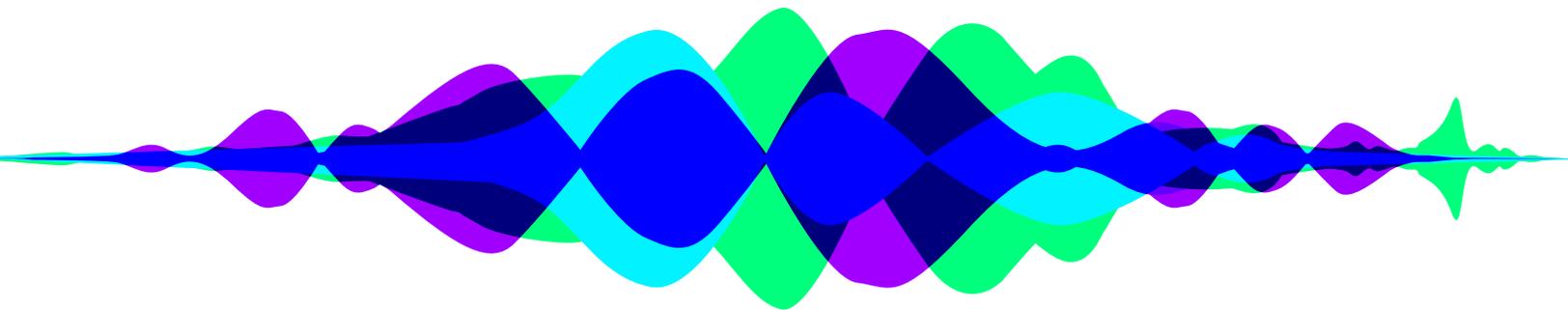




HOW AI BOOSTS INDUSTRY PROFITS AND INNOVATION

By Mark Purdy and Paul Daugherty

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The steady decline in business profitability across multiple industries threatens to erode future investment, innovation and shareholder value.

Fortunately, a new factor of production—artificial intelligence (AI)—is emerging that can help kick-start profitability. AI consists of multiple technologies that can be combined in different ways to sense, comprehend, act and learn. Accenture research shows that AI has the potential to boost rates of profitability by an average of 38 percent by 2035 and lead to an economic boost of US\$14 trillion across 16 industries in 12 economies by 2035.

But this will only happen if organizations adopt a people-first mindset and take bold and responsible steps to apply AI technologies to their business. Our research has identified eight cross-industry strategies to help seize the AI opportunity.

REINVIORATING PROFIT POTENTIAL

Corporate profits are now in decline. In the United States, after reaching their highest share of national income in the post-war era, the growth of profits dropped from 25 percent in 2010 to -3 percent in 2015 (Figure 1).

Furthermore, this phenomenon is evident across most industries, from Manufacturing to Utilities to Financial Services.

Declining profits are a cause of concern in themselves. Even more worrying, however, is the effect of decreasing investment, innovation and long-term shareholder value. Why?

Dialing back investments not only erodes a company's ability to grow, but also freezes resources to innovate in an increasingly disruptive environment. Together, low investment and innovation efforts can drag on shareholder value as investors question a company's ability to meet market expectations.

Indeed, the current data do not suggest an environment conducive to growth. Business investment is already close to stalling. For instance, in Manufacturing business investment growth has declined from 14.8 percent in 2012 to -5.2 percent in 2016 in the United States and from 5.9 percent in 2012 to -6.6 percent in 2016 in the United Kingdom¹. And growth in R&D spending, a key indicator for an industry's capacity to innovate, has equally been sluggish. For instance, Manufacturing's figures fell from 6.6 percent in 2008 to -2.6 percent in 2013 in Germany and 7.4 percent to -0.9 percent respectively in Italy².

While prospects may appear dismal, help is at hand in the form of a new factor of production—AI—that can transform opportunities not only for economic growth, but also for corporate profitability. Accenture defines AI as a constellation of technologies that allow smart machines to extend human capabilities by sensing, comprehending, acting and learning—thereby allowing people to achieve much more.

Driven by a massive increase in data, soaring computational power at decreasing costs and breakthroughs in technology, AI is becoming a commercial reality. More than a productivity enhancer, we view AI as an entirely new factor of production that can reverse the trend of falling profit growth in three ways: by optimizing processes with intelligent automation systems, by augmenting human labor and physical capital, and by propelling new innovations. (For more information, see sidebar as well as Accenture's related report, "[Why Artificial Intelligence is the Future of Growth](#)."

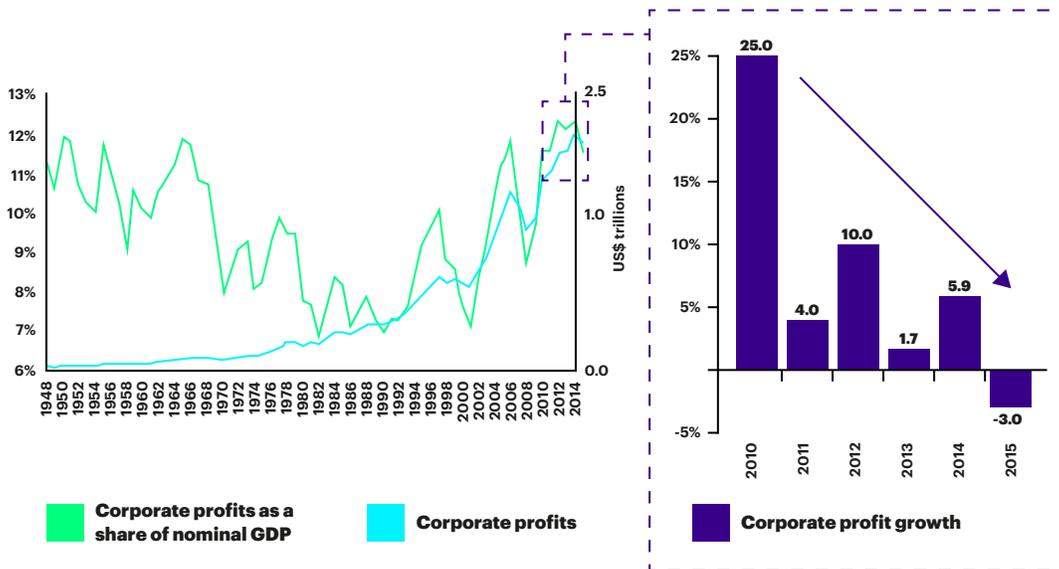
But to capitalize on this tremendous opportunity, businesses in every industry will need to synthesize AI into their strategies and develop responsible AI systems that are aligned to society’s moral and ethical values and provide better outcomes for all people. AI’s unique

characteristics as a capital-labor hybrid—such as the ability to augment human labor at scale and speed, self-learn and continuously improve over time—will require new approaches and models in areas such as investment, innovation and human capital development.

Figure 1. Corporate profits

United States corporate profits reached their highest level as share of gross domestic product (GDP) in the post-war period but are now in decline.

United States corporate profits*



*Before tax with inventory valuation and capital consumption adjustments
 Source: Bureau of Economic Analysis, Accenture analysis

WHY ARTIFICIAL INTELLIGENCE IS THE FUTURE OF GROWTH— MACROECONOMIC VIEW

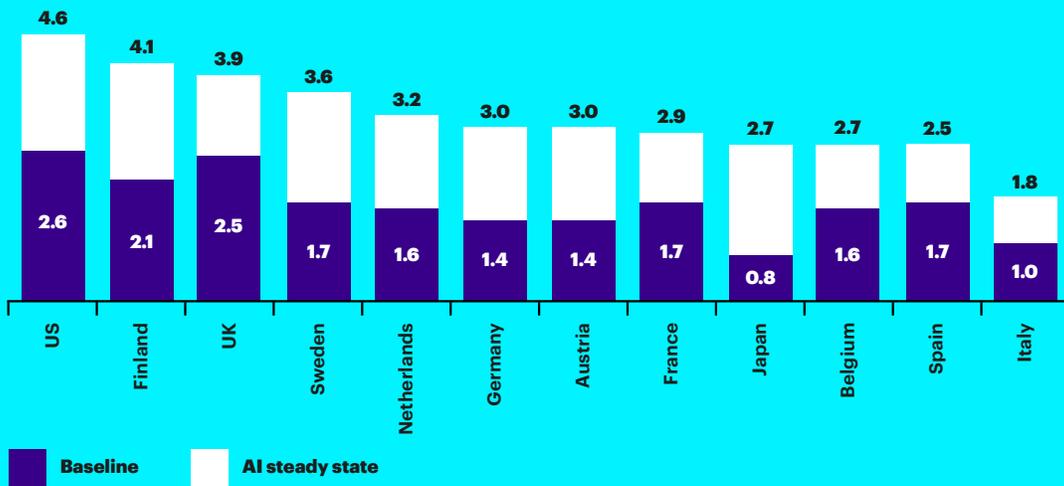
In the first phase of this research, Accenture Research, in collaboration with Frontier Economics, modeled the impact of AI on 12 developed countries that together generate more than 50 percent of the world’s economic output.

Our research reveals that AI could double annual economic growth rates by 2035 by changing the nature of work and creating a new relationship between people and machines, in which people are firmly in control and technology increasingly adapts to our wants and needs.

The impact of AI technologies on business is projected to increase labor productivity by up to 40 percent—and enable people to make more efficient use of their time. For further insights please refer to our report, [“Why Artificial Intelligence is the Future of Growth.”](#)

Figure 2. The economic impact of AI on countries: Our modeling shows that AI has the potential to double growth rates in the 12 countries that we analyzed.

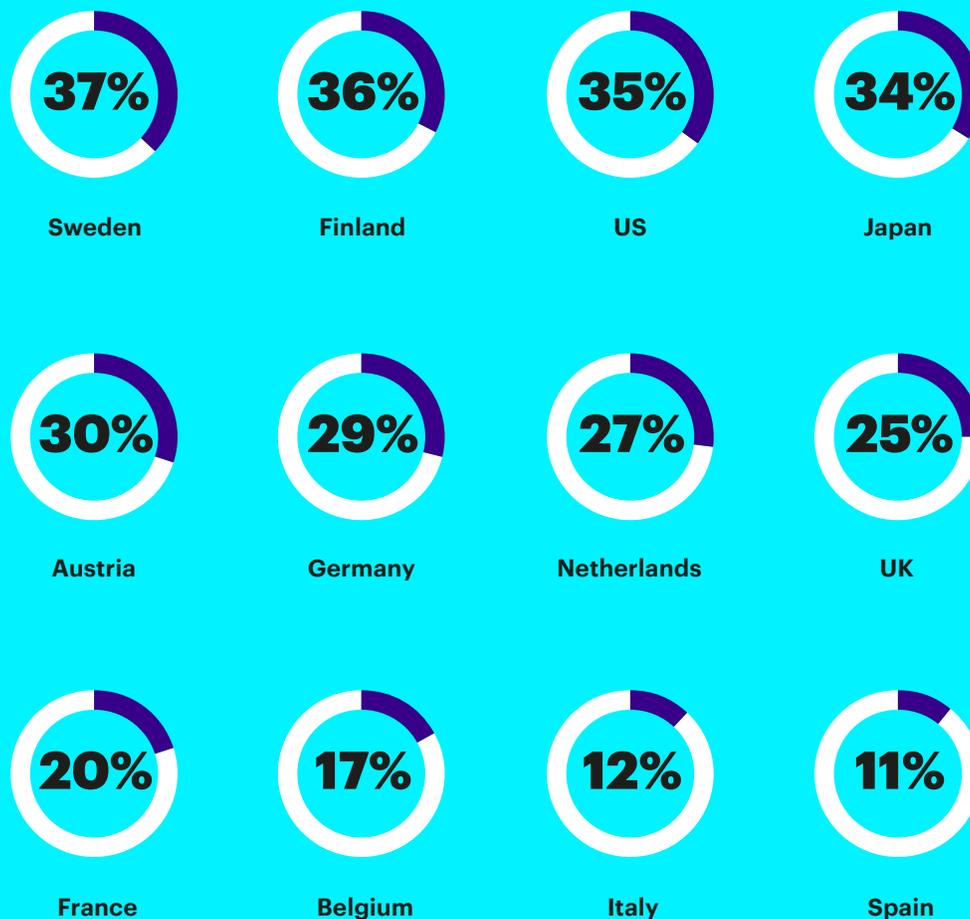
Annual growth rates by 2035 of gross value added (a close approximation of GDP)



Source: Accenture and Frontier Economics

Figure 3. Labor productivity in an AI world: AI promises to significantly boost the productivity of labor in developed economies.

Percentage difference between the baseline in 2035 and AI steady state in 2035.



Source: Accenture and Frontier Economics

THE VALUE OF AI TO INDUSTRY

Our second phase of research shows AI holds vast potential for avoiding the low-profit spiral and for ushering in a new era of growth for businesses across industries.

The economic potential of AI

Accenture, in association with Frontier Economics, modeled the potential economic impact of AI for 16 industries covering a diverse field, from Manufacturing to Utilities to Healthcare. As our yardstick, we used growth in gross value added (GVA), a close approximation of GDP. GVA is an output measure that accounts for the value of goods and services produced in a certain sector. It can be thought of as the contribution of different sectors to economic growth.

We compared two scenarios for each industry to assess AI's future impact. First, the baseline case shows the expected economic growth for industries under current assumptions. Second, the AI steady state shows expected growth with AI integrated into economic processes. As it takes time for the impact of a new technology to feed through, we used 2035 as the year of comparison (for further details see "Appendix: Modeling the GVA impact of AI").

Our research shows that Information and Communication, Manufacturing and Financial Services are the three sectors that will see the highest annual GVA growth rates in an AI scenario, with 4.8 percent, 4.4 percent and 4.3 percent respectively by 2035 (Figure 4).

In the Information and Communication industry, with its heavy reliance on technologies, AI capabilities can coalesce with existing systems to generate US\$4.7 trillion in gross value added in 2035 (Figure 5). For instance, providers can develop new AI platforms for offering cyber-attack protection services to their customers.

A close-up photograph of a hand holding a single coin between the thumb and index finger, positioned directly above a tall, vertical stack of many coins. The background is plain white, and the lighting is soft, highlighting the texture of the skin and the metallic sheen of the coins.

In Manufacturing, precursors like the Internet of Things (IoT) create favorable conditions for the seamless integration of intelligent systems. Today's IoT technologies enable physical devices such as assembly lines to connect and communicate with digital systems. Moreover, AI can bridge the gap between current forms of automation and learning with more advanced forms. Our research shows that AI could add an additional US\$3.8 trillion GVA in 2035 to this sector—an increase of almost 45 percent compared with business-as-usual.

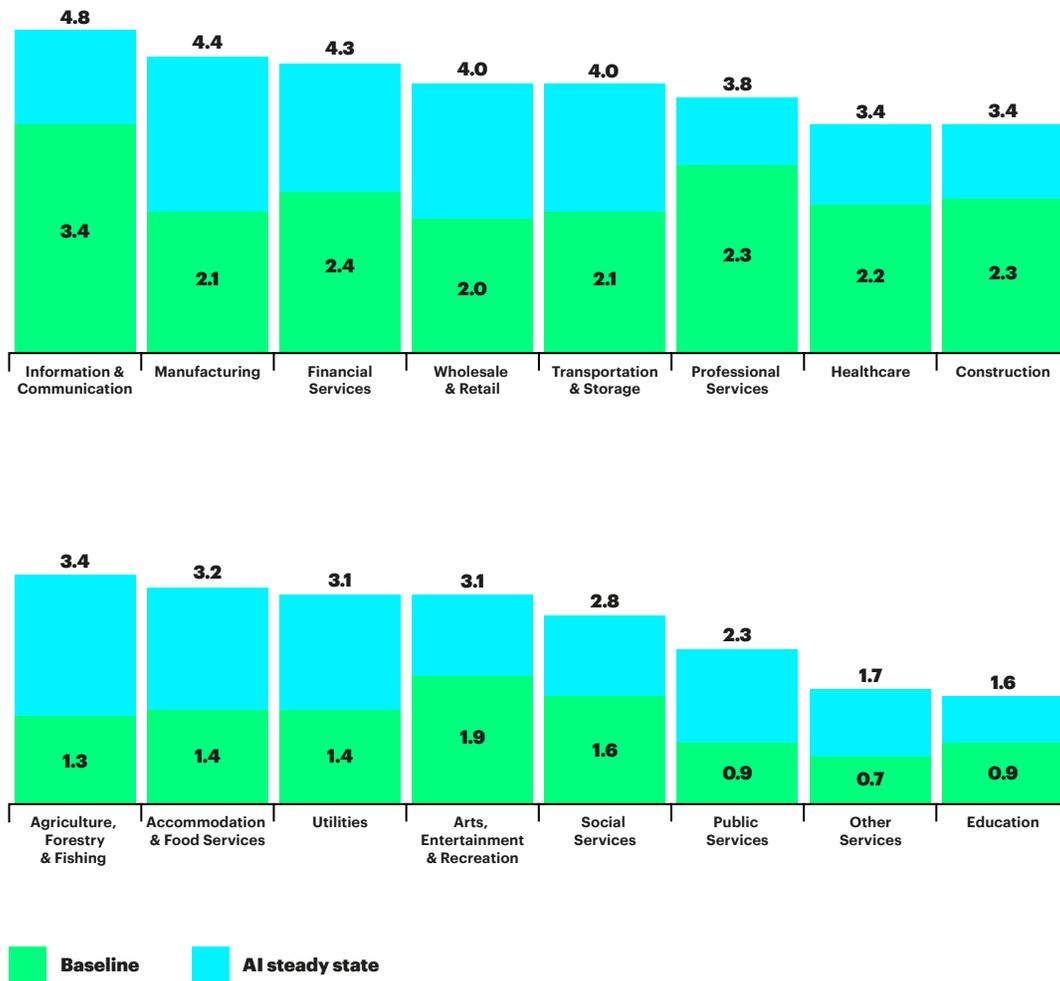
Financial Services can capitalize on AI technologies to relieve knowledge workers from mundane, repetitive tasks such as generic customer queries, mortgage reviews and market research. Overall, this sector will benefit from US\$1.2 trillion in additional GVA in 2035.

Even labor-intensive sectors—where productivity growth is notoriously slow—will experience significant increases in GVA growth rates. Education will see a boost from 0.9 percent to 1.6 percent by 2035 and Social Services from 1.6 percent to 2.8 percent, yielding substantial increases in economic output (an additional US\$109 billion and US\$216 billion in GVA respectively).

Figure 4. The impact of AI on industry growth

AI has the potential to increase economic growth rates by a weighted average of 1.7 percentage points by 2035 across 16 industries.

Real annual GVA growth by 2035 (%)

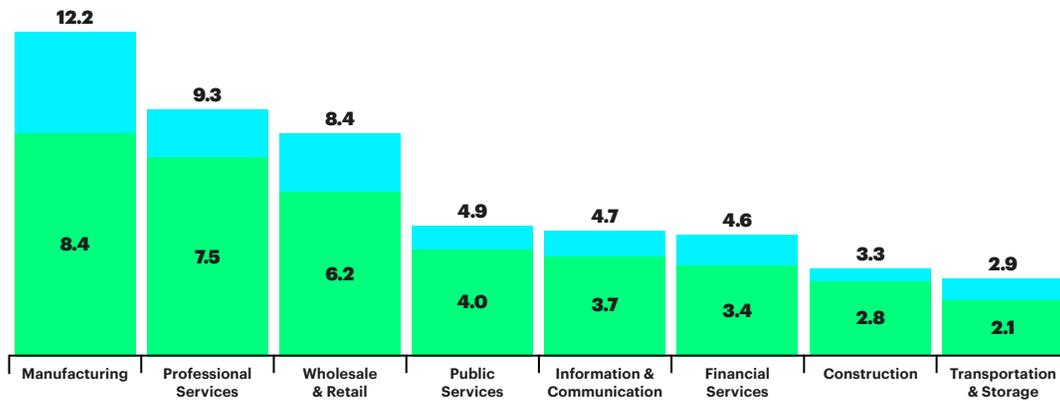


Source: Accenture and Frontier Economics

Figure 5: The impact of AI on industry output

AI can substantially raise economic output for industries. For Manufacturing alone, AI can boost GVA by almost US\$4 trillion in 2035.

Real GVA in 2035 (US\$ trillions)



Source: Accenture and Frontier Economics

BOOSTING INDUSTRY PROFITS WITH AI

What could the increases in economic output generated by AI mean for corporate profitability spanning multiple industries? Significant improvements to the bottom line, according to our research—AI has the potential to boost rates of profitability by an average of 38 percent by 2035 across 16 industries.

Accenture has identified three channels through which AI can reverse the cycle of low profitability across industries: intelligent automation, labor and capital augmentation, and innovation diffusion.

Intelligent automation



AI offers huge advantages over traditional automation. Take supply chain management, where time means money. For example, for the average *Fortune* 100 company, a supply chain shortened by just one day frees up anywhere from US\$50 million to US\$100 million in cash-flow³.

Companies that rely on a globally integrated network, such as Tesla and Johnson & Johnson, are turning to Elementum, an AI start-up, to streamline their supply chains⁴. Elementum monitors one-off incidents, tracks transportation and records manufacturing outputs to provide real-time supply chain visibility.⁵ By analyzing more than 10 million incidents per day and US\$25 trillion worth of products in real time, Elementum can provide early warning of potential problems and propose alternative solutions⁶.

For instance, in 2014 a fire in a Chinese DRAM chip factory put a considerable squeeze (25 percent) on world supply. Whereas most equipment manufacturers were only made aware days later, Elementum's customers knew about the incident within minutes and secured their supply of DRAMs before prices reacted to the shortage.⁷

But it is not just the production chain that can benefit from intelligent automation. With valuable time and resources spent chasing sales leads, sales activities are also poised to change dramatically with AI. Lattice Engines is focusing its AI capabilities on streamlining the sales process. By learning companies' buying patterns, it can sort the "hot" leads from the "cold" ones. Using Lattice's AI platform, Dell's European marketing department cut its sales leads by 50 percent, resulting in a doubling in sales productivity, efficiency and revenue.⁸

Labor and capital augmentation



AI is set to augment labor productivity by enabling workers to delegate low value-added tasks to AI and be more productive in their main tasks.

The application of AI is spreading to areas where intellect and critical thinking have long dominated. For instance, consider business research, traditionally a highly time-consuming task. Conatix's semi-automated business intelligence system, based on recent advances in machine learning, enables companies to discover, source, structure and share previously unstructured data and information from outside their organizations. By working in close collaboration with researchers, the Conatix algorithm can adjust its course based on human feedback, creating and updating high-quality insights.

AI can also help businesses maximize their asset utilization rates. Heavy industries, such as Energy and Manufacturing, require large

up-front investments, making them particularly vulnerable to the lost revenues associated with asset downtime.

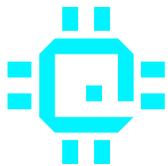
Consider wind turbines, for example: Unexpected downtime requires a coordinated effort to source equipment, maintenance staff and spare parts, all the while cutting into revenue. In the case of gearbox failure, which can result in as much as two weeks of asset downtime per failure, the benefit of increased asset utilization is significant.⁹

AI start-up NEM, using an algorithm based on the human immune system, is targeting wind farm productivity by predicting and preventing failures.¹⁰ The platform first analyzes instances of wind turbine failure to learn what the symptoms are, then monitors the turbines in real time to detect symptoms and flag any potential problems.¹¹

“As the new factor of production, AI can drive growth in at least three important ways. First, it can create a new virtual workforce—what we call intelligent automation. Second, AI can complement and enhance the skills and ability of existing workforces and physical capital. Third, like other previous technologies, AI can drive innovations in the economy. Over time, this becomes a catalyst for broad structural transformation as economies using AI not only do things differently, they will also do different things.”

Mark Purdy, Managing Director
Accenture Research

Innovation diffusion



AI is poised to drive innovation by accelerating the development of new products. This increase in innovation eliminates redundant costs and generates new revenue streams, thereby increasing profitability.

The development of new drugs is an instructive example. Currently, drug development is dominated by a hypothesis-driven discovery method, with less than 10 percent of new drugs obtaining final approval. Using AI, Berg Health monitors the progress of cancers by following trillions of data points from both cancerous and non-cancerous cells.¹² So far, the effort has yielded a new cancer-fighting drug that is currently undergoing clinical trials. This AI approach to new drug discovery is estimated to halve the development cost of a single drug from US\$2.6 billion to US\$1.3 billion.¹³

AI is also helping companies to create new products based on design goals and constraints. Autodesk is pioneering this new approach with its computer-aided design system, Dreamcatcher.¹⁴ Using AI algorithms, Dreamcatcher draws on the power of the cloud to create thousands of virtual prototype iterations and compare their function, cost and material along their specified criteria. Dreamcatcher starts off with a solid mass that fits a desired shape, then begins to chisel away material. Removing a piece of material that worsens or improves performance is “remembered,” enabling the algorithm to comprehend how each bit of material contributes to performance.

In the Healthcare industry, Dreamcatcher has been used to design a facial implant that accelerates recovery and tissue regrowth. In the Automobile industry, the AI-powered product has helped to develop a new roadster.¹⁵

Profit potential by industry

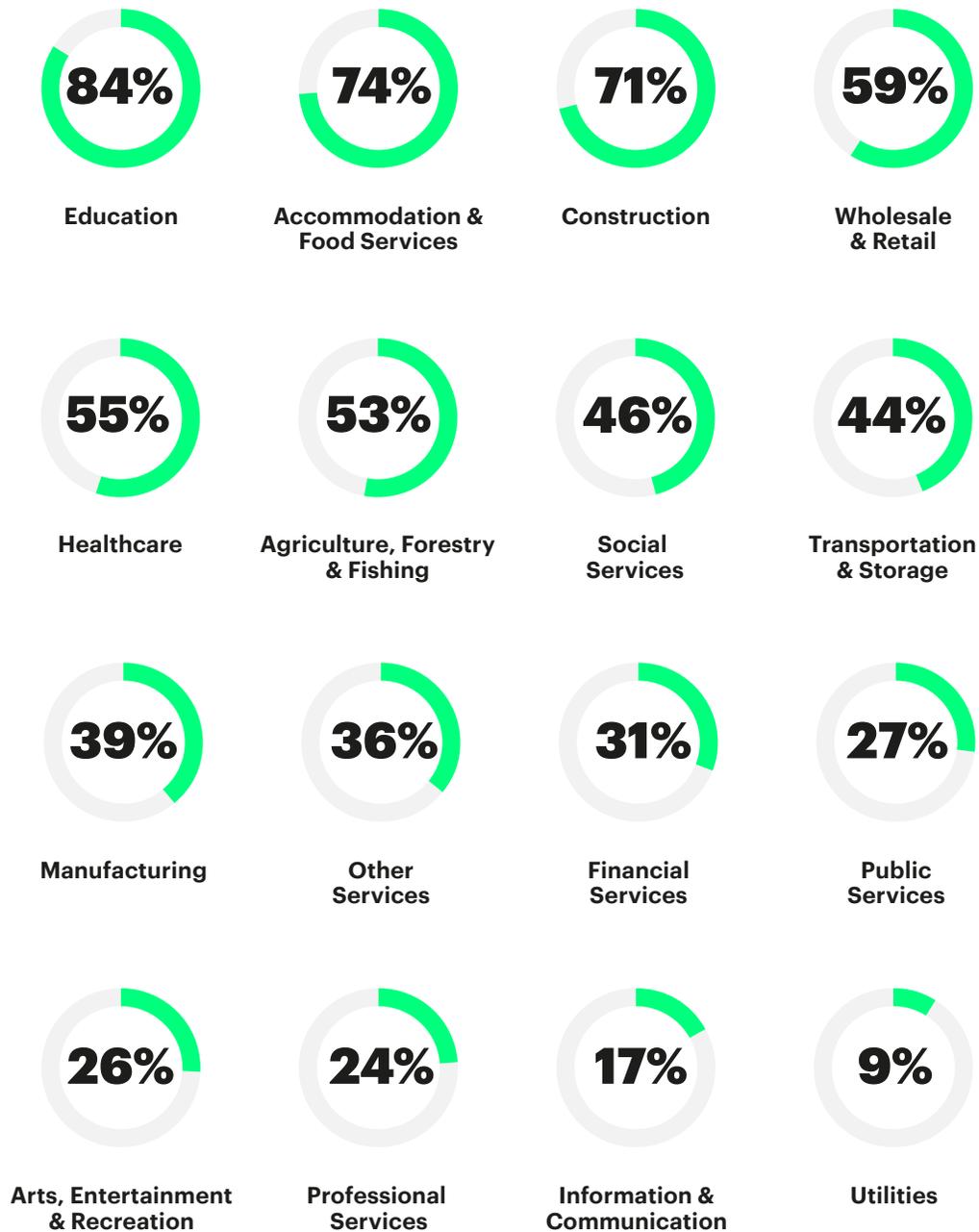


Through these channels, AI offers unprecedented profitability opportunities. Case in point: With labor-intensive sectors, such as Wholesale and Retail, Arts, Entertainment and Recreation, and Healthcare, AI augments the human workforce, enabling people to become more productive over time and redirecting their focus on critical tasks. For the Wholesale and Retail sector, this can lead to a profit increase of almost 60 percent—from US\$17 to US\$27 for every US\$100 of revenue (Figure 6).

For traditionally capital-intensive industries, the AI impact on profitability can be equally dramatic. In Manufacturing, for example, faulty machines and idle equipment will become a thing of the past as AI-powered systems deliver constantly rising rates of return due to their ability to learn, adapt and evolve over time. Things like rapid prototyping or dynamic resource allocation can significantly reduce time-to-market and cut costs in the process. The net result for the sector? A share-of-profit increase of 39 percent.

Figure 6. The impact of AI on profits by industry

Share-of-profit increase per industry between baseline in 2035 and AI steady state in 2035 (%)



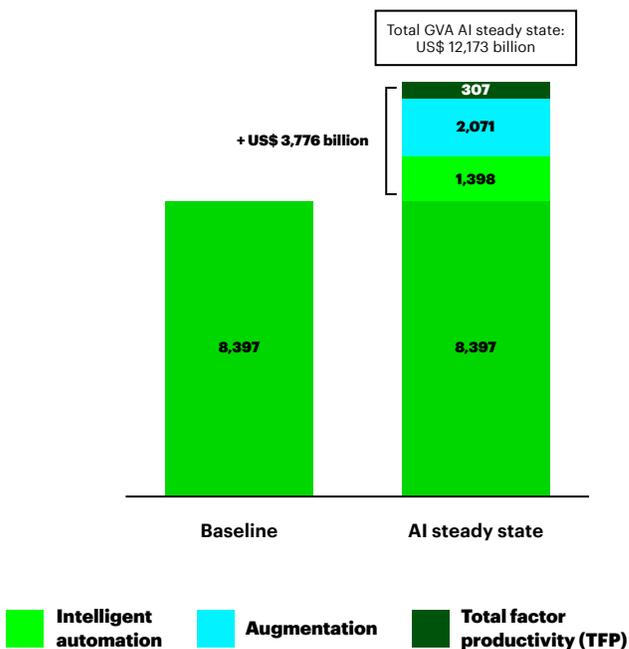
Source: Accenture and Frontier Economics

INDUSTRY SPOTLIGHTS

Manufacturing

Manufacturing’s dependence on heavy machinery primes the industry for the application of AI technologies. Our research shows that with AI, Manufacturing can generate an additional US\$3.8 trillion in GVA by 2035. The augmentation channel is expected to drive the majority of the benefits for this sector. Not only will human labor become more productive, but AI will also lead to the realization of the full potential of existing machinery on the factory floor.

Figure 7. Manufacturing GVA in 2035 (US\$ billion)



Source: Accenture and Frontier Economics

Wholesale and Retail

AI can yield more than US\$2 trillion in additional GVA in 2035 for the Wholesale and Retail sector—an increase of 36 percent compared with the baseline case. Retailers can draw on AI’s intelligent automation capabilities to streamline inventory and warehouse management, while augmented reality technologies can enable immersive shopping experiences with customers. Among the sectors that Accenture studied, this industry is expected to benefit considerably from additional innovation effects spurred by AI—for instance, helping to uncover pockets of latent demand.

Healthcare

In our model, AI will accelerate growth in the Healthcare industry from 2.2 percent to 3.4 percent by 2035, generating US\$461 billion of additional GVA. The intelligent automation channel accounts for more than 60 percent of the benefits. AI-powered systems can analyze massive amounts of unstructured data and produce predictive diagnoses that can detect issues before they become a serious health risk. The innovation channel also adds more than US\$100 billion to the industry in 2035. Just one example of AI’s enormous potential in Healthcare: The industry has collaborated with previously unrelated fields, such as manufacturing and design, to create cutting-edge 3D printing techniques for organ transplants.

Figure 8. Wholesale and Retail GVA in 2035 (US\$ billion)

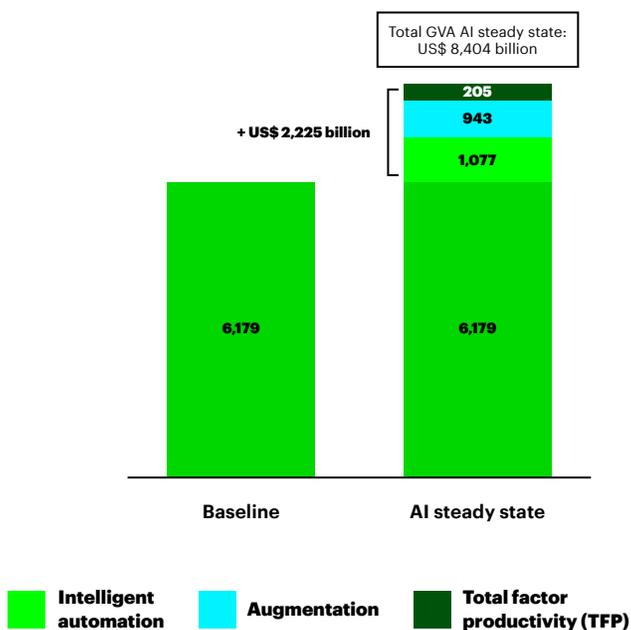
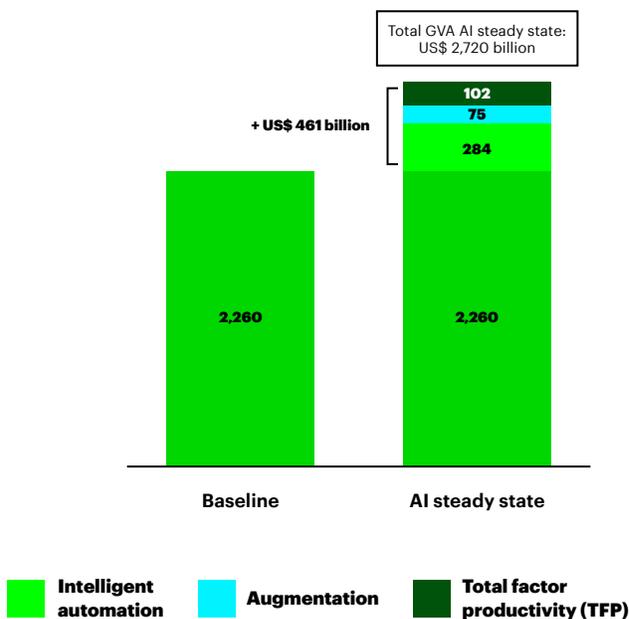


Figure 9. Healthcare GVA in 2035 (US\$ billion)



Source: Accenture and Frontier Economics

Source: Accenture and Frontier Economics

CROSS-INDUSTRY STRATEGIES FOR SUCCESS

Regardless of industry, companies have considerable opportunity to apply AI now and invent new business capabilities for unprecedented growth, profitability and sustainability. But to achieve the full potential of AI, they must fully prepare for the attendant disruption.

As a new factor of production, AI will interact with traditional capital and labor inputs to create fresh challenges, and leaders will need to evolve in new and unexpected ways as their roles become increasingly interdependent. To prepare their organizations for a successful future with AI, business leaders have opportunities to adopt the following eight strategies:

AI strategy and leadership



In too many firms and industries, the impetus and interest for AI still comes from the bottom or from the middle of the organization—from digital enthusiasts that have seen these technologies and are personally excited by their promise. But attaining the value from AI that our analysis suggests will demand recognition and action from the very top of the company.

An essential first step is to make the benefits of AI tangible to the C-suite. That means spending time with real AI machines, interacting with them, questioning and testing them. There is no substitute for visiting AI laboratories or innovation centers where experts can be probed, ideas can be tested and prototypes can be developed.

An AI Roadmap will be essential. It should be a plan to grow the business, incorporating AI as a critical enabler. As such, it is incumbent on leaders and strategic planners from across the business to have a sufficient grasp of AI to effectively transform existing business plans, to define key decision points and to guide appropriate investment decisions.

Reinvent HR into HAIR



Since AI is a form of virtual labor, it will interact with the workforce, contributing and adding value in the same way a human co-worker would. Hence, the role of the Chief HR Officer will not only be about managing human employees, but also the supervision of AI workers—Human AI Resources. This will raise questions, such as: How do companies remodel performance metrics? How do they optimize workforce requirements between human and AI labor? As a result, the CHRO will play a much bigger role in business strategy and innovation, as well as accumulate a greater technical understanding of AI technologies and how these will shape the future of work.

The HR function itself will also need to incorporate AI technologies in all aspects of its work, from hiring to retirement. For example, SAP SuccessFactors helps companies move their HR management from “isolated self-services into end-to-end intelligent services.” The application, used by Microsoft, can synchronize legacy programs, offer employee collaboration platforms, derive actionable insights from workforce data and predict the impact of resource decisions on other business areas.¹⁶

Learn with machines



To fully exploit the potential of AI, human and machine intelligence must be tightly interwoven. There will be a need for new skills in the workforce that leapfrog technical expertise, with a new emphasis on human abilities—judgment, communication, creative thinking—that complement technologies.

AI will transform not only what people learn, but also how they learn. Traditionally, career paths followed a linear progression from entry level to experienced senior. But with AI taking over mundane and low-value-added tasks, a skills gap will open up between young professionals and older workers, favoring those workers with experience.

To adapt their businesses to the changing nature of learning and employee training, business leaders can focus on the needs of their workforces, particularly in the area of agile skills development.

MasterCard, for instance, is trialing AI software that draws on the knowledge of experienced staff to help their workers become better sellers. Merging human and big data insights, the software can scale the expertise of seasoned people to the entire team, reducing the need for large training groups. The combined input acts as a personalized advisor for each member of the sales team so that they can optimize their sales strategies.¹⁷

Appoint a chief data supply chain officer



The performance of AI will directly depend on the quality and amount of data that are available. Accenture research shows that the majority of executives are unsure about the business outcomes they derive from their data analytics programs, which can mean that enterprise data remains vastly underutilized.¹⁸ While many large companies already have added a chief data officer (CDO) to the C-suite (Gartner estimates that 90 percent of large organizations will have a CDO by 2019)¹⁹, a key

focus for these executives is on data security, regulations and governance rather than being stewards of treating data as a supply chain.

A chief data supply chain officer will need to construct an integrated, end-to-end data supply chain, considering issues such as: What is the balance between internal and external data sources? What is the company's data churn and cost per day? Where are the data silos? How can our company simplify data access?

Create an open AI culture



Corporate culture must adapt to the presence of its new AI employees. Humans and machines will be collaborating, teaching and learning from one another. This demands trust, openness and transparency, just as any co-working relationship. For example, it may become tempting to blame machines for poor performance or faulty output, rather than identifying weaknesses—whether human or machine—and improving them. Just as in human relationships, adversarial or transactional interactions will be a barrier to overcoming shared hurdles and maximizing shared value. Rather, help the computer to help you.

Human concerns over the impact of AI on job security, wages and privacy can also affect the attitudes of employees and how they embrace AI in their work. Leaders have a responsibility to explain the risks and opportunities that a hybrid workforce brings. But they can also shape the culture and guidelines that minimize those risks and maximize the opportunities. They can go even further by proactively using AI itself to improve workplace culture. AI solutions already exist, for example, that can detect emotional stress and worker burnout through natural language processing, helping managers to shape and improve workplace culture and satisfaction.

Step beyond automation



Automation has been a critical staple of business strategy in the past. Yet, with recent strides in AI, companies need to take a step beyond to harness the intelligence of dynamic, self-learning and self-governing machines.

Accenture research reveals that the potential benefits of AI can be considerably greater than the past impact of automation. Between 1993 and 2007, for example, traditional automation is estimated to have generated 0.9 percent to 1.3 percent additional annual growth across developed economies. However, the future impact of AI could be 70 percent higher in the case of Finland and 50 percent higher in the United States.²⁰

Embracing AI can, therefore, be a powerful source of competitive advantage. Bosch, for instance, is placing AI at the forefront of their business. The company's "thinking factory," currently rolled out in one of Bosch's German automotive plants, aims to enable AI-powered machines to self-diagnose technical failures, autonomously order replacement parts and anticipate maintenance needs. Overall, Bosch predicts more than US\$2 billion of additional revenues and savings from the widespread use of intelligent systems and machines by 2020.²¹

Take the crowd into the cloud



Over the last decade, businesses have used the power of the crowd to move to open innovation models. At the same time, cloud technologies have provided an opportunity to scale rapidly with lower computing costs and without the confines of internal IT structures.

The next step in innovation will be to combine the crowd-sourced data in the cloud with AI capabilities to create new and disruptive business opportunities. To this end, cloud-based machine learning platforms such as Google Cloud Platform and Amazon Web Services are already in use.

Measure your return on algorithms



Measures for traditional factors of production include return on capital (ROC), as well as human performance metrics for employees. As a new factor of production, AI will also require new or adapted measures.

Unlike traditional assets that depreciate over time, AI assets, with their self-learning technologies, gain value as time passes. This compounding asset appreciation effect creates greater returns for companies that make early AI investments. In addition, although some of its applications have clear results, the learning nature of AI means that many of the benefits will stem from yet-to-be determined sources.

Therefore, traditional measures for tracking capital investments will become outdated in an AI era. CFOs will need a new toolbox of financial metrics to properly assess the “Return on AI.” Perhaps it will be related to value generated from each algorithm or some combination of initial outlay and ongoing costs. The bulk of both benefits and costs will appear in future time periods, making it challenging to estimate future value with confidence. This complexity risks deterring AI investment decisions, underlining the urgent need for new thinking and new terminology for capital expenditure and valuation models. Perhaps AI itself will be employed to calculate more accurate predictions across time horizons.

“To realize the opportunity of AI, it’s critical that businesses act now to develop strategies around AI that put people at the center, and commit to develop responsible AI systems that are aligned to moral and ethical values that will drive positive outcomes and empower people to do what they do best—imagine, create and innovate.”

Paul Daugherty, Accenture Chief Technology and Innovation Officer

MODELING THE GVA IMPACT OF AI

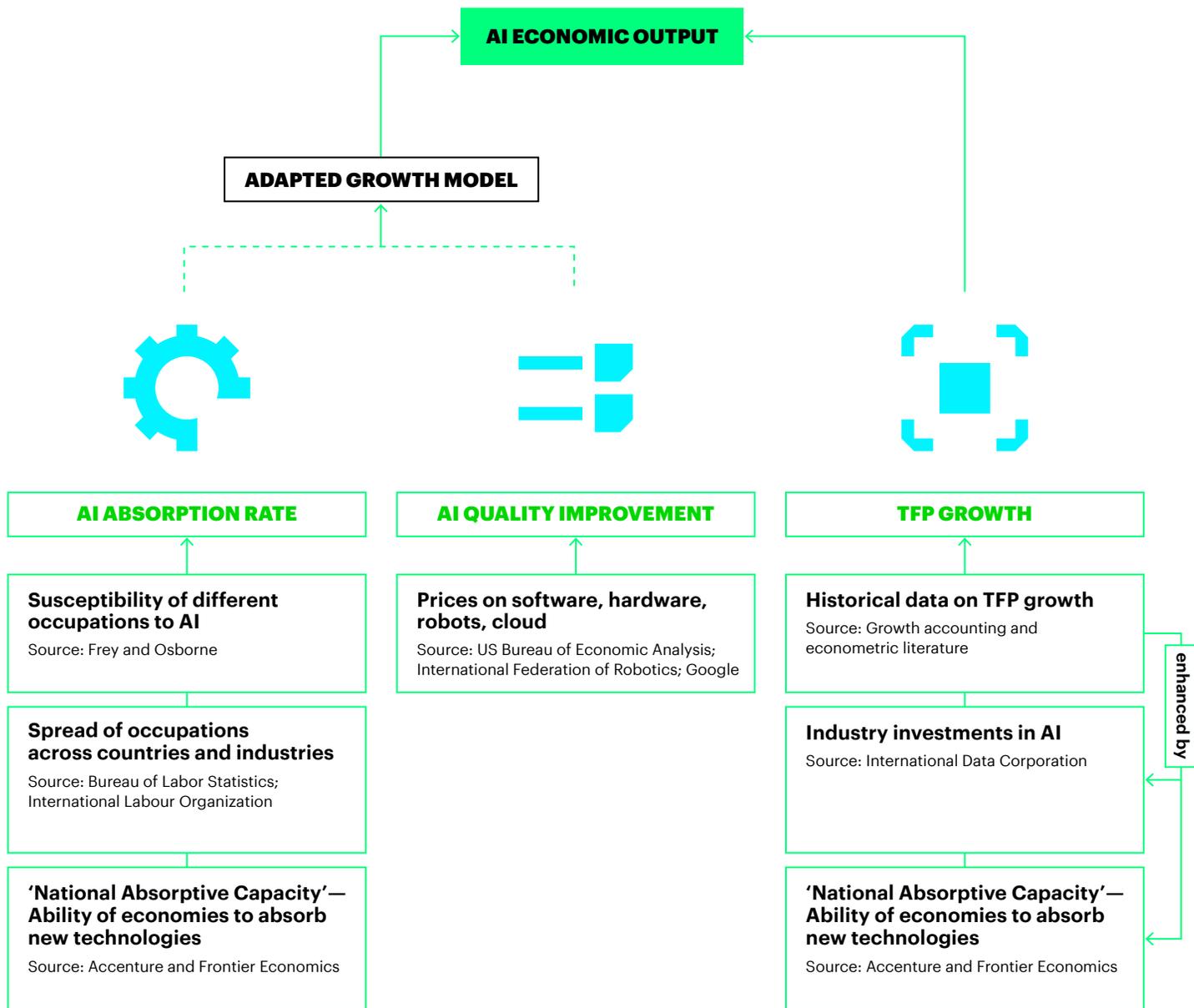
This report examines the impact of AI on 16 industries. In the publication “Why Artificial Intelligence is the Future of Growth,” Accenture analyzed the economic impact of AI on 12 advanced economies.

The results of these publications are based on the same economic model that we developed in association with Frontier Economics. We introduce AI as a new factor production that will change how growth is generated on a country and industry level. To measure this growth, our model proceeds in three steps as shown in Figure 10:

- 1** We draw from research that looks at the share of tasks that are susceptible to AI in the overall labor force. We estimate the probability of individual occupations to be automated in the future. We then look at the spread of these occupations across industries and countries from the labor statistics data of the analyzed countries. This exercise of matching the susceptibility of tasks to AI with the spread of occupations per country and industry enables us to determine a view of the AI absorption rate per country and industry.
- 2** We include the quality improvements of AI over time. We measure this variable by referring to data on falling prices of software, hardware, robots and cloud from 1990 to today.
- 3** We determine the additional innovation effects expected from the diffusion of AI as measured in total factor productivity (TFP). We refer to historical data on the impact of information and communication technologies (ICT) on TFP growth and enhance that figure by investment figures in AI across industries, as well as the capacity of national economies to absorb new technologies.

Having taken these steps, we have a view of the economic potential of AI per country and industry. For the country results, we aggregate the results for each of the 16 industries per country. For the industry results, we aggregate the data across the 12 countries per industry. Our profitability forecasts are based on the industry GVA results. To arrive at a proxy for profits, we subtract labor compensation from GVA. That gives us the gross operating surplus (GOS) per industry (GOS describes the surplus generated by operating activities after the labor factor input has been subtracted), an approximation of profits. For a truer measure of profitability, we apply a deflator comprising data on capital depreciation to the GOS results.

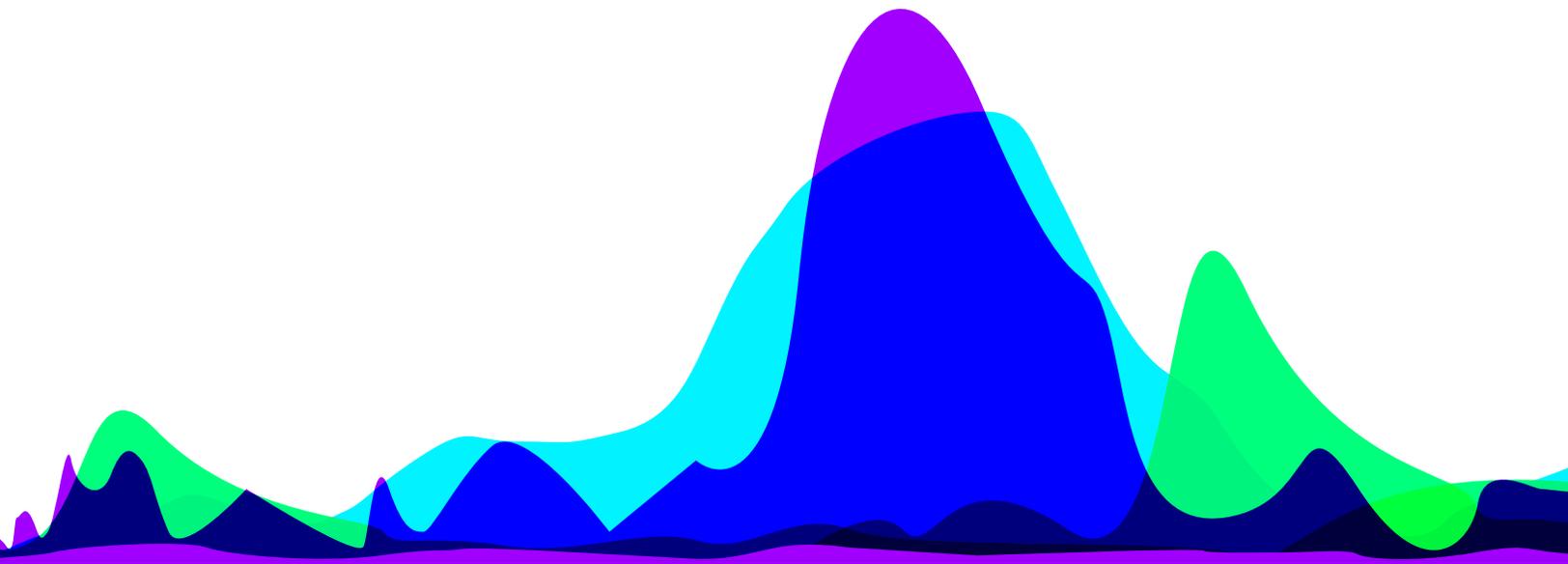
Figure 10. Factors for modeling AI benefits on GVA by industry



Source: Accenture analysis

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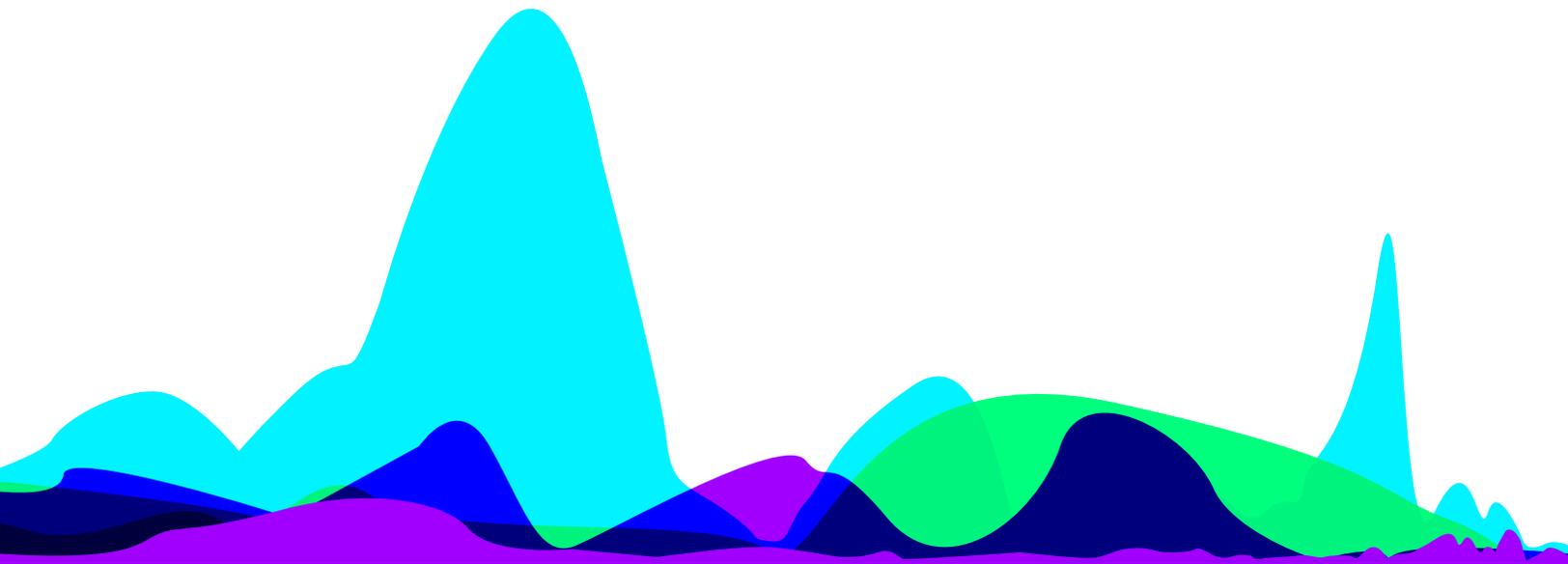
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