access management

Payment Security

Edge/ Endpoint Security

Security analytics intelligence response and orchestration

0% 10% 20% 30% 40% 50% 60%

Source: IDC EMEA, IDC European Tech and Industry Pulse Survey 2019-2020 – Manufacturing. N= 290 Respondents asked to select 3 to 5 Very Important IT Security Priorities (Multiple Selection)

Manufacturers see operational loss as being their greater concern regarding a security attack. Effective management of cybersecurity has a direct business impact that cannot be underestimated.

What is your organization's greatest concern regarding a security attack?

- Equipment damage and downtime
- Financial loss
- Loss of intellectual property (IP)
- Customer loss
- Reputational damage

Source: European Security Strategy Survey, Manufacturing sample, N=67

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Essential Guidance

Being a digital company is more than having the right technologies. ————

- Manufacturers are on the verge of a revolution in the way they use information. Everybody will need to access information through cloud, mobile tools and even wearables. Be aware: the more information that is available, the more it will be requested by shop floor users and other business units.
- Users will want a continuous stream of information from integrated applications. In order to be relevant to the business, CIOs will need to find a way to bridge the gaps between business applications as well as to continuously update existing applications for the latest and greatest functionality.
- Make sure you have the necessary technical and organizational foundation for smart manufacturing in place before starting the initiatives, specifically looking at how IT/OT functions need to be integrated.

Enterprise Information Management impacts every manufacturing process. Companies need end to end information management tools and concepts. ————

- Enterprise applications, content and document management, master data management and IoT will all converge to create this integrated information and process flow.
- Carefully plan the transformation steps to avoid delays. Before achieving seamless, real-time and bidirectional data and information flows, there will be many changes and disruptions to roles and processes.
- Consider the concrete outcomes to be a higher priority than eliminating information silos. Every single piece of information has to be delivered to multiple audiences, but with the right script and context around it.

Manufacturing organizations must look to implement an integrated governance model — this will be the norm within 5 years ————

- Clearly define the value that is sought through the adoption of modern technologies. Relevant business cases must be sold throughout the manufacturing organization, starting from the plant floor.
- The fundamentals of a smart manufacturing initiative will require secure plant floor connectivity – for IP equipment and mobile devices, analytic capabilities (either in-house or sourced), robotic skills (hardware & software), system integration from shop floor to top floor and possibly customer to supplier, and IT/OT integration.
- An evolving and ever-tightening regulatory and IT security environment must also be considered. Business and IT must work together — it's too important to be left to IT alone.

Bottom Line   Every company has to learn that new technology in an old organization just makes the old organization more expensive.

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