Artificial Intelligence: What's Possible For Enterprises In 2017

The Short Answer Is "Lots," But Don't Let Your Hopes Get Too High

by Mike Gualtieri

November 1, 2016

Why Read This Report

Artificial intelligence is not new. It emerged as a computer science discipline in the '50s and has been a persistent theme in science fiction. What is new now is that billions of dollars are flowing into AI startups and software development efforts by both the internet heavies and enterprise software vendors alike. It promises to be the technology Valhalla for AD&D pros who wish to use it to transform or invent new business models by infusing applications with intelligence. Read this report to understand the pragmatic building blocks you can use today to add AI to your applications.

Key Takeaways

Enterprise Interest In AI Is Surging

AI is a hot, hot topic among Forrester clients — both enterprises and technology vendors. They didn't start the fire. It was always burning since AI emerged in research and science fiction.

Pragmatic AI Technologies That Every AD&D Pro Should Know

Forrester has identified 10 AI technology building blocks that AD&D pros can use to add a modicum of intelligence to existing and new applications. But the maturity of these building blocks varies.

Danger, Will Robinson

Pure AI may be the digital ghost in the machine, if it can even be achieved at all. However, some are so sure of its "in-our-lifetime" success that they fear it will result in unintended negative consequences for humanity. We think those fears are misplaced.

Artificial Intelligence: What's Possible For Enterprises In 2017

The Short Answer Is "Lots," But Don't Let Your Hopes Get Too High

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Forrester leveraged briefings, advisory projects, inquiries, interview notes, and academic papers as well as recent ad hoc survey data as part of the research to inform this report.

Related Research Documents

Artificial Intelligence Can Finally Unleash Your Business Applications' Creativity

How AI Will Change Software Development And Applications

A Machine Learning Primer For BT Professionals

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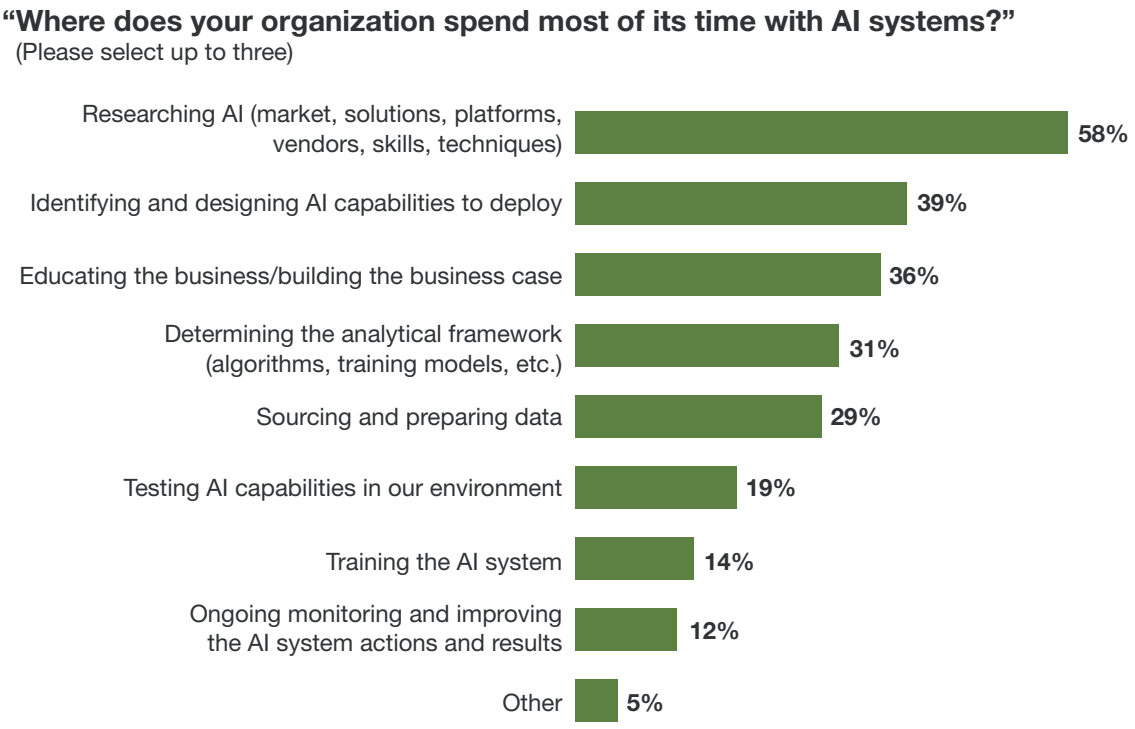
Is AI Ready For Prime Time?

Forrester surveyed business and technology professionals and found that 58% of them are researching AI, but only 12% are using AI systems (see Figure 1). This gap reflects growing interest in AI but little actual use at this time. We expect enterprise interest in, and use of, AI to increase as software vendors roll out AI platforms and build AI capabilities into applications. Enterprises that plan to invest in AI expect to improve customer experiences, improve products and services, and disrupt their industry with new business models (see Figure 2).

But the burning question for application development and delivery (AD&D) pros is: How can your enterprise use AI today? The answer depends on how you choose to define AI.[1]

FIGURE 1 Forrester Expects More Organizations To Research And Implement AI Capabilities



Base: 391 business and technology professionals
Note: "Don't know" responses were excluded from analysis.
Source: Forrester's Q2 2016 Global State Of Artificial Intelligence Online Survey

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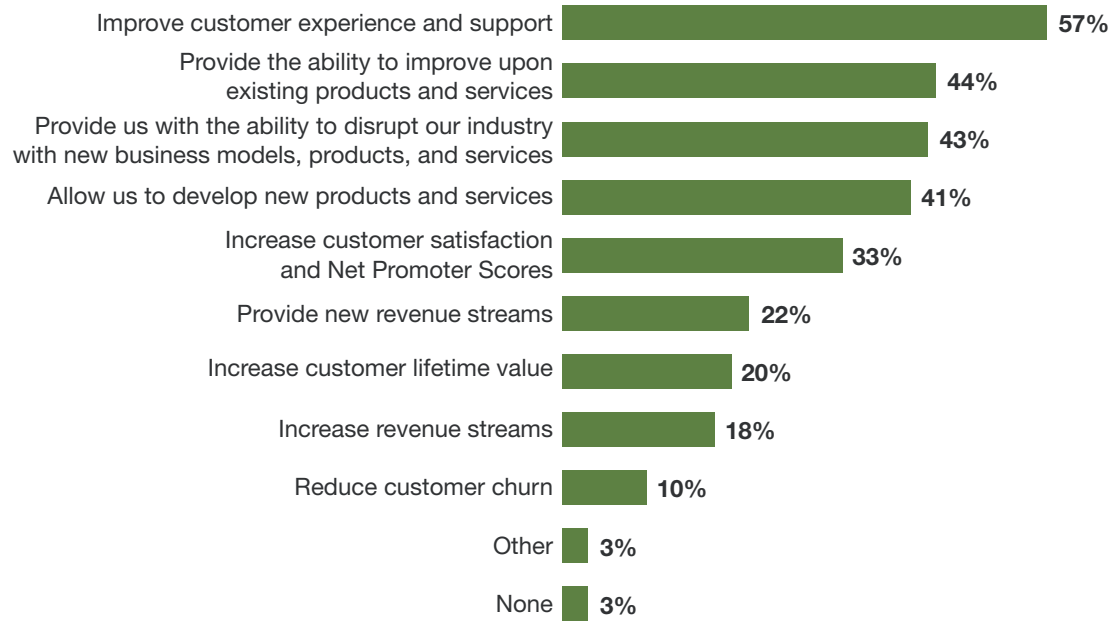
FIGURE 2 Enterprises Believe The Benefits Of AI Will Be To Improve Customer Experience And Support

"What are the biggest strategic/growth benefits AI will contribute to your organization?"
(Please select up to three)



Base: 598 business and technology professionals
Source: Forrester's Q2 2016 Global State Of Artificial Intelligence Online Survey

Temper Your Expectations, But Don't Give Up On AI

AI has been oft overhyped, including in 1967 when Marvin Minsky, a pioneer in the field of artificial intelligence and cofounder of the Massachusetts Institute of Technology's AI laboratory, stated that "within a generation the problem of creating 'artificial intelligence' will substantially be solved."[2] He was wrong, but not entirely:

- **Humanity is still far away from pure AI . . .** The highest benchmark for AI is the humanlike ability to perceive (sense), learn, think (formulate ideas), interact, and take actions. This is pure AI.[3] We aren't there yet, although forms of pure AI have been imagined in science fiction such as *Ex Machina* (humanoid robot), *The Matrix* (large computer), and *Star Wars* (various robots). AI doesn't have to take human form or any form at all. It can be just software. Some AI researchers envision AI that could ultimately exceed human intelligence, an idea also commonly explored in science fiction.[4]

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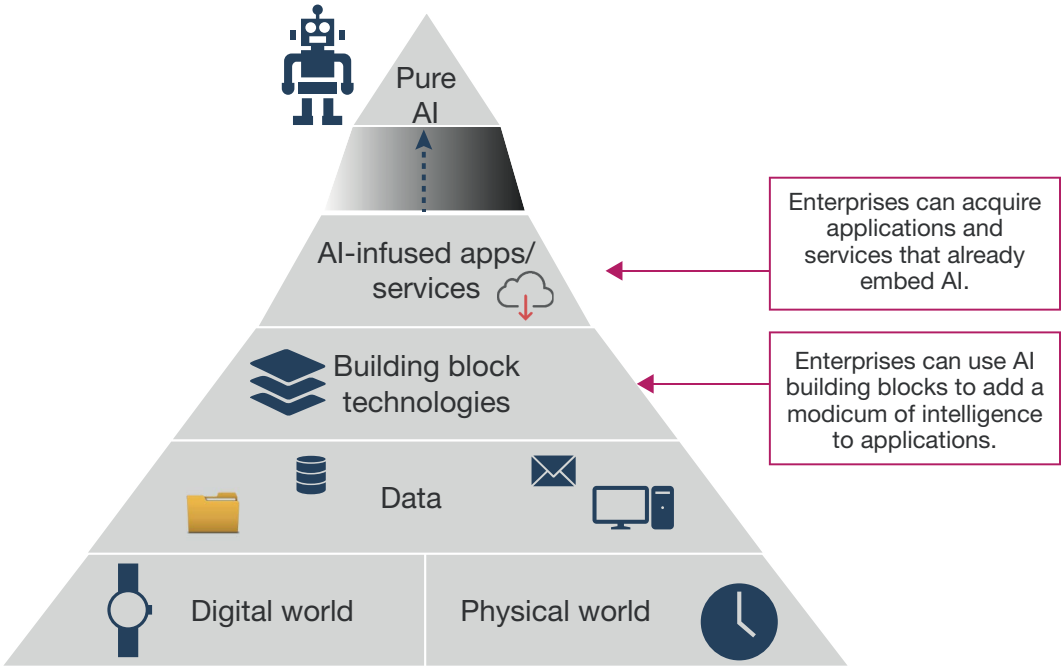
› **. . . but pragmatic AI can have transformative value today.** AI is not one universal technology. Rather, it is composed of technology building blocks that, individually or in combination, are advanced enough to add some intelligence to applications that can lead to significant business transformation. This is pragmatic AI. The state of the art in pragmatic AI is bright glimmers of intelligence that is advanced enough for enterprises to exploit now.[5] For example, enterprises use machine learning — a pragmatic AI building block — to build predictive models and natural language processing (NLP) to analyze customer interactions. AD&D pros can leverage those AI technology building blocks to add a modicum of intelligence to applications that dramatically boost their ability to learn and adapt from data (see Figure 3).

FIGURE 3 Enterprises Can Use AI Building Blocks To Add A Modicum Of Intelligence To Applications



AD&D Pros Should Focus On AI Building Blocks

Internet giants and digital natives such as Airbnb, Alibaba, Amazon, Apple, Facebook, Google, Netflix, Uber, and others use AI technology building blocks to build billion-dollar empires. Google CEO Sundar Pichai describes AI as "a core, transformative way by which we're rethinking how we're doing everything."[6] Apple CEO Tim Cook concurs, saying that "AI will make this product [the iPhone] even more essential to you [the customer]."[7] These technology behemoths are no longer alone. Software giants (such as IBM, HP Enterprise, Microsoft, Oracle, Salesforce, and SAS), startups (such as Artificial

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Solutions), and open source projects (such as TensorFlow and Apache SystemML) offer AI tools, platforms, and/or solutions for enterprise consumption. Enterprises, inspired by these technology giants, want to create scalable, individualized customer experiences and look to build their own AI capabilities with help from enterprise software vendors and open source solutions.[8]

To understand how AI can help enterprises, AD&D pros have to understand the maturity and scope of AI building blocks and how they can infuse applications and business processes with intelligence. AI building blocks range from technologies that haven't made it out of the lab to pragmatic technologies that you can use right now (see Figure 4):

- **Knowledge engineering.** Knowledge engineering is a process to understand and then represent human knowledge in data structures, semantic models, and heuristics (rules). AD&D pros can embed this engineered knowledge in applications to solve complex problems that are generally associated with human expertise.[9] For example, large insurers have used knowledge engineering to represent and embed the expertise of claims adjusters to automate the adjudication process. IBM Watson Health uses engineered knowledge in combination with a corpus of information that includes over 290 medical journals, textbooks, and drug databases to help oncologists choose the best treatment for their patients.[10]
- **Robotics.** A robot is an autonomous mechanical device that can perform tasks and interact with the physical world.[11] Robots may look humanoid, but most are designed to take a form that is more appropriate to their function. For example, manufacturing welding robots take the form of a large jointed arm. A driverless car is a robot because it is autonomous, and it obviously takes the form of an automobile. Enterprises mostly use robotics to automate repetitive tasks in controlled manufacturing environments for materials handling, assembly processes, and quality checks. But, as robotic technology advances, enterprises can use it to automate a wider range of business processes, customer interactions, or new product development.
- **Speech recognition.** Speech recognition technology converts the audio of spoken words to text that applications can use to take commands from humans (like Apple's Siri, Google Now, or Amazon Echo), transcribe a conversation, or participate in a conversation. For example, Nuance offers a speech recognition solution called Dragon Medical that integrates with major electronic health record (EHR) applications such as Epic Systems, Cerner, and eClinicalWorks to help doctors capture clinical narratives.[12] This is a literal application of speech recognition technology; however, understanding spoken words also requires an understanding of the context in which they are said. Say aloud "This machine can recognize speech." Now say it again, but picture yourself on a Cape Cod beach looking at a backhoe. You probably hear instead "This machine can wreck a nice beach!" Context-aware speech recognition is still a challenge in many situations.
- **Natural language processing.** NLP technology strives to understand the meaning of words in conversations and written text. The ultimate goal of NLP is to do this at scale — extract meaning expressed in language in libraries, the internet, and billions of conversations that take place every minute of every day. Today, enterprises can use NLP to analyze any text to extract topics, sentiment,

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meaning — and knowledge. A large financial information services firm uses NLP to monitor social media and financial market news in real time to look for changes in sentiment that may signal an opportunity for its customers to buy or sell a financial instrument. eCommerce companies use NLP to analyze customer product reviews and then correlate it with star ratings to determine salient product features, quality issues, and general sentiment toward the product and manufacturer.

- **Natural language generation (NLG).** Natural language generation is the inverse of NLP. This technology strives to express information stored and modeled in software in natural language that humans can understand as if they were hearing or reading text written by a native speaker. Applications use NLG technology to speak or converse with humans. For example, intelligent digital assistants such as Amazon Alexa talk back to humans who ask them a question. Enterprises can use NLG to provide employee-less customer service agents such as Amelia from IPsoft and Watson Engagement Advisor from IBM. Enterprises can also use NLG to produce software-written narrative reports. USAA uses Narrative Science's Quill to generate customized investment advice reports for its customers.[13]
- **Image analysis.** Image analysis is technology that strives to identify and understand what is seen — objects, people, and situations in static digital images and/or video.[14] Image analysis technology assigns textual labels to identify objects and/or motion that AD&D pros can use within applications to give them the power of vision. Lemon Tree Hotels in New Delhi uses NEC's hotel face recognition system to alert hotel staff when VIPs enter the lobby and security officers when undesirable guests enter the hotel. A large chip manufacturing firm uses image analysis to visually assess silicon wafers for quality defects.
- **Machine learning.** Machine learning is composed of tools, techniques, and algorithms to analyze data that AD&D pros and data scientists use to create predictive models or identify patterns in data.[15] Machine learning is not a singular approach to analyzing data. There are dozens of specialized classes of algorithms that focus on specific problem domains. For example, some machine learning algorithms design personalized product recommendations for customers, while others predict customer behavior (such as when a customer might churn). Cognitive search technology uses machine learning to identify recurring patterns in search results to make them increasingly relevant to customers over time.[16]
- **Deep learning.** Deep learning is a branch of machine learning that specifically focuses on algorithms that construct artificial neural networks inspired by biological neural networks formed in the brain.[17] It is a computationally intensive technique that makes neural networks more efficient to create at scale.[18] Today, all the internet giants use it to analyze and predict online behavior, improve search, and label uploaded images. Other enterprises can experiment with deep learning to organize information and predict outcomes or to boost the accuracy of other AI building blocks, such as image analysis and speech recognition. As a newer technique, deep learning uses open source frameworks such as Caffe specifically for image classification and Google TensorFlow and

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Theano for more general purposes. Enterprises must be prepared to invest in research to try these multiple frameworks. AI researchers see great potential for deep learning because it may evolve into a general-purpose learning system similar to the human brain.

- **Sensory perception.** Sensors measure and collect one or more physical properties of persons, places, or things — such as location, pressure, humidity, touch, voice, and much more.[19] AI applications exist in the physical world and often need information about the physical environment to provide context. AD&D pros should take inventory of the sensors available to their applications for information that add context or training data for other AI building blocks. For instance, GE's Predix Asset Performance Management is an internet-of-things (IoT) application that uses sensory information from industrial equipment to build machine learning models; these models help firms optimize maintenance routines and predict equipment failures before they happen. NTT Docomo's sensor packages help detect if a cow is ready to go into labor, allowing for faster veterinarian response time and a safer calving process.
- **Cognition.** Applications are Turing complete. That's computer science jargon meaning an application performs exactly as it is programmed. Intelligence doesn't or shouldn't work that way. Applications that are cognitive must perceive, interact, learn, act, and evolve — that's pure AI. Cognition occurs when all of the above AI building blocks come together to create an application that has a "mind" of its own — it can use acquired knowledge to problem-solve toward a goal. In the past few years, IBM has popularized the phrases "cognitive computing" and "cognitive services" to mean systems and applications that use the pragmatic AI technology building blocks we've described here to make applications more intelligent. Vendors such as Accenture, Microsoft, SAS, and many others including startups now also use the "cognitive" moniker to describe what we'd more accurately call pragmatic AI. So, when you hear "cognitive," know that true cognitive computing is still the subject of research and it means vendors are actually offering pragmatic, not pure, AI.

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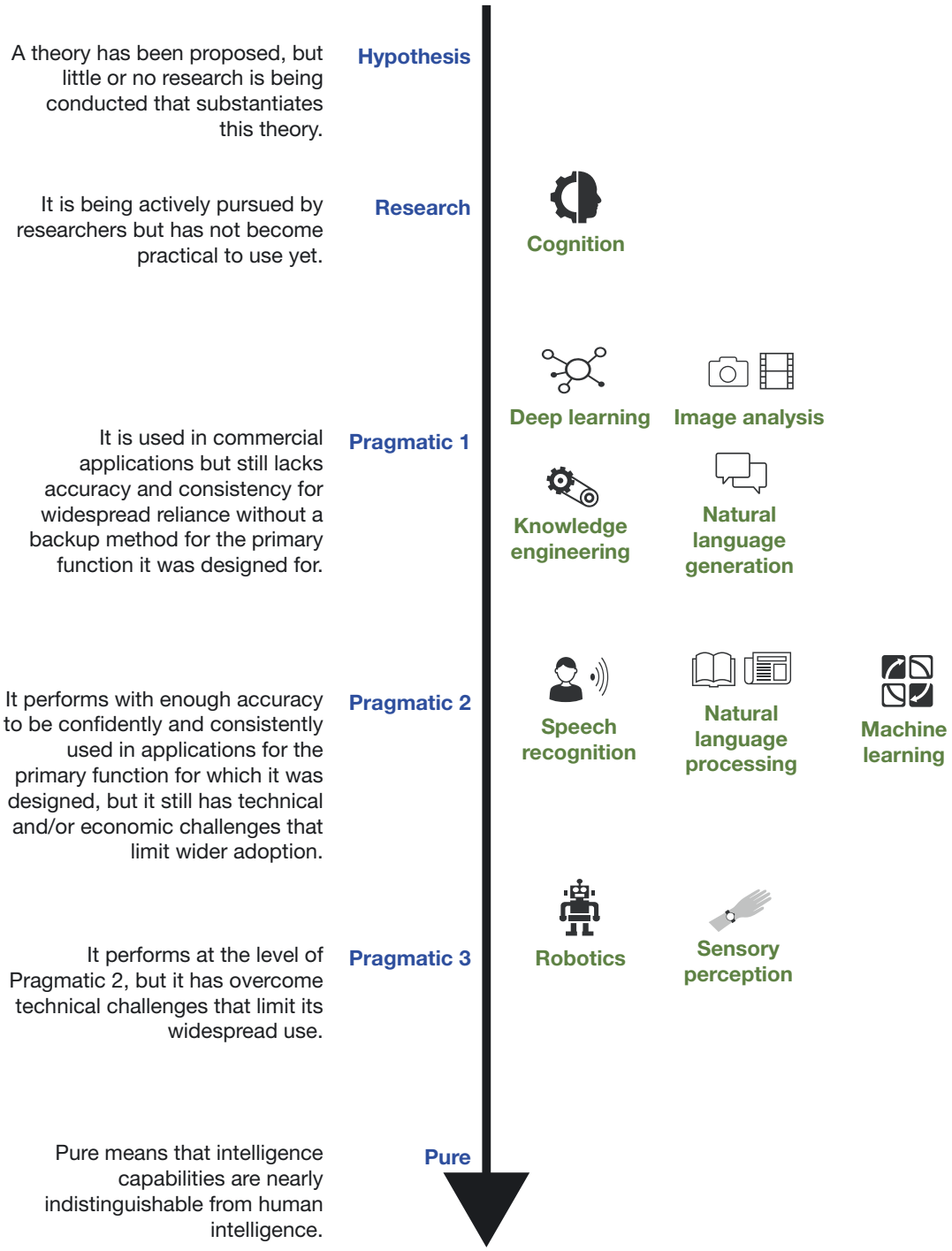
FIGURE 4 AI Technology Building Blocks — Assessment Categories And Meanings



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Pragmatic AI Use Cases That Can Work Today

To succeed with AI today, AD&D professionals must focus on how combinations of AI technology building blocks are orchestrated together to add intelligence to applications that power customer experiences and business processes. Today, AD&D pros can add the following pragmatic AI capabilities to an application to:

- **Make it converse.** Speech recognition accuracy is acceptable enough now to add it to apps that can interface with people via speech using natural language rather than stilted voice or text commands. Listening is one thing; understanding is another. Speech understanding is getting better, but it is still very easy to stump any of these systems. Understanding the spoken or written word is key to allowing an application to converse with the speaker or chat back in a dialog. Enterprises can add speech recognition and conversations to applications such as automated customer service, personal digital assistants, or just about any electronic device. For example, most automobile manufacturers have added speech commands in their vehicles.

  Primary building blocks: speech recognition, natural language processing, natural language generation

- **Make it see.** An enormous amount of useful information is visual. Real-time analysis of video and static image analysis has progressed rapidly. You can find face detection in even the cheapest phone cameras, and Facebook can already recognize specific people. Google Photos uses deep learning to analyze images to detect and label objects, situations, and scenes. Enterprises can use image analysis technology to enhance applications, such as an insurance app that lets consumers take a picture of damage and then perform an estimate of repair costs.

  Primary building blocks: image analysis, deep learning

- **Make it predict.** Most applications use data, but they don't learn from it to get smarter. Machine learning can analyze data to build predictive models for use in applications to then adapt and learn with experience.[20] Enterprises can use machine learning models to infuse applications with learned logic — logic that adapts as the model gets smarter. Amazon and Netflix use machine learning to create their recommendation engines. Enterprises routinely use predictive models to identify customers who are likely to churn or to identify specific customers' propensity to buy additional products.

  Primary building blocks: machine learning, knowledge engineering

- **Make it discover.** Enterprises can use AI technology to provide business intelligence or intelligent access to information. Advanced search technologies can quickly recall information, discover links between information, and find entirely new patterns or risks that humans could not do on their own. This ability to recall contextual information can be very valuable when embedded in applications.[21] Pharmaceutical companies use AI-infused search applications to provide research scientists with

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the most relevant information they need to quickly test hypotheses about new uses for previously approved drugs. Oil and gas exploration firms use image analysis and machine learning on aerial images and ground samples to predict the most prolific drilling sites.

Primary building blocks: machine learning, natural language processing, knowledge engineering

› **Make it move.** Well before most even imagined the possibility of a self-driving car, robots were deployed in manufacturing plants for 40 years. Enterprises can create applications and devices that use robotic technology to add mobility and/or physical interaction with the world. Enterprises can also use robotics to create new products, just as SoftBank Robotics has created a human-shaped robot called "Pepper" that the company says is "kindly, endearing, and surprising" as a "day-to-day companion, whose number one quality is his ability to perceive emotions."[22] Robotics can also automate some supply-chain operations and manufacturing processes.

Primary building blocks: robotics, image analysis, sense perception

Recommendations

Infuse Or Choose Pragmatic AI Apps

Pure AI is cool to think about, but it is pragmatic AI that AD&D pros must focus on now. Until artificial intelligence in applications becomes the norm, you have an opportunity to get out in front of the trend and use AI to facilitate more efficient business processes and, of course, better, more individualized customer experiences. You have two ways to leverage pragmatic AI today:

› **Add AI to an existing application.** You don't have to build a net-new application to benefit from pragmatic AI. Enterprises have dozens, hundreds, and often thousands of applications that employees and customers use. Think of each and every one of those applications as candidates for an AI infusion. Analyze your enterprise and customer-facing applications and systems of engagement, such as marketing automation or eCommerce platforms, to see if they would benefit from the capability to see, converse, predict, discover, or even move. Now you have candidate applications that may benefit from AI technology in the next version.

› **Buy AI in a new application.** You also have the option to shop for prebuilt applications and services from software vendors that are building pragmatic AI capabilities directly into their applications. IBM, Oracle, Salesforce, SAS, and many others — including many startups — are increasingly adding pragmatic AI technologies to their applications.

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What It Means

Imitation Is The Sincerest Form Of Flattery . . . And Fear

Pure AI is true intelligence that can mimic or exceed the intelligence of human beings. It is still a long way off, if it can even ever be achieved. But what if AI became pure — could perceive, think, act, and even replicate as we do? Humanity has been both beautiful and brutal. The *beauty* of ingenuity, survival, exploration, art, and kindness. The *brutality* of crime, war, and pettiness. What would pure AI grow up to be? An equal, positive partner of humanity — the best of us? Or a self-serving technology that perceives humanity as a threat?

The spooky stuff aside, Forrester firmly believes that all enterprises must have an AI strategy now. AI will enable AD&D pros and enterprises to do the things they have always been doing better and to do new things that they have always wanted to do. Donald Fagen, of Steely Dan fame, imagined in his 1982 "I.G.Y. (What a Beautiful World)" lyrics an AI future that you will develop if you choose to do so:

> "A just machine to make big decisions / Programmed by fellows with compassion and vision / We'll be clean when their work is done / We'll be eternally free, yes, and eternally young / What a beautiful world this will be / What a glorious time to be free"

Next Steps

Related Webinar

Artificial Intelligence: What's Possible Today

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Supplemental Material

Survey Methodology

The Forrester Q2 2016 Global State of Artificial Intelligence Online Survey was fielded in May, June, and July 2016. This online survey included 612 respondents globally. For quality assurance, we screened respondents to ensure that they met certain standards in terms of job responsibilities and the size of their organization. Artificial Intelligence was defined to respondents as a self-learning system that is able to interact with humans naturally, understands the environment, solve problems, and perform tasks that normally require human intelligence, qualities, and abilities without the need to code instructions and rules.

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Endnotes

[1] Forrester defines AI as: "A self-learning system that is able to interact with humans naturally, understands the environment, solve problems, and perform tasks that normally require human intelligence, qualities and abilities without the need to code instructions and rules."

[2] Source: Katrin Weigmann, "Does intelligence require a body?" NCBI, November 13, 2012 (http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3512413/).

[3] AI researchers refer to "strong AI" and "weak AI." Strong AI does not exist yet. Weak AI refers to what is possible now. Most use the term "general AI" to mean what we call "pure AI."

[4] Author Ray Kurzweil makes several predictions about the future of humanity in his book The Singularity Is Near. One of the most notable is his expectation that machine intelligence will become more powerful than human intelligence with the technological advancements of the future. Kurzweil predicts that in 2045, an exponential increase in technologies will reach a point where progress is so rapid, it outstrips humans' ability to comprehend it. Source: Raymond Kurzweil, The Singularity Is Near: When Humans Transcend Biology, Viking, 2006.

[5] Enterprise developers are starting to use AI to build cognitive computing systems. Forrester will help enterprise architecture professionals navigate the AI market landscape, understand how cognitive computing can enhance their business applications, and map how AI technologies may fit (or be retrofitted) in their existing architecture. See the "Artificial Intelligence Can Finally Unleash Your Business Applications' Creativity" Forrester report.

[6] Source: Tom Simonite, "Google's Quantum Dream Machine," MIT Technology Review, December 18, 2015 (http://www.technologyreview.com/news/544421/googles-quantum-dream-machine/).

[7] Source: Roger Fingas, "Tim Cook says AI & augmented reality are core technologies in Apple's future," AppleInsider, August 14, 2016 (http://appleinsider.com/articles/16/08/14/tim-cook-says-ai-augmented-reality-are-core-technologies-in-apples-future).

[8] The answer to developing apps that dazzle the digital consumer and making your company stand out from the competition lies in what Forrester calls predictive apps. Predictive apps leverage big data predictive analytics to provide the right functionality and the right content on the right device at just the right moment for the right person — an individual person, not a target, niche, or segment. To learn more, see the "Predictive Apps Are The Next Big Thing In Customer Engagement" Forrester report.

[9] "Expert systems" is also a term used to describe applications that embed human knowledge.

[10] IBM describes its Watson Health initiative as "pioneering a new partnership between humanity and technology with the goal of transforming global health. Cognitive systems that understand, reason and learn are helping people expand their knowledge base, improve their productivity and deepen their expertise. With cognitive computing, we are now able to see health data that was previously hidden, and do more than we ever thought possible." IBM calls these "cognitive systems" that use "cognitive computing." The "cognitive" term is interchangeable with AI. IBM uses multiple AI building blocks to create cognitive systems. Source: "2015 Corporate Responsibility Report," IBM, June 2016 (https://www.ibm.com/ibm/responsibility/2015/communities/health.html).

[11] Descartes vigorously defended mind-body dualism — the idea that the mind and body are distinct and exist independently of one another — and it is therefore possible for one to exist without the other. Source: "René Descartes: The Mind-Body Distinction," Internet Encyclopedia of Philosophy, (http://www.iep.utm.edu/descmind/).

However, the growing research discipline of embodied cognition suggests that to understand the world, we must experience the world — that the mind and the body are existentially linked. For this reason, we include robotics as a building block because intelligence must perceive and act to be useful. Source: Monica Cowart, "Embodied Cognition," Internet Encyclopedia of Philosophy (http://www.iep.utm.edu/embodcog/).

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[12] Nuance is a technology company that offers solutions for speech recognition and natural language understanding. Source: "Dragon Medical Speech Solutions for Clinicians," Nuance (http://www.nuance.com/for-healthcare/dragon-medical/index.htm).

[13] Source: "Narrative Science Announces New Customer Agreement and $10 Million Investment Round led by USAA," Narrative Science press release, November 28, 2014 (https://www.narrativescience.com/press-release-usaa).

[14] Image analysis is also known as computer vision. Computer vision implies more of a real-time analysis of video such as in driverless cars or robots.

[15] Don't worry. You don't need a Ph.D. in computer science to use machine learning in your apps. AD&D pros can use machine learning to make their apps a whole lot smarter by continuously adapting the user experience, predicting outcomes, and revealing new insights. And you don't have to program algorithms from scratch; you just have to use them to build experiences that are efficient and engaging. Both commercial and open source tools are available to use machine learning to create models that can easily be embedded in applications. This report helps AD&D pros understand machine learning, outlines use cases for new app experiences, and provides an overview of machine-learning tools that are available right now. See the "A Machine Learning Primer for BT Professionals" Forrester report.

[16] Keyword search is obsolete. Cognitive search is the new watchword. We've gone far beyond the traditional search box with a simple list of results to cognitive search. That means less searching and more knowledge. Relevance is the key. This report helps AD&D pros understand how they can use cognitive search technology in their applications so that every employee and every customer can have the right information at the right time. See the "Brief: Cognitive Search Is Ready To Rev Up Your Enterprise's IQ" Forrester report.

[17] The neural system in the human body consists of three stages: receptors, the neural network, and the effectors. Receptors receive stimuli from the internal or external world and pass information into neurons. The neural network then processes the input of this stimuli and makes the proper decision of output. Finally, the effectors translate this decision into a response to the outside environment. Neuroscientists study human and animal brains to understand how the brain acquires, stores, transmits, and creates information. Source: Michael A. Arbib, *Brains, Machines, and Mathematics*, Second Edition, Springer-Verlag, New York, NY, 1987.

A neural network is an interconnected graph of processing nodes organized in layers with an input layer, middle layers, and an output layer.

[18] Neural networks are computationally intensive, which is why companies like NVIDIA have specifically created a software development kit (SDK) that allows deep-learning developers and researchers to use NVIDIA's GPU processors.

[19] Most apps are boring. Sensors can help. Data from sensors can be the spice that adds zing to your applications and can help impress customers, make workers more efficient, and boost your career as an AD&D professional. This report provides a definition and foundational taxonomy of sensors that you can use to identify sensor opportunities for you to design, develop, and deliver more useful and engaging apps for your business partners and customers. See the "Use Sensors To Take Apps To The Next Level Of Customer Engagement" Forrester report.

[20] Every AD&D professional and every technology management leader should know what predictive analytics is. This report gets AD&D pros up to speed quickly so that they can lead the charge. See the "Predictive Analytics Can Infuse Your Applications With An 'Unfair Advantage'" Forrester report.

[21] For more information, see the "Brief: Cognitive Search Is Ready To Rev Up Your Enterprise's IQ" Forrester report.

[22] Pepper is the first humanoid robot capable of recognizing the principal human emotions and adapting its behavior to the mood of its interlocutor. Source: "Who is Pepper?" SoftBank Robotics (https://www.ald.softbankrobotics.com/en/cool-robots/pepper).

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