

Top 10 Strategic Technology Trends for 2016: At a Glance

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Gartner's top 10 strategic technology trends will shape digital business opportunities through 2016. IT leaders must understand and prepare for the impacts these disruptive trends will have on people, their businesses and IT departments, and then determine how they can provide competitive advantage.

Key Findings

- A "digital mesh" is evolving around the individual. It is an expanding set of devices, individuals, information and services that are fluidly and dynamically interconnected. New, continuous and ambient user experiences are emerging to exploit the digital mesh.
- Advances in 3D printing materials and composites open up new opportunities and affect an expanding list of industries.
- Machine-learning technology combines the "information of everything" with smart machine algorithms to make an algorithmic business possible.
- Relentless and ever-increasing security attacks require adaptive security architectures that emphasize application self-protection and user and entity analytics.

Recommendations

IT leaders must:

- Evaluate their businesses and the IT impact of the expanding set of end-user devices (including "things") in the digital mesh, especially the impact on the design of continuous and ambient user experiences.
- Challenge and rethink how materials are being created and used to enable their businesses, along with the products and services offered.

- Revolutionize their business models with smart machine technologies that will harness massive amounts of information and bring advanced intelligence to deliver unique and unimaginable business models.
- Augment perimeter defense and rule-based security detection with user and entity behavior analytics as well as application self-protection during the next two to three years.

Analysis

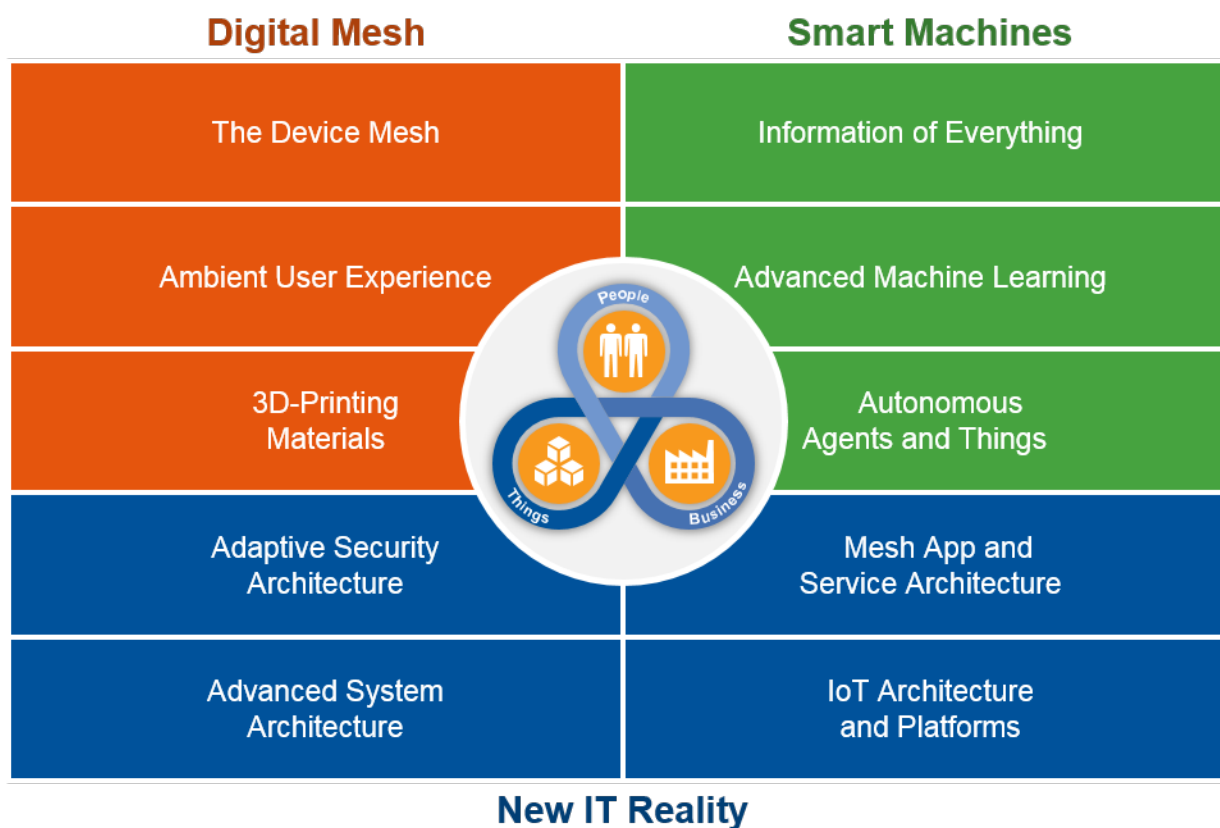
Digital business is an overarching theme that covers how the blurring of the physical and virtual worlds is transforming business designs, industries, markets and organizations. Autonomous business is a complementary theme covering how increasingly intelligent algorithms enable smart machines and systems to become autonomous actors in the digital business as agents for human beings. When IT leaders respond to digital and autonomous business, they must respond to the disruptive enabling technology trends that brought them about.

Strategic technology trends have substantial disruptive potential that is just beginning to materialize; however, that could hit an inflection point within the next five years. Our top 10 list highlights strategic trends with broad industry impact within the next three years. These trends aren't yet broadly recognized or are experiencing significant changes. Organizations must examine the business impact of our top 10 strategic technology trends, and adjust their business and IT strategies and operational models appropriately. If they don't, they'll risk losing competitive advantage to those that do.

The top 10 strategic trends include three groupings of complementary trends (see Figure 1) that are mutually reinforcing with amplified disruptive characteristics:

- **The digital mesh** is a human-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 throughout the day. Building digital business solutions and user experiences for the digital mesh, while addressing the challenges they create, must be a priority for IT leaders.
- **Smart machines** describe a theme that starts with how the information of everything is evolving 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.
- **The new IT reality** theme addresses key areas in which technology architectures and platforms must change to support the world of digital and autonomous business enabled by the digital mesh and smart machines. New architectures for security, systems, applications and services will be required. Also, platforms must evolve to address not only the ongoing mobile computing challenges, but the unique requirements of the Internet of Things (IoT). Unless organizations address these architectural and platform issues, they won't be able to address the opportunities and challenges of the digital mesh and smart machines.

Figure 1. Top 10 Strategic Technology Trends for 2016



Source: Gartner (October 2015)

Trend No. 1: The Device Mesh

The device mesh refers to an expanding set of endpoints people use to access applications and information, or interact with people, social communities, governments and businesses. The device mesh moves beyond the traditional desktop computer and mobile devices (tablets and smartphones) to encompass the full range of endpoints with which humans might interact. Devices are increasingly connected to back-end systems through various networks, but often operate in isolation from one another. As the device mesh evolves, we expect connection models to expand and greater cooperative interaction between devices to emerge.

We expect significant innovation in new types of devices during the next five years. This will create many new digital business opportunities, but also pose significant IT security and management challenges.

The device mesh includes:

- Traditional computing and communication devices, including desktop and mobile devices

- Wearable devices, including head-mounted displays that enable virtual and augmented reality
- Home electronics and other consumer devices, including appliances
- Transportation devices — including the automobile — that become digital endpoints
- Environmental devices, including objects, cameras and other sensors in the IoT

Related research:

- "Wearables: New Interactions and New Opportunities"
- "The Evolving Role of the Personal Cloud in the Digital Workplace"
- "Master the Four Stages of Connected-Vehicle Evolution to Lead the Renaissance of the Automobile"
- "Market Trends: Head-Mounted Displays for Virtual Reality and Augmented Reality"
- "Maverick* Research: Goodbye Smartphones, Hello HMDs"
- "Market Trends: 5G — A New Generation of User Experience and Opportunities"

Trend No. 2: Ambient User Experience

The device mesh creates the foundation for a new continuous and ambient digital experience. A continuous experience preserves continuity of user experience across traditional boundaries of devices, time and space. Users can interact with an application in a dynamic multistep sequence that may last for an extended period. The experience seamlessly flows across multiple devices and interaction channels. The experience blends physical, virtual and electronic environments, and uses real-time contextual information as the ambient environment changes, or as the user moves from one place to another.

The ambient user experience provides a greatly enhanced and immersive user experience, building on augmented and virtual reality. As well as specialized head-mounted displays, the ambient user experience uses the full array of the connected devices — including IoT things — in the mesh surrounding the user. For example, it may use a tablet to display a real-time video of the world around the user with superimposed information or translations related to the objects in the video.

User experience and app design are shifting with the expanding set of endpoints in the device mesh. In the new user experience, new input/output mechanisms emerge using audio, video, haptic, taste, olfactory and other sensory channels, such as radar. These sensory modes have capabilities beyond those of human beings. Apps will target an orchestrated collection of devices being used together, rather than an individual device used in isolation. The realization of the ambient user experience requires a profoundly better appreciation of privacy and permission. Missteps by some organizations will probably lead to regulation that will affect everyone.

Related research:

- "Hype Cycle for Human-Machine Interface, 2015"

- "Market Trends: Head-Mounted Displays for Virtual Reality and Augmented Reality"
- "IT Leaders Should Drive to Perfect the Customer Experience Through Mobile Apps"
- "Toolkit: How EA Enables Digital Humanism via Business Outcomes Journey Maps to Exploit Digital Disruptions"
- "How User Experience Can Make or Break Your Customer Experience"
- "Use Journey Maps in User Experience Design and Digital Workplaces"

Trend No. 3: 3D-Printing Materials

Advances in 3D printing have already enabled 3D printing to use a wide range of materials, including advanced nickel alloys, carbon fiber, glass, conductive ink, electronics, pharmaceuticals and biological materials. These innovations are driving user demand as the practical applications for 3D printers expand to more sectors, including aerospace, medical, automotive, energy and the military. The growing range of 3D-printable materials will drive a compound annual growth rate of 64.1% for enterprise 3D-printer shipments through 2019.

Recent advances make it possible to mix multiple materials together with traditional 3D printing in one build. These advances will necessitate a rethinking of designs unconstrained by traditional manufacturing processes. New supply chain processes that exploit opportunities for 3D printing on demand, and assembly line processes that can embed components within 3D-printed materials, will create business disruption. Biological 3D printing — such as the printing of skin and organs — is progressing from theory to reality. Researchers are doing much bioprinting work, but politicians and the public don't have a full understanding of the implications.

Related research:

- "Forecast: 3D Printers, Worldwide, 2015"
- "An Enterprise Architect's Best Practices for 3D Printing"
- "Hype Cycle for 3D Printing, 2015"
- "Hype Cycle for Life Sciences, 2015"
- "Market Guide for 3D Printing"

Trend No. 4: Information of Everything

Everything surrounding us in the digital mesh is producing, using and communicating with virtually unmeasurable amounts of information. Harnessing this information requires organizations to understand the flood of unstructured information that goes beyond textual, audio and video information to include sensory and contextual information. While information has been available in disparate repositories for decades, the information of everything is the result of the confluence of the miniaturization of compute, network ubiquity, advanced algorithms, and vast new sources of information. Information of everything addresses the:

- Identification of the information from the digital mesh that provides strategic business value
- Approaches to access from different data sources
- Exploration of how algorithms leverage information of everything to fuel new business designs

Fueling smart machines, and ultimately an algorithmic business, existing and emerging semantic approaches, data classification models and information analysis techniques will enable information of everything, mapping relationships between the different data elements. Advanced machine learning is closely related to this trend; it provides new ways to classify information and discern patterns that would be difficult or impossible for human beings to accomplish.

Related research:

- "Best Practices for Successfully Leveraging Enterprise Architecture in Big Data Initiatives"
- "Information Classification: An Essential Security Thing You're (Still) Not Doing"
- "Leveraging Enterprise Architecture to Enable Business Value With IoT Innovations Today"
- "Cool Vendors in Data Science, 2015"
- "Hype Cycle for Enterprise Information Management, 2015"

Trend No. 5: Advanced Machine Learning

Advanced machine learning moves beyond previous attempts at creating algorithmic-based solutions that harness information of everything to become more insightful, self-directed and autonomous. The explosion of data sources and complexity of information makes manual classification and analysis infeasible and uneconomic. Machine learning automates these tasks and makes it possible to address key challenges related to the information of everything trend.

Machine learning algorithms are composed of a set of many technologies — deep learning, neural networks, natural-language processing and other technologies — used in unsupervised as well as supervised learning ways to understand information, activities and the world. Advanced machine learning is what makes smart machines appear "intelligent." Advanced machine learning not only enables a smart machine to understand concepts in the environment, but enables it to learn. Through machine learning, a smart machine can change its future behavior. For example, by analyzing vast databases of medical case histories, "learning" machines can reveal previously unknown insights in treatment effectiveness. This area is evolving quickly, and organizations must assess how they can apply these technologies to gain competitive advantage.

Related research:

- "Smart Machines See Major Breakthroughs After Decades of Failure"
- "Cool Vendors in Smart Machines, 2015"
- "Hype Cycle for Smart Machines, 2015"

- "Leveraging Enterprise Architecture to Enable Business Value With Smart Machine Innovations Today"
- "Analytics and Learning Technology: CIOs, CTOs Should Rethink Art of the Possible"
- "How to Maintain Smart Machines"

Trend No. 6: Autonomous Agents and Things

Advanced machine learning gives rise to a spectrum of smart machine implementations — including robots, autonomous vehicles, virtual personal assistants (VPAs) and smart advisors — that act in an autonomous (or at least semiautonomous) manner. VPAs such as Google Now, Microsoft's Cortana and Apple's Siri are becoming smarter and are precursors to autonomous agents. The emerging notion of assistance feeds into the ambient user experience in which an autonomous agent becomes the main user interface. Instead of interacting with menus, forms and buttons on a smartphone, the user speaks to an app, which is really an intelligent agent. These intelligent agents may be associated with an individual app or act across multiple apps. IT leaders should explore how they can use autonomous things and agents to free people for work that only people can do. However, they must recognize that smart agents and things are a long-term phenomenon that will continually evolve and expand their uses for the next 20 years.

Related research:

- "IT Strategists Must Prepare for the Rise of Virtual Personal Assistants in the Workplace"
- "Smart Agents Will Drive the Switch From Technology-Literate People, to People-Literate Technology"
- "Exploit the Rise of Smart Nonindustrial Robots for Work and Home"
- "Create Smart Machines With Ethics in Their 'Minds'"
- "Internet of Things Scenario: When Things Become Customers"

Trend No. 7: Adaptive Security Architecture

The complexities of digital business and the algorithmic economy, combined with an emerging "hacker industry," significantly increase the threat surface for an organization. Relying on perimeter defense and rule-based security is inadequate, especially as organizations exploit more cloud-based services and open APIs for customers and partners to integrate with their systems. IT leaders must focus on detecting and responding to threats, as well as more traditional blocking and other measures to prevent attacks. Application self-protection, as well as user and entity behavior analytics, will help fulfill the adaptive security architecture.

User and entity behavior analytics are an important emerging category of security. These systems profile and baseline the activity of users, peer groups and other entities, such as endpoints, applications and networks. They correlate user and other entity activities and behaviors, and detect anomalous behavior and patterns using advanced machine learning and statistical models that

compare activity to profiles. Organizations will be able to see, for example, whether individuals are visiting sites they haven't visited before or are downloading things they don't normally download. Unusual behavior will trigger alarms. Much venture capital exists in this area, along with new tools and technologies.

Infrastructure and perimeter protection technologies lack the means to ensure accurate detection of application vulnerabilities and protection against application-level attacks. Moreover, they can't protect against behind-the-perimeter insider attacks, which are as devastating as outsider attacks. Therefore, technologies are emerging that enable application security self-testing, self-diagnostics and self-protection.

Related research:

- "Market Guide for User and Entity Behavior Analytics"
- "Best Practices and Success Stories for User Behavior Analytics"
- "Hype Cycle for Application Security, 2015"
- "Maverick* Research: Stop Protecting Your Apps; It's Time for Apps to Protect Themselves"
- "Magic Quadrant for Security Information and Event Management"

Trend No. 8: Advanced System Architecture

The digital mesh and smart machines require intense computing architecture demands to make them viable for organizations. Providing this required boost are high-powered and ultra-efficient neuromorphic architectures. Fueled by field-programmable gate arrays (FPGAs) as an underlining technology for neuromorphic architectures, there are significant gains to this architecture, such as being able to run at speeds of greater than a teraflop with high-energy efficiency. It thus outpaces graphic processing units (GPUs) by a factor of three in energy efficiency, along with a throughput increase of 70% with comparable energy used.

Systems built on GPUs and FPGAs will function more like human brains that are particularly suited to be applied to deep learning and other pattern-matching algorithms that smart machines use. FPGA-based architecture will allow further distribution of algorithms into smaller form factors, with considerably less electrical power in the device mesh, thus allowing advanced machine learning capabilities to be proliferated into the tiniest IoT endpoints, such as homes, cars, wristwatches and even human beings.

Related research:

- "Altera Acquisition Will Extend Intel's Reach in the Cloud"
- "Hype Cycle for Semiconductors and Electronics Technologies, 2015"
- "Smart Machines See Major Breakthroughs After Decades of Failure"
- "IT Market Clock for Storage, 2015"

Trend No. 9: Mesh App and Service Architecture

The mesh app and service architecture are what enables delivery of apps and services to the flexible and dynamic environment of the digital mesh. This architecture will serve users' requirements as they vary over time. It brings together the many information sources, devices, apps, services and microservices into a flexible architecture in which apps extend across multiple endpoint devices and can coordinate with one another to produce a continuous digital experience. IT will increasingly deliver services as cloud services in the mesh app and service architecture, supported by software-defined application architectures, containers and microservices. IT needs a DevOps mindset to bring together development and operations in support of continuous development, and continuous integration and delivery.

Related research:

- "An Introduction to How Software-Defined Application Services Enable the Apps and Services Architecture"
- "Selecting Technology to Support an SDAS Service Control Gateway"
- "Hype Cycle for Application Architecture, 2015"
- "Cool Vendors in Web-Scale Platforms, 2015"
- "Docker Democratizes Virtualization for DevOps-Minded Developers and Administrators"
- "Assessing Microservice Architecture for Scalable Application Delivery"

Trend No. 10: Internet of Things Architecture and Platforms

IoT platforms exist behind the mesh app and service architecture. The technologies and standards in the IoT platform form a base set of capabilities for communicating, controlling, managing and securing endpoints in the IoT. The platforms aggregate data from endpoints behind the scenes from an architectural and a technology standpoint to make the IoT a reality. The IoT is an integral part of the digital mesh and of the continuous and ambient experience. The emerging and dynamic world of IoT platforms makes them possible. Vendors — including IBM, Oracle, SAP and Microsoft — are beginning to provide IoT platform elements. However, most offerings are incomplete. Rapid evolution and competition will occur in the next three years. IT leaders will need to assemble their own IoT platform architectures, often using multiple IoT platforms from different vendors. This will make integration an ongoing challenge.

Related research:

- "Market Guide for IoT Platforms"
- "Best Practices in Exploring and Understanding the Full Scope of IoT Solutions"
- "Cool Vendors in the Internet of Things, 2015"
- "Hype Cycle for the Internet of Things, 2015"

- "Agenda Overview for the Internet of Things, 2015"

Gartner Recommended Reading

Some documents may not be available as part of your current Gartner subscription.

"Digital Business Is Here Now"

"Digital Business Drives Enterprise Architecture to Refocus on Personal Architectures"

"When Smart Things Rule the World — Introducing Autonomous Business"

"Leveraging Enterprise Architecture to Lead the Enterprise Response to Disruptive Technologies"

"Toolkit: How Enterprise Architects Can Conduct Digital Disruption Innovation Workshops for Business and IT Leaders"

"Hype Cycle for Emerging Technologies, 2015"

"Toolkit: What Enterprise Architects Need to Drive Computing-Everywhere Strategies"

"Leveraging Enterprise Architecture to Enable Business Value With IoT Innovations Today"

"Toolkit: What Enterprise Architects Need to Know About IoT Technologies"

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