

E-BOOK

Artificial Intelligence in 2019

A handbook for business leaders



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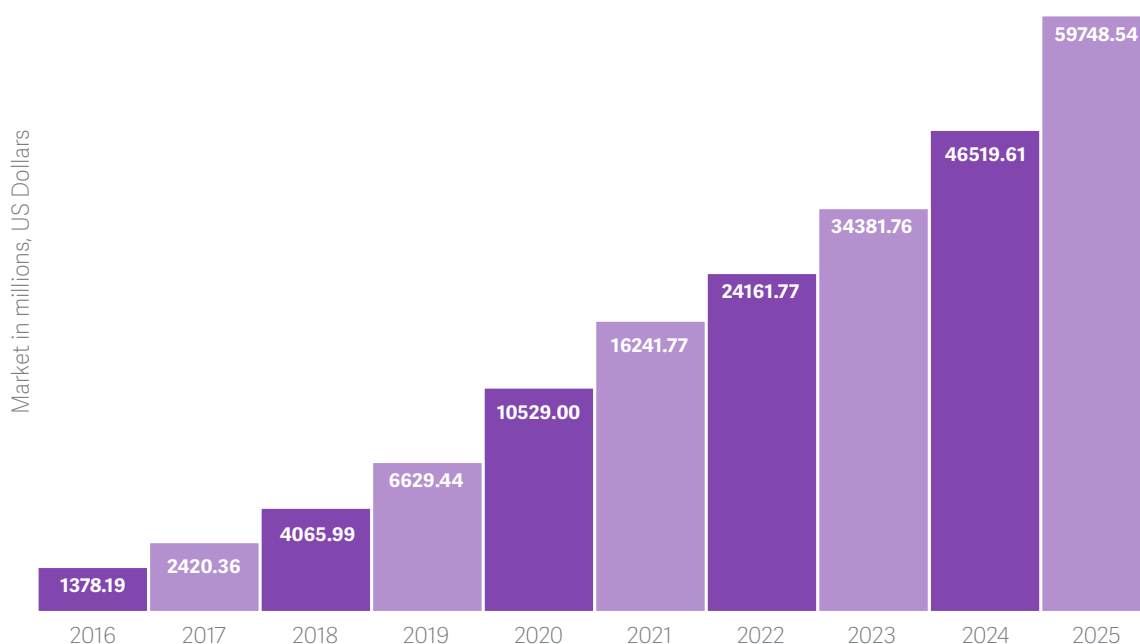
AI in the enterprise

To understand how large businesses can use artificial intelligence (AI), let's first look at what it means.

Why is there so much buzz around AI? In the tech space, increasing demand by businesses for productivity-boosting technology is pushing enterprise software vendors across industries to look at introducing AI into their product strategies. Gartner analysts believe that by 2020, AI technology will be pervasive in almost every new product and service.

According to AI market research from Tractica, the revenue from the AI market worldwide will grow to nearly \$60 billion by 2025.

The analyst Gartner defines AI as technology that appears to emulate human performance typically by learning, coming to its own conclusions, appearing to understand complex content, engaging in natural dialogs, enhancing human cognitive performance, or replacing people in execution of non-routine tasks.



Source: Tractica

The largest proportions of revenue will come from the enterprise applications AI market, with work being done in image recognition, object identification, detection and classification, as well as automated geophysical feature detection.

Factors driving a wave of growth in enterprise AI include:

- The availability of AI platforms that democratize access such as Amazon Machine Learning and Google TensorFlow, meaning businesses no longer need data science teams to 'apply AI' and prep data systems
- Wider recognition in multiple industries that AI-powered innovation can transform the enterprise by changing the way we work, with hype turning into reality.
- A significant increase in investment by venture capital firms or angel investors into AI startup companies.

Growth in the use of technology rises in line with its availability. So where are we now when it comes to AI – and where are we going? First, it makes sense to understand where we are with automation, which is already widely used in the business world.



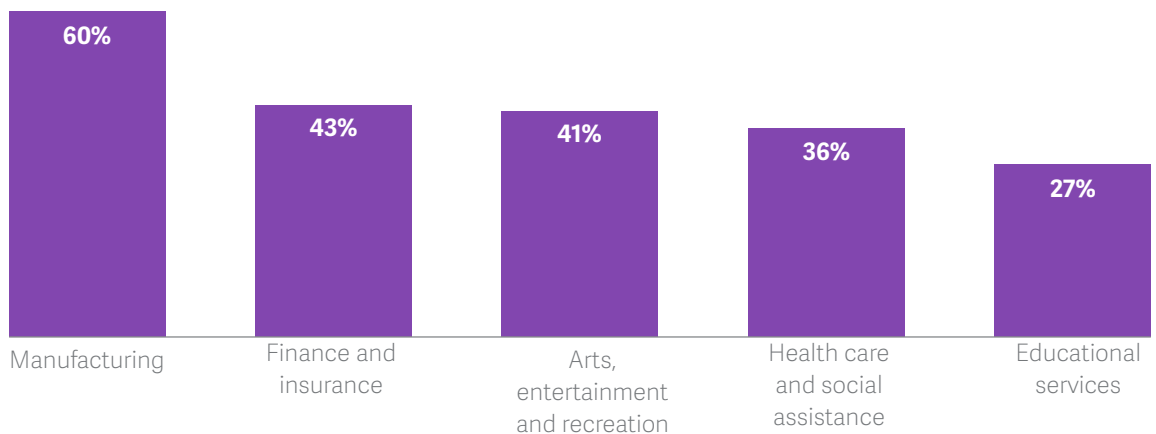
The role of business automation

Automation already contributes significantly in today's enterprises, where machines powered by software follow preprogrammed rules to perform repetitive tasks, such as those that robots might do in an assembly line. This can increase productivity, but also offers benefits such as lower cost, superior quality and lower downtimes.

Factors that may affect the speed that automation makes a difference in your industry could include openness to change, the cost of new technology, the dynamics of the labor market, or regulatory and economic change.

The graph below shows the technical feasibility of automation across industries – the percentage of processes that could be automated. As you can see, it holds huge potential for finance and particularly manufacturing, with 60% of processes possible to automate.

Automation potential across industries



Source: McKinsey & Company

In the near-term, the impact of AI has been described by McKinsey as 'automation on steroids', meaning the set of things we can automate with computers has got that much bigger – think scaling complex technical tasks to mass production levels.

But though the terms automation and AI are often used interchangeably, it's important to understand they mean different things. Currently, most automated systems are rule-based and aren't generally built to improve independently. With AI, we're fundamentally moving in a direction where it's about getting machines to replicate human behavior and make their own decisions

“I often tell my students not to be misled by the name ‘artificial intelligence’—there is nothing artificial about it. AI is made by humans, intended to behave like humans and, ultimately, to impact humans’ lives and human society.”

Fei-Fei Li, Associate Professor of Computer Science at Stanford University

The cloud powers today's advanced AI

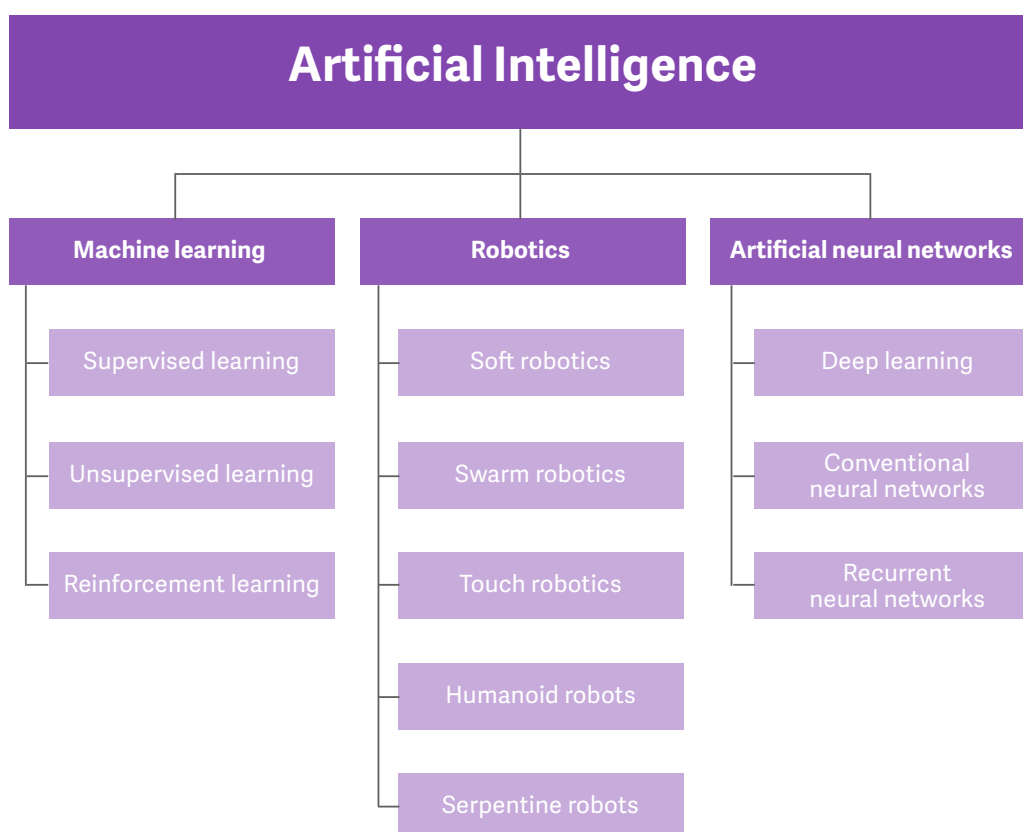
Essentially, AI is a reference to computer technologies that relate and are inspired by the way humans use their brains and nervous systems to reason and make decisions.

Today, AI is getting smart. Technology is getting to the stage where it's possible to think about computers with true intelligence, with the potential to understand natural language and make decisions on its own whim.

This is made possible by the cloud and the use of massive computing processing power. The cloud allows businesses to access huge datasets, allowing their systems to cope with the scale required to provide data-intensive services. Computer scientists, with the use of mathematics and powerful computers, can now run increasingly complex data models.

This has given rise to branches of AI like deep learning, which attempts to mimic activity in layers of neurons in the neocortex, the area of the brain where thinking occurs. This allows software to recognize patterns in digital representations of sound and image for instance.

It means that intelligent machines can potentially escape what we've read in science fiction and give rise to the transformation of industries as varied as manufacturing, transportation, finance and healthcare.



Source: McKinsey & Company



There are three important types of AI that you should understand:

Machine learning

This involves the designing of algorithms that allow computers to act without having to be explicitly programmed. These computers will be able to analyze large volumes of complex data - recognizing patterns, predicting, and adjusting where needed.

Robotics

This is where robots are developed and trained to interact with people in predictable ways. Robots are already widely used in factories performing high-precision jobs such as welding, and might be of particular value in carrying out tasks that are dangerous to humans.

Artificial neural networks

This is where algorithms are built to mimic the brain's neocortex, where thinking occurs. Deep learning is being used in areas useful for businesses such as image recognition – self-driving cars for instance, could be programmed to identify and respond to what they can 'see' on the roads.

New technologies connected with AI could contribute as much as \$15.7 trillion to the world economy by 2030, according to PwC, fueling global growth and productivity. This is more than the current combined output of China and India.

AI advancements to look out for

The rise of AI has been supported by an exponential increase in big data and analytical capabilities supported by advancements in computing power. AI applications need large volumes of data to deliver accurate results – AI systems get ‘smarter’ in direct proportion to the amount of data consumed. Together with computing power, distributed computing network systems can now interface with infrastructure platforms and cloud applications, and analyze data taken from sources such as Internet of Things (IoT) sensors.

Here is a selection of the type of advancements and research underway within AI.

Artificial emotional intelligence

Development over the last few decades has focused on computers developing linguistic, mathematical and logical reasoning. Recently however, the focus has been more on developing systems that are ‘human’ or ‘emotionally intelligent’. We’re seeing a rise in smart assistants, with work being done on systems capable of displaying human emotion – sensors are now capable of observing and recognizing facial features and gestures for example.

Sequential learning

Humans have an ability to draw on and analyze past experiences to solve problems. This has been difficult for computers, as it has been impossible to create AI systems that can learn skills on top of each other. For example, if a machine becomes great at a task (like playing chess), it can’t learn another game without overwriting this ability. Research around ‘sequential learning’ is being done by various companies to allow AI systems to preserve neural connections created from learning a task, before moving onto something else.

Deep learning

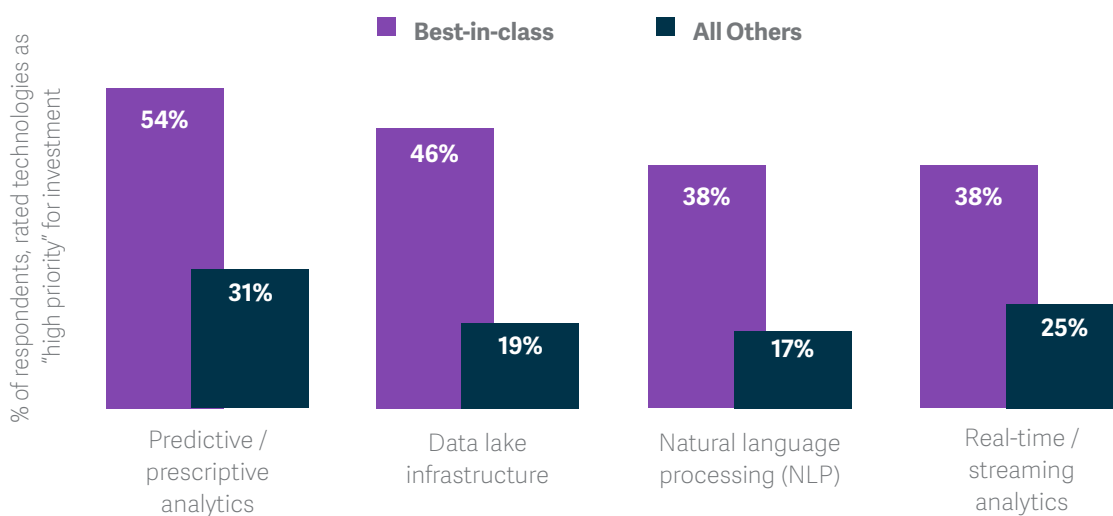
Work has been done on developing deep learning systems that allow machines to make sense of data themselves and learn as they experience – effectively giving them the ability to hear and understand like humans. Deep learning is being used in industries such as healthcare, where it can be used to analyze data to create personalized treatments, and cyber security, allowing for the comprehensive and sophisticated detection of malware.

Why should businesses care about AI?

Many of the theories and technical ideas behind AI have been around for many years. However, computational power has increased to an extent that many of the benefits AI could give to businesses are finally becoming a reality in multiple industries.

This trend, powered by digital transformation, means leaders should care about AI, if they are seriously thinking about the long-term health of their businesses. Customer preferences change constantly, and expectations for service and support continue to rise. AI will lead to the transformation of many businesses, and potentially give rise to organizations that do business in a way we've never seen before.

According to Aberdeen Group's 2017 Big Data Survey, top-performing businesses were more likely to explore investment in these progressive technologies.



Source: *Thinking outside the big data box: What can AI do for you? November 2017, Aberdeen Group*

Innovation like predictive analytics and natural language processing (NLP) are within reach to businesses of all sizes. For example, NLP has the potential to allow business users to ask questions of their data in a way that makes sense to them.

In the consumer world, we're already well familiar with conversational NLP in the form of tools such as Apple Siri, Google Now, Amazon Echo and Microsoft Cortana. This is also referred to as natural language understanding (NLU), allowing systems to define context and user intent. Instead of the formalized syntax of computer languages, computers can communicate to people in a human language.

What can you do with AI?

Because technology changes so fast, it's difficult to make guesses about where AI is going. Hype makes it difficult for business leaders to fully understand what's happening in this growing and emerging market. So instead of being wrapped up in the latest trend, you might be better off focusing on these questions:

1. Can the application of AI make your business run more effectively and efficiently?
2. Can AI solve your business problems?
3. Can AI make your business more profitable?

If AI doesn't hold any answers for your business yet, that's OK. But the likelihood of AI solving some of your biggest challenges grows as the technology gets closer to maturity. To achieve success in deploying AI, there must be a clear focus on it achieving business goals. The goals of the enterprise must be the driving force.

If you're thinking about practical AI business applications, you could look at how computers process and identify patterns in data much more effectively and efficiently than humans, allowing much better insight. This is extremely valuable to businesses, where insight is the new currency.

Standardized and 'off the shelf' AI services might address simple scenarios like image recognition, and voice to text, but advanced predictive scenarios that provide more business value need much more sophisticated and customized solutions tailored to their specific business and operational needs.

“If, for example, we look at AI-powered predictive scenarios, these should go beyond feeding data and adding parameters into the system to get predictive results. To deliver truly impactful business outcomes, organizations need to deploy machine learning capabilities that use data over time to iteratively train the models and improve the accuracy and quality of the output. Organizations should therefore focus on deploying the AI technology solutions that will be insightful, actionable and valuable to them.”

Mark Troester, VP of Strategy at Progress

“I’ve seen a lot of companies in a lot of industries funnel tens of millions of dollars into an innovation arm and not end up with much in the way of practical results, or intangible changes to their product offerings or business model. Then they might forget about it, get flustered and move on.”

Arshak Navruzyan, Chief Technology Officer, Sentient Technology



Identify AI talent internally and externally

In PwC's 2017 Digital IQ survey, only 20% of executives said their organizations had the skills necessary to succeed with AI. As a result, the power of AI has been largely inaccessible to most organizations. With Silicon Valley giants like Facebook and Google hoovering up the best of the best when it comes to people skilled in AI technology, where does that leave the rest of the business world?

Embarking on an aggressive recruitment strategy is one option, but businesses may be better off training the right people internally, as it cuts the risk of new hires not working out. Those that are serious about AI need to treat it as a core competency. It's not about simply creating an 'AI lab'. The businesses that will succeed will have made a serious investment, thinking along the lines of attracting and incentivizing skilled AI talent to work for them and grow their careers.

AI skills that potential recruits will possess are very specialised and in high demand. Machine learning expertise is not resident in every computer programmer or scientist. It is unlikely, if you have not addressed AI until now, that there is someone already present in your workforce who could take up this role.

The key is to identify your need early. It will likely take a significant amount of time and expense to find the right person, and the salary attached to these specialists requires due diligence that their education and experience is up to scratch.

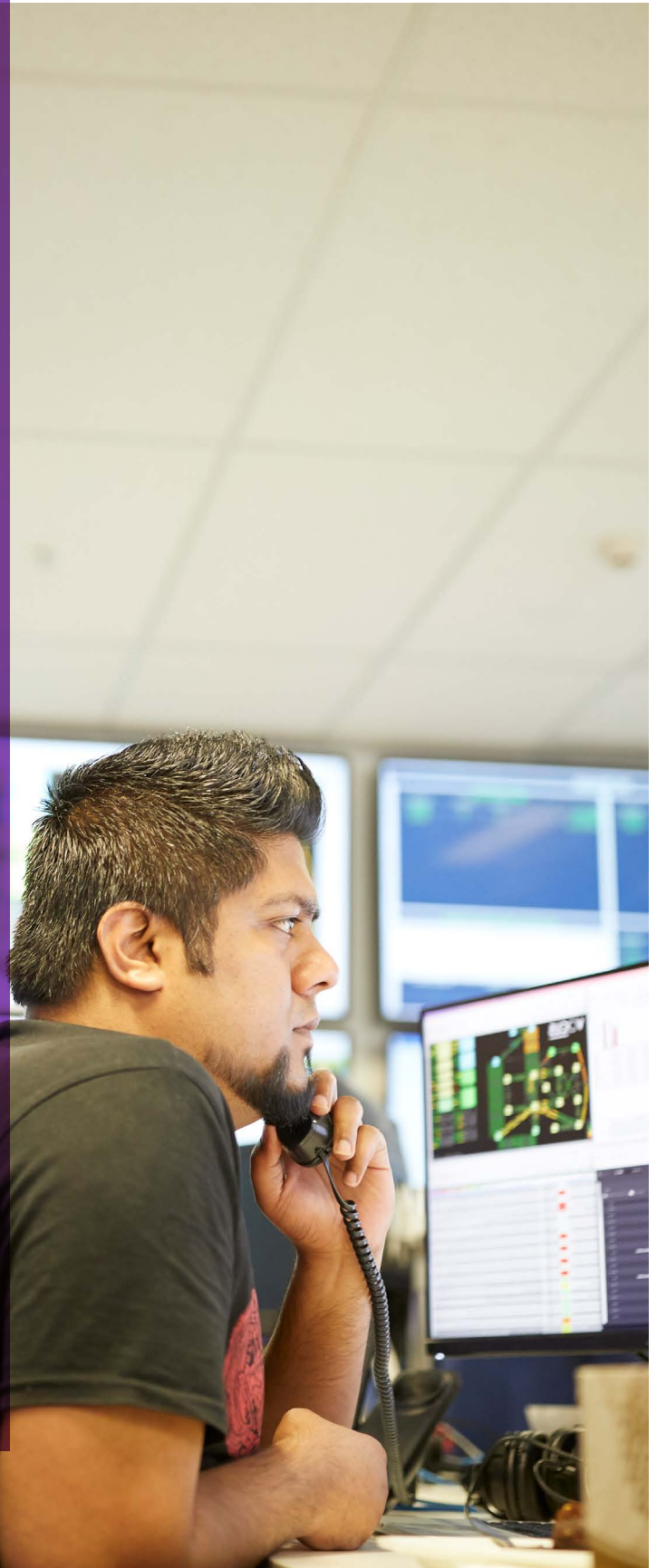
However, recruitment is only half the problem. AI specialists are only as good as the platforms they are paired with. Depending on the complexity of your business, you will need an AI platform that will make a difference when it comes to the problems you need to solve. Consultants and vendors can help you make this decision, but you'll also need to do your own research.

“Businesses should no longer treat AI as the exclusive domain of data scientists. They should on the contrary adopt a more holistic approach that moves beyond silos that treat the analytics and the app development teams as separate.

Application developers need to become more knowledgeable about the data science lifecycle and application designers need to think about how AI and predictive insights can drive the application experience.

By ensuring that the teams within the organisation can work together seamlessly business can get access to a much broader pool of skillsets and talent.”

Mark Troester,
VP of Strategy at Progress



AI in financial services

Financial services is an industry reliant on numbers and data, which naturally makes businesses involved in the sector great candidates for the disruption brought by AI. Already, a lot of work has been done using deep learning algorithms on large amounts of historic data to automate tasks, prevent fraud and generate insight.

Hedge Funds

Hedge fund businesses have already turned their attention to AI for methods such as quantitative trading, which uses algorithms and computers to trade client assets. Machine learning for example, can allow systems to detect patterns that are not noticeable by humans, through crunching millions of data points in real time.

Wealth management

In wealth management, we've seen growth in the number of robo-advisors, built using simple, rule-based algorithms and used to select exchange-traded funds based on historical data such as age, risk appetite and income. A new generation powered by AI could offer much more – an ability to self-learn and create better individual, personalized advice.

Financial management

The banking industry has seen widespread use of Robotic Process Automation (RPA), which replaces routine analysis work and helps with lower transaction processing times, increased productivity and elimination of manual error. The future could see RPA combined with machine learning to automate tasks that usually require human interaction.

Fraud detection

The growth of connected devices and the risk of fraud and hacking has moved financial institutions to look at machine learning techniques to help battle against criminality. AI techniques help organizations study the behavior of customers, comparing data to other indicators in building a picture of a transaction.

AI in financial transactions

AI could be used to track digital trails produced by financial transactions, which means finance teams shouldn't have difficulty in seeing where money goes after it leaves the company.

AI applications such as machine learning, deep learning, and data mining could revolutionize spend visibility. These technologies can allow professionals to make more strategic decisions on sourcing, budgeting, approvals, and more. Total spend visibility is important when a company is facing changes to their business model, needs to adapt to shifts in demand and operations, or is under pressure to uncover internal hidden pockets of potential savings.

Companies could use machine learning technologies to capture images of the physical and unstructured documents (financial transactions recorded on paper, emails, PDFs), extract data, and move it all under one roof for company-wide spend intelligence. Once extracted and translated into the language of machines, transaction data can flow into machine learning algorithms before landing in big data tools, cloud-based data warehouses, and other affordances made possible by immense computing power.

“Companies could have their spend data extracted, combined, validated, classified, and enhanced with related business information, all with machine learning automating throughout the process. Company finance and procurement experts would only need to spot check for accuracy and answer occasional questions to ensure the model kept working. Common errors, costly processing time, and inaccuracies caused by human biases would cease to exist.”

Gert Sylvest, Co-Founder, Tradeshift

AI in manufacturing

Digital manufacturing and Industry 4.0 is all the rage, with innovations like 3D printing/additive manufacturing, industrial robots, self-driving vehicles, drones, augmented/virtual reality, and the IoT. All of them are about making manufacturing more agile, flexible, and personalized. 'Smart' factories are based on a set of manufacturing concepts that includes full connectivity, agility, sub-assemblies, and products moving on automated guided vehicles (AGVs).

Now in manufacturing we are seeing AI in the form of machine learning used in predictive analytic tools. AI tools lend themselves well to pattern recognition exercises (which are tedious for humans) and suggest next best actions based on certain rules, allowing people to focus on more value-added strategic work.

“In the future, AI technologies such as pattern recognition or outlier detection could be used on production, quality, and inventory data to provide surprising information, which the traditional enterprise software user would not have systematically looked for, or may not have expected or detected. This data could then be fed into the cloud enterprise system and overlaid with production, process, or labor data at the business intelligence (BI) level, where AI technologies can be used to glean further valuable insights and prescriptions.”

PJ Jakovljevic, Principal Analyst, Technology Evaluation Centers

Predictive maintenance

This is an area where advanced pattern recognition and machine learning algorithms can help manufacturers lower maintenance costs, improve uptime and in turn customer service levels. Machine sensor data streams can be input into advanced modelling software and compared to real-time operating data, alerting on deviations from expected equipment behavior. This can provide early warning of any equipment issues before they can cause problems, allowing operators to catch issues and save lots of money.

If you deploy predictive maintenance on IoT applications, sensors can continuously gather, clean, analyze and store operating data. Predictive and machine learning algorithms can then monitor the health of critical components. If AI predicts a failure, it will send a maintenance request that could include expected failure time.

The concept of predictive maintenance of internal assets can also be extended to monitoring sold products in use at the customer site. IoT sensory devices can monitor product performance and user habits, and through AI algorithms be predictive and proactive.

As an example, AI could help a washing machine manufacturer know the exact machine part that failed in someone's home. Usually, consumers would have to wait for a repair technician to diagnose the problem, and wait even longer for an ordered part to arrive. In that time, they won't have access to the machine. With AI, an appliance manufacturer could predict the likely failure and act on it before the malfunction happens.

Service level agreements

Through service level agreement (SLA) contracts, manufacturers can increase revenue streams beyond the one-time sale of a product. With 'product as a service', you can generate revenue from product leases – selling cubic feet instead of processors, or hours of engine operation instead of engines.

This setup can increase a manufacturer's value proposition with services that go further than a simple sale. By sharing relevant product and service data, a manufacturer can be provided with important information.

Forecast and demand-driven planning

Machine learning can help with better forecasting and demand-driven planning, especially with irregularly-demanded items, brand new items, promotions, and the incorporation of social sentiment. Predictive analytics tools in enterprise resource planning (ERP) and supply chain management (SCM) software can also be used to predict specific supply risks, such as declining quality, solvency, and other supplier issues.

Reducing scrap rates

Deep learning visual inspection gadgets coupled with machine learning algorithms can help with detecting and predicting quality patterns and issues in statistical process control (SPC).

Manufacturers could reduce scrap rates based on machine learning-based root-cause analysis and reduce testing costs using AI optimization methods. In-process quality control and parts availability are also possible with AI scenarios, as they involve the intersection of data acquisition, contextualization, analysis, and workflow rules.

Shop floor management

When deployed in shop floor order management, AI algorithms can recommend the most efficient path for moving materials, while minimizing energy consumption, and the need for quality checks. As the product configuration or shop floor environment changes, enterprise software can replan the next location for a production machine, assembly or inspection station, based on availability. AI could also be used for predictive scrapping of parts in an assembly line, with the goal of automatically scrapping parts as early as possible – reducing manufacturing costs by avoiding unnecessary rework.

AI in the automotive industry



AI solutions are increasingly being used for software and hardware solutions across multiple industries, thanks to advances in computing power and the proliferation of big data. The automotive sector has taken advantage, with AI used in technology supporting vehicle dashboards, factory assembly lines and vehicle design. Many cars are fitted with sensors that capture real-time data, used to support an AI system in providing safety information to a driver.

AI is used to power self-driving or autonomous cars – Google, Tesla and Uber are three of the big players in this area. This certainly seems to be a growth area – according to IHS, we might see around 21 million self-driven cars by 2035.

Through deep learning, businesses are developing technology which can allow cars to learn from experiences and adapt to real time situations without the intervention of a human. Software engineers can't cover every variable a robot driver might face – so deep learning AI is necessarily for autonomous driving to work.

To get deep learning to work, algorithms must be fed with massive amounts of data, which is why vehicle connectivity has become so important. Many automotive companies are racking up miles with autonomous cars simply to get data to use for algorithms that can allow cars to adapt to any situation you can think of.

With the large amounts of data collected by connected vehicles and needed to power AI technology in safety and autonomous cars for example, many automotive businesses have turned to the cloud, as it moves away from traditional IT structures and offers vast amounts of computing power and data. In the future, crowdsourcing this data could open the way to more disruption and a revolution when it comes to innovation.

“The automotive industry won’t be the same in 10 years. High-end automotive brands are constantly working on innovations like cruise control and adaptive breaking, and there’s an increasing amount of work being done on self-driving autopilot capabilities. There’s a role for the next-generation car to be more actively involved in the driving process, even if a human is still at the wheel.”

Arshak Navruzyan, Chief Technology Officer, Sentient Technology



The AI conversations businesses must have

AI holds rich potential for businesses – it can deliver real insights and real-world applications. Because of increasing processing power and the limitless possibilities of the cloud, we're at a point where AI already powers web platforms, mobile apps and personal devices.

We're already seeing greater efficiency at work with automation allowing bots to take on jobs which are prone to manual error. In some industries, we're seeing better safety with machines taking over dangerous and repetitive tasks. AI has great potential to increase productivity, without needing to increase headcount.

Businesses have a role in communicating the benefits of AI and how useful it can be when it comes to task automation, customer service or internal support. But it also means they have a role in putting the right safeguards in place so that people can establish real trust with a technology.

Businesses can educate by:

- Streamlining and accelerating employee understanding of AI by sharing positive case studies through channels like in-person meetings, email, or the intranet.
- Delivering AI information, education, training and certification for those people working directly with the technology.
- Communicating steps taken to test AI for performance flaws, safeguarding work done with the technology to potential users.
- Ensure AI can maintain its own ethical operations, adapting when unusual requests of interactions pop up
- Announce to a human user that they are interacting with AI up front, explain the value to someone within the context of an interaction, and understand any difference in circumstances.

Businesses also need to be honest and transparent about what impact AI might have on jobs, turning it into a positive conversation. As tasks get automated, they have a responsibility to reskill employees in industries where they will be working in tandem with AI.

In practice, industry needs to emphasize commitment to retraining current employees for an uncertain future and point to the significant new job creation AI will bring to a digitally native workforce.

“We need to train people to test AI systems, and to create these kinds of safety and fairness mechanisms. That’s something we can do right now. We need to put some urgency behind prioritizing safety and fairness before these systems get deployed on human populations.”

Kate Crawford, Distinguished Research Professor at New York University

Our responsibility

Technology firms like Sage have a unique opportunity to shape AI positively for the public's benefit, leading the international community in AI's ethical development, rather than passively accepting its consequences.

Globally we see groundbreaking AI companies, academic research and a vigorous start-up ecosystem. We should make the most of this environment, but it's essential that ethics take central stage in AI's development and use.

AI is not without its risks and there must be moves made to mitigate these. An ethical approach ensures the public trusts this technology and sees the benefits of using it. It will also prepare them to challenge its misuse.

At Sage we have five core principles when it comes to developing for AI

1. AI should reflect the diversity of the users it serves

We need to create innately diverse AI. As an industry tech community we must develop effective mechanisms to filter our bias as well as any negative sentiment in the data that AI learns from, and ensure AI does not perpetuate stereotypes.

2. AI must be held to account – and so must users

We have learnt that users build relationships with AI and start to trust it after just a few meaningful interactions. With trust, comes responsibility. AI needs to be held accountable for its actions and decisions, just like humans.

Technology should not be allowed to become too clever to be accountable. We don't accept this kind of behaviour from other 'expert' professions, so why should technology be the exception?

3. Reward AI for 'showing its workings'

Any AI system learning from bad examples could end up becoming socially inappropriate—we have to remember that most AI today has no cognition of what it is saying. Only broad listening and learning from diverse data sets will solve for this.

One of the approaches is to develop a reward mechanism when training AI. Reinforcement learning measures should be built not just based on what AI or robots do to achieve an outcome, but also on how AI and robots align with human values to accomplish that particular result.

4. AI should level the playing field

AI provides new opportunities to democratize access to technology, especially because of its ability to scale. Voice technology and social robots provide newly accessible solutions, specifically to people disadvantaged by sight problems, dyslexia, and limited mobility.

Our business technology community needs to accelerate the development of these technologies to level the playing field and broaden the talent pool we have available to us both in the accounting and technology professions.

5. AI will replace, but it must also create

The best use case for AI is automation—customer support, workflows, and rules-based processes are the perfect scenarios where AI comes into its own, AI learns faster than humans and is very good at repetitive, mundane tasks, and in the long term, is cheaper than humans.

There will be new opportunities created by the robotification of tasks, and we need to train humans for these prospects—allowing people to focus on what they are good at - building relationships, and caring for customers. We should never forget the need for human empathy in core professions like law enforcement, nursing, caring, and complex decision-making.

To sum up, businesses adopting AI should think about:

- Research and due diligence, and understanding which solutions and approaches work best for them. There should be technology-focused ethical frameworks and roadmaps into corporate investment strategies from the start.
- Identifying value-adding and human-complementing benefits AI can deliver to specific industries, customers and communities.
- Taking responsibility for communicating ethical AI around the world.



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