PUTTING ARTIFICIAL INTELLIGENCE TO WORK

AI has already shown itself to be highly effective in creating value across industries and functions, leaving little doubt that it will fundamentally transform business.

by Philipp Gerbert, Martin Hecker, Sebastian Steinhauser and Patrick Ruwolt

IN RECENT YEARS, artificial intelligence (AI) has left the machine room and entered the world of mainstream business. Today's AI algorithms already support remarkably-accurate machine sight, hearing and speech, and can access global repositories of information. Thanks to deep learning and other advanced techniques, a staggering level of growth in data, and continuing advances in raw processing power, AI performance continues to improve, leading to an explosion in AI-enabled business applications.

As always, this new era will have winners and losers. But our research suggests that if current patterns continue, the separation between the two could be especially dramatic and unforgiving. In this article we will offer practical guidance for introducing and spreading AI within large organizations.

Artificial Intelligence in Action

Despite the increase in AI-enabled business applications, significant adoption of AI in business remains low. According to our survey, only one in 20 companies has extensively incorporated AI. Nevertheless, every industry includes companies that are ahead of the pack. The following uses demonstrate how pervasive AI already is — and how effective it can be in creating value.

MARKETING AND SALES. AI gives companies the opportunity to offer customers personalized service, advertising and interactions. The stakes are huge: Brands that integrate advanced digital technologies and proprietary data to create personalized experiences can increase revenue by six to 10 per cent — two to three times the rate among brands that don't. In retail, healthcare and financial services alone, $800 billion in revenue will shift toward the top 15 per cent of personalization companies during the next five years.

Many best practices of successful personalization have emerged in fast-moving retail environments. One global retailer, for example, used a loyalty app's smartphone data — including location, time of day and frequency of purchases — to gain a deep understanding of its customers' weekly routines. By combining millions of individual data points with information on general consumer trends, the retailer built a real-time marketing system that now delivers 500,000 custom offers a week.

In some sales-and-marketing organizations, AI augments rather than automates processes. For example, a multiline insurer relied on machine learning to segment its customers in order to recommend 'next best offers' — offers positioned at the intersection of a customer's needs and the insurer's objectives — to the company's sales agents. To accomplish this, the insurer built a model of the insurance needs of customers as they pass through various life stages. The model relied on complex algorithms that crunched more than a thousand static and dynamic variables encompassing demographic, policy, agent tenure, and sales history data. As a result, the insurer could match particular policies with individual members of specific clusters. The system has the potential to increase cross-selling by 30 per cent. The insurer can also use the machine learning system to improve sales optimization efforts by processing geographic, competitive, and agent performance data.

Such examples demonstrate the effectiveness of AI in decentralized settings — such as retail or financial services sales— that benefit from a rich supply of contextual and specific customer data. Properly constructed pilot projects can generally validate a proof of concept within four to six weeks and help determine the data infrastructure and skill building necessary for a full rollout.

RESEARCH AND DEVELOPMENT. R&D problems are complex, deeply technical, and bounded by hard scientific constraints. Even so, AI has high potential in this field. For instance, in the biopharmaceutical industry, where R&D is the primary profit driver, AI could reverse the trend toward higher costs and longer development times. **Citrine Informatics**, an AI platform designed to accelerate product development, illustrates one way to meet the challenge of limited data in R+D.

Most published studies have a bias toward successful experiments and, potentially, the interests of the funding organization. Citrine overcomes this limitation by collecting unpublished data through a large network of relationships with research institutions. "Negative data are almost never published. But the corpus of negative results is critical for building an unbiased database," says **Bryce Meredig**, Citrine's co-founder and chief science officer. This comprehensive approach has enabled the company to cut R&D time for its customers by one-half for specific applications.

Within the industrial goods sector, leading manufacturers combine AI, engineering software, and operating data — such as repair frequency — to optimize designs. AI is especially helpful in developing designs for additive manufacturing, also called 3D printing, because its algorithmically-driven processes are unconstrained by engineering conventions.

Aggressive forms of data collection should be a key element in the design of AI pilots in R&D. It may be necessary to collaborate with universities, digitize old records, or even generate new data from scratch. Given the knowledge and expertise required to engage in R&D, useful turnkey AI solutions will rarely be available. Instead, scientists must rely on systematic trials for guidance in building the data inventory they need for future AI applications.

OPERATIONS. Operational practices and processes are naturally suited for AI: They often have similar routines and steps, generate a wealth of data, and produce measurable outputs. Many AI concepts that work in one industry will work in another. Popular current uses of AI include predictive maintenance and nonlinear production optimization, which analyzes a production environment's elements collectively rather than sequentially or in isolation.

An oil refinery wanted to predict and avoid breakdowns of an important gasifier unit responsible for converting residual products of the refining process into valuable synthesis gas used in generating electricity. An unplanned outage of that unit forced a costly suspension of electricity generation for a month. Although the refinery had accumulated plenty of data about ongoing operations, it had no clear understanding of what specific factors drove the unit to break down. Conventional engineering models could not fully describe the complex interdependencies that existed among more than a thousand variables that might lead to failure.

Working closely with data scientists, the refinery's engineers turned to artificial intelligence to determine the cause of the breakdowns, feeding six years' worth of operational data and maintenance information through a machine learning algorithm. The AI model successfully quantified the impact of all key factors (including feedstock type, output quality, and temperature) on overall performance. Engineers were then able to gauge whether the unit would continue to run between episodes of planned maintenance.

Relying on insights that the machine learning algorithm generated, engineers designed a transparent, rules-based system for adjusting key operational settings for variables such as steam and oxygen to enable the unit to keep running between scheduled maintenance periods. This system minimizes the risk of unplanned shutdowns of the unit and reduces the number of short-term changes in the maintenance schedule, yielding significant economic benefits.

Predictive maintenance solutions can also work for humans. A U.S. insurer receiving fixed payments from Medicare wanted to use AI to reduce avoidable visits to the doctor or to hospitals by Medicare patients. The insurer fed data from medical histories, such as adverse reactions to drugs, and case managers' notes into a machine learning system. The system devised an intelligent segmentation of customers and provided useful insights into preventive action. For instance, the recent loss of a patient's spouse proved to be highly predictive of future medical intervention and the need for preventive care. These insights allowed the payer to redesign programs to achieve potential annual savings of $650 million.

Moving beyond maintenance, a smelter operator used AI and non-linear optimization to improve the purity of its copper, which engineers had spent years trying to do. Working with a team of data scientists, the engineers fed five years of historical data into a neural network. The system suggested production changes that resulted in a two per cent increase in purity—an improvement that doubled the smelter's profit margins. The exercise took six weeks and did not require additional capital or operational spending.

PROCUREMENT AND SUPPLY CHAIN MANAGEMENT. In procurement, structured data and repeat transactions are common and AI's potential is substantial but largely unrealized. Machines today can beat the top poker players in the world and trade securities, but they have not yet shown the ability to outsmart vendors in corporate purchasing — at least publicly. Companies may be using AI-enabled procurement systems but not telling their suppliers, or anyone else, in order to maintain a competitive edge. The known examples of AI in procurement involve chatbots; semi-automated contract design and review; and sourcing recommendations based on analysis of news, weather, social media, and demand. Significant augmentation or even automation of sourcing is only now emerging.

Supply chain management and logistics are a different story. Historical data is readily available for these processes, making them a natural target for machine learning. One global metals company recently built a collection of machine learning engines to help manage its entire supply chain, as well as to predict demand and set prices. The company integrated more than 40 data warehouses, ERP systems, and other reporting systems into one 'data lake'. As a result of these changes, the systems can now identify and predict the way complex and opaque demand patterns ripple throughout the supply chain. For example, a shift in the U.S. corn harvest by a single week has global repercussions along the supply chain for aluminum, a common packaging material for corn.

The company's initiative helped improve its customer service levels by 30 to 50 per cent. It is also set to achieve a two-to-four per cent increase in profit margin within three years and a reduction in inventory of between four and ten days within two years. This example highlights the importance of data, data preparation, and data integration in bringing AI to life. It takes far more time to collect data and build the data infrastructure than to build a machine learning model.

SUPPORT FUNCTIONS. Companies often partially outsource support functions, which tend to be similar across organizations. But soon, they may be able to buy AI-enabled solutions for these processes. Heavy AI development is underway at outsourcing giants such as **IBM**, **Accenture**, and India's Big Four players (**HCL**, **Infosys**, **Wipro** and **Tata**). These companies are shifting focus from emphasizing lower labour costs and scale to building intelligence and automation platforms in order to offer higher-value services.

Many service organizations are starting to recognize the benefits of combining AI with robotic processing automation (RPA). They are using rules-based software bots to replace human desk activity and then adding flexibility, intelligence and learning via AI. This approach combines the rapid payback of

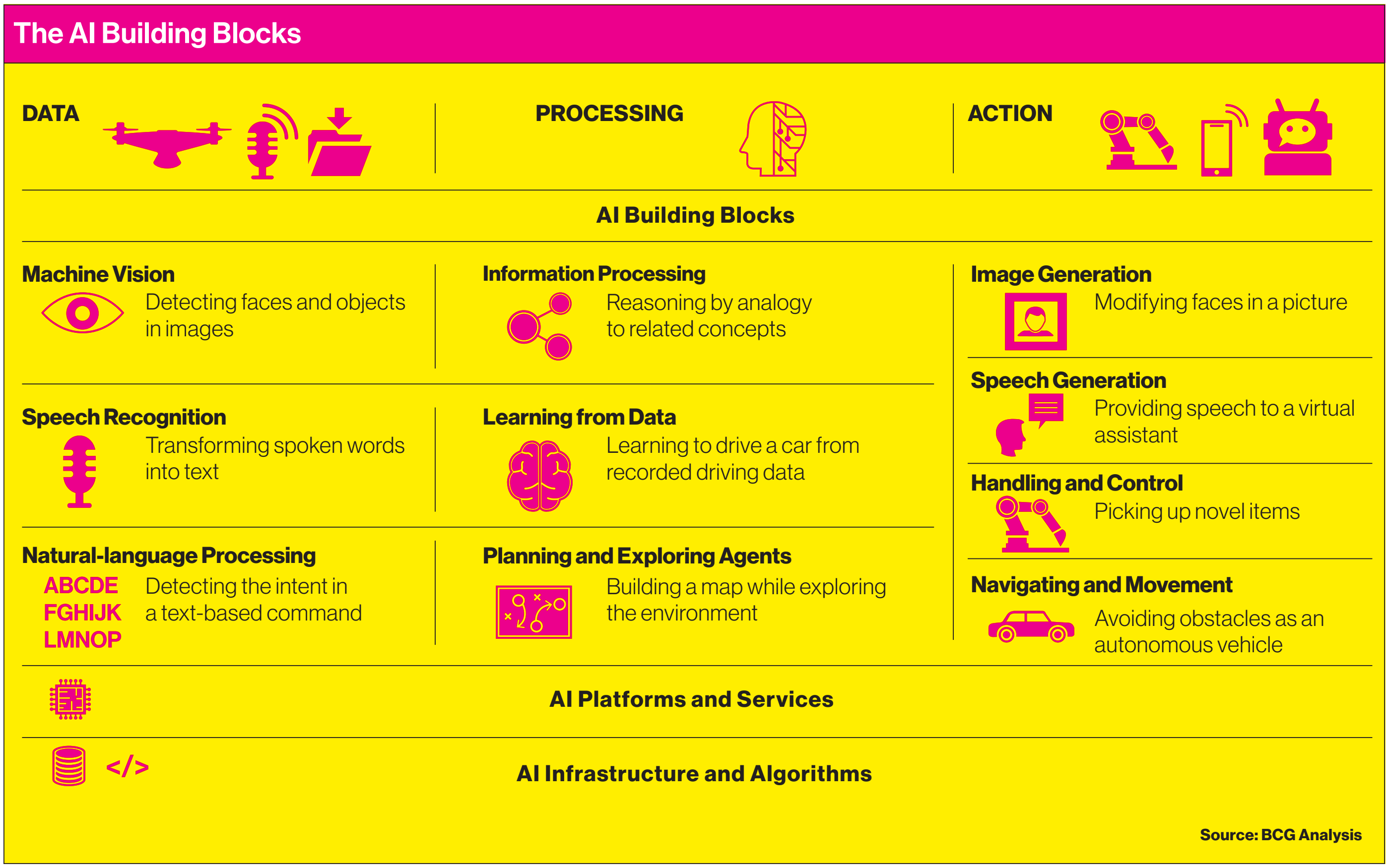


FIGURE ONE

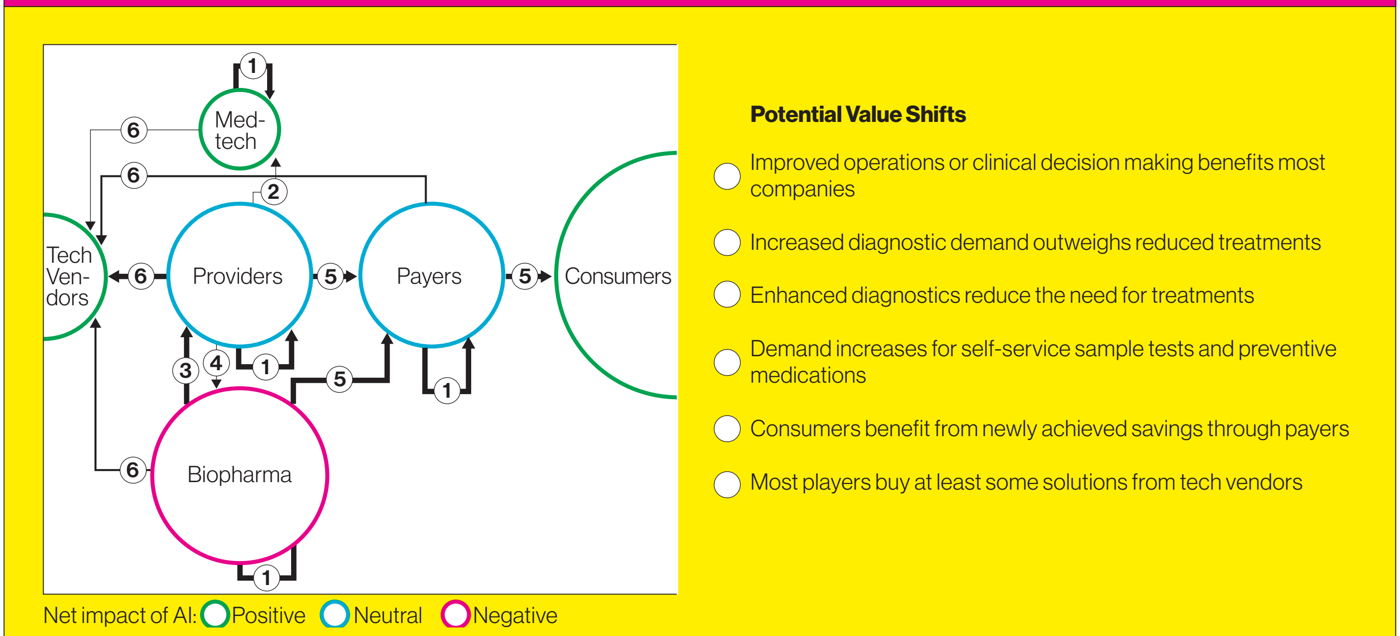
RPA and the more advanced potential of AI. To replace human tasks, one Asian bank installed RPA and AI systems that learned on the fly. These systems routed cases to human workers only when they were uncertain about what to do, enabling the bank to reduce costs by 20 per cent and decrease the time devoted to certain processes from days to minutes.

PRODUCT AND SERVICE OFFERINGS. Unlike most of the prior examples, AI applications that involve advanced product and service offerings — digital personal assistants, self-driving cars, and robo-investment advisors, for example — tend to receive a lot of attention. Companies that offer AI-enabled services are eager to demonstrate to the public the competitive performance and features of these offerings. Because their products and services and potentially their entire business models are at stake, companies must build strong internal AI teams. This helps explains the fierce competition for AI talent among technology vendors, car manufacturers and suppliers.

In the auto industry, for example, **Bosch** is investing €300 million over the next five years to establish AI facilities in Germany, India and the U.S. "Ten years from now, scarcely any Bosch product will be conceivable without artificial intelligence. Either it will possess that intelligence itself, or AI will have played a key role in its development or manufacture," said **Volkmar Denner**, the company's CEO. At the same time, automation creates new business models. Insurers and manufacturers, for example, will be able to use AI to predict risk with greater accuracy, allowing them to price on the basis of use, care or wear.

How Industry Value Pools Could Shift

Collectively, use cases and potential scenarios will influence entire industry structures. Self-driving cars, for example, will affect not just car manufacturers but also drivers, fleet owners and traffic patterns in cities. The city of Boston has determined that self-driving vehicles could reduce both the number of vehicles in transit and the average travel time by 30 per cent. Parking needs



Note: Arrow width is proportional to the estimated value impact of AI in five to ten years. The size of each circle reflects the approximate EBIT value for the corresponding sector in the U.S.

Source: BCG Analysis

FIGURE TWO

would fall by half, and emissions would drop by two-thirds.

Healthcare offers another dramatic example. It consists of several sectors, including medical technology, biopharmaceuticals, payers and providers, each with distinct and often competing interests. The industry is the scene of rampant AI experimentation across the value chain, particularly in the areas of R&D, diagnostics, care delivery, care management, patient behaviour modification and disease prevention.

Figure Two illustrates one potential scenario for how overall healthcare value pools may shift with the increased adoption of AI. Of course, value shifts for individual players within sectors will vary, and there will be winners and losers in each sector. Initially, most companies will benefit from the incorporation of AI into internal operational processes. Biopharma companies and payers are likely to gain the most from these efforts because they can take advantage of R&D efficiencies, personalized marketing, and streamlined support functions.

Over the next five years, we expect AI to gain significant traction in diagnosing illnesses. Visual AI agents already outperform leading radiologists at diagnosing some specific forms of cancer, and many start-ups and tech giants are working on AI-enabled methods to detect cancer even earlier and to provide ever more accurate prognoses. In the primary-care setting, AI can improve or replace some physician interactions. Meanwhile, remote diagnostics can eliminate or drastically reduce the number of patient visits to the hospital for some conditions. These changes are likely to primarily benefit medtech companies, while possibly hurting biopharma companies and to some extent, providers, as better, earlier diagnoses and methods of prevention reduce demand for treatment.

With its intrinsic performance metrics, artificial intelligence will likely accelerate the trend toward value-based health care — the practice of paying for *outcomes* rather than volume. This trend should benefit consumers as payers pass along savings and set new rates for providers and biopharma companies.

Finally, most companies are likely to buy at least some of

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their AI solutions from technology vendors, including traditional tech players that enter the healthcare space. This possible scenario — which would occur against a backdrop of increasing demand for healthcare — could improve health outcomes, but biopharma companies could feel the heat. Alternatively, biopharma companies might make bolder moves in diagnostics, and personalized medicine might take off, opening up new profit pools. Furthermore, payers could themselves develop remote diagnostics, while providers start incorporating AI into their patient treatment protocols. In almost any scenario, medtech and technology vendors will profit.

How to Get Started

We recommend that executives divide their AI journey into three steps.

1. IDEATION AND TESTING. At this stage, companies should rely on four lenses: customer needs, technological advances (especially those involving the AI building blocks shown in **Figure Two**), data sources, and decomposition (or systematic breakdown) of processes — to identify the most promising use cases.

Customer needs offer crucial guidance in discovering valuable AI uses. The customers may be external or, in the case of support functions, internal. An in-depth understanding of developments in AI building blocks will be critical for systematically incorporating technology advances. Rich data pools, especially new ones, provide another important lens, given AI's dependence on them. Finally, by breaking down processes into relatively routine and isolated elements, companies may uncover areas that AI can automate. Aside from customer needs, these lenses are quite distinct from those that companies must use to identify digital opportunities.

For companies with limited AI experience, we strongly recommend including a second, parallel testing stage based on a use case that is likely to deliver value, is reasonably well defined, and is only moderately complex. This test will help the organization gain familiarity with AI and will highlight data or data integration needs and organizational and capability hurdles — critical inputs for the next step.

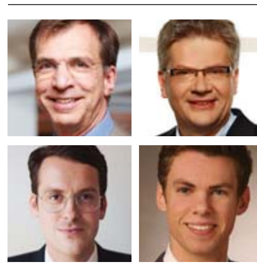
2. PRIORITIZING AND LAUNCHING PILOTS. Pilots should be prioritized based on each pilot's potential value and speed of delivery. The testing done in the first step will provide insight into the time requirements and complexity of potential pilots. Once the organization has selected a final set of pilots, it should run them as test-and-learn sprints, much as in agile software development. Since most pilots will still have to deal with kludgy data integration and processing, they will be imperfect. But they will help correctly prioritize and define the scope of data integration initiatives, and identify the capabilities and scale needed for a fully operational AI process. Each sprint should concurrently deliver concrete customer value and define the required infrastructure and integration architecture.

3. SCALING UP. The last phase consists of scaling up the pilots into solid run-time processes and offerings, and building the capabilities, processes, organization, and IT and data infrastructure. Although this step may last 12 to 18 months, the ongoing rhythm of agile sprints should maximize value and limit major, unexpected course corrections.

In closing

Leaders across industries need to familiarize themselves with the basics of AI and build an intuitive understanding of what is possible. The good news is, at their core, algorithms are simple; and beyond the mysterious jargon, the field is quite accessible.

The even-better news: What is hard but doable today will likely be easy within a few years, and the impossible today may be possible within three to five years. Make no mistake, AI will fundamentally transform business. Your best chance to succeed is to tune out the hype and do the necessary work. There is no substitute for action. ***RM***



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