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Top 10 Strategic Technology Trends for 2016

David W. Cearley

Our top 10 trends are key enablers for today's digital business and set the stage for the future algorithmic business. We describe how smart machines supporting an evolving digital mesh create disruptive opportunities, but require new IT architectures and platforms.

Analysis

Digital Business Demands Continuous Technology Innovation

Digital business is an overarching theme that covers how the blurring of the physical and virtual worlds is transforming products and services, as well as business designs, industries, markets and organizations. Major business and technology advancements — such as the Internet of Things (IoT), 3D printing and smart machines — combine to disrupt existing business models and create the opportunity for entirely new ones.

High-profile companies such as Uber and Airbnb are examples of digital businesses in which digital capabilities have created new

digital business models threatening existing industries. However, digital business transformation is occurring beyond the high-profile examples and is affecting almost every industry. For example, AstraZeneca and Adherium are working on a digital medical drug inhaler that records the date and time the patient uses it and the dose the patient takes. It then transmits the data to a smartphone app for analysis by the patient's doctor. [1](#) Bigbelly garbage and recycling bins use sensors to signal when each bin needs to be emptied, enabling cities such as Los Angeles and Atlanta to drive more-efficient operations and a cleaner environment. [2](#) Because digital business is changing the underlying economics of business, senior leaders must respond to remain competitive.

Gartner predicts that, by 2025, every industry will be transformed by digital business. Recognizing this inevitability, 52% of CEOs and senior business executives say their organization has a digital business strategy. [3](#) In leading organizations, the digital business strategy *is* the business strategy. This reflects an emerging trend of organizations creating new business and operating models that effectively blend the physical and virtual worlds. In ["Digital Business Is Here Now,"](#) we detail the results of the Gartner Digital Business Baseline Survey that highlights why it is important to act now.

Digital business affects every aspect of the business model, from the products and services the company offers, to back-office processes. This creates the demand and opportunity for new technologies. Key digital business opportunities and drivers include:

[4](#)

- **Digitizing products and services.** Defining products and services around integrated digital capabilities or delivery of digital content.
- **Innovating across business ecosystems.** Organizations can innovate by collaborating with complementary organizations.
- **Being "smart."** Organizations can use big data and predictive analytics to deliver the right information, product, service or action at the right time.
- **Blending technology and business.** Digital business demands a blending of capabilities. These are combinations of the technologies and business models of the Nexus of Forces (social trends, mobility, cloud and information). Here, there is no distinction between technology and the business.
- **Becoming a "test and learn" organization.** Digital technologies build on one another with each wave of innovation. Customers adopt products and services in unexpected ways. There is no right answer, so organizations must keep experimenting and adapting, using lean startup [5](#) or agile approaches.

Individually and collectively, these digital business drivers are changing how business is done. They require impassioned CIOs and other IT leaders with creative ideas who can inspire their organizations and lead them in transforming into digital businesses. These drivers have shaped our selection of the top 10 strategic

technology trends that are enabling the shift to digital business and are accelerated by it. ["Digital Business Key Initiative Overview"](#) is a quick-start guide to help CIOs, digital business leaders and enterprise architects move from digital dreams to digital reality.

Algorithmic Business Drives Transformation

Algorithmic business is an accelerator and extension of digital business. It focuses on how increasingly intelligent algorithms enable smart machines and systems to become autonomous actors in the digital business as agents for human beings. Algorithms drive the connectedness between people, things, businesses and information that drives business value. Algorithms provide the "intelligence" to get the most out of the connections and interplay between people, things, processes and information. Algorithms also are critical to delivering a differentiated customer experience.

Although big data remains a major concern for CEOs (see ["2015 CEO Survey: Committing to Digital"](#)), big data generated as part of the digital business process is of no value in itself. It is only when the organization shifts from a focus on big data to "big answers" that value begins to emerge. Analyzing big data to identify patterns and insights that drive business actions is the start of this shift. Algorithmic business transformation occurs when organizations encapsulate these insights into algorithms tied tightly to real-time business processes and decision makers, and when they use machine learning to allow increasingly autonomous algorithmic action. Algorithms are more essential to the business than data alone. Algorithms define action. In ["Predicts 2016: Advanced](#)

["Analytics Are at the Beating Heart of Algorithmic Business,"](#) we explore the critical role of advanced analytics in driving algorithmic business.

Algorithmic business extends beyond data and analytics to influence the evolution of applications, business models and future digital business solutions. This is ushering a postapp era in which system and application vendors such as Microsoft, Google and Apple are likely to deliver platforms and applications with ever-more powerful agent-based interfaces. Algorithmic business also gives businesses the opportunity to trade algorithms in algorithmic marketplaces (see ["Algorithm Marketplaces Are Bringing the App Economy to Analytics"](#)).

The world's first "robot hotel" — Henn-na Hotel in Sasebo, Japan — is an iconic example of the move toward digital and algorithmic business. ⁶ Robot receptionists greet guests, and a robot porter escorts guests to their rooms, showing them videos along the way of the Huis Ten Bosch theme park, where the hotel is located. Guests gain entry to their rooms by using facial recognition, and control room features by talking to a lamp-sized object. This is an example of creating a digital experience and exploiting digital moments.

Algorithmic business builds on digital business, shifting the emphasis to the intelligence encoded in software. CIOs and enterprise architects must add algorithmic business and related enabling technologies to their planning and future enterprise, data, security and application architectures. In ["Rising to the Challenge of](#)

[Digital Business: Key Insights From the 2015 Gartner Symposium/ITxpo Keynote,"](#) we outline the journey from digital business to algorithmic business.

IBM's acquisition of The Weather Company is an example of algorithmic business. The Weather Company has a massive IoT implementation, with hundreds of thousands of weather sensors sending 28 billion transactions to its cloud every day. Before the acquisition, IBM had an agreement to feed data to IBM Watson for weather prediction. With the acquisition, IBM brings together The Weather Company's digital environment and associated data with IBM's analytical and cognitive computing capabilities. This has created an algorithmic business providing analytical services and results to a business ecosystem with more than 5,000 customers. These customers — in, for example, airlines, insurance companies and retailers — can use the algorithmic input to drive their own business operations. [7](#)

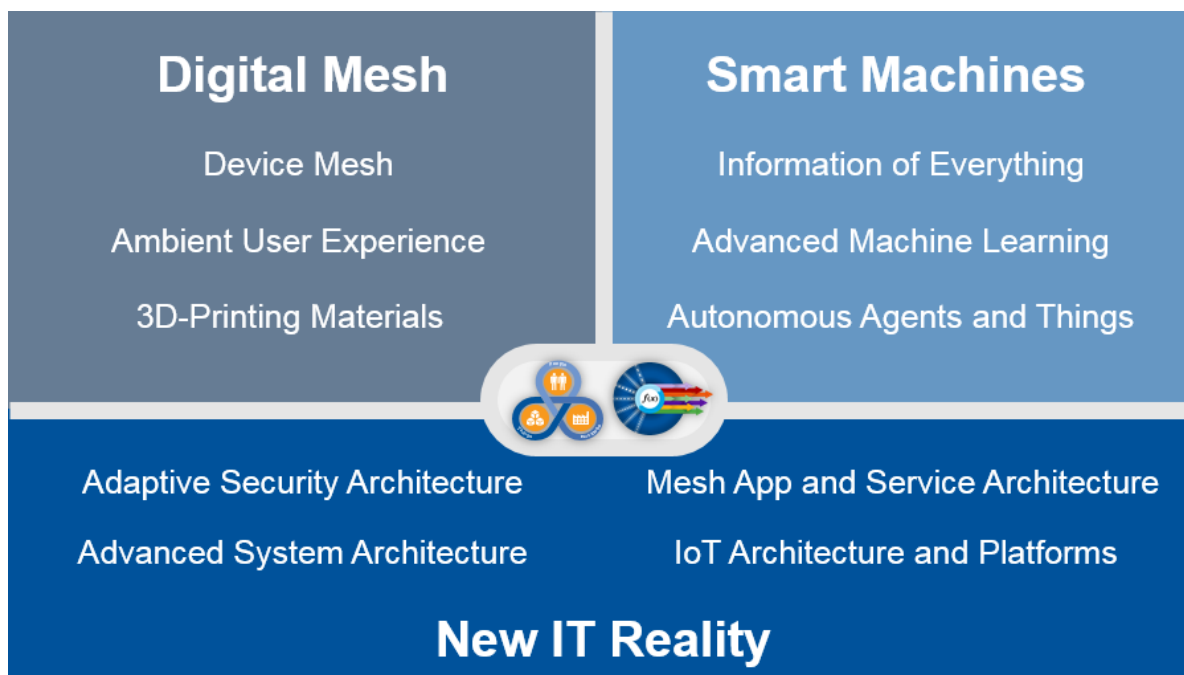
Use Our Top 10 Strategic Technology Trends to Enable Digital and Algorithmic Business

We select trends for inclusion in our top 10 list based on their potential to create disruption for people, businesses or the IT market. We use insights from analysts across Gartner and key research projects — including Hype Cycles, Predicts and Magic Quadrants — to identify and evaluate candidate trends. The trends' disruptive potential is just beginning or rapidly expanding. Another criterion is the degree to which the trends are shifting or reaching critical tipping points, and are challenging conventional wisdom to

such an extent that organizations need to look again at the trends and related technologies. We prioritize trends that have broad impact across a wide range of industries and organizations. Our top 10 is not a ranked list, with one trend being more important than the others. Rather, it is a list of interconnected trends, with their relative importance shifting by industry, business need and maturity of the enterprise. Organizations must examine the potential impact of these trends, factor them into their strategic planning for 2016 and 2017, and adjust business models and operations appropriately. If they fail to do so, they will risk losing competitive advantage to organizations that do.

Our top 10 strategic technology trends for 2016 fall into three groupings (see Figure 1) that are mutually reinforcing with amplified disruptive characteristics. The digital mesh revolves around three key trends that are bringing the virtual and physical worlds together and driving the expansion of digital business. Smart machines involve three interlinked trends anchored on data science and smart algorithms that are extending digital business into algorithmic business. The new IT reality consists of four trends that address key areas in which technology architectures and platforms must change. This change is necessary to support the world of digital and autonomous business that the digital mesh and smart machines enable. Together, our top 10 trends are forcing changes to the strategies, processes and tools used by IT professionals to deal with the complexities of digital and algorithmic business.

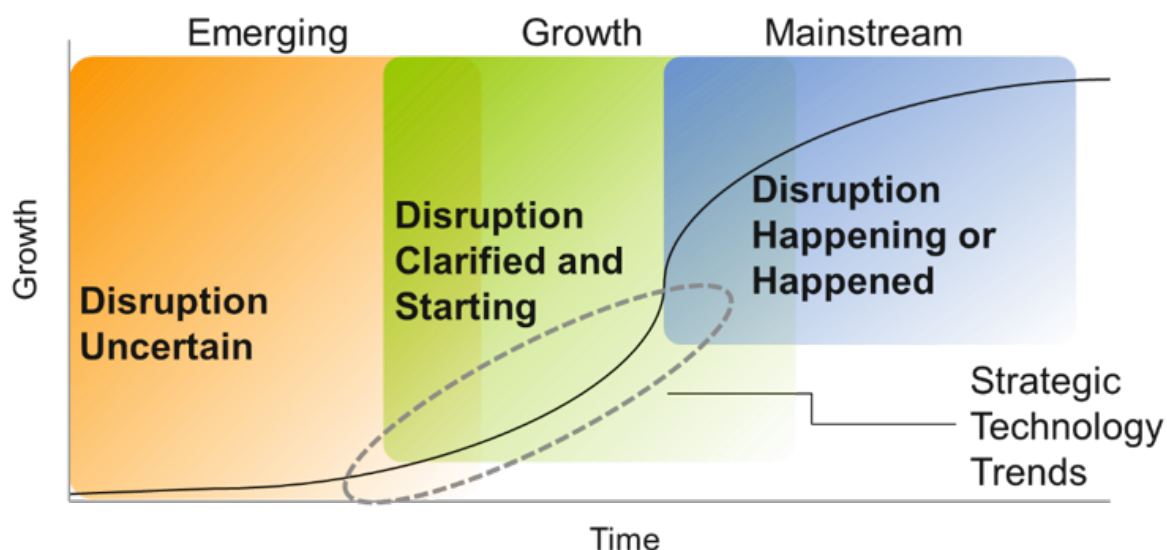
Figure 1. Gartner's Top 10 Strategic Technology Trends for 2016



Source: Gartner (February 2016)

When we evaluate candidate trends, we look across the technology adoption life cycle, focusing on late-stage emerging technologies with solidifying capabilities and disruption, and early-stage growth technologies that are evolving rapidly (see Figure 2). We occasionally include highly disruptive trends that are entering the mainstream if we identify a shift in the trend's trajectory or the introduction of a new technical element. Most of our top 10 trends for 2016 are emerging trends, as digital business is poised to evolve into algorithmic business in 2017 to 2020.

Figure 2. *The Technology Adoption Cycle*



Source: Gartner (February 2016)

Our top 10 list is an evolving one. When a trend remains critically important, with ongoing shifts in the trend and related technologies, it stays on the list, but the emphasis shifts to a new aspect of the trend. For example, 3D printing remains on our list, but the emphasis has shifted to tracking the evolution of advanced materials. Sometimes, a new trend will grow directly from, and be similar to, a trend from a previous list. For example, the digital mesh theme is a solidification and extension of the merging the real world and the virtual world theme from 2015. A trend drops from the list when it becomes more understood, the related technologies are adopted, and the evolutionary trajectory of the trend and technologies stabilizes. However, this does not mean the trend becomes unimportant. Many trends from previous lists (such as mobile apps and applications and software-defined anything) remain important and provide the foundation or inspiration for a new trend.

Some industries and regions may be addressing trends at different

rates. See our previous lists of top 10 strategic technology trends for additional topics that may be important in your particular situation. [8](#)

Use this research to assess the impact of these trends on your organization, and begin forming an appropriate response. Make adjustments based on geography, market dynamics, industry factors, unique business models and technology adoption strategies (for example, early-adopter, mainstream or risk-averse) to emphasize and prioritize some trends over others.

Research Highlights

This research looks at each of the top 10 strategic technology trends in depth.

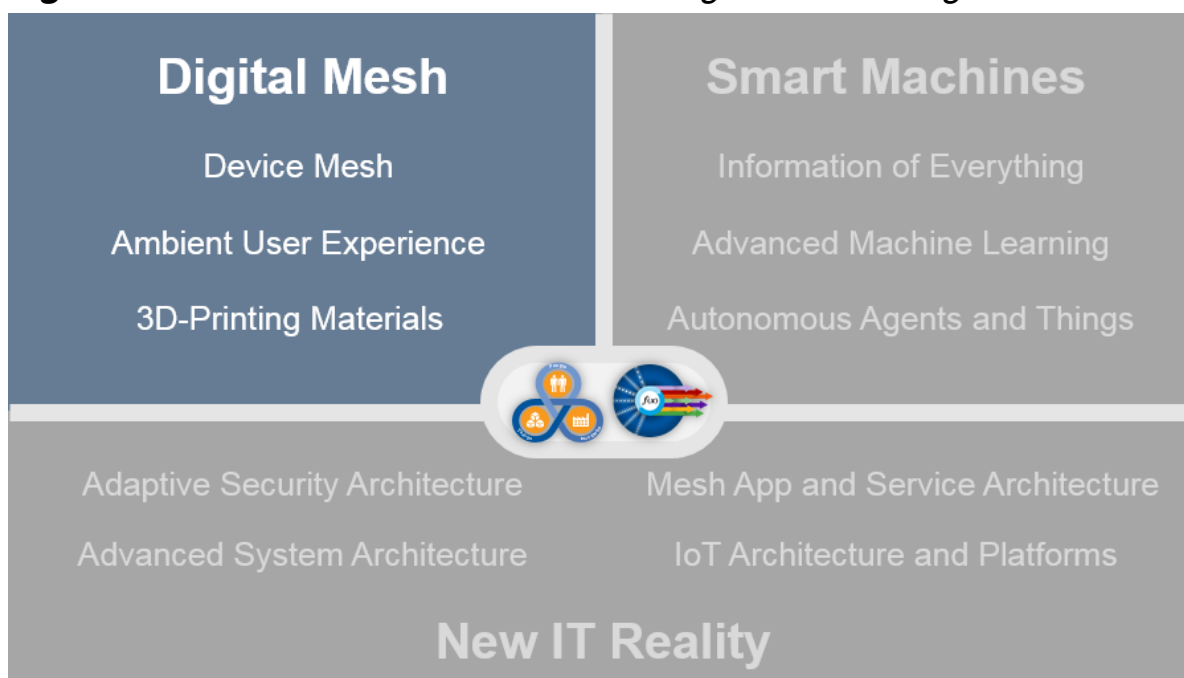
The Emergence of the Digital Mesh

In "[Digital Business Gives Rise to the New Economics of Connections](#)," Gartner defines the "economics of connections" as the creation of value through increased density of interactions between business, people and things. As an organization increases the density of its connections (between people, business and things), it increases the potential value it can realize from those connections. Connections are at the core of digital and algorithmic business models.

The digital mesh (see Figure 3) builds on the economics of connections, focusing on the connections between devices, services, applications and information. The digital mesh is a people-

centered theme that refers to the collection of devices (including things), information, apps, services, businesses and other people that exist around the individual. As the mesh evolves, all devices, compute and information resources, businesses, and individuals will be interconnected. The interconnections are dynamic and flexible, changing over time. Building business solutions and user experiences (UXs) for the digital mesh, while addressing the challenges they create, must be a priority for enterprise architects.

Figure 3. Trends Connected With the Emergence of the Digital Mesh



Source: Gartner (February 2016)

The digital mesh has emerged as a result of the collision of the physical and virtual worlds, as computing capability becomes embedded in virtually everything around us. Additional advances allow the virtual world to enter the real world through advanced UI and virtual reality models, as well as physical items created with 3D printers. This blending of both worlds delivers new insights into the

physical world, allowing us to understand it in greater detail, and interact with it in new and intelligent ways. This will change how people experience the world in their daily lives. Opportunities for new business and operating models will abound.

Three trends make up the growing digital mesh theme:

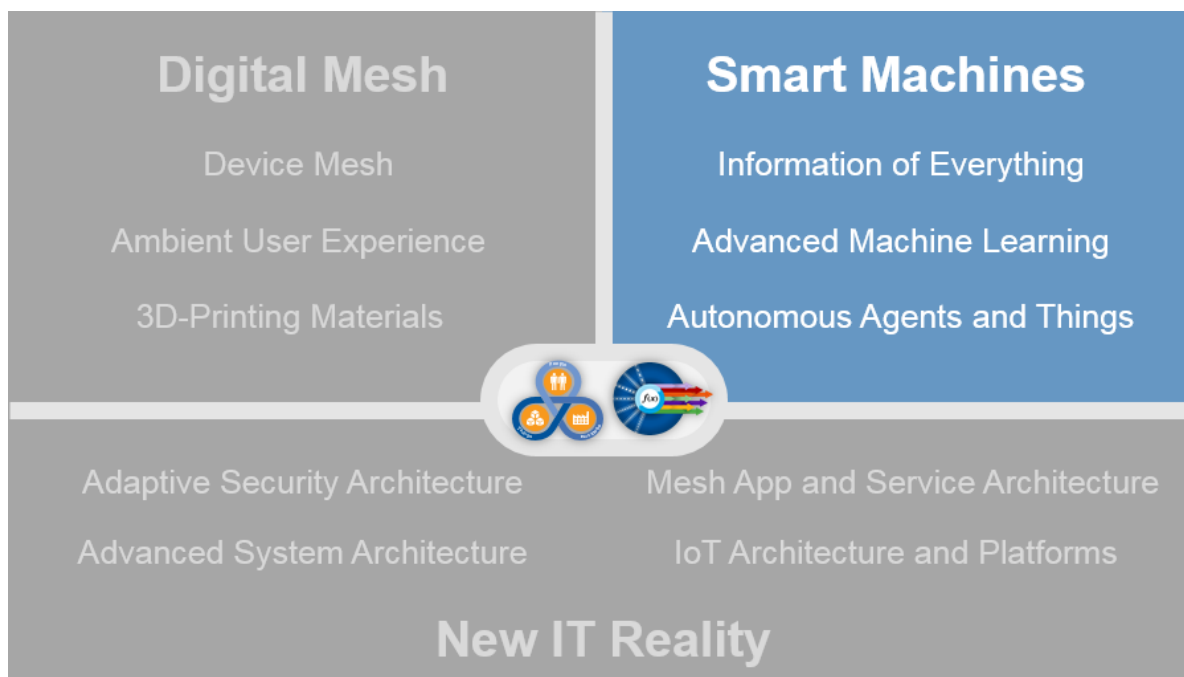
- **Trend 1: The device mesh.** The device mesh brings together traditional desktop-centered computing, mobile computing, the IoT and cloud computing in a common, connected framework of endpoints and supporting services. This enables it to deliver digital experiences, and support digital and algorithmic business opportunities. In ["Top 10 Strategic Technology Trends for 2016: The Device Mesh,"](#) we explore the implications of the expanding set of endpoint devices, encompassing traditional, mobile and IoT devices. This set shifts the focus from mobile *devices* to mobile *people* surrounded by an ever-shifting set of devices.
- **Trend 2: Ambient user experience.** Ambient UX deals with the new demands of delivering a simple, fluid and rich experience over time to people across the full range of digital mesh endpoints that surround them. The ambient UX ultimately ushers in the postapp era in which people have access to their own personal cloud of services dynamically provided through intelligent-agent-based interfaces. In ["Top 10 Strategic Technology Trends for 2016: Ambient User Experience,"](#) we identify the major technology shifts affecting the design of the UX, moving from isolated apps on devices to a mesh of devices with an immersive experience through and across devices.

- **Trend 3: 3D-printing materials.** Advances in 3D printing continue at a steady pace, with an improved price/performance ratio and increases in quality making it applicable to wider markets. A major gating factor in 3D printing is the materials that can be used and the ability to print a single item with multiple materials. Advances in 3D-printing materials are creating a flood of opportunities for 3D-printed items. In ["Top 10 Strategic Technology Trends for 2016: 3D-Printing Materials,"](#) we explore how these advances in materials will expand the use of 3D printing across a wider range of industries.

Smart Machines Set the Stage for Algorithmic Business and the Algorithmic Economy

The smart machines theme (see Figure 4) describes how information of everything is developing to extract greater meaning from a rapidly expanding set of sources. Advanced data analysis technologies and approaches are evolving to create physical and software-based machines that are programmed to learn and adapt, rather than programmed only for a finite set of prescribed actions.

Figure 4. *Trends Connected With Smart Machines*



Source: Gartner (February 2016)

The amount of big data collected by the many devices currently in place is staggering. However, the accelerating merger of the physical and virtual worlds will make the present volumes seem paltry. New kinds of data will continuously stream from new types of devices at record rates.

This oversupply will overwhelm those who are ill-prepared. For those who are prepared, the potential to gain new kinds of critical intelligence will be unprecedented. Leading senior executives will build a strong competency in turning this data into critical intelligence that will drive their organizations' future direction. Additionally, leading organizations will significantly advance operational agility with near-real-time information, feeding business processes that can absorb it and react accordingly. Data coming from almost all directions provides the possibility for intelligence everywhere when combined with advanced artificial intelligence

algorithms and other machine-learning techniques.

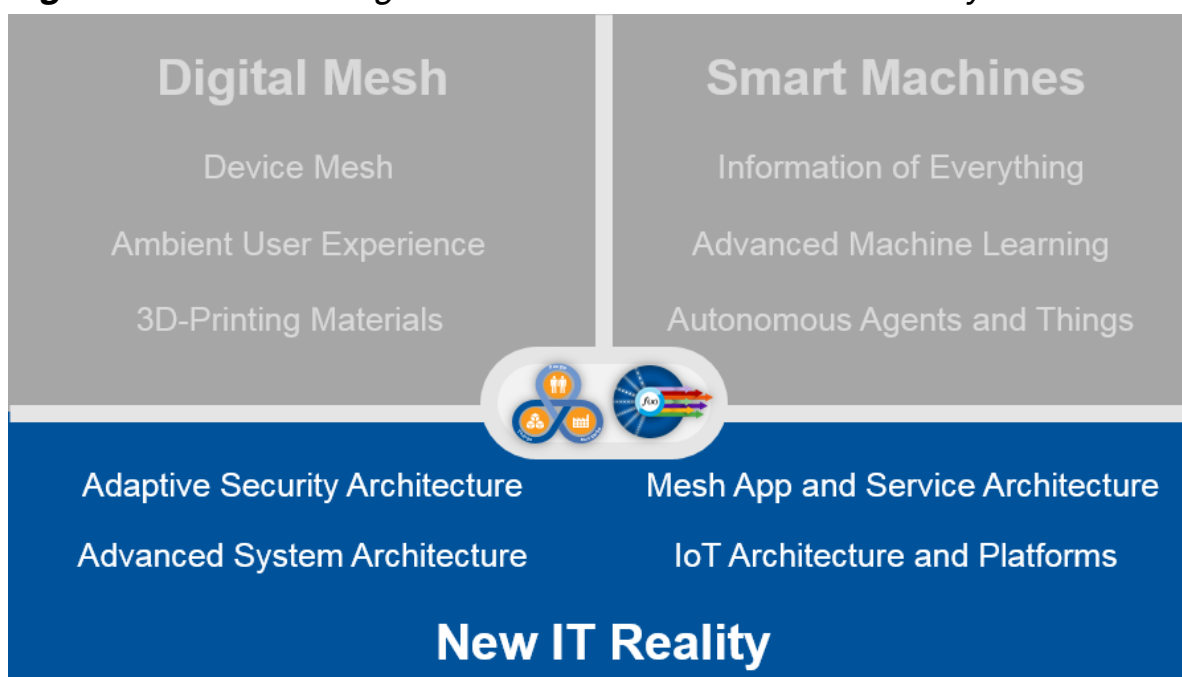
Three distinct trends are intimately linked in the smart machines theme. They represent an evolution in how systems deal with data, and the machines and people that create and consume this data, culminating in intelligence everywhere:

- **Trend 4: Information of everything.** Massive amounts of data from traditional systems, cloud sources and the IoT create an overload that must be addressed by more-advanced analytics integrated into the fabric of applications, business processes and routine user activities. In ["Top 10 Strategic Technology Trends for 2016: Information of Everything."](#) we examine the implications and opportunities arising from the massive increase in the volume, velocity and variety of information. We also discuss the implications for advanced analytics and data science.
- **Trend 5: Advanced machine learning.** Machine learning enables computers to act without being explicitly programmed. ⁹ Massive amounts of data, unprecedented advances in machine-learning algorithms and new hardware platforms delivering massively parallel compute power are accelerating machine learning. ¹⁰ In ["Top 10 Strategic Technology Trends for 2016: Advanced Machine Learning."](#) we analyze the rapid evolution of machine learning as the next step in data science and the foundation for creating smart machines and the algorithmic economy.

- **Trend 6: Autonomous agents and things.** Businesses and IT leaders have a broad range of opportunities to exploit machine learning. These opportunities offer the potential to deliver autonomous and semiautonomous agents and things, including robots, autonomous vehicles, smart vision systems, virtual customer assistants, smart agents and natural-language processing. ¹¹ Even everyday objects such as a stethoscope and enterprise software such as CRM systems or security tools increasingly have a smart and autonomous aspect. In "[Top 10 Strategic Technology Trends for 2016: Autonomous Agents and Things.](#)" we look at how information of everything and advanced machine-learning algorithms, supported by advanced system architectures, are leading to more intelligent software and hardware-based solutions. These are creating new market segments and enhancing existing ones.

Digital Business and Algorithmic Business Require a New IT Reality

The new IT reality theme (see Figure 5) addresses key areas in which technology architectures and platforms must change to support the world of digital and autonomous business that the digital mesh and smart machines enable. New architectures for security, systems, applications and services will be required. Also, platforms must evolve to address the ongoing mobile computing challenges, as well as the unique requirements of the IoT. Unless organizations address these architectural and platform issues, they won't be able to exploit the opportunities and address the challenges of the digital mesh and smart machines.

Figure 5. Trends Emerge Connected With the New IT Reality

Source: Gartner (February 2016)

This final set of strategic technology trends looks at how IT leaders must think about technology architecture and use. Embracing the complexities of digital business technologies that merge the physical and virtual worlds, along with solutions powered by intelligence everywhere, renders old architecture models insufficient or obsolete.

We need new approaches for designing applications, integrating them with one another and presenting them to users. The digitalized world requires a complex and dynamically shifting set of endpoints and cloud services. This means we must change the way we manage and secure the environment, and how we understand IT culture. The trends enabled and accelerated by digital business affect IT. This is a direct result of the new digital technology capabilities from the merging of the physical and virtual worlds,

along with the emergence of intelligence everywhere.

In the new IT reality, the following trends are starting to emerge:

- **Trend 7: Adaptive security architecture.** Adaptive security architectures recognize that traditional access control and perimeter defense are insufficient, and we need a full range of tools. Security must start with application design, extend through robust application testing, and follow through with runtime application self-protection for operational systems. In addition, user and entity behavior analytics using contextual analysis and machine-learning algorithms will deliver real-time monitoring and active protection for internal systems. In ["Top 10 Strategic Technology Trends for 2016: Adaptive Security Architecture,"](#) we examine how security must evolve to deal with the increasing complexity of the digital mesh, smart machines and cloud computing.
- **Trend 8: Advanced system architecture.** Advances in system architecture — especially chip architectures to support parallel processing — have helped ignite the growth of smart machines. In ["Top 10 Strategic Technology Trends for 2016: Advanced System Architecture,"](#) we provide a view of the innovations occurring at the system level to support the needs of smart machines and algorithmic business.
- **Trend 9: Mesh app and service architecture.** Cloud computing principles and adaptive, layered applications that span an ever-changing sea of client endpoints provide the

foundation for the digital mesh. Software-defined approaches that emphasize the creation of microservices with rich, layered APIs and delivery of services using OS containers provide greater deployment flexibility to support the dynamic nature of the digital mesh. Application architecture must also deal with the full range of potential endpoints, with an increasingly dynamic and intelligent UI layer assembling service components as needed. In ["Top 10 Strategic Technology Trends for 2016: Mesh App and Service Architecture,"](#) we highlight the major shifts in application architecture for the digital mesh and ambient UX, as well as key enabling technologies to support this emerging architecture.

- **Trend 10: IoT architecture and platforms.** Enterprise architects must consider security, privacy, cost, ease of access, agility and performance to determine the best architecture for their IoT initiatives. ¹² An IoT platform enables enterprises to monitor and control IoT endpoints and build applications to meet digital business requirements. ¹³ In ["Top 10 Strategic Technology Trends for 2016: Internet of Things Architecture and Platforms,"](#) we explore how the IoT elements of the digital mesh are driving the demand for new architectures and a new set of platform capabilities to support IoT solutions.

Putting Our Top 10 Strategic Technology Trends Into Action

It's important to track disruptive technology trends and factor them into business and IT strategies. However, many organizations have, at most, an informal process for doing so. Often, the activity is

relegated to a disjointed set of meetings of particular groups (such as marketing and development) or considered only within the context of an ongoing IT project. Sometimes, an organization may have an annual meeting at which it considers long-term trends, but this is often lost in the day-to-day activities that follow.

Organizations that have created a more formalized process to track and evaluate disruptive trends often identify potential business impact earlier than competitors, enabling them to turn the disruption into market advantage. Enterprise architecture (EA) and technology innovation leaders are well-placed to address these disruptions. In ["Using EA to Master Emerging and Strategic Trends Primer for 2016,"](#) we highlight the role that enterprise architects can play in exploiting disruptive technologies for business innovation.

As Figure 6 shows, and as described in ["Leveraging Enterprise Architecture to Lead the Enterprise Response to Disruptive Technologies,"](#) enterprise architects take a deliberate approach when addressing disruptive technologies. At the highest level, they use this approach to:

- Explore the trends that matter
- Rationalize what these trends mean to the business
- Deliver high value with these trends

Figure 6. *How Enterprise Architects Put Digital Disruptions Into Action*

Exploration

Discover and examine what innovations offer

Rationalization

Understand the specific impact and opportunities that innovations present to your organization

Delivery

Create actionable plans that business and IT leaders can use as the basis for making informed decisions



Source: Gartner (February 2016)

By using a structured approach to evaluate disruptive technologies, enterprise architects can take advantage of this leading EA technique to help their organizations seize opportunities, while reducing the risks of adoption. The landscape of disruptive technology trends is complex, and not all trends will be equally important to every organization. To be successful, organizations must use enterprise architecture and take a structured — yet flexible and iterative — approach. This will enable them to quickly identify the disruptive trends they must investigate, analyze their impact on the organization and deliver actionable recommendations that drive change.

Gartner Recommended Reading

Evidence