A Framework for Applying AI in the Enterprise

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**Analyst(s):** Bern Elliot, Whit Andrews

This document provides an overview of Gartner AI-related research and analyst resources. Enterprise architecture and technology innovation leaders should leverage this reference to optimize Gartner support when defining and developing enterprise strategies and plans.

**Key Findings**

- The term artificial intelligence (AI) covers a broad and continuously evolving range of technologies.
- AI technologies are being used in many different applications and industries.
- Enterprise planners often are unfamiliar with what AI can do for their enterprise and are uncertain of how and where to start using AI-based solutions.
- Recent advances in the AI areas of deep learning (deep neural networks) and allied areas of natural-language processing (NLP) have spawned renewed interest in what advanced AI applications can accomplish.

**Recommendations**

Enterprise architects looking to apply AI in the enterprise should:

- Use the Gartner research outlined here to become familiar with AI and how it can be applied within their enterprises.
- Exploit areas of more significant opportunity, including where enterprises use deep learning (deep neural networks) and allied areas of NLP applications, to mine data quickly and efficiently to uncover underlying insights that humans would take much longer to discover, if at all.
- Manage and exploit the AI-based features over time that will be nearly pervasive in all new applications by 2020.

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Analysis

This document provides a framework to assist enterprise architects in understanding and applying the broad and rapidly evolving area of artificial intelligence (AI). Each section in this document provides a brief overview of its topic, the names of analysts who can provide additional information on the topic, and references to the Gartner published research that is most relevant.

Figure 1 provides an overview of the framework that divides the enterprise approach to AI into four major areas.
Core AI technologies are the foundational AI technologies that underlie all AI solutions and are applied in a wide variety of ways. Table 1 provides a list of these core AI technologies.

**Table 1. Core AI Technologies**

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Source: Gartner (June 2017)

These core technologies are incorporated into a broad range of AI applications, which are then used in a variety of ways in the enterprise. The section on leading AI application areas, summarized in Table 2, describes some of the more common application areas for AI technologies. The ways in which these application areas are then applied are described in subsequent sections.
Table 2. Leading AI Application Areas

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Source: Gartner (June 2017)

The section on AI in the enterprise, summarized in Table 3, provides an overview of how different departments and service areas with an enterprise are applying or can apply AI.

Table 3. AI in the Enterprise

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</table>

Source: Gartner (June 2017)

The section on AI in vertical industries, summarized in Table 4, provides an overview of how AI technologies are being leveraged in key industries.
Table 4. AI in Vertical Industries

<table>
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<th>AI in Vertical Industries</th>
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<td>Automotive</td>
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<td>Banking, Asset and Wealth Management, Capital Markets</td>
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Source: Gartner (June 2017)

What Is AI?

The artificial intelligence acronym "AI" might more appropriately stand for "amazing innovations" that do what we thought technology couldn’t do. Over time, as we learn the limitations of the amazing innovations and get used to their capabilities, AI becomes "aging innovations" that are better understood, lower in risk and, to many, boring. The AI term has evolved over the years, along with the underlying technologies. Gartner has previously characterized the more advanced AI solutions as "smart machines." Examples of current, more-advanced forms of AI, or amazing innovation, include deep learning (deep neural networks) and the allied areas of NLP. Many valuable and useful technologies that were once known as AI are now taken for granted.

Analyst Resources: Whit Andrews, Mike Rollings

Research:

- "Artificial Intelligence Primer for 2017"
An Executive and Strategic Perspective on AI

Using AI to add value to the business is complicated and demands that organizations make sure they understand how it can help and the best place to deploy it. Using Gartner's planned research will allow enterprises to use AI's ability to mine data quickly and efficiently to uncover underlying truths that humans would take much longer to discover. This, in turn, will let enterprises work more efficiently in reaching customers, deploying staff and making budgetary decisions.

AI will be used to render new insights, transform decision making and drive improved business outcomes. It includes many areas of study and technologies behind capabilities like voice recognition, NLP, image processing and others that benefit from advances in algorithms, abundant computation power and advanced analytical methods like machine learning and deep learning. These rapidly advancing capabilities are behind new business models based on data and a wide-range of impacts across the enterprise. Most organizations may not pursue the leading-edge uses of AI, such as building robots and self-driving cars; however, AI will play an increasingly important role in the top-three business objectives cited for the office of the chief data officer (CDO) in Gartner's CDO survey — greater customer intimacy, increasing competitive advantage and improving efficiency. While many enterprises will be content to leverage applications incorporating new capabilities, enterprise leaders should understand leading use cases, determine where the greatest potential exists for AI technologies, assess where "quick wins" can be obtained and determine organizational responsibilities to address the breadth of opportunities.

*Analyst Resource:* Mike Rollings

*Research:*

- "Chief Data Officer Desk Reference for Artificial Intelligence"
- "Predicts 2017: Artificial Intelligence"
- "Prepare for When AI Turns Skilled Practices Into Utilities"
- "Enterprises Must Prepare 'Now' for the Disruptive Power of Conversational AI Platforms"
- "Top 10 Strategic Technology Trends for 2017: Artificial Intelligence and Advanced Machine Learning"
- "Develop Your Artificial Intelligence Strategy Expecting These Three Trends to Shape Its Future"
- "Top 10 Strategic Technology Trends for 2017: Intelligent Apps"
- "Cool Vendors for Artificial Intelligence, East Asia, 2017"
Core AI Technologies

Machine Learning, Deep Learning and Neural Networks

Formally defined, machine learning is a technical discipline that aims to extract knowledge or patterns from a series of observations. The concept of machine learning is relatively simple (see Figure 2).

Figure 2. The Basics of Machine-Learning Technology

Source: Gartner (June 2017)

Deep learning is a variation on machine learning: Business problems are solved through the extraction of knowledge from data. Deep learning expands standard machine learning by allowing intermediate representations to be discovered. These intermediate representations allow more-complex problems to be tackled and others to be potentially solved with higher accuracy, fewer observations and less cumbersome manual fine-tuning. The most common class of deep learning is the feedforward deep neural network (DNN), which uses numerous layers of interconnected processing units to "discover" appropriate intermediate presentations from raw input data. DNNs provide a powerful framework that can be applied to a wide array of business problems.

Training a DNN, which may have thousands or millions of parameters, relies on a highly iterative and computationally intensive procedure, using "gradient descent" and "backpropagation," which are heuristic, numerical optimization techniques. These optimizations have only become feasible today on such a broad scale because of the recent breakthrough in high-performing graphics processing unit (GPU) architectures.

Analyst Resources: Tom Austin, Svetlana Sicular, Alexander Linden, Martin Reynolds, Carlton E. Sapp, Chirag Dekate
Natural-Language Processing, Speech Recognition and Text to Speech

While natural language, speech recognition and text to speech have been possible for over a decade, recent advances in deep-learning technology have significantly increased the accuracy and performance in these areas. Related technology areas that have also seen improvements include speech biometrics, translation and transcription.

In some cases, these technologies are integrated with analytical and modeling technologies to help users develop a deeper understanding of a particular domain. Common application areas for these include virtual assistants, customer service, consumer products and games, hands-free control, healthcare, and military uses. Some of the leading speech recognition vendors are Amazon Web Services, Google, IBM, Microsoft and Nuance.
Computer Vision

Computer vision technologies (CVTs) involve the capture, processing and analysis of digital images, essentially decoding their meaning and context. There are many CV technology areas, including machine vision, optical character recognition, image recognition, pattern recognition, facial recognition, edge detection and motion detection, all of which support the overall CV technology spectrum.

The convergence of enabling technologies, such as deep learning, neural networks, massively parallel processors, augmented reality and advanced camera systems, has significantly advanced the field. This is especially true over the past four years, which is when CVT was first optimized for GPUs and deep learning. Best-in-class CVT implementations can classify hundreds of millions of objects with more than 95% accuracy, and they are becoming more accurate at identifying organic objects, such as people, landscapes, insects and foliage.

Providers such as Amazon, Baidu, Google, IBM and Microsoft all offer imaging technologies pinned to their AI platforms. Although CV is in its adolescence, it is quickly becoming a key technology due to its broad applicability. The increasing maturity of AI and CV is underpinning the development of applications across many industries, ranging from self-driving cars (see Figure 3), autonomous drones, automated retail stock checks, augmented and virtual reality, and a wide range of robotics applications.

Figure 3. Detecting, Tracking and Characterizing People in Unconstrained Environments in Real Time

Note: “Sprit Lobby Demo”

Source: Apical/Softbank

Analyst Resources: Nick Ingelbrecht, Brian Blau, Tuong Huy Nguyen
Research:

- "Market Trends: Video/Image Analytics Will Be Indispensable to Smartphone and Wearable Personal Camera Products"
- "Innovation Insight for Video/Image Analytics, 2016"
- "Market Guide for Augmented Reality"
- "Smart Vision Systems Promise a Lot, but Are Difficult to Adopt Successfully"
- "Market Trends: Video Analytics See Step Change to Smarter Cloud Solutions"

Machine Reasoning, Decision Making and Algorithms

Algorithms are a mechanism to capture knowledge and insight in a packaged form that can be simply reused in a consistent fashion. At the simplest level, algorithmic business is about the delivery of business value from algorithms and data, but this is a very broad description.

Business and IT leaders must focus more precisely on those instances where algorithms are not only providing the insight, but also have become pivotal to competitive differentiation, and are recognized for their value contribution. Perhaps the pinnacle would be Google's PageRank, the algorithm that defined the company, but Amazon, Netflix, global retailers, airlines and financial services organizations around the world have all realized the value that their algorithms deliver, and are steadily taking steps to expand their use.

Analyst Resources: Tom Austin, Alexander Linden, Svetlana Sicular, W. Roy Schulte, Carlie J. Idoine, Laura Craft, Helen Poitevin

Research:

- "Explore Algorithmic Business to Drive Differentiation"
- "Algorithms Will Transform Talent Acquisition"
- "The Emergence of Precision Algorithms in Healthcare"

Business Analytics and Data Science

Analytics is the discipline that applies logic and mathematics to data to provide insights for making better decisions. To meet the time-to-insight demands of today’s competitive business environment, many organizations aim to democratize analytics with self-service capabilities. The associated insertion of analytics deeper into lines of business has significantly changed the traditional business intelligence (BI) model and end-user requirements.

A modern BI platform supports IT-enabled analytics content development. It is defined by a self-contained architecture that enables nontechnical users to autonomously execute full-spectrum analytics workflows from data access, ingestion and preparation to interactive analysis and the collaborative sharing of insights. By contrast, traditional BI platforms are designed to support
modular development of IT-produced analytics content. Specialized tools and skills, and significant upfront data modeling, coupled with a predefined metadata layer, are required to access their analytics capabilities.

**Analyst Resources:** Svetlana Sicular, Rita L. Sallam, W. Roy Schulte, Alexander Linden, Peter Krensky, Roxane Edjlali, Carlie J. Idoine

**Research:**
- "Magic Quadrant for Business Intelligence and Analytics Platforms"
- "Extend Your Portfolio of Analytics Capabilities"
- "Technology Insight for Modern Business Intelligence and Analytics Platforms"
- "How to Modernize Your Business Intelligence and Analytics Platform for Agility, Without Chaos"

**Robots and Sensors**

This section focuses on mechanical robots rather than software robots, with the exception of robotic process automation (RPA), which is included here to avoid confusion, because it uses the term "robot."

Robotics is a very broad area and generally is the branch of technology that deals with the design, construction, operation and application of robots, as well as with computer systems for their control, sensory feedback and information processing for robotics. These technologies deal with automated machines that can take the place of humans in dangerous environments or manufacturing processes, or resemble humans in appearance, behavior and/or cognition. Many of today’s robots are inspired by nature, contributing to the field of bio-inspired robotics.

RPA tools are software applications designed to replace or assist in manual tasks and mimic the same "manual" path taken through applications by a human. Generally, there is no AI in RPA. Most RPA provides functional graphical user interfaces on top of scripting tools that gather data (often using screen scraping) from one application and enter it (via rekeying) into another application. Beyond recognizing data in emails, images, logical display screens, scans and faxes, there is no amazing innovation or aging innovation in RPA, but sometimes, RPA is all that’s needed to improve performance, reduce errors and cut operating costs.

**Analyst Resources:**
- General coverage of robotics — Kenneth F. Brant
- Consumer robots (hardware and software) — Kanae Maita, Gerald Van Hoy
- Communication or personal care physical robots (such as SoftBank Pepper, MIT Jibo as well as Relay by Savioke and Lowe’s Innovation Labs’ OSHbot) — Kanae Maita, Tracy Tsai
- Robotics for manufacturing, and the use of robotics in and across manufacturing operations (that is, factories making things) — Simon F Jacobson
• Commercial unmanned aerial vehicles (drones hardware and software) — Brady Wang, Gerald Van Hoy
• Robotics (hardware and software) in life science (for example, automated high-throughput screening drug discovery, medical instrumentation and manufacturers) — Michael Shanler
• Exoskeletons — Michael Shanler, but only in joint calls with supply chain or healthcare analysts
• Self-driving autos — Martin Birkner
• Robotics and the EU’s Industry 4.0 Program — Bettina Tratz-Ryan
• Virtual robots and RPA — Cathy Tornbohm, Frances Karamouzis and Bruce Robertson
• RPA in insurance (property and casualty, and life) — Kimberly Harris-Ferrante
• Robots doing what humans used to do in industries, besides manufacturing, an informal discussion list — Bruce Robertson
• Ethics and robots — Frank Buytendijk (digital conscience)

Research:

• "Market Guide for Robotic Process Automation Software"
• "Market Trends: Personal Assistant Robots for the Home"
• "Market Guide for Robotic Process Automation Software"
• "Robotic Process Automation: Eight Guidelines for Effective Results"
• "Use Cases for Robotic Process Automation: Providing a Team of ‘Virtual Workers’"
• "Market Trends: Five Emerging Artificial Intelligence Use Cases Fuel IT Services Opportunities for Intelligent Automation"

Leading AI Application Areas

Bots, Chatbots and Virtual Assistants

Bots are microservices or apps that can operate on other bots, applications or services in response to event triggers or user requests. They may invoke other services or applications, often emulating a user or app, or using an API to achieve the same effect. These requests can be initiated via conversational UIs or in response to a change in the state of a back-end application or database. Bots automate tasks based on predefined rules or via more sophisticated algorithms, which may involve machine learning.

Virtual assistants (VAs) have emerged as one of the fastest-growing areas of AI, and there are many levels of VA capabilities. VAs are bots that can progressively handle simple natural-language queries, act on simple natural-language commands and engage in limited dialogue with the user (such as ask the user a qualifying question like “Was that for tomorrow AM or PM?”). They also can
turn over control to other bots/apps, as in Amazon’s Alexa Skills or WeChat. VAs exist in many forms: for example, text bots, voice bots, SMS bots and consumer messaging bots. Conversational AI platforms, covered in a separate section below, engage in richer dialogue, context preservation and user intent determination, so are significantly more capable, but also more complex to develop.

In many cases, VAs target a specific segment of users or applications. For instance, virtual customer assistants (VCAs) for customer service, virtual personal assistants (VPAs) for personal use or virtual employee assistants (VEAs). Engagement with a VA is possible via the web, SMS, consumer messaging apps, mobile apps, peer-to-peer communities, kiosks and other web-based or mobile interfaces, and the engagement is text-based. In addition, a VA can support speech- and text-based engagement in situations where voice processing is enabled. The VA relies on knowledge repositories and NLP technologies.

**Analyst Resources:** Van L. Baker, Magnus Revang, Brian Manusama, Meike Escherich, Anthony Mullen, Jessica Ekholm, Bern Elliot (bot frameworks)

**Research:**
- "Four Use Cases for Chatbots in the Enterprise Now"
- "Market Guide for Virtual Customer Assistants"
- "Competitive Landscape: Virtual Personal Assistants, 2016"
- "Seven Decision Points for Success With Virtual Customer Assistants"
- "Architecture of Conversational Platforms"

**Conversational AI Platforms**

Gartner makes a distinction between conversational AI platforms and the platforms that may use text or speech as input and output, but do not hold a conversation with the user. These platforms, or applications built on platforms, and solutions (systems consisting of applications and platform) can converse in natural languages with people via touch, gesture, speech, keyboards and other means. One effect of this technology is that it will eliminate much of the need for computer literacy training for new technology. The technology will learn how to interact with people, not the other way around. Individuals and teams will rely on proactive smart agents they control to interact with their applications for them. Imagine smartphones filled with smart agents.

**Analyst Resources:** Magnus Revang, Van L. Baker, Brian Manusama, Whit Andrews, Mark Hung, Tom Austin

**Research:**
- "Architecture of Conversational Platforms"
- "Conversational AI to Shake Up Your Technical and Business Worlds"
- "Market Insight: Conversational Commerce — Hype or Reality?"
“Smart Agents Will Drive the Switch From Technology-Literate People, to People-Literate Technology”

“Market Insight: Conversational Commerce Creates Frictionless Customer Journeys”

“Enterprises Must Prepare 'Now' for the Disruptive Power of Conversational AI Platforms”

“Cool Vendors in AI for Conversational Platforms, 2017”

Analytics and Predictive Analytics Models

Advanced analytics is a strategic technology being applied by business leaders in various departments within enterprises, including marketing, claims, customer service and production. It is enabling real-time automated event detection, decision support, risk modeling and customer profiling, which will assist business leaders in driving revenue enhancements, avoiding loss and improving customer experiences. All of this is a competitive advantage in the market. Furthermore, it helps companies synthesize large amounts of data automatically to help support automation and human decision making. Deep neural networks (the heart of current amazing innovation elements AI) are a specialized instance of advanced analytics (see Figure 4).

Figure 4. Predictive and Prescriptive Analytics Are Domains of AI and Machine Learning

Source: Gartner (June 2017)

Analyst Resources: Svetlana Sicular, Alexander Linden, Peter Krensky, Carlie J. Idoine

Research:

- "Market Guide for Advanced Analytics Service Providers"
- "Data and Analytics Programs Primer for 2017"
Smart Objects, Sensors and Environments

Smart objects, sensors and environments encompass a broad range, including robotics, smart buildings and, increasingly, intelligence integrated with Internet of Things (IoT) applications. AI technologies, such as deep neural networks, can master vision, sound, environmental and other sensory input to add value in all of these areas. The challenges for enterprises remain formidable in all these areas, because no one just buys a commercial off-the-shelf robot, smart building or IoT project. Enterprises need to prepare for custom projects that leverage immature ecosystems, technology stacks and standards, requiring consulting and professional services. Business units drive most of these projects, so CIOs will need to have short-term policies for integration, analytics and security, while laying long-term governance and cooperation strategies. CIOs will need to think about how to integrate information flows securely into enterprise systems, while laying the groundwork for digital ethics and information policies.

Analyst Resources: Mark Hung, Martin Reynolds

Research:

- "Internet of Things Primer for 2017"
- "Hype Cycle for the Internet of Things, 2016"
- "Indoor Location-Sensing Technologies Enable New Contextual Experiences, 1Q16 Update"
- "Innovation Insight: How CIOs Can Leverage the IoT to Break Down Building Management Silos"

AI in the Enterprise

General Enterprise AI Strategies

As summarized in the "How to Define and Use Smart Machine Terms Effectively," the smart machine or AI space is a value chain (as depicted in Figure 5) that can be viewed from either end — the technologies or the business results. Between technologies and business results lie product categories, applications and specific use cases. The numbers of observed instances increase sharply as you move from technologies to business results: What starts with an expanding handful of critical technologies grows into a larger collection of product categories in which there will be
thousands of applications tied to millions of different specific uses driving a very broad range of diverse business results.

**Figure 5. AI Technology Value Chain**

![AI Technology Value Chain Diagram]

Source Gartner (June 2017)

Not everything in the chain is AI. For example, applications will contain a mix of amazing innovation and other technologies. (And enterprises may choose to avoid AI technologies, relying instead on aging innovation rule-based or expert systems — particularly when the problem is simple enough and the rule-based option is already well-proven and demonstrably meeting similar needs for other users.)

**Analyst Resources:**
- AI project strategies — Kenneth F. Brant
- General enterprise strategy — Whit Andrews

**Research:**
- "How to Define and Use Smart Machine Terms Effectively"
- "Develop Your Artificial Intelligence Strategy Expecting These Three Trends to Shape Its Future"
- "Smart Agents Will Drive the Switch From Technology-Literate People, to People-Literate Technology"
- "Prepare for Big Changes in Software and SaaS Pricing, Driven by AI and IoT"
- "Maverick* Research: Is It Time for Fire Your Security Team and Hire Machines?"
- "Cool Vendors in Artificial Intelligence for Marketing, 2017"

**Customer Service and Support**

AI-related technologies are used in multiple areas of customer service and support. Key areas are the use of VCAs, the use of predictive customer analytics, the use of speech recognition for self- and assisted service, the use of sentiment analysis, and the use of bot orchestration design tools. Gartner expects that the use of VCAs for customers will triple through 2019 as enterprises seek to increase customer satisfaction and reduce operating costs.
The technology allows organizations to offload the customer service representative in the contact center and let customers engage 24/7 across channels, which brings the experience customers expect. AI is used in the channels of interactive voice response (IVR), web chat, email management, chatbot, VCAs and messaging. Bots work best with a human in the loop, to assist or offload the virtual agent when situations demand it, as well as in some cases to enable the human to provide supervised training to allow the bot to better learn its tasks.

A broad range of analytics technologies are also used in contact centers, including to obtain insights on customer behavior and to improve contact routing.

**Analyst Resources:**
- Brian Manusama (customer service support and bots)
- Bern Elliot (bot flow orchestration frameworks)
- Jenny Sussin (sentiment analysis)

**Research:**
- "Seven Decision Points for Success With Virtual Customer Assistants"
- "Market Guide for Virtual Customer Assistants"
- "The Gartner CRM Vendor Guide, 2016"
- "Market Guide for Communications Platform as a Service"
- "Prioritize the Six Styles of Customer Analytics for Better Customer Experience"
- "Improve Customer Experience for Wearables With Artificial Intelligence"
- "Artificial Intelligence Requires IT Leadership to Use Genuine Empathy"

**Digital Business Initiatives**

Amazing AI innovation is one of multiple areas disrupting existing markets and enabling new digital business initiatives. There are many areas where AI technologies and methods are used as part of digital business initiatives, including self-driving cars, personal assistants and customer care, all of which anticipate and service user needs. In general, AI is leveraged into digital businesses in one of six key ways: (1) dealing with complexity, (2) making probabilistic predictions, (3) learning, (4) acting autonomously, (5) appearing to understand and (6) reflecting a well-scoped or well-defined purpose.

**Analyst Resources:**
- Mike Rollings
- Rob Dunie (situationally adaptive behavior)

**Research:**
- "Machine Learning Drives Digital Business"
Digital Commerce and Digital Commerce Personalization

Digital commerce engages customers throughout their journey from awareness, research and evaluation to purchase, review and usage. It generates a lot of data in the process to help business understand the customer behavior and interest across multiple channels and devices, and thus can match customer interest with the right content and drive sales. Most digital commerce applications are manually coded to address possible paths customers can take, accommodating the variety of interests and attributes they demonstrate throughout the journey. These models can get extremely complex, yet still may not be able to capture the transient nature of customer behavior. AI will help address this challenge by understanding the underlying relationship among datasets much more efficiently, and help businesses build complex models to address the dynamic changes in digital commerce. Decision models can also predict an event with more accuracy and granularity, supported by the insight from AI and machine-learning technologies, making one-to-one engagement possible.

Looking specifically at digital commerce personalization, there is confusion as to what constitutes personalization, and many vendors claim to offer it. Personalization means different things to different people. Although personalization engines offer a relatively standard process for gathering and analyzing visitor data, the functionality offered by each vendor after the data is analyzed is different.

Personalization should be built on a foundation of solid design and a consistent customer experience across all the seller’s touchpoints, starting from a one-to-many approach, and migrating to deliver a one-to-one experience based on what is known about an individual. Personalization is becoming just as relevant for the B2B and consumer buyer, which has led to our use of the term "individual."

Analyst Resources: Jason Daigler, Magnus Revang, Penny Gillespie, Sandy Shen

Research:

- "How to Apply Artificial Intelligence to Digital Commerce"
- "Market Guide for Digital Personalization Engines"

Governance and Information Management for AI

Traditional ideas and modes of governance are being challenged in the digital world, where ownership of data and technology is unclear or dispersed. To combat this, digital strategy leaders need to rediscover the old-fashioned principles of stewardship. AI technologies are self-learning and adaptable, meaning that human responsibility and action could be supplanted by machine
decisions and behaviors based on processing growing volumes of data. In many cases, it is unclear who would be responsible for these decisions.

As a result, digital strategy leaders should invest time and effort in going beyond a supplier/customer relationship, whereby there is just a transfer of ownership and a right to have service. They should make sure their stakeholders feel stewardship for the technologies they have in their possession. This means creating a mutual understanding (value alignment) between the enterprise and its customers about the real value being delivered through communicating this value, and monitoring whether it is perceived that way. Success will likely rely on using proven techniques that encourage and incentivize digital stewardship behaviors for responsible public use of digital products and services.

**Analyst Resources:** Svetlana Sicular, Frank Buytendijk, Alexander Linden, Thomas W. Oestreich, Mark A. Beyer, Mike Rollings

**Research:** "Modern Digital Technology Requires Shared Responsibility, Not Enforced Policy"

### Human Capital Management/Recruiting

Human capital management and recruiting leverage AI technology and solutions in multiple ways. The principal applications are as follows:

- **Recruiting:** A wide variety of applications of AI exist in the recruiting space, often focused on matching talent supply and demand, or predicting recruitment success. Predictors include the fit of a particular candidate for a job, the likelihood that a candidate would be open to exploring a new job opportunity, behavioral profiles through analysis of voice or video interviews, the probability that a candidate would apply for a job, or that the candidate would be hired.

- **Skills and job taxonomies:** Skills evolve over time, and the same job is often described in very different ways, even within a single enterprise. Using more-advanced NLP techniques to establish skills and job taxonomies on a global basis (multilingual) is allowing for a new generation of search and matching to emerge, going beyond the previous generous of semantic search libraries. This work is often foundational for other applications.

- **Sentiment analysis and theme detection in employee feedback and employee engagement measurement tools.**

- **Recommendation engines for learning content, mentors, career paths and adaptive learning paths.**

- **Chatbots to support HR service delivery or further process automation:** Automated job assignment, shift scheduling and monitoring, or the "roboboss."

Because these solutions involve personal data about workers, digital ethics principles need to be applied. The employee-employer relationship is complex and unequal. Responsible employers take this into account and put the necessary controls into place to ensure the proper build and usage of machine learning on employee data.

**Analyst Resources:** Helen Poitevin
Internet of Things

IoT generates large amounts of data. AI, on the other hand, needs large amounts of data. This virtuous cycle between IoT and AI will initially have the greatest impact on visual and audio-related applications, but this will eventually translate to other types of applications as well. IoT and AI primarily interact in one of three ways:

- **IoT as the input to the AI system**: In this architecture, the IoT system acts as a data-gathering mechanism for the AI system, especially for training purposes. Examples include video surveillance cameras in smart city and retail applications, environmental sensors in smart agriculture, and wearables in sports and fitness.

- **AI as the application on the IoT system**: In this architecture, AI serves as one of the (many) applications for the IoT system. Examples include smart home devices, robots and drones.

- **IoT and AI as a two-way system**: In this architecture, both the IoT and the AI systems interact with each other on a continuous basis to each other’s benefit. Examples include onboard inferencing engines in autonomous vehicles and embedded sensors in surgical robots.

AI will also be used to improve performance of IoT environments by moving trained DNNs to edge and intermediate devices in a multilayer architecture, summarizing what’s happening and distributing those findings up, down and laterally to make the system more robust and able to scale.

*Analyst Resources: Mark Hung, Martin Reynolds, Emil Berthelsen*

Research:

- "Hype Cycle for the Internet of Things, 2016"
- "Thing Commerce: IoT-Enabled Digital Commerce"
- "AI on the Edge: Fusing Artificial Intelligence and IoT Will Catalyze New Digital Value Creation"

**IT Service Monitoring/Help Desk**

The digital workplace centers around proactively promoting employee effectiveness and engagement through a more consumerlike computing environment. Transforming IT service desk operations into a proactive function requires that infrastructure and operations leaders take a comprehensive approach to incorporating advanced machine learning, big data and other AI
technologies to provide predictive, personal and dynamic insight across service desk activities. Those that do not will become increasingly irrelevant.

The following are a few scenarios in which these AI technologies could be utilized to address current and future needs:

- Assisted and augmented notification
- Assisted and augmented collaboration
- Automated knowledge artifact creation and curation
- Automated detection of both positive and negative abnormal behavior of both people and systems
- Automated entry and/or handling of first-line and non-IT questions and requests by VPAs (such as Apple’s Siri, Microsoft’s Cortana, Google Now) and the IoT

**Analyst Resources:** Colin Fletcher, Katherine Lord, Will Cappelli, Chris Matchett (Bots in ITSM), Milind Govekar

**Research:**

- "Apply Machine Learning and Big Data at the IT Service Desk to Support the Digital Workplace"
- "Use ITOA to Manage the Internet of Things"
- "Digital Business Initiatives Demand the Use of IT Operations Analytics to Spark Transformation"

**Legal, Ethical and Social Issues**

AI will increase productivity, disrupt workplaces and customer relationships, and profoundly affect employment patterns. It is forcing debate about new realms of ethics and liability. CIOs and other affected roles should engage now.

CIOs should work with top executives, as well as business unit and IT leaders, to devise an enterprise AI strategy, identifying how AI will affect the organization’s strategic direction and business capabilities. This strategy should also outline predictive models on the effects of investments in human resources and technology through to 2020.

**Analyst Resource:** Whit Andrews

**Research:**

- "Seek Diversity of People, Data and Algorithms to Keep AI Honest"
- "Modern Digital Technology Requires Shared Responsibility, Not Enforced Policy"
- "Predicts 2015: Smart Machines to Complicate Labor Markets and Ethics"
- "Predicts 2017: Artificial Intelligence"
Sales

AI and sales technologies are pairing nicely, as can be seen, for example, for identifying fresh leads based on the similarities of existing customers, nurturing prospects by establishing a relationship through intelligent messaging and use guided selling to increase sales growth. Technologies such as virtual digital sales assistants (VDSAs) are combining functions of predictive and prescriptive systems with a responsive voice interface that is similar to Amazon's Alexa software. When paired with a mobile phone, for example, VDSAs offer an entirely new, nearly frictionless method for accessing sales activities and updating information. The impact of AI on sales is high. Customers reported an increase in leads and appointments of up to 30% and a decrease of call times of 45% (Gartner estimate). Consequently, these time savings provide sales teams with more selling possibilities (see Figure 6).

Figure 6. Shifting Approach to Sales That Leverages AI and Machine Learning

Source: Gartner (June 2017)

Analyst Resources: Ilona Hansen, Tad Travis

Research:

- "Predicts 2017: CRM Sales"
- "The Future of CRM Sales Technology Promises New Algorithmic and Automation Approaches"
Security and Fraud

AI is a term that is used in different ways. Gartner research in security and fraud addresses how advanced analytics are transforming security and fraud user environments, markets and vendors; how they are evolving; and how organizations are adapting to these changes.

We look at how these technologies are applied to the four phases of the adaptive security architecture — protect, detect, respond and predict. We also look at the integration of these techniques into different security domains and how it is being applied to solve old and new problems (see Figure 7).

**Figure 7. Old-School vs. New-School Security Products**

<table>
<thead>
<tr>
<th>Old-School Rule-Based</th>
<th>New-School Analytics</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIEM Broad-Scop Monitoring</td>
<td>UEBA Broad-Scop Analytics</td>
</tr>
<tr>
<td>Intrusion Detection and Prevention</td>
<td>Network Traffic Analytics</td>
</tr>
<tr>
<td>Data Loss Prevention via Keywords</td>
<td>Data Flow Analytics</td>
</tr>
<tr>
<td>Identity Access Management</td>
<td>Identity Analytics</td>
</tr>
<tr>
<td>Antivirus and Anti-Malware Protection</td>
<td>Endpoint Detection and Response</td>
</tr>
</tbody>
</table>

Source: Gartner (June 2017)

We examine AI in fraud detection and management as well, across verticals like financial services, healthcare, retail and more. We keep a close eye on best organizational practices and strategies, competing products, and market direction.

Finally, we examine how advances in cognitive computing and open data will disrupt and transform this fast-evolving marketplace of AI in security and fraud.

**Analyst Resources:** Avivah Litan, Toby Bussa, Tricia Phillips, Danny Luong, Jonathan Care, Van L. Baker

**Research:**

- "The Fast-Evolving State of Security Analytics, 2016"
- "Market Trends: User and Entity Behavior Analytics Expand Their Market Reach"
Workplace and Digital Workplace

In a digital workplace, the two-world view — where physical and virtual spaces are thought of as separate environments with separate strategies — becomes obsolete. As physical workplace surroundings become digitalized (via the IoT, for instance), the AI-empowered workspace becomes a proactive participant in the employee experience. It enables new ways to discover, organize and contextualize information and promote collaborative interaction based on spatial and temporal factors that are generally not part of the current approaches to improving knowledge-based work. AI also simplifies the process of finding and scheduling resources and services in the office environment. The vendors that provide applications for managing the end-to-end life cycle of a facility — the integrated workplace management system (IWMS) vendors — have incorporated both IoT and AI into their product offerings.

To best understand and act on the analysis and recommendations in this research, we suggest the following research be reviewed beforehand (because this research connects preceding Gartner approaches into a unified planning and design strategy):

**Analyst Resources:** Matt Cain, Mike Gotta, Van L. Baker (VPAs), Nikos Drakos (knowledge management), Carol Rozwell (IWMS)

**Research:**

- "Contextualizing Virtual Assistants for More Effective Meetings in the Digital Workplace"
- "Hype Cycle for the Digital Workplace, 2016"
- "How to Make Collaboration Work With Gartner’s ACME Framework"
- "The Rebirth of Office Space: What Every CIO Needs to Know and Do"
- "How Smart Machine Technologies Will Change Knowledge Management"
- "Align Smart Workplace Efforts With Employee Needs for Knowledge-Based Work"
- "Office 365, G Suite or Other Cloud Office Initiatives Primer for 2017"
- "The IT Role in Helping High Impact Performers Thrive"
- "Automate Knowledge Management With Data Science to Enable the Learning Organization"
- "Market Guide for Integrated Workplace management Systems"
- "Smart Machines Will Fundamentally Change Infrastructure Outsourcing Services for the Better"
AI in Vertical Industries

AI is applied in a wide variety of ways by industries; however, three common areas are:

- **Machine-learning and, increasingly, deep-learning approaches are having a significant effect on many industries.**

- Predictive analytics approaches analyze data, identify patterns and anticipate future scenarios. These result in simulations, statistical models, forecasts and machine learning.

- Virtual assistants, at a minimum, possess a specialized algorithm plus machine-learning and natural-language-processing functions tuned specifically to a purpose-built, curated body of big data to generate insights, discoveries, recommendations and decisions. These assistants must be purposely designed and built, then rigorously trained to produce "expert" advice. They are not effective nor cognitive without the participation of human subject-matter experts in development and operation.

- Unfortunately, over the next several years, most verticals are also likely to experience some very poorly designed virtual assistants and bots, where design and implementation quality and capabilities will vary enormously.

In the following sections, we provide Gartner analyst and written research resources for a range of vertical industries.

**Automotive**

The car and commercial vehicle of the future is nothing but a huge traveling connected computer that is equipped with large computing power on board and cloud connectivity. It will be increasingly integrated in consumers’ intermodal mobility experience as a mobility-as-a-service component. As technological development progresses, vehicle travel will increasingly be automated and become one of the most intelligent devices. Commercial vehicles will be integrated in fully automated and optimized logistic chains, including vehicle-specific maintenance, dispatch and operations.

AI technology is a key enabler for the emerging value chain of connected and automated vehicles. AI will help the automated vehicle to make sense of environmental, contextual sensor and engine data to provide an accurate location, a real-time view environmental model of the vehicle surroundings, path planning and driving strategies that, together, keep automated travel in all instances safe and secure.

Driver identification via face recognition and cognitive conversation agents for mobility service optimization and recommendation will be core elements that make the vehicle an integral part of developing mobility-as-a-service concepts.

AI in automotive will enable a high degree of customer personalization in the ways vehicles are configured and sold, as well as in the way vehicles react to specific customer moods or wishes — to take a certain route, make a purchase or have a specific interior digital mood based a design or the music played.
Finally, AI will continue to revolutionize automotive manufacturing, making manufacturing facilities more efficient, flexible and speedy without comprising on large-scale quality output. Today, just-in-time delivery already eliminates the need for inventories. AI and tracking all parts in real time enable production to react to short-term notice changes. In the future, vehicles, as well as spare parts, will be able to know by themselves when it is time for replacement or service. They will be able to diagnose and fix themselves or arrange for service.

**Analyst Resources:** Martin Birkner, Michael Ramsey, James F. Hines, Mark Hung

**Research:**

- "Uber-Volvo Autonomous Car Alliance Could Force Open Platforms on Automakers"
- "Cool Vendors in Automotive Electronics, 2016"
- "2017 CIO Agenda: An Automotive Perspective"
- "Automaker CIOs Should Move Quickly to Implement Complete-System Over-the-Air Update Capability"

**Banking, Asset and Wealth Management, Capital Markets**

AI and machine learning are moving from product creation, asset trading and process automation to transforming financial services. Asset management firms are exploring ways to deploy AI and machine learning beyond portfolio analytics. Gartner believes that asset management CIOs should expand the use of AI and deep learning in four key functional areas — client acquisition, risk and compliance, customer interaction, and investment support — to realize their full potential.

Wealth management firms are beginning to explore ways to scale and personalize client interactions and engagements. Roboadvisors are just the tip of the digital iceberg disrupting wealth management. AI and machine-learning advisor assistants will have to uncover more-complex client needs and solutions while enabling more-meaningful collaboration between advisors and clients. Capital markets are finding ways to use AI-based technologies, including machine learning and advanced NLP to automate platforms and make trade surveillance tools. To facilitate the adoption of AI and machine learning, financial services firms must embed and operationalize AI insights in dashboards, applications, systems, databases and devices.

**Analyst Resources:**

- Wealth management — Ali Merji, Chuck Thomas
- Banking — David Furlonger, Avivah Litan (security and fraud), Stessa B. Cohen (consumer banking)
- Capital markets — Moutusi Sau

**Research:**
"Top Three Technology Trends for Asset Management CIOs to Address in 2017 and Beyond"

"Integrate Financial Coaching to Create Real Value From Roboadvisor 2.0 Tools"

"Five Key Areas Where Advanced Analytics Can Create Value in Wealth Management"

"Preparing and Architecting for Machine Learning"

"Where Banks Can Use Smart Machines"

"Cool Vendors in AI for Banking and Investment Services, 2017"

**Business Process Outsourcing — Customer Management, Finance and Accounting Procurement, and Human Resources**

Combinations of AI and RPA will be a key direction of business process outsourcing (BPO) as it morphs to better supply business process services, and already, machine learning and analytics services are add-ons to leading business process service offerings. However, one tool will not fix every unautomated activity in a BPO deal, so using AI tools will be just one of multiple options.

Options to contract for a fully managed intelligent automation service for a front, middle or back office, or combination of process, will increase rapidly. The challenges, therefore, will include figuring out how you get to an equitable price for the activities, outcomes or transactions facilitated by the AI tool. Most organizations still have a lot of routine processes that manually manipulate structured and unstructured data that could potentially be automated. AI and analytics can be particularly effective at cleansing and validating data.

Finance and accounting business processing AI use cases include:

- Cash allocation SaaS as available from HighRadius or Billtrust
- Digitalized order entry SaaS, as available from OmPrompt
- Supply chain data, as available from Rage Frameworks
- SaaS to analyze the validity of invoice delivery charges, as available from Rage Frameworks
- The use of robowriters to draft management account reports

Customer management business process analysis (BPA) AI use cases include:

- Virtual personal customer assistants and chatbots to both process and structure unstructured customer or supplier calls, as available from IPsoft’s Amelia
- Written customer inquiries in email with expert systems or tools like Celaton

Procurement BPA AI use cases include:

- Support of purchase decisions with analytics, as available from IBM Watson
- Handling supplier inquiries with VPAs
Leaders responsible for BPO should start cataloging the activities where AI could facilitate better business outcomes. They should also identify unautomated processes, which comprise manual, repetitive rule-based activities, noting when the data is structured and unstructured. Leaders should then evaluate their automation options, including AI, but also considering other options, such as RPA, intelligent business process management suites, APIs and dedicated software tools.

**Analyst Resources:** Cathy Tornbohm, TJ Singh, Brian Manusama, Helen Poitevin

**Research:**
- "Market Guide for Virtual Customer Assistants"
- "Plan to Use Smart Machines as Robobosses"
- "Use Cases for Robotic Process Automation: Providing a Team of 'Virtual Workers'"
- "Robotic Process Automation: Eight Guidelines for Effective Results"
- "Market Guide for Robotic Process Automation Software"
- "Cool Vendors in Smart Machines, 2016"

**Consumer Products With AI**

AI will simplify the world for users and shape choices across all areas of interaction with technology. As of today, AI is the most visible in consumers' lives in the form of VPAs on smartphones (such as Siri, Cortana, Google Assistant or Baidu) and VPA speakers in the home (such as Amazon Echo or Google Home). In fact, by 2020, end-user spending on VPA speakers will reach $2.1 billion, growing at a compound annual growth rate of 43% from 2015 through 2020, while by 2018, 30% of our interactions with technology will be through "conversations." The impact of AI on the future of consumer technology is high: Users want a friendly, multimodal way of interacting with devices, which includes dialogue services between people and machines, and people-literate AI technology, reducing the need for people to learn technology. AI in the form of contextual design of apps, as well as predictive analysis, will become crucial factors for success as a system's usability increases dramatically according to how much it knows about the user’s surrounding environment.

**Analyst Resources:** Werner Goertz, Anthony Mullen, Meike Escherich, Mark Hung

**Research:**
- "Hype Cycle for Human-Machine Interface, 2016"
- "Invest Implications: 'Market Trends: Connected Home Platforms Unify Use Cases and the User Experience"
- "Improve Customer Experience for Wearables With Artificial Intelligence"
- "Competitive Landscape: Virtual Personal Assistants, 2016"
Government

Digital government facilitates the operations as well as service delivery to users efficiently in a context-based environment. Currently, all levels of government are experimenting with AI to improve workflow while creating a better citizen experience. Local government and smart cites are especially interested in applying AI in VPA and deep learning to create citizen journeys in traffic, health and environment, resource usage, and ambience through lighting or shared-asset services, such as bikes and vehicles. In cities with national health services, elderly care, fitness and healthy communities will benefit from NLP, because users can personalize their interaction with this service environment. Smart mobility through autonomous vehicles, drones and delivery bots will leverage AI to capture data, including video feeds from traffic movement, air quality, or street parking availability, to optimize and generate road and journey advice through applications on personal devices and mobility platforms. Deep learning will be applied in all levels of government to create service improvements, such as in file management, fraud detection for social services and duplication of payments, as well as tax evasion. Law enforcement and prosecution will apply video analytics, deep learning and chatbots for crime prevention, and also faster crime processing, data mapping, record keeping in the court and case management.

Analyst Resources:

- Smart cities — Bettina Tratz-Ryan
- Smart buildings — Gavin Tay
- AI video/image analytics, closed-circuit TV, body-worn cameras, surveillance and smart vision systems — Nick Ingelbrecht
- Advanced Research Projects Agency (ARPA) research — Katell Thielemann
- Prisons, police and security — Gerald Van Hoy, Earl Perkins
- Military — Gerald Van Hoy

Research:

- "Innovation Insight: Smart City Aligns Technology Innovation and Citizen Inclusion"
- "Emerging Technology Analysis: Smart Machines and Robots Empower Home Healthcare for the Elderly in Japan"
- "Predicts 2017: Drones"
- "Market Trends: Video/Image Analytics Will Be Indispensable to Smartphone and Wearable Personal Camera Products"
- "Top 10 Strategic Technology Trends for 2017: Intelligent Things"
Healthcare, Life Science and Pharma

All aspects of healthcare are leveraging digital business to operate more efficiently and improve research, discovery and outcomes. AI-empowered wearables and remote monitoring devices are being used to monitor high-risk and chronic-condition patients. Areas that are leveraging AI are doing so to predict the onset of disease, aid diagnosis, understand drug-to-drug interactions, detect fraud and discover new cures. AI has enormous potential to decrease medical errors, improve outcomes and to truly enable precision medicine. In fact, our national agenda for precision medicine cannot be realized without AI and advanced computational computing capabilities. Currently, we see AI being used for genomics studies. Deep learning and AI are also being applied to images to help in diagnosis and make the radiologist more efficient in reading images. In the future, we expect to see virtual personal health assistants "learn about their human" and to help keep them healthy and well through reminders, health prompts and so on. AI will replace many medical decisions and may even replace the human interface for medical care.

Analyst Resources:

- Healthcare — Laura Craft, Tracy Tsai, Kanae Maita, Gerald Van Hoy
- Life science — Michael Shanler
- Pharma — Gerald Van Hoy

Research:

- "How to Make Smarter Decisions About Artificial Intelligence in Life Science R&D"
- "Predicts 2017: Life Science R&D — Digital R&D Gets Smart"
- "Business Moment: Digitalized, Remote Clinical Trials for Pharma"
- "Forecast Analysis: Internet of Things — Endpoints, Worldwide, 2016 Update"
- "Predicts 2017: Identify Your Buyers to Seize Their Personal Technologies Purchases"
- "Market Trends: Personal Assistant Robots for the Home"
- "Maverick* Research: Endangered! How Technology Will Cause Extinction of the Primary Care Tier of Medicine"
- "The Emergence of Precision Algorithms in Healthcare"
- "Emerging Technology Analysis: Smart Machines and Robots Empower Home Healthcare for the Elderly in Japan"
- "Cool Vendors in AI for Healthcare, 2017"
**Education (K-12 and Higher Education)**

AI and machine learning hold great promise to help higher education scale its student interactions and improve student experience, both within pedagogy, as well as student support. AI-empowered student advisors, AI teaching assistants and AI-aided adaptive learning are some key areas of interest. Key outcomes so far are 24/7 student interaction and the unloading of simpler questions, saving time for teaching assistants and student advisors to take on more-complex tasks. One thing is clear from early implementations: the machine on your team needs to be taught before it is useful. That teaching process starts with understanding what data to use, how and where to get the data, as well as what volume and quality of data is needed. Perhaps paradoxically, personalization is a key to compete in an expanding education ecosystem. Fortunately, the increasingly digital dimension helps produce the data, although AI is needed to collect and connect the data to put it to good use.

*Analyst Resources: Jan-Martin Lowendahl, Kelly J. Calhoun Williams, Gerald Van Hoy*

**Research:**

- "Analytics, Assessment and Adaptive Learning Will Prepare You for the Algorithmic Education Evolution"
- "Deakin University Uses Smart Machines to Innovate Student Engagement"
- "Predicts 2017: Education Gets Personal"
- "Top 10 Strategic Technologies Impacting Higher Education in 2017"

**Insurance Services — Property, Casualty and Life**

Innovative property and casualty and life insurers are already adopting AI and machine learning for a variety of use cases, ranging from customer-facing activities to back-office transaction processing. For example, technologies such as chatbots are used to help drive e-commerce and e-service through web, mobile and call center channels, and NLP is used to amplify the customer experience and customer intelligence. Other opportunities exist, such as applying technologies like roboadvisors to replace and/or augment financial advisors in life insurance; using AI to support human-based tasks in areas, such as underwriting or claims for decision support; and leveraging robotic process automation for data entry where systems are not integrated and where paper-based documents are still being received (such as claim forms). Niche areas, such as fraud detection, can be improved using machine learning, and advancements where AI/machine learning is leveraged in combination with IoT or sensors like those that operate autonomous vehicles will ultimately provide insurers with new ways of underwriting and managing both customer experience and risk.

Insurers should look to embed AI and machine learning into their enterprises, especially where there are high analytical requirements (for example, high data volumes that need to be analyzed fast and where patterns are unknown/changing). This will help insurers transform their organizations and prepare digital business initiatives.

*Analyst Resource: Kimberly Harris-Ferrante*
Research:

- "The Next Frontier of Insurance Customer Experiences Requires a New Model and Technology Innovation"
- "Smart Machines Provide a Platform for Insurers to Transform and Improve Customer Experiences"
- "Market Insight: What Insurance Buyers Want in 2017"

Invest/Venture Capital and AI

Amid the venture capital (VC) slowdown in 2016, AI stood out from the pack, and there were record deals and funding for companies with potential applications powered by AI technologies. By the end of 2016, 658 deals (according to CB Insights) were closed, with funding spanning industries like healthcare, cybersecurity, financial services, robotics and alternate/virtual reality startups. This trend is just getting started. In 2017, it is expected that this area will only get hotter, with bigger merger and acquisition deals closing by bigger established players. Currently, the deals look very much North-America-focused; however, there are many interesting use cases in AI that are emerging from other regions, like Israel, Germany, France and India.

Analyst Resources:

- Moutusi Sau
- Sandra Notardonato (service-focused),
- Andrew Neff or Adam Woodyer (technology-focused)
- Tom Austin

Research:

- "Impact From the VC Slowdown: Who Stands to Win or Lose?"
- "Market Insight: Disruptive Macro Trends for 2025 Personal Tech Market — Artificial Intelligence — Me, Myselves and AI"
- "Market Insight: March of the DARPA Smart Machines"
- "Invest Implications: ‘Cool Vendors in Smart Machines, 2016’"

Manufacturing Operations

In manufacturing operations, AI will add new dimensions of interpretation, judgment and expertise to create a self-adaptive and automatically reconfigurable production capability. This will be done through a confluence of physical and virtual automation that shortens cycle times, raises quality, accelerates continuous improvement and improves factory service levels through:

- Robots to execute routine and repetitive tasks, as well as mitigating variable wage rates.
Specialized algorithms, plus machine learning and natural-language processing, to generate insights and discoveries, and to provide operators with recommendations and decisions based on current conditions.

**Analyst Resource:** Simon F Jacobson

**Research:**

- "Artificial Intelligence Will Make Manufacturing Operations Smarter — But a Learning Curve Comes First"
- "Hype Cycle for Manufacturing Strategy, 2016"
- "Smart Machines Will Offer Major Opportunities, Cause Cultural Disruption and Radically Change Manufacturing Operations"

**Retail**

AI is heavy with the promise of transforming the retail industry, and retailers should view AI as the primary interpreter of their data in a fast-moving digital business world. Their already voluminous data hoards are becoming more and more unmanageable as they begin to feel the additional impact of IoT-generated data. Moreover, the increasing speed of the production of structured and nonstructured data, both inside and outside the environment they control, means that they must also increase the speed at which the data is captured, stored, cleansed, extracted, analyzed and evaluated to make judicious business decisions faster. Through the confluence of machine learning, NLP and algorithms, AI can be used in all these stages to deliver both cost and revenue optimization, at the right time, based on the goal of enhancing both the employee and the customer experience.

On the operational side, AI can be used, for example, to optimize the cost of goods — the largest cost category for a retailer, which include the costs of selection, assortment, pricing, promotion, inventory levels, and distribution and delivery of products and services offered. Examples include improving sales forecasts for better inventory and operations planning, finding new product and service providers, optimizing labor models, automating or augmenting labor, and improving cross-channel insight to reduce customer attrition. On the customer side, examples include increasing employee knowledge to deliver better real-time customer service, engaging customers through timely personalized conversations in "conversational commerce" and enhancing the in-store customer experience.

**Analyst Resources:** Robert Hetu, Miriam Burt, Kelsie Marian

**Research:**

- "Conversational AI Platforms Will Be the New Strategic Gateway for Retail Customer Loyalty in Digital Business"
- "Using Algorithmic Retailing to Drive Competitive Advantage"
- "Industry Vision: Reimagining the Retail Store With Smart Machines"
"Cool Vendors in Retail, 2016"

"Smart Machines Will Be the Catalyst for One of the Most Disruptive Eras in Retail"

**Supply Chain**

AI will play three roles in supply chain: human decision-making augmentation, compensating for human bias and upskilling people through "cognitive advisors." AI can also be used in decision-making automation, being orders of magnitude more consistent and faster than humans in specific tasks, while improving performance over time based on self-learning.

Through the use of NLP, predictive and prescriptive analytics and machine learning, AI solutions in supply chain can typically provide three capabilities:

- Language interface, through Q&A or verbal dialogue/conversation
- Semantic intelligence by identifying complex patterns and making inferences
- Executive decision by using expert systems to evaluate scenarios and choosing the best action

AI supports many supply chain use cases, including predictive maintenance, risk management, procurement, order fulfillment, supply chain planning and promotion management.

**Analyst Resources:**

- Noha Tohamy
- Bart De Muynck (transportation)
- Simon F. Jacobson (manufacturing)
- C. Dwight Klappich (warehouse)
- Tim Payne (supply chain planning)

**Research:**

- "CSCOs: Use Cognitive Solutions to Accelerate Supply Chain Analytics Maturity and Bridge Talent Gaps"
- "Hype Cycle for Chief Supply Chain Officers, 2016"

**Telecom**

Communications service providers (CSPs) have a series of issues that can be tackled by AI and machine learning. They have high-volume, high-velocity data within their networks, which benefits from more-advanced troubleshooting, predictive techniques and automation. In addition, employees and customers undertake a variety of interactions with other humans and with machines, especially within their channels — these would benefit from VEAs and VCAs, as well as techniques such as
natural-language processing. Lastly, there are opportunities for robotic process automation and better decision making across various areas of the CSP.

*Analyst Resource: Charlotte Patrick*

*Research:*

- "How CSPs Can Exploit Artificial Intelligence and Machine Learning"
- "How CSPs Can Exploit Artificial Intelligence"
- "Market Trends: Top Five Disruptive Trends for CSPs, Worldwide, 2017-2022"

*Topics Specific to Regional AI Usage*

In some cases the use of AI varies by region. Below is research related to regional AI usage and trends.

*Research:*

- "Cool Vendors in Artificial Intelligence, East Asia, 2017"
- "Cool Vendors in Artificial Intelligence in India, 2017"
- "Predicts 2017: Artificial Intelligence"
- "Market Guide for Conversational Artificial Intelligence in China"
- "Cool Vendors in Spain, 2017"

*Gartner Recommended Reading*

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

"Artificial Intelligence Primer for 2017"

"How to Define and Use Smart Machine Terms Effectively"

"Hype Cycle for Smart Machines, 2016"

"Cool Vendors in Smart Machines, 2015"

"Cool Vendors in Smart Machines, 2016"

"Chief Data Officer Desk Reference for Artificial Intelligence"

"Predicts 2017: Artificial Intelligence"

"Prepare for When AI Turns Skilled Practices Into Utilities"
"Enterprises Must Prepare 'Now' for the Disruptive Power of Conversational AI Platforms"

"Top 10 Strategic Technology Trends for 2017: Artificial Intelligence and Advanced Machine Learning"

"Develop Your Artificial Intelligence Strategy Expecting These Three Trends to Shape Its Future"

"Top 10 Strategic Technology Trends for 2017: Intelligent Apps"

"Cool Vendors for Artificial Intelligence, East Asia, 2017"

More on This Topic

This is part of two in-depth collections of research. See the collections:

- Creating Digital Value at Scale: A Gartner Trend Insight Report
- Research Roundup: Computer Vision — Industry Trends, Use Cases and Best Practices