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6 Critical Changes That Affect the Future of Asset Maintenance

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Equipment characteristics and related process changes will transform business ecosystems from simple, own-maintain models to complex, collaborative ones. Asset-intensive industry CIOs must respond to changes in asset attributes, maintenance management, supply chains and business value.

Overview

Key Findings

- Technology-driven changes such as the use of Internet of Things, artificial intelligence, pay for performance, virtual reality and digital twins are altering the way asset-intensive industry company CIOs must plan for systems to manage equipment maintenance.
- Physical and digital attributes, an abundance of data, edge computing, supply chain movement, 3D printing, ecosystem participation and changed business value will influence the capabilities of future assets.
- Enterprises increasingly will be driven to capture, share, leverage (and potentially monetize) the data and IP rights they collect from their machines, production facilities and customers, while ensuring appropriate privacy safeguards and intellectual property rights.

Recommendations

Asset-intensive industry company CIOs who are responsible for cross-industry innovation and disruption should take these steps:

- Build expertise on what is possible with enhanced asset capabilities and on what competitors are doing by engaging with outside experts and other CIOs.

- Do a gap analysis on your current asset maintenance capabilities starting with your EAM systems and asset performance management. Modernize the basic EAM systems to create a platform for extending and augmenting your capability into remote monitoring and digital twins.

- Experiment with 3D printing for critical parts in remote areas, which can obviate the need for complex supply chains and storage of parts. In the case of obsolete equipment that needs to be maintained, this may supplement or replace the historic skills of fitters and turners.

- Work with your suppliers, OEMs and service companies to understand their technical competence and direction, including in what ways they are using new asset-related data (e.g., from IoT) to drive improvements in their business. Engage in discussions on how they can help, and to what degree their development and ecosystem may change what you need to undertake and what data can be shared and what data needs to be protected.

Strategic Planning Assumptions

By 2022, More than 80% of asset-intensive organizations will have implemented digital twins.

By 2020, two-thirds of asset operators will use digital twins from their component suppliers, up from one-third currently.

By 2021, 10% of large manufacturing enterprises will use 3D printing to produce new parts and products that cannot be made with conventional techniques.

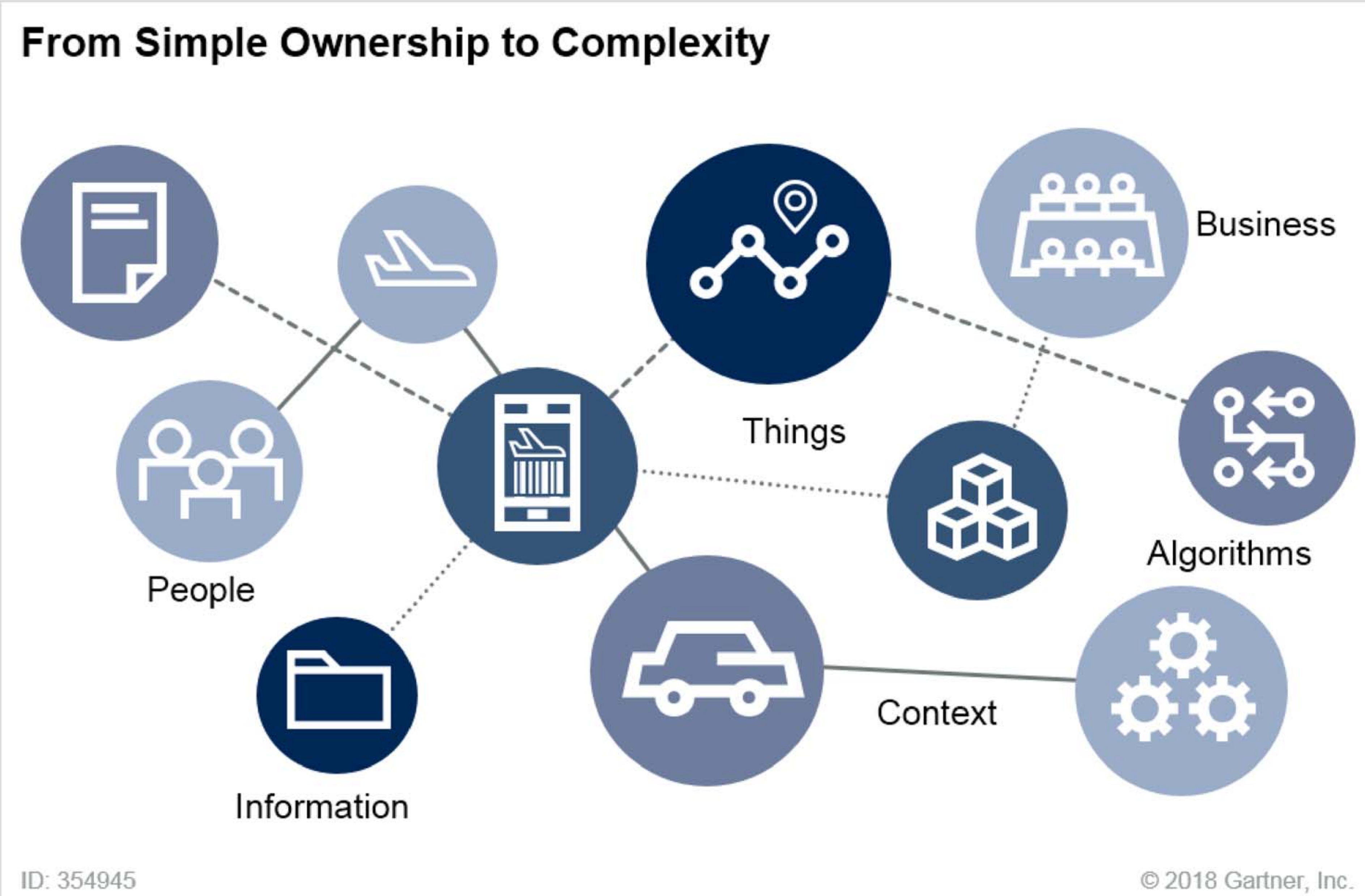
Analysis

Changes in equipment capabilities, asset structures and asset maintenance processes will transform business ecosystems, moving from simple own-operate-maintain models to more complex ownership and management (see Figure 1). Rapid, technology-driven change is the environment you as a CIO will have to deal with in the future. You will be in a state of change that we refer to as ContinuousNext (see "From Digital Transformation to ContinuousNext: Key Insights From the 2018 Gartner Symposium/ITxpo Keynote"). For example:

- Internet of Things (IoT) and digital twins will provide more direct and detailed insight into operational performance, enabling asset-intensive organizations to make more informed decisions, and will become intrinsic to business strategy (as this example of remote airplane engine maintenance shows).
- Increased data volumes not only enable vastly improved asset situational awareness, but also increase complexity, risk, latency and error problems, driving expanded business ecosystems specializing in aggregating and analyzing the data (as described by Gartner in 2016).
- Specialist relationships will characterize future planning. Equipment operators may need to have relationships with manufacturers that inform detailed asset metadata and operational data if the equipment is not directly purchased. Specialist maintenance roles from either the OEM or a third party will necessitate transferring information to all parties to execute their role, resulting in data access, ownership and transparency challenges (as evidenced by this maintenance, repair and overhaul [MRO] debate in the airline industry).
- Systems in place for existing maintenance models will be outdated. For example, enterprise asset management (EAM) systems were designed in the 1990s to support an own-operate-maintain model (i.e., one company performs all roles). As we move to a more outsourced and specialized future, EAM process structures will not support the new model (i.e., data and process steps are not easily shared) (see Figure 1). They should be replaced progressively by software solutions that are IoT-data enriched and that more seamlessly integrate to include, depending on what role you play in the ecosystem (as in, which combination of owner, operator and maintainer), components of:
  - EAM
  - Field service
  - CRM
  - Analytics
  - Artificial intelligence (AI)
  - Machine learning (ML)
  - Financial management features

In some cases, your usage contract may even preclude your right to repair unless there is specific legislation granting it.

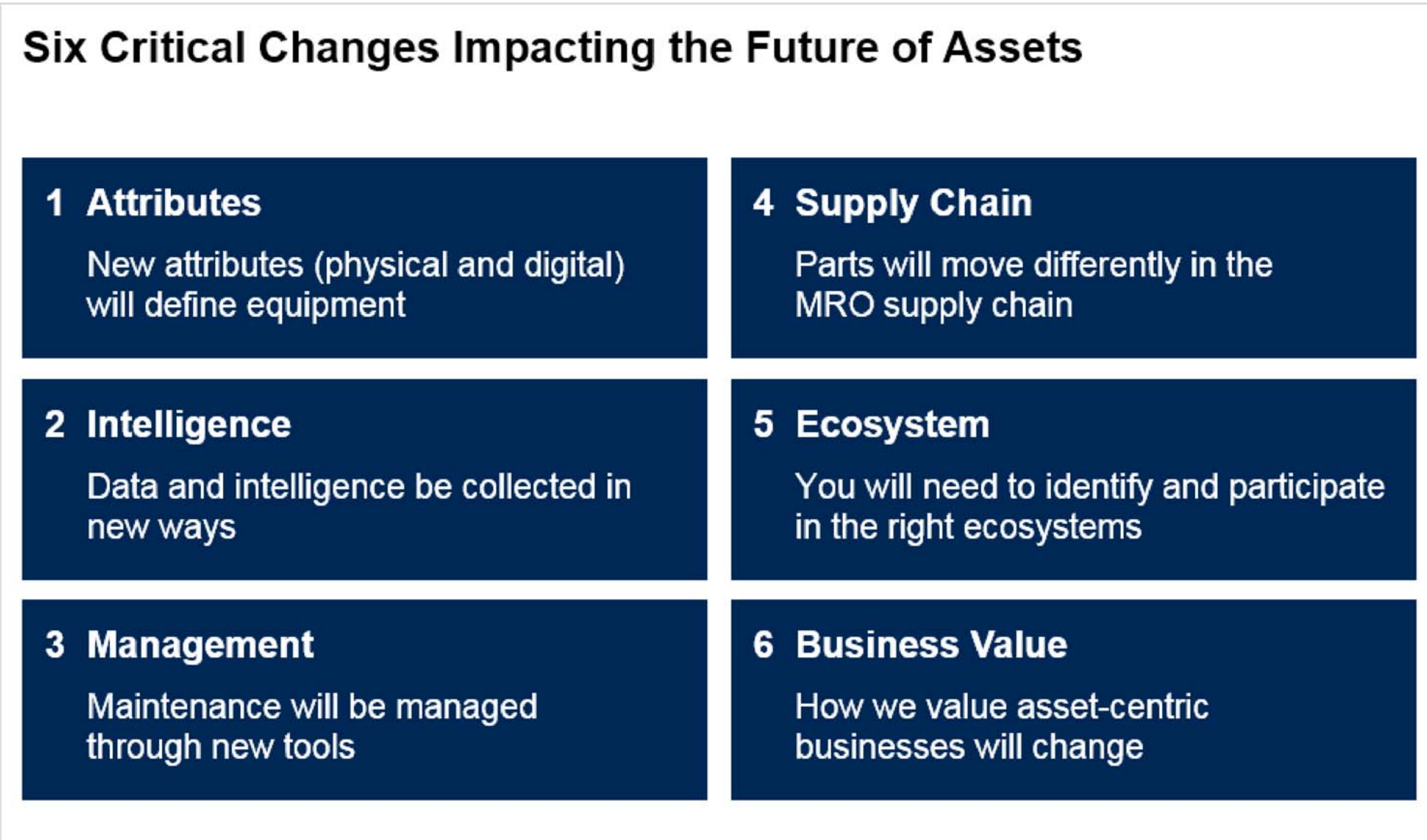
Figure 1. From Simple Ownership to Complexity



Source: Gartner (December 2018)

To begin exploring the future of assets amid digital transformation, survey your organization and affected stakeholders on how big changes across the full breadth of your equipment universe are impacting business operations (see Figure 2). This will help structure your path to the future of assets, but may call for ecosystem analysis and taking stock of your current capabilities, and possibly the culture of your organization:

Figure 2. Six Critical Changes Impacting the Future of Assets



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Source: Gartner (December 2018)

Each of these changes challenges how an enterprise will adapt to be relevant in the future and exploit changes. There are already examples of companies that are engaged and leveraging new technologies to support modified processes so that they can shift their business models.

For example, mining companies Rio Tinto, BHP and Roy Hill mining are able to change their on-site practices and planning by remotely managing and monitoring significant assets from thousands of kilometers away. In another impact, in many industries, (led by aviation), it is normal to outsource critical-asset maintenance to specialist MRO firms because of remote monitoring technology. This approach will increase across other industries as equipment becomes more technologically capable, allowing monitoring and management technologies to be used across ecosystems. Using analytics to develop better predictive maintenance models is also rising as companies follow the Gartner roadmap of maintenance and reliability (see "Mapping a Route to Asset Management and Reliability").

This research examines the most significant technology changes and provides recommendations for exploiting them. However, we do not address in this research the consequent cultural changes needed (see "Culture Crush: Design Your Roadmap for a Culture of Innovation") or the overall data management changes (see "Data Management Strategies Primer for 2018").

Change No. 1: New Attributes (Physical and Digital) Will Define Equipment

As assets become smarter, so companies must define and take stock of both physical and digital attributes. Machines are no longer just pieces of metal engineered for physical performance and reliability measures. In our client interactions (300-plus inquiries in 2018), we frequently see asset contracts move to ROI-based metrics rather than using only purchase cost and value return assessments based on initial and ongoing maintenance costs. Pay for performance is becoming an option that will obviate the need to do your own equipment maintenance.

For example, "power by the hour" is a normal proposition in power-generation equipment contracts. In addition to measuring economic value generated, we are now seeing continuous monitoring and charging fees based on value provided, thanks to real-time data gathered from connected operational technology (OT) systems and IoT sensors added to older equipment.

With real-time data from connected devices, companies can manage assets remotely, which will be crucial for those located in dangerous or remote locations like the oil industry in underwater exploration. This capability has already materialized and been valuable in mining and oil and gas industries, which are also leading the way in autonomous equipment that can operate using a combination of AI and ML. With older equipment this will require extensive refitting of equipment with IoT sensors, but this will come at a lower cost over time.

While autonomous cars are the most visible examples of this trend toward remote monitoring and control, it is actually much easier to achieve in the controlled, private environment of a business, such as warehouses, mining or manufacturing. Asset intelligence will also extend to self-diagnosing faults beyond alerts, initially to inform maintenance planners and operators, but eventually to perform corrective actions (internal adjustments) to prevent failure and extend asset life. Think of this as the 21st century equivalent of a speed governor on a steam engine, but at a much larger scale, with more precision and with more immediacy.

“Smart” assets not only perform more efficiently and effectively, but also can self-adjust and “self-order” parts. Operations can utilize cognitive technologies (smart machines) and embedded services in sourcing and procurement to:

- Provide significant cost reduction.
- Improve turnaround time.
- Reduce equipment downtime.
- Deliver value to the business stakeholders.
- Enable the sourcing and procurement team to become a strategic advisor.

In effect, the asset becomes the customer in a transactional sense, bypassing the internal administrative processes (see “Digital Disruption Profile: Things as Customers”). As a result, manual spare parts assessment and ordering may no longer be part of the EAM application but will be external, not only from EAM, but also from other company business applications. The attributes of smarter machines will change the support needs we are used to.

For some industries, even the concept of equipment location will be challenged, and we don’t just mean the traditional challenge of mobile equipment like vehicles, airplanes, rail cars and service equipment. This will come about because autonomy and remote monitoring means less reliance on human participation; therefore, equipment can be relocated more easily. The potential for a fixed plant to be moved around, relocated and connected can lead to a “factory in a box” that can be used and then moved (for example, concrete beam manufacture is often set up temporarily on a construction site) (see “Supply Chain Brief: ‘Factory in a Box’ Concept

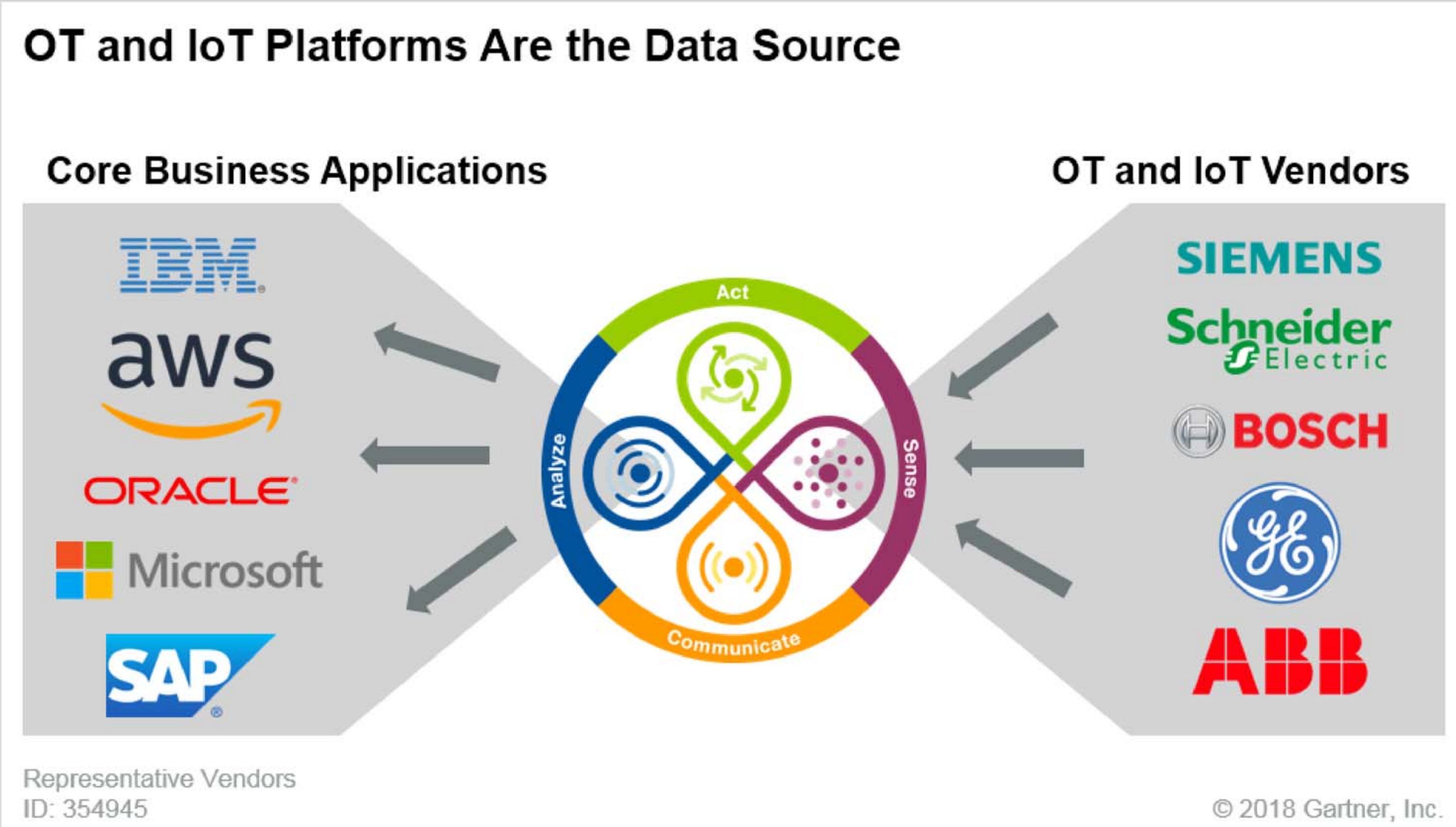
Challenges Traditional Factory Setup”). Additional legal and financial issues will emerge as new questions of ownership and location could change what it means to be “manufactured” in a particular country. EAM systems that assume a fixed location or region for an asset will need to change to support this new, more dynamic model in some industries, such as construction and specialist manufacturing.

OT and IoT Platforms Expand the Data Sources From Equipment

Through all of this change in asset characteristics, companies need to get comfortable with the idea that IT systems and the departments that support them are not going to be the source of much of this data. Much of the data will come from OT and IoT systems. In asset-intensive organizations (companies with large portfolios of physical assets and equipment), OT systems resemble the state of older IT systems, when stand-alone systems were commonplace, and IoT is emerging sometimes within the operational department. To fully leverage digital transformation opportunities, as a CIO you can lead the transition from a solely IT focus, to one that aligns and integrates IT, IoT and OT environments (see “2018 Strategic Roadmap for IT/OT Alignment”). IT departments who attempt this data aggregation and integration alone will be far less likely to succeed, as operational groups will reject intrusions from IT unless there is groundwork in collaboration and planning.

Asset-intensive industry CIOs will be better equipped for digital optimization and transformation by being party to IT/OT alignment and integration. The diversity of IT, IoT and OT systems will require harmonized and better-managed asset control systems in the coming years (see Figure 3).

Figure 3. Disparate Data Sources



Source: Gartner (December 2018)

Note: For the purposes of this research, any reference to OT includes industrial IoT products and management. New developments will compel some industry CIOs to invest in new OT offerings that draw on IoT sensors to expand data acquisition reach.

In many organizations, IT and OT worlds are separated by virtual — and in many cases, physical —walls, as well as cultural and organizational barriers that result in different IT/OT support processes. Organizations will seek ways to integrate or connect IT and OT, but integrating without aligning technology governance will hinder sustained integration as the two sides drift apart in their approach to technology support.

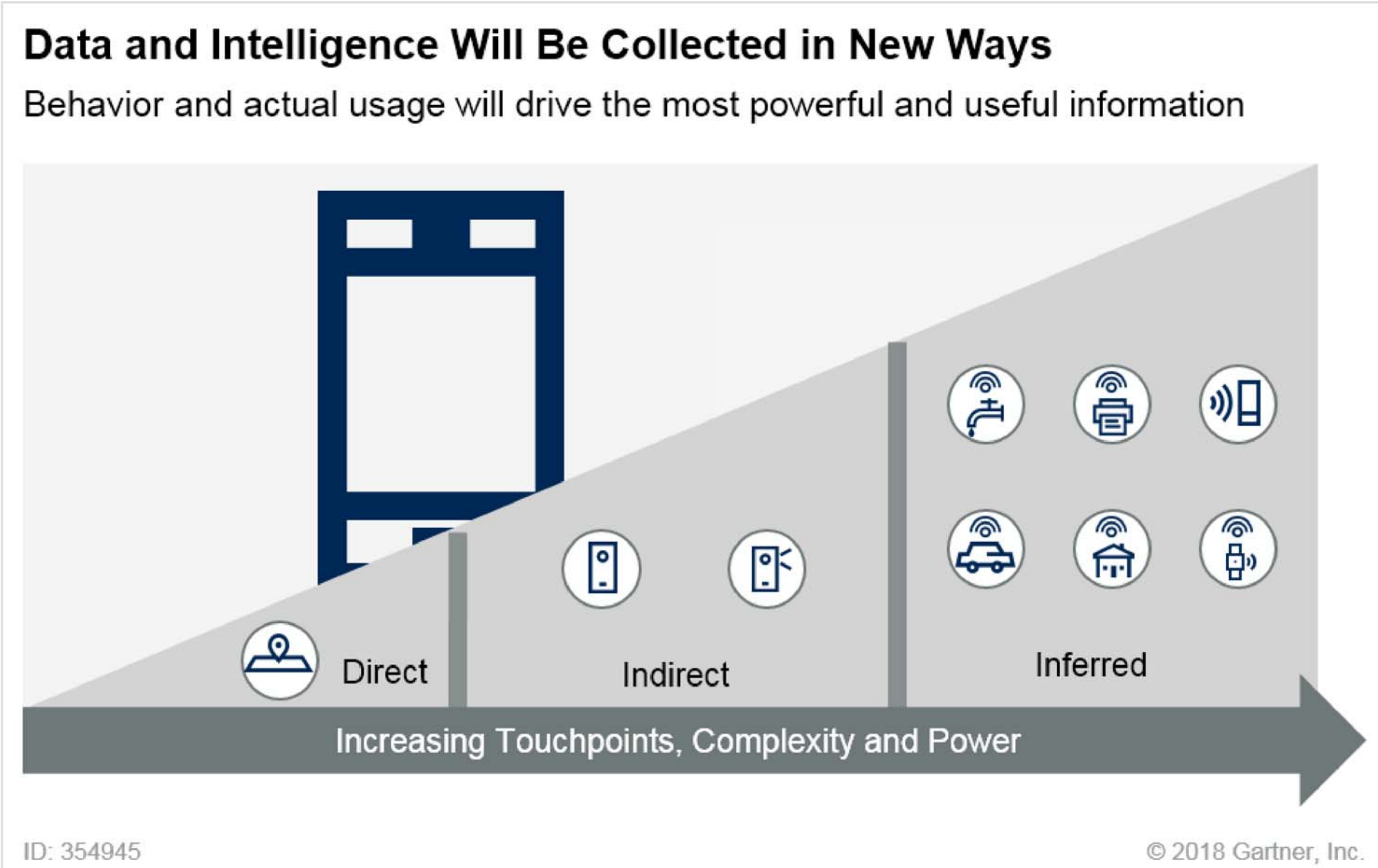
We believe Gartner's five-step maturity model and complementary roadmap will help CIOs evolve their IT and business environments to cater for the needs of OT environments.

Change No. 2: Data and Intelligence Will Be Collected in New Ways

To be best in class in maintenance and reliability, insight and analysis of equipment health to drive improved situational awareness has to become a core competency. Business intelligence/analytics are always at the top of the list when we ask CIOs what capabilities will have the biggest impact on their business. In fact, 23% of CIOs ranked it as the No. 1 technology that will attract new funding (see "2019 CIO Agenda: Global Perspectives for Asset-Intensive Industries"). The very nature of this activity changes in the future as data collection becomes more intrinsic to assets, and OEMs offer their own analytical capabilities.

To understand what this change could look like for your organizations, you should understand the three fundamental methods for collecting intelligence: direct, indirect and inferred (see Figure 4).

Figure 4. How Intelligence Will Be Collected



Source: Gartner (December 2018)

- **Direct** — Sources observations directly from monitoring the asset, typically in the form of data from existing PLC and supervisory control and data acquisition (SCADA) systems (OT), fed into an analytics platform via a data historian or a direct IoT platform connection.
- **Indirect —** Leverages further observations from IoT sensors on the equipment or from environmental observations around the equipment. Acoustic, visual, thermal and environment sensors do not have to be connected directly to the machine.
- **Inferred —** Provides feedback through observed behaviors such as production quality measures that are impacted by equipment performance, power consumption or other third-tier impacts. This may include data acquired from other users of the same equipment via a data broker or data purchase.

It is important to note, too, that the data generated by assets may far exceed the data that is transferred from assets. This apparent contradiction stems from the on-site generation versus what useful data needs to be transmitted back for analysis and action after edge computing processes. While a machine such as a turbine can generate many terabytes of data a day in operation, not all of it needs to be extracted — only the exceptions and events. What we will see more of in the future is edge computing utilizing AI, effectively acting as an onboard analysis and filter. This will react to instant condition changes. Only trending and event data needs to travel back to analysis by an asset performance management (APM) system for longer-term projections used in predictive maintenance planning and understanding fleet trends across a group of like assets (see “Market Guide for Edge Computing Solutions for Industrial IoT”).

Who Owns the Data and Who Should Have Access?

As IoT provides more robust datasets and types, and as the concept of data grows more complex, many different stakeholders are increasingly realizing data’s value. With the increase in data value, monetization “rights” have to be carefully examined. There is a battle brewing for control of equipment data. Unfettered by privacy rights (since machines have no rights), it is unchartered territory for many companies, but is impacted and constrained by copyright and IP protection.

Data has diverse value and meaning to different stakeholders. Who “owns” or needs access to the data and to what end? Equipment manufacturers? Financing entities? Insurers? Regulators? Engineering bodies? End customers? How much data does each entity own and how do they want to use it? In what form and in what time period will this occur? Will the data be actual, summarized, correlated or derived? For example:

- **Equipment makers** want exclusive access to the data for product improvements, and for potential maintenance and support relationships.
- **Maintainers** need it for support planning and, if exclusive, they have a better negotiating position for future contracts.
- **Owners and insurers** see data as a valuable adjunct to a piece of equipment's "logbook," and as a direct link to retained value and financial risk.
- **Operators** need to retain as much flexibility as they can to ensure that they remain in control of their destiny.
- **Regulators** gain economic value from the asset but may never directly touch it or have direct decision rights over it, but have a stake/right in the outcome from its performance.

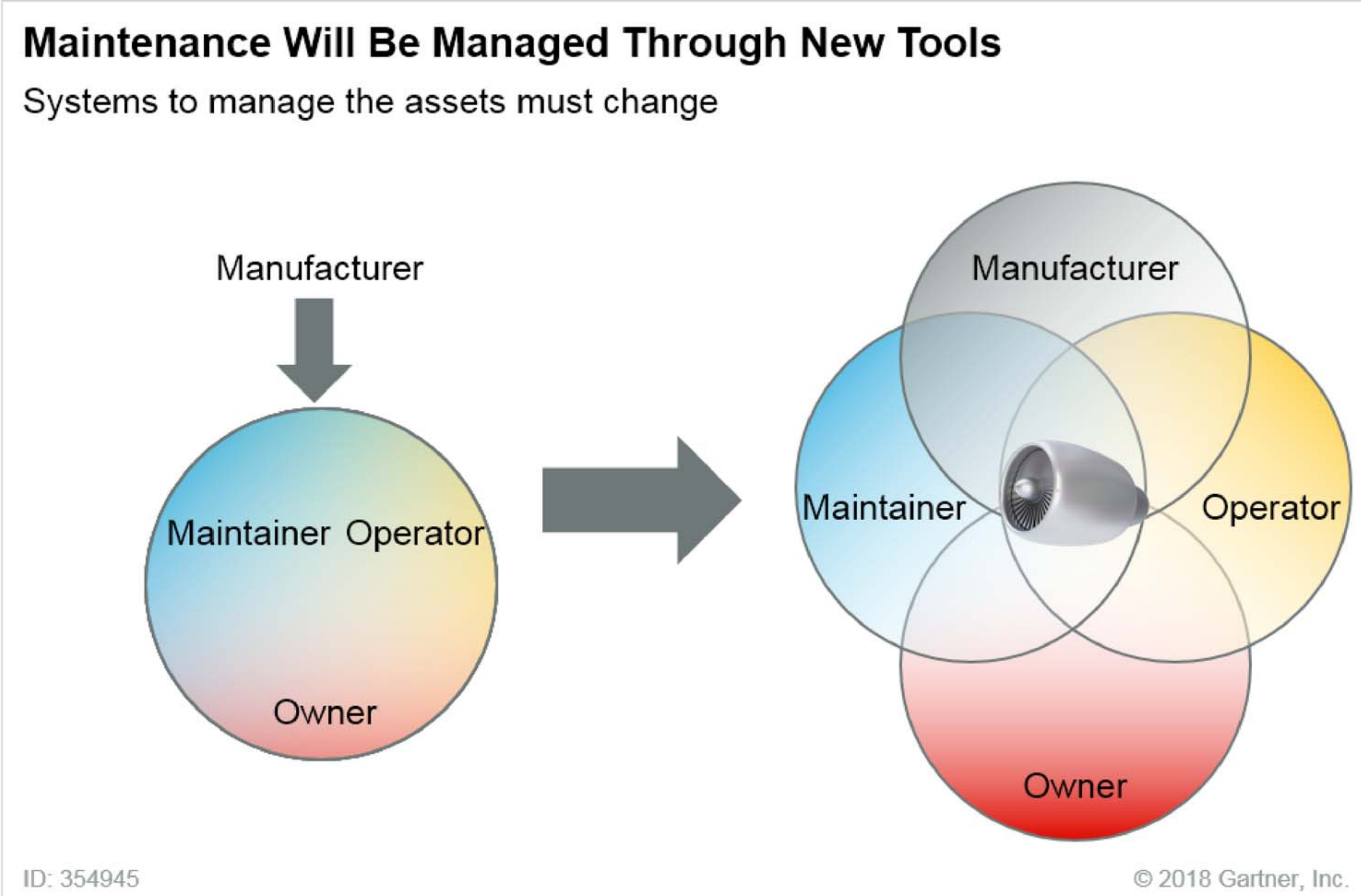
In recent years, business equipment valuations have centered on the equipment's work output, and how that output contributes to business success or failure. Newer, more-data-enabled equipment or that retrofitted with more sophisticated technology is designed with data acquisition capabilities using IoT extensions to the embedded OT systems. As a result, data is becoming more abundant, accessible and an integral part of making assets, machines and equipment more efficient, and for measuring failure and fault rates of components.

We are seeing this ecosystem of interested parties increase to include regulators and insurers in some circumstances. For example, Munich Reinsurance Co. recently invested in in the future of asset data by acquiring IoT middleware vendor Relayr. [1] CIOs are suddenly forced to factor machine-related data rights into their day-to-day activities (see "Don't Just Talk About Information as a Strategic Asset, Manage It Like One!" and "Data Ownership of IoT-Connected Equipment Poses New Challenges for CIOs").

Change No. 3: Maintenance Will Be Managed Through New Tools

For decades, in most industries a piece of equipment's owner, operator and maintainer were the same entity. The only other player in the picture would be the equipment manufacturer. Many industries worked that way for a long time. Some still do. In this scenario, the question of data ownership or data access is an internal matter and, at worst, an interdepartmental dispute (which can be resolved through IT/OT alignment, as mentioned earlier). As Figure 5 shows, we are now seeing an evolved scenario more often.

Figure 5. Where and How Assets Will Be Managed



Source: Gartner (December 2018)

The manufacturer is still in the picture, but the owner, maintainer and operator roles are separating. This may happen for a number of reasons. One driver is a company's strategy to outsource noncore activities either because they do not have the in-house expertise, to lower costs, improve performance or to get operating or ownership costs off the books.

However, the maintainer usually collects the equipment-generated data (as much or as little as it deems necessary), which can give the maintenance company a distinct competitive advantage in future maintenance contracts. Additionally, in many asset-intensive industries, such as oil and gas or mining, it is not uncommon for one company to own the equipment, yet hire another company to operate it — potentially losing line of sight from the data.

Again, the owner company may benefit from outsourcing a noncore function, but may forfeit the benefits of collecting and analyzing the asset's data. In industries such as mining or renewable energy, an asset owner may be interested only in an asset's financial aspects, but it might want access or even ownership rights to the data being generated. The detailed use cases of the data will also vary; for example:

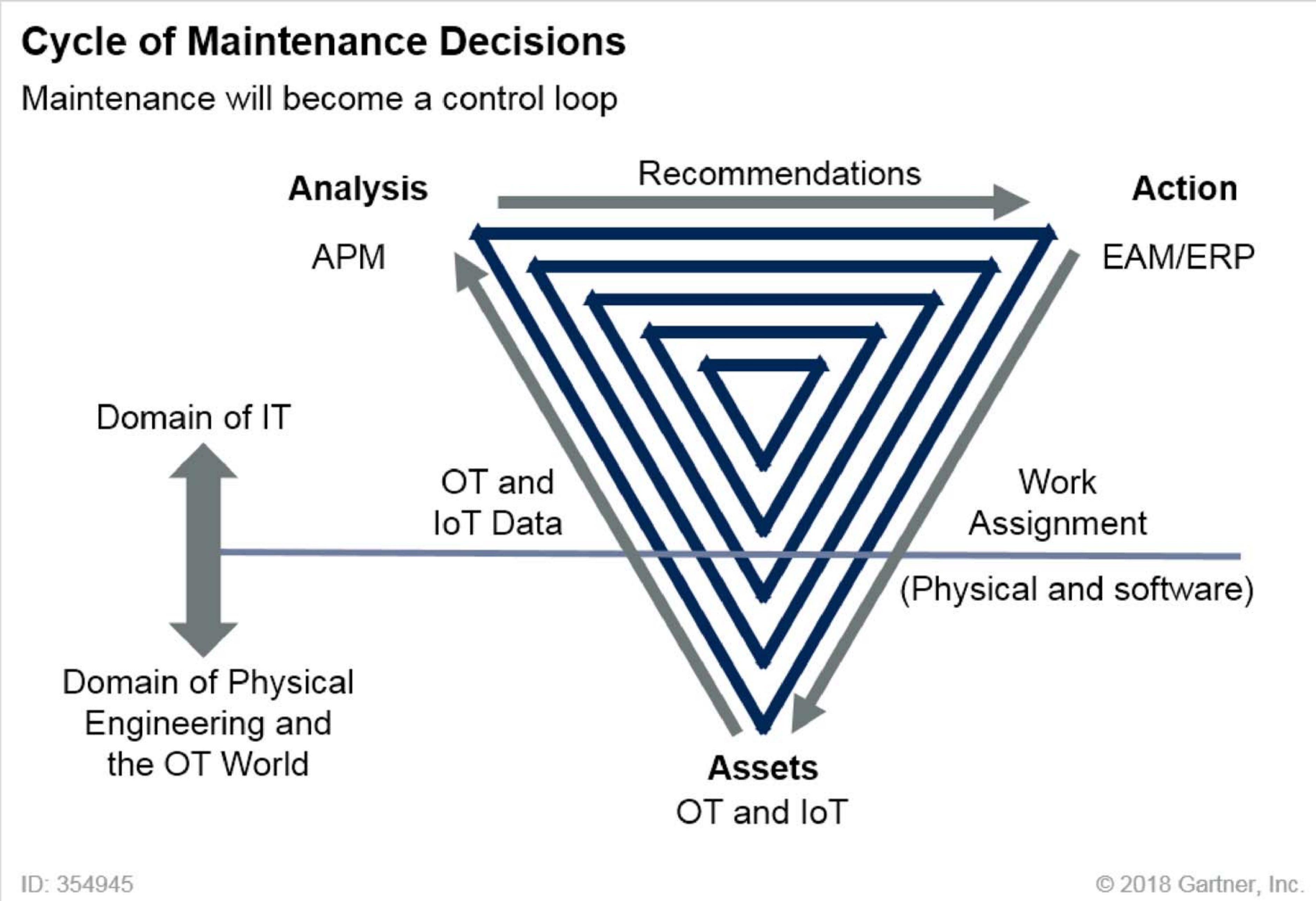
- Design information about a piece of equipment (including software and physical characteristics) — IP of the maker
- Degradation and reliability information — IP of the maker, but sought by the maintainer
- Usage and performance information — IP of the operator, but sought by the owner and maintainer

Data will be a big part of where and how assets are managed. In the data negotiation process, be aware of other parties' motivations and business models, as well as the reasons they find the data valuable, so you can better reach a mutually beneficial agreement.

In a simple view of this dynamic, there are three key event points in the maintenance cycle, and process links must join these concepts (see Figure 6):

- Assets generate data.
- Analysis provides recommendations for action.
- Actions assign work to be performed on the assets.

Figure 6. Maintenance Will Become a Control Loop of Asset-Analysis-Action



Source: Gartner (December 2018)

In the traditional asset support environment, an EAM system caters to these event points but only in a most basic form, with data often being input manually. A delayed batch transfer of the analysis would be simplistic, and the actions (work schedule) the main focus. Mobile extensions to EAM have improved this, but as we move to more technology-enabled EAM systems, the focus will shift to actions.

While work assignment and other more specialized solutions will support data acquisition from the assets and the analytics process, even work assignment will evolve from simple physical repair and maintenance activities to include software maintenance. Because assets depend on software as well, those OT and IoT products themselves will need maintenance. EAM systems will need to evolve and combine with IT asset management-like products to track and maintain the software embedded in the assets. Hence, maintenance will become a combined and interwoven physical and software maintenance activity.

Different asset management strategies have emerged over time — each for specific purposes and situations. They were usually developed by engineering or operations groups, and tended to be siloed. For example:

- Failure detection
- Planned maintenance (based on the calendar or actual usage)
- Condition-based maintenance
- Predictive maintenance
- Reliability-centered maintenance
- Financial optimization based on risk or asset investment planning

The first three are intrinsic to EAM applications. The second three are gradually coalescing into APM systems.

New Asset Management Support Tools Are Emerging

New tools and systems will become mainstream in the coming years:

- **Asset performance management** (APM) — Interest in APM is being accelerated by the realization that a key use case of the industrial IoT is equipment reliability, which is a fundamental capability of APM. Asset management strategies continue to mature from preventive to predictive and look toward becoming financially optimized, although at a varied pace.

Digital twins — Recently, the emergence and proliferation of IoT coupled with cloud computing, as well as advanced analytics, have given rise to digital twins. Interest developed in the manufacturing sector (Industry 4.0). However, digital twins have become increasingly a focus in other industries such as utilities, oil and gas and transportation. Digital twins are developing as a central feature of IoT-based architectures for monitoring and simulation. This usually begins with a focus on equipment/plant, and expands. Digital twins add value to more traditional analytical approaches to improve situational awareness of and better respond to changing conditions, particularly for asset optimization and maintenance.

- **Location tracking** — This technology enables more effective digital business in asset-intensive organizations. Providing an asset's locational and contextual insights is increasingly critical in some industries — for example, for maintenance cost optimization or to help facilitate flexible manufacturing processes. These technologies could allow inclusion of weather and environmental information relating to impacts and effects on assets and overall production.

- **Asset investment planning (AIP)** — AIP is becoming a key application for some industries such as those regulated such as utilities, oil and gas, transportation and government interested in optimizing their capital spend and, in some jurisdictions, improving adherence to government guidelines or compliance requirements. AIP solutions incorporate asset condition, criticality and the impact of time in their analysis of alternative investment scenarios.

- **Cloud EAM** — Increasing acceptance of cloud as a deployment option has led to the growth of EAM deployments in the cloud and, therefore, an expanding choice for buyers. This has allowed CIOs to not have to choose between functionality and cloud (see "Cloud EAM Is Facing Headwinds").

- **Augmented reality (AR)/virtual reality (VR)** — AR and VR bridge the physical and digital worlds by overlaying information, such as audio, text, images and interactive graphics, onto the physical environment. These types of technologies can allow field workers and maintenance technicians a more immersive and efficient working experience, but may not be suitable in all working environments.

- **Blockchain** — Blockchain consists of sequentially grouped, consensually verified blocks of transactions that are chained together, creating a shared record of all exchanges, which establishes trust among unfamiliar or unknown partners. The information is stored over many different or decentralized locations with no central intermediary (such as a bank or company.) The ledger where this information is stored forms an immutable (or unchangeable) record of transactions dating back to the first, or genesis, transaction. Blockchain has potential in:

  - The supply chain process for identifying sourcing and handling (see "Blockchain Solutions in Supply Chain: 2018 Market Insight")

- The maintenance process to record and validate maintenance activities by third parties not directly using a common maintenance management system (e.g., regional or remote maintenance of a vehicle by a third party)

For analysis, APM is an analytical decision layer that takes OT and IoT data through algorithms to determine probability and timing of degradation and failure.

For actions, EAM is a system of record for equipment and components with a work management layer to assign jobs to people and a supply chain capability to issue or order required parts and materials. However, with the rise in embedded software the action stage will begin to have increased needs for software maintenance planning as well as physical equipment maintenance to take advantage of the downtime to care for the embedded software.

Change No. 4: Parts Will Move Differently in the Supply Chain

No matter how well we design or manufacture a component, if it isn't where it needs to be when it needs to be there, it is irrelevant. Quite simply, an effective supply chain matters. Improvements in associated technologies, fuel pricing and availability/labor rate increases and regulatory changes will come together in the future to make new delivery modes not only possible, but also economically advantageous in certain circumstances, geographies and product categories.

While companies are experimenting with this today mainly in the consumer area, this will transfer to the industrial domain. Each of these consumer examples could potentially apply to industrial spare parts delivery, particularly for remote operations:

- **UPS** delivered a test package to a rural home in Florida last February. An unmanned aerial vehicle (UAV, aka drone) was launched from the truck, allowing the driver to continue delivering packages to other locations. This is the ultimate in productivity, as this actually allowed the driver to be in "two places at the same time." [2]
- **DHL** trialed parcel delivery with its "Parcelcopter" in 2016 in a Bavarian (Germany) community. [3]
- **Amazon** has filed patents for a special parachute shipping label and beehivelike towers that house multiple drones for use in urban areas. [4, 5]
- **Just Eat and Starship Technologies** teamed up for food delivery with robots in the U.K. [6]
- **Anheuser Busch and Uber subsidiary Otto** partnered to deliver beer in an autonomous delivery truck in 2017 in Colorado. [7]

IoT, cloud and analytics fuel this trend, as well. Components, equipment, packages, crates and pallets will be enabled with sensors where appropriate to facilitate autonomous supply chains, driving greater efficiency, transparency and safety across the value chain.

This is not going to be as simple as just adding sensors and leveraging ML to allow machines, robots, drones and trucks to move autonomously and with transparency. Government regulations will certainly impact how this is deployed, and there will be impact on other industries like insurance, as those companies face challenges with who pays when an autonomous vehicle has an accident. But we can expect changes in how supply chains operate. Margin, safety and reliability will be driven by an increasingly autonomous supply chain that hinges on rapidly advancing technologies like IoT.

On-Site Replenishment

While some companies are actively experimenting with newer technologies to gain supply chain efficiencies, others are experimenting with on-site replenishment, or "micro-manufacturing." These types of initiatives will shift logistics and supply chain business models from a planner and delivery model to managing replenishment on-site. This is the manufacturing of products in small quantities using small manufacturing facilities that are on-site of your organization, not to be confused with additive manufacturing (aka 3D printing, or 3DP).

The concept is similar to a copy machine. For instance, your office copy machine is not capable of printing large quantities of documents at a fast pace like that of a professional commercial grade copier. However, it is there to print on demand, when you need it, without waiting and scheduling. As an example, an OEM could produce containerized manufacturing and place it on-site at its buyer's assembly location and remote-management it. These types of initiatives are still emerging, mainly in healthcare and electronics, and don't replace mass production and inventory.

However, supply chain practitioners are ill-prepared, with 45% saying 3DP in mainstream production presents a significant challenge. Yet, 81% of supply chain practitioners surveyed report their supply chain organization is now using or plans to invest in 3DP within two years (see "Take a Strategic View of 3D Printing to Maximize Its Value Within Your Supply Chain").

3D Printing

The economics of mass inventory of replacement parts are compelling. Conventional wisdom is that scale matters and the unpredictability of parts demand leads many companies to focus on having warehouses of just-in-case inventory. Some inventory level management is already being mitigated by planned and predictive maintenance, but actual parts shipping and storing may change in the future.

Additive manufacturing (3DP), combined with evolving distribution models, changing demographics/economics and creative thinking, can lead to new business models. Parts don't have to be centrally manufactured and then delivered; they can be made at the location where they will be used, to suit the equipment and operator needs.

What is striking already about additive manufacturing is the breadth of products that can now be produced, spanning from jet engine parts to bridges and rare or unavailable spare parts. It is likely that over time there will be a meaningful application for every asset-intensive industry. Producing to demand and producing locally will impact the supply chain for parts or industrial products, and mass customization will continue to broaden as appropriate. Again, 3DP doesn't replace mass production and inventory, but creates new opportunities for localization, customization and just-in-time replacement parts.

Change No. 5: Companies Will Need to Identify and Participate in the Right Ecosystems to Expand the Data Reach

As challenging and difficult as digital business or the future of assets might seem, you do not have to do it on your own. In fact, you may not be able to do it alone. There are many government and consortium-driven industrial initiatives that can be leveraged as you build out your future in asset management. These consortia and initiatives are likely to:

- Have secondhand effects on other industries.
- Provide local competitive advantage.
- Be an avenue for collaborative innovation.
- Provide the mechanism for establishing standards.

Industrie 4.0 may be the most well-known of these initiatives, but there is tremendous overlap in goals and strategies for these programs.

CIOs should not only understand the relevant consortia and participate where you can find advantage, but also recognize that your business and IP are still what give you competitive advantage. Your challenge will be to sort through the initiatives to adopt the most effective strategies for your company.

Identifying the Right Ecosystems

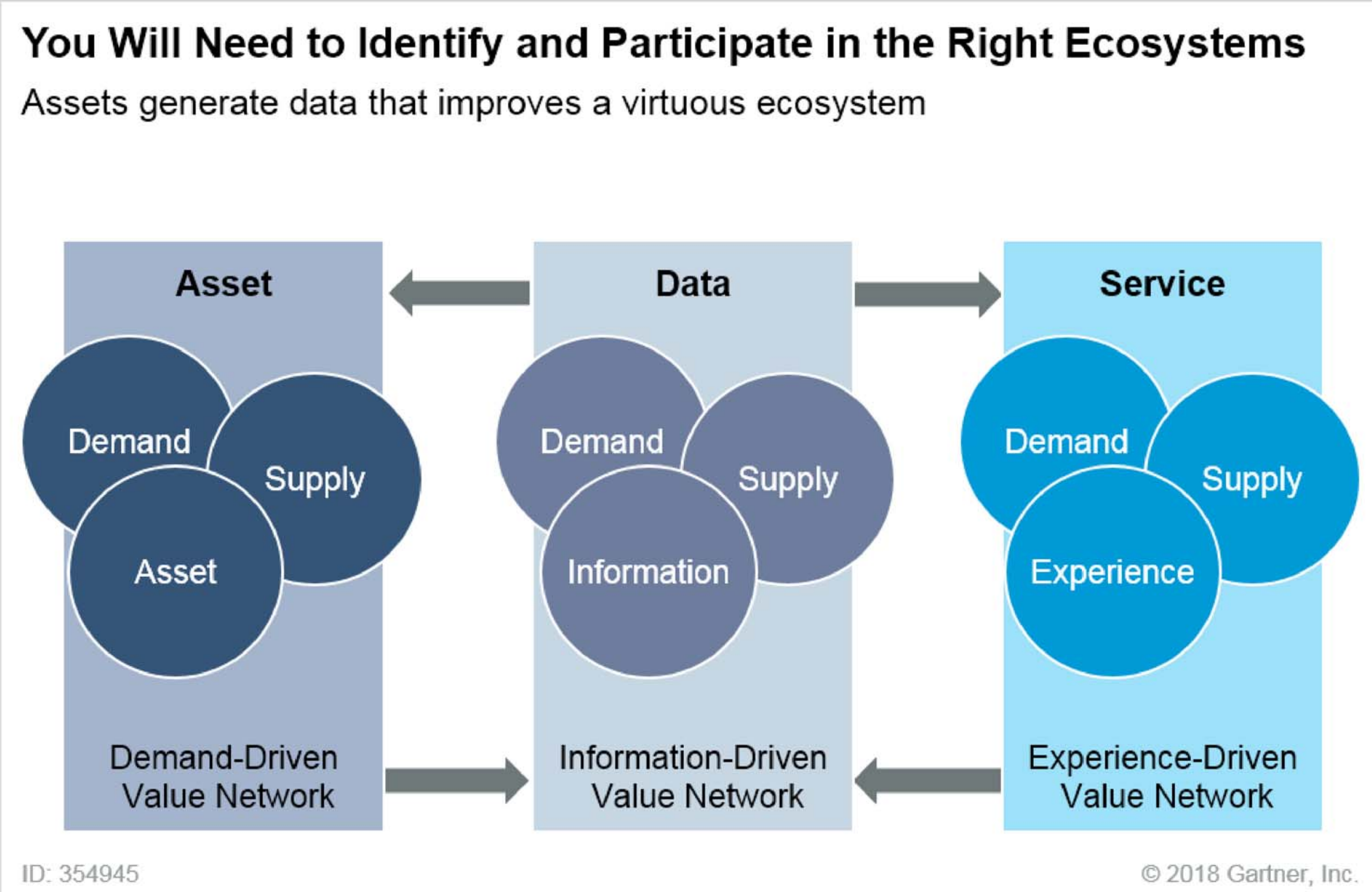
Assets generate data that improves a virtuous ecosystem. You can think of data, assets and services as individual ecosystem opportunities, but they will not be the only ecosystems that you will need to either participate in or design. However, your own data will be the value that entitles you to participate in other ecosystems. Traditionally, companies have thought of their supply chain as the most relevant ecosystem or value network, but there are other aspects apart from the physical supply chain.

Demand-Driven Value Network Definition

Gartner defines demand-driven value network as a holistically designed set of processes and technologies that senses and orchestrates demand based on a near-zero-latency signal across multiple networks of employees and trading partners.

Not all companies operate this way. However, this will increasingly become a necessity to remain competitive in the market, and will occur at a different pace among asset-intensive industries. They will have a well-functioning ecosystem that is incredibly agile and connects trading partners, employees, technology and processes to drive greater value (see Figure 7).

Figure 7. How to Identify the Right Ecosystems



Source: Gartner (December 2018)

In the near future, the traditional asset value network will be combined with a service- and information-driven value network. These networks exist today to some extent like customer demand signals or supplier delivery information, but are usually incomplete. Blending equipment with relevant services and leveraging and monetizing the generated data every time a product or service is produced, delivered, sold or consumed/used will maximize a business' value. Bear in mind that, as we discussed in Change No. 2, the ownership of this data may be in question for some companies.

This is a key aspect within digital twins. For instance, a new opportunity to improve multiparty collaboration is emerging around the life cycle of connected products and assets stemming from technologies such as IoT and analytics. These new digital ecosystems will transcend traditional transaction-based ecosystems and use digital twins to drive new forms of collaboration around physical asset data and events. This will help the enterprise scale up, across and out. The enterprise drives this ecosystem collaboration by building the asset digital twin (not a traditional transaction system) to generate the "master data" that it analyzes to establish asset status and events. These are used to trigger multiparty actions, such as replenishing consumables, scheduling of maintenance, geofencing alert responses and so forth (see "Exploiting Digital Twins to Drive Ecosystem Strategies").

It will not be sufficient in the future to operate as three different ecosystems. There is synergistic value to be generated by designing, producing and selling equipment that consider the combination of service, data and asset. Products and services generate data that improves asset support in a virtuous ecosystem.

Participating in the Right Ecosystems

Data is valuable and becoming increasingly monetized, and multiple constituencies all want access, ideally exclusively for commercial reasons. Datasets have different values and meanings to different stakeholders. For example, in aviation, different stakeholders could include the engine manufacturer, aircraft maker, asset owners or lessors, and aircraft maintenance companies. Even the pilot could make a legitimate claim on it because it is a measure of his or her personal performance. All of this raises the issue of personal privacy. CIOs will increasingly need to determine who "owns" or needs access to the data and for what purpose.

As complicated as it is with just a single asset, data rights/access/ownership issues become even more complex in a fleet situation.

Example: Disparate Data

Consider a trucking company that operates a fleet of 1,000 tractors. If it owns, operates and maintains everything, then it generates data about the trucks' performance and has 1,000 data points that can help inform decisions about parts (repairing or replacing) and which brands to buy.

However, if an external maintenance organization is used, then detailed information expands on a number of parameters (such as miles traveled, replacements, repairs and breakdowns) made up of a mix of brands (for example, International Trucks, Freightliner, Kenworth, Volvo and Peterbilt Motors). If the trucking company owns, operates and maintains everything, it is unlikely that everything will all be from the same manufacturer, and it will not be providing data on the same standards or agreements. So, you, as an operator/maintainer, may have many disparate data agreements to navigate.

Example: Data Monetization

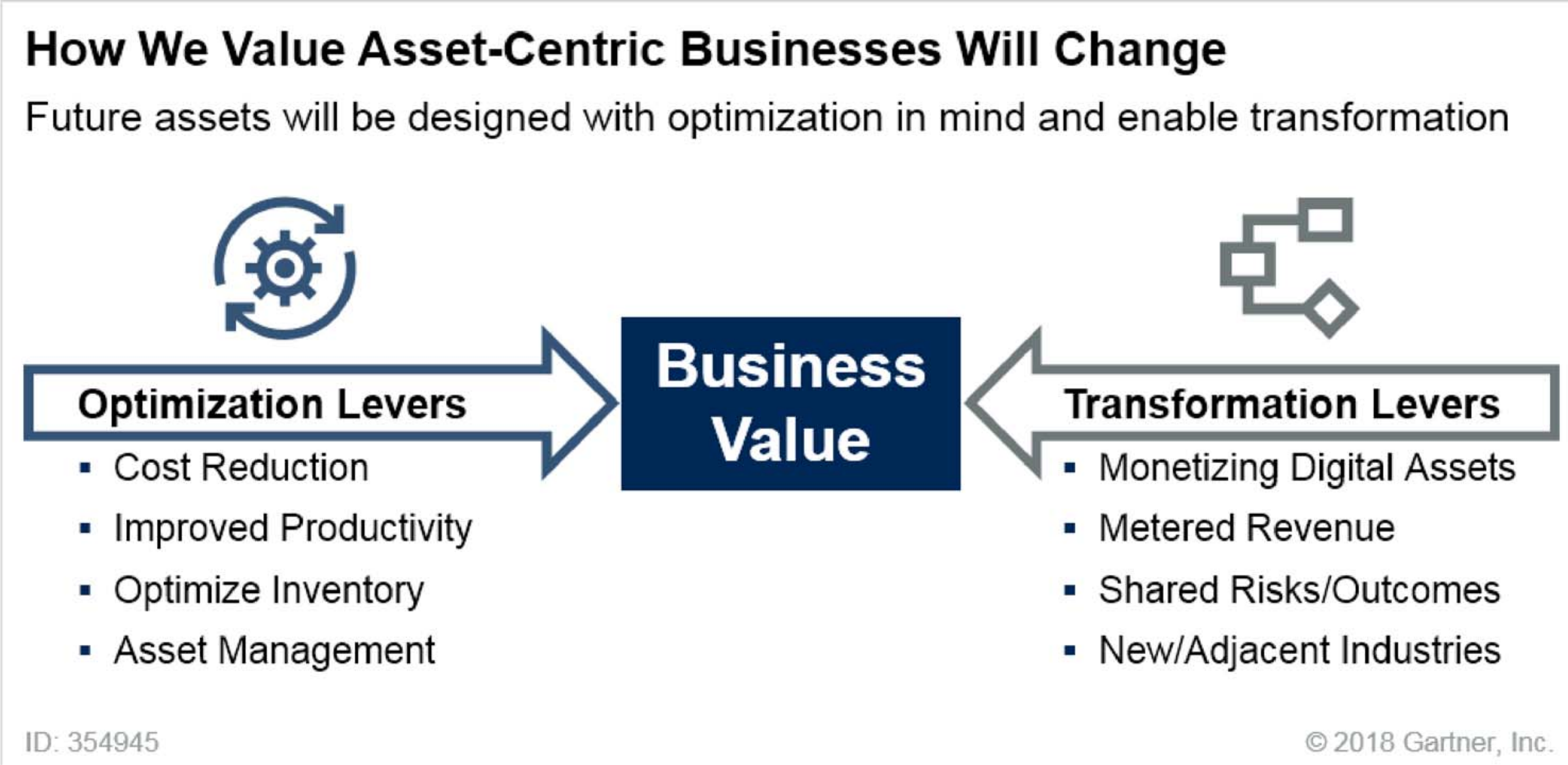
There is also a massive shift in gathering and sharing machine performance data as infonomics gives rise to data monetization. GE Digital is a multibillion-dollar investment based on data sharing. Likewise, SAP has promoted the asset intelligence network supporting the idea of information sharing in an industrial setting.

The proliferation of OT data collected from sensors may drive CIOs to seek new benefits from third parties, either the OEMs of equipment (such as GE, ABB or Siemens), or “data brokers” and data exchange businesses (such as Terbine). It is also likely that the consumer and commercial information giants like Amazon and Google will see economic opportunity in the realm of industrial data management, and may increasingly enter these new markets.

Change No. 6: How We Value Asset-Centric Businesses Will Change

Whenever a CIO has to go to the CEO about implementing new initiatives or technologies, the common and appropriate retort is: “Show me the money.” That makes this the most important question to ask. How do we make a return on our investments in digital business? Historically, technology has been leveraged to enable incremental improvements in process and productivity optimization. Future assets will be designed with optimization AND transformation in mind (see Figure 8).

Figure 8. How We Will Value Asset-Centric Businesses



Source: Gartner (December 2018)

Electric motors provide a good example. We can embed technology in the equipment or in the service model to help operators, OEMs and their service agents reduce costs, increase productivity and manage asset value. This too is highly valuable. Ultimately, if we design equipment with incremental value in mind, we can maximize multiple revenue sources, create new business models that may be more profitable and reduce the risk of current business models failing.

Manufacturers of equipment must understand how owners and operators seek value from the assets they use, and are willing to shift away from status quo business models. Doing so enables enterprises to move into the transformation zone and have the potential to create completely new business models and even industries. This may well be the holy grail of digital business. The happy surprise is that the journey also creates value. Today we might think of optimization and transformation as separate projects. Future assets will be designed with optimization in mind and enable business transformation.

For regulated industries likes utilities, the heterogeneity of regulation and its various constraints may mean less opportunity for transformation. However, some regulators are in favor of these initiatives separately, which would indicate that in the future they will converge in regulated utilities. Note: As in asset management, this will happen at different pace across different industries. An example for optimization for AIP from the California Public Utilities Commission titled "Safety and Environment Division Evaluation Report on the Risk Evaluation Models and Risk-Based Decision Frameworks in A.15-05-002, et al." is an interesting one (particularly, major findings No. 7, No. 10 and No. 12). There is no optimization of portfolio of risk mitigation activities. None of the utilities have a way to optimize their portfolio in a mathematically rigorous sense. There is no explicit consideration of optimization.

Digital Twins Enable New Strategic Business Models

Assets will increasingly include digital twins:

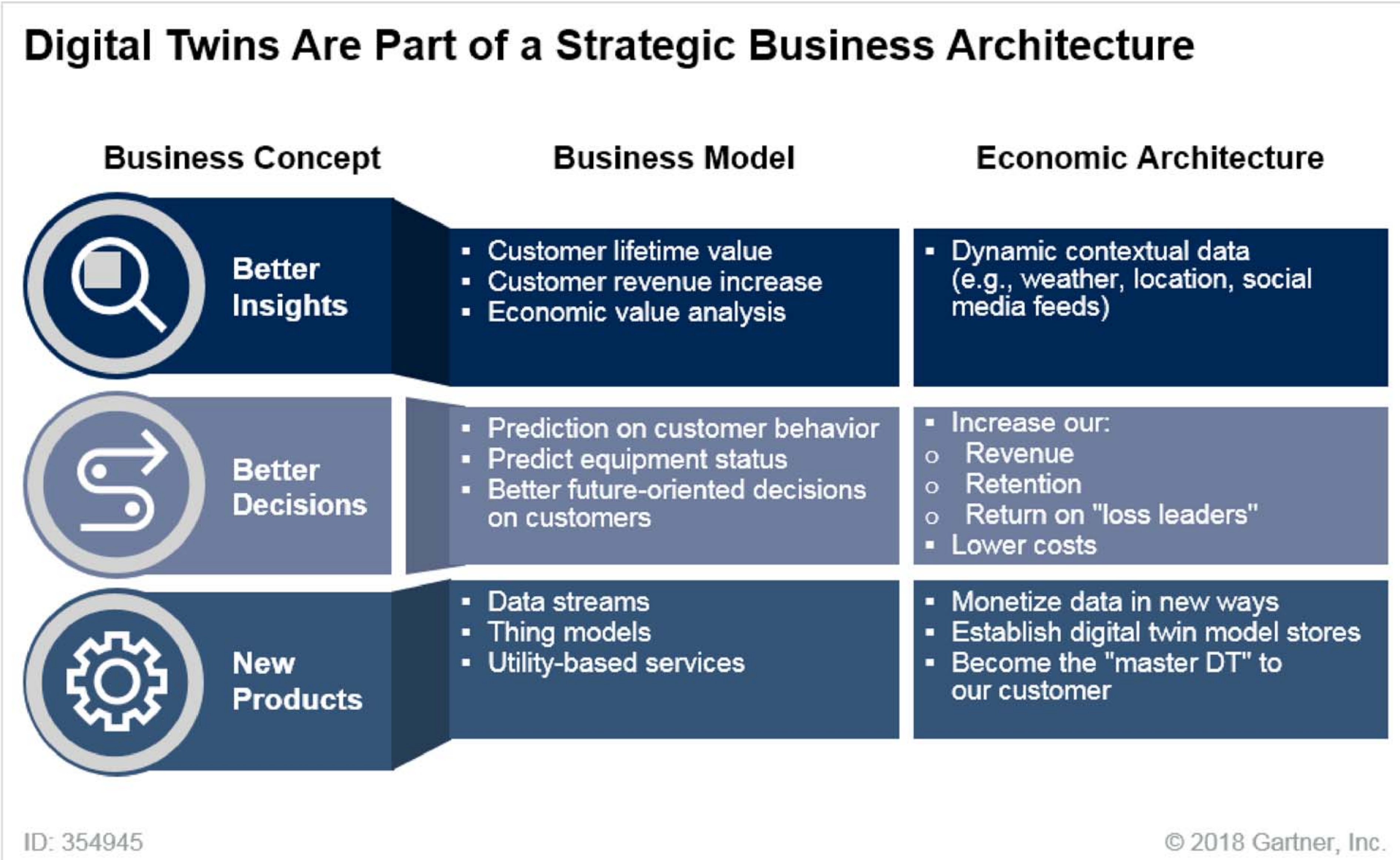
- A digital twin is a digital representation of an object.
- The implementation of a digital twin is an encapsulated software object that mirrors a unique physical object.
- A digital twin must have a model, data, uniqueness and monitoring ability.
- Digital twins represent things that add value to more traditional analytical approaches to improve situational awareness of and better respond to changing conditions, particularly for asset optimization and maintenance.
- Digital twins' use and value will depend from the perspective of the observer (OEM vs. operator).

As Figure 9 illustrates, digital twins are part of a strategic business model, for three solid reasons:

- Better insights: Digital twins provide value for customers based on indicators such as status data on a motor and asset usage data and can simulate asset behavior and impacts on how that will change with incorporating different factors and scenarios. These insights help companies rethink business/financial models and use the data to create new ways to measure customer lifetime value or determine how to add more value to both the customer and the enterprise. More accurate customer value models result, leading, ultimately, to more revenue from either differentiated equipment sold or new service and maintenance approaches.

- Better decisions: Digital twin data can help companies examine how to increase revenue per customer or lower equipment operating costs by enabling them to make better asset decisions. Companies can also use relevant contextual and asset data to analyze the enterprise stakeholder within the context of the equipment.
- New asset designs: On the surface, this looks like the most straightforward framework. Monetization models in this framework center around selling data, selling digital twin models, or selling services enabled by the digital twins. One experiment currently taking place is with financial securities that are backed by revenue streams from contracts on assets that are trusted due to their digital twin data. Companies can help re-evaluate customers' capital and operating expenditure decisions by using digital twin data and information to identify new business opportunities. Digital twin data can also help with existing assets; for example, new owners of assets such as buildings would want to know about the buildings' history of modifications, asset maintenance and plumbing.

Figure 9. Digital Twins Are Part of a Strategic Business Model



Source: Gartner (December 2018)

Recommendations

This is a great time to be a CIO and IT leader in asset-intensive organizations. Historically, asset-intensive industries have been risk-averse and slow to change. IT's role was to enable reliable, viable and profitable corporate performance. In Gartner's CEO survey of asset-intensive industries, only 9% of asset-intensive industry CEOs ranked digital and technology as their most important culture change dimension, which is much less than the 15% in other industries (see "2018 CEO Survey: CIOs Should Be Ready to Change Asset-Intensive Industries' Conservative View"). But we also saw a changing attitude to investment that would support more IT spend. The future gives an opportunity for IT to be in the driver's seat at least some of the time, if you are willing to step up and influence your organization. IT will be the main driver of transformation of business models. As a CIO, particularly in asset-intensive organizations, you should:

- Actively build your expertise and knowledge on both what is possible and what your competitors are already doing by:
  - Engaging with outside experts and other industry CIOs
  - Doing scenario planning with your teams to determine which of these six changes will impact you soonest and most, and what you need to do about them
- Do a gap analysis between your capabilities and the six changes enumerated in this research — and for each one, identify what investments you must make to close each gap and what business objective KPIs you'll use to track your progress.
- Dare to think laterally and be a student of how every industry, not just asset-intensive ones, is chasing the future of assets by learning about how other industry disruptions could impact your industry.
- Start thinking about how digital twins will impact your asset and equipment data and your analytics strategy. These may be a key resource for complex critical assets and be used in combination to create a more complete view of the business.
- Evaluate your current asset maintenance capabilities starting with your EAM systems and APM analytics. You may need to modernize the basic systems to create a platform for extending and augmenting your capability.
- Experiment with 3DP for critical parts in remote areas, which can obviate the need to complex supply chains and storage of parts. In the case of obsolete equipment that needs to be maintained, this may supplement or replace the historic skills of fitters and turners.
- Work with your suppliers, OEMs and service companies to understand their technical competence and direction and how they may be evolving in parallel to your own organization. Determine how much they can help and to what degree their development and

ecosystem may change what you need to undertake.

- Study how assets can benefit from all the data they generate to first suggest adjustments to the way they are operated, but later to eventually self-adjust themselves.

Evidence

[1] "Munich Re Acquires Tech Company Relayr," Munich Re press release.

[2] "UPS Drivers May Tag Team Deliveries With Drones," CNN Business.

[3] "DHL Uses Completely Autonomous System to Deliver Consumer Goods," New Atlas.

[4] "Amazon Patent Reveals Drone Delivery 'Beehives,'" CNN Business.

[5] "Amazon Patents Shipping Label With Built-In Parachute for Drone Deliveries," CNN Business.

[6] "Hungry? Call Your Neighborhood Delivery Robot," National Public Radio.

[7] "'Driverless' Beer Run; Bud Makes Shipment With Self-Driving Truck," CNBC.