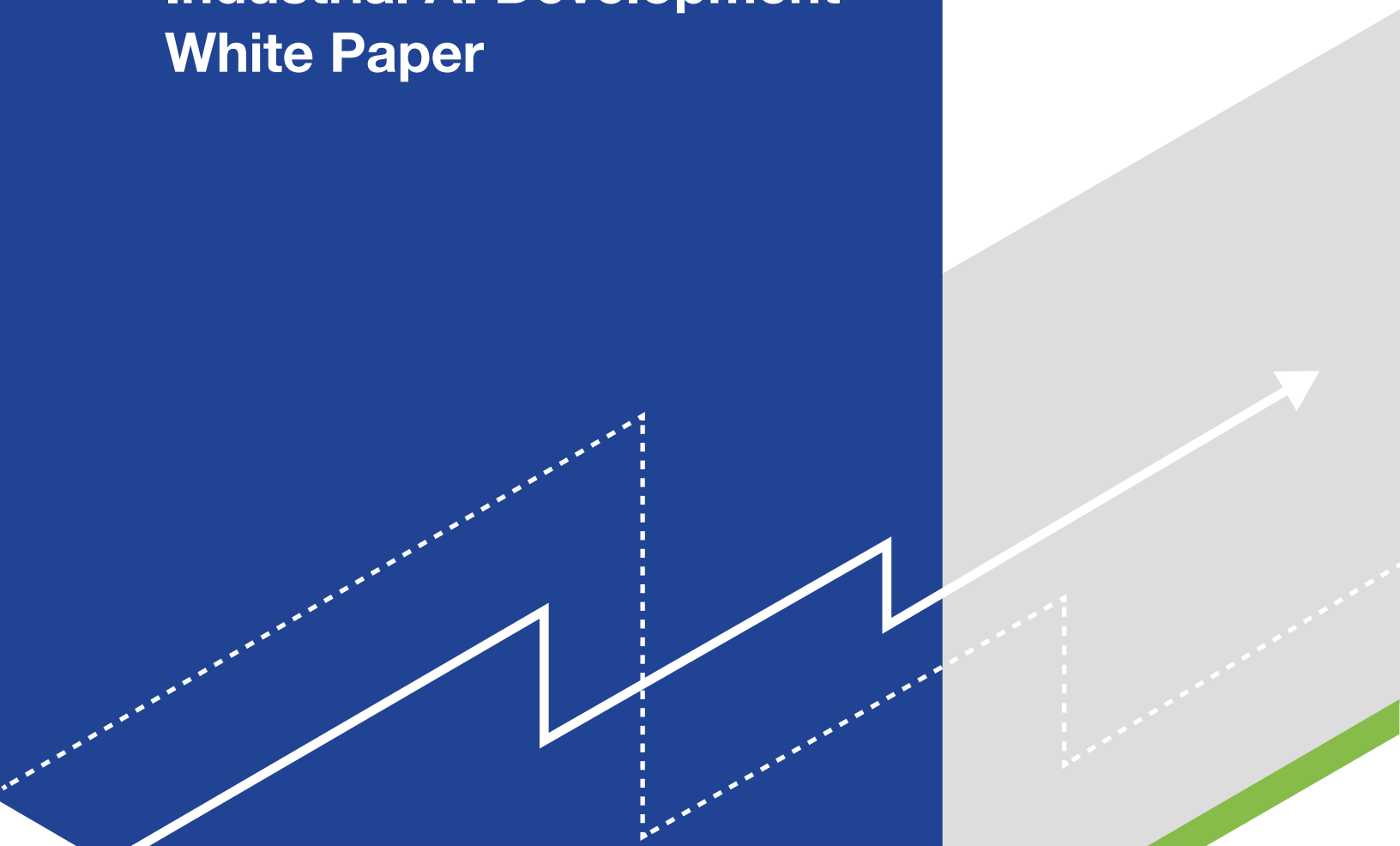
A Forrester Consulting
Thought Leadership Paper
Commissioned by Huawei Cloud BU

September 2018

Industrial AI Development White Paper



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ABOUT FORRESTER CONSULTING

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Executive Summary

86% of respondents believe AI will be a core driver for the next round of transformation in their industry.

In recent years, China's economy has shifted from high-speed growth to high-quality growth. China is now in the critical process of reshaping their development mode, optimizing economic structure, and transforming growth engine. The age of all-round digital transformation is coming and it will have significant industrywide impact. Emerging technologies are driving a new industrial revolution across the entire planet, and artificial intelligence (AI) has undoubtedly become the main force that will release the potential of the fourth industrial revolution. After more than half a century's development, AI has taken great leaps forward and entered a new stage of growth. Advances in new theories and technologies, i.e., the internet, big data, supercomputing, sensor networks, and data science, as well as strong economic and social demands and trends, have made it possible for AI to be a legitimate part of any organizations' automation strategy. As the core driver for a new round of industrial innovation, AI will further develop and unleash the enormous energy that once powered previous technological and industrial revolutions to create a new, strong engine that reshapes economic activities from production, distribution, to exchange and consumption. This will generate new demands for intelligence at both the macro and micro levels and incubate new technologies, products, industries, businesses, and models, which will further trigger a profound shift in economic structure as well as the way that human beings orient themselves to reality — eventually achieving widespread progress in social productivity.[1]

In June 2018, Huawei Cloud commissioned Forrester Consulting to conduct a survey on China's industrial AI market. To better understand how AI is applied to help manufacturing, online new media, healthcare, and industries go digital, the survey targeted 200 large and medium-sized companies that are in the process of digital transformation. This survey provides strategic suggestions and supports the identification of trends and challenges that industries are facing when adopting AI.

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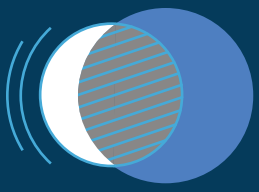


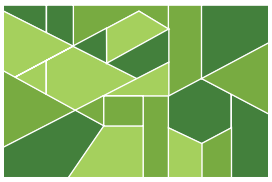
Key Findings

- **Industrial AI will be the foundation of digital transformation and business innovation.** Sixty-five percent of respondents believe that AI will play an extremely important role in their digital transformation. Eighty-six percent of respondents treat AI as a driver of innovation in their industry.
- **Challenges remain before industrial AI can be embraced more broadly.** The main concern of over half (57%) of respondents is the lack of professional AI talents. There is an urgent need for third-party partner support to help narrow the gap in industrial practices, technology development, and ecosystem support.
- **Full-scale and full-stack globalized industrial AI will accelerate digital innovation.** The public cloud has become a major platform for new technologies including AI. It can provide infrastructure resources and flexible services at platform and application layers with low costs and high flexibility through automation and resource abstraction. Public cloud is a key driver for industrial intelligence as it helps companies quickly build up their application capabilities and develop new intelligent applications. Companies need to work alongside technology partners to develop full-scale industry strategies, reply on full-stack AI systems, and take advantage of partners' broad experience and multilevel services. Only by embracing the global ecosystem and AI applications across multiple dimensions will they be able to achieve a real leap forward in digitization. That in turn will support brand-new customer experiences, industry innovation, improved/smarter process controls, insights-driven company automation, and ultimately, differentiation and success through superior products and services.

The Age Of Industrial AI Is Coming For Digital Transformation And Business Innovation

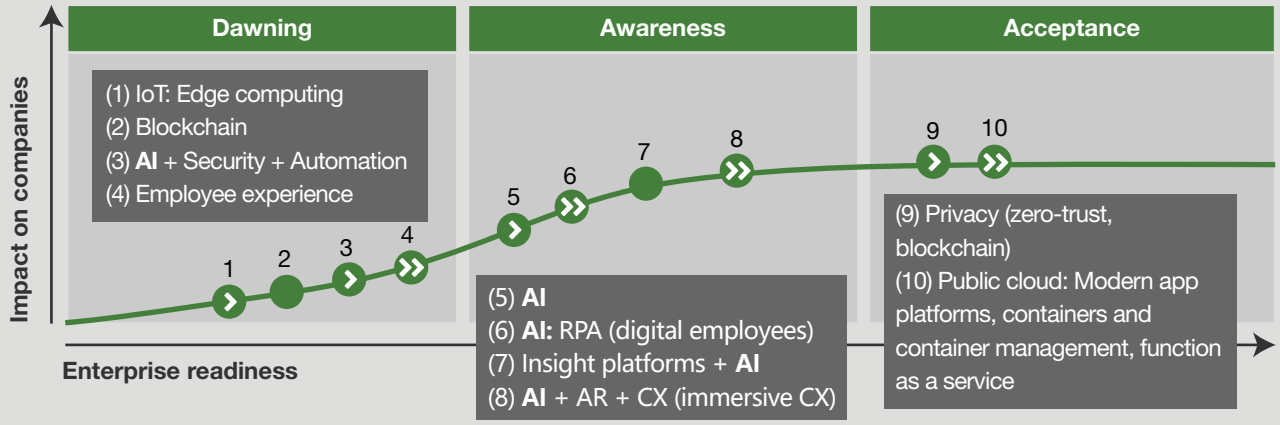
Along with the development of deep learning technology, AI has attracted wide attention since 2006. Deep learning has driven major breakthroughs in technologies such as voice/image recognition and natural language processing, enabling AI to play a significant role in the daily lives of ordinary consumers. Nowadays, various industries are taking a keen interest in AI, looking to leverage AI and technological innovations to make positive changes and accelerate industrial revolution. Already, AI is a key enabler of digital transformation and business innovation, and the importance of AI is starting to be recognized at the national level in economic reforms, industrial upgrades, and technological innovations.

In 2017, Forrester summarized the most prominent technology trends over the next three years (see Figure 1). AI is a core new technology that will affect the adoption of other technologies by companies at all phases of development. AI will also be a major factor that decides the impact of new technologies on companies. In this survey, 65% of respondents believe that AI will play a vital role in their digital transformation.



The focus of AI is now shifting from consumer applications to industrial applications.

Figure 1: AI Is A Key Innovation Driver



Source: "The Top 10 Technology Trends To Watch: 2018 To 2020," Forrester Research, Inc., October 19, 2017.

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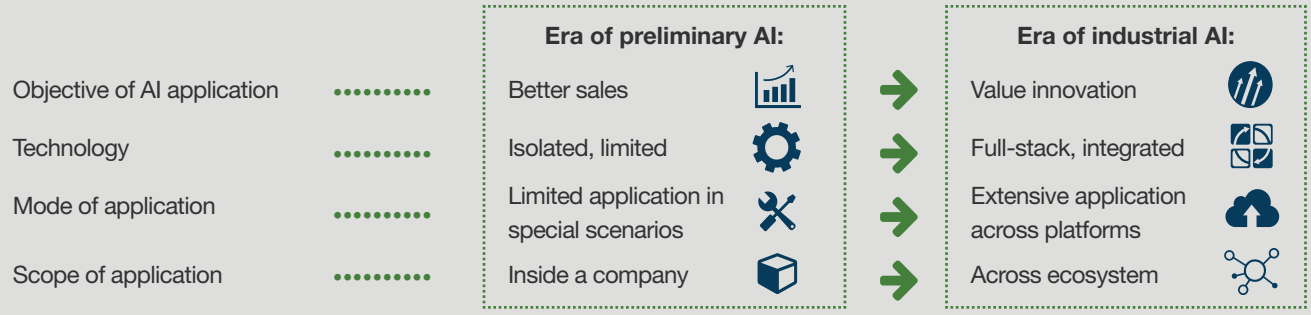
INDUSTRIAL AI WILL BE A NEW PRODUCTIVE FACTOR IN NATIONAL ECONOMIC DEVELOPMENT

New technologies, primarily AI, will unleash massive technological productivity. This vision has been made an important part of China's national economic strategy.

- **AI will be the core driver for a new round of industrial revolution across industries (see Figure 2).** Historically, every major technological advance has brought with it productivity and economic growth, from steam power in the first industrial revolution (in the 1760s) to the power of electricity in the second industrial revolution (in the 1870s) and information technology in the third industrial revolution (in the 1970s). New technologies including AI are now leading China and other countries towards a fourth industrial revolution. These technologies can be deeply integrated into existing industries and will become a new engine for the transformation and upgrade of economic structure. Nearly 90% of respondents believe that the development of AI will unleash the enormous energy of previous technological and industrial revolutions.
- **AI will create strong productivity.** By changing the way that work gets done, AI helps companies make the best use of practical experience to massively boost productivity, and AI can even displace traditional labor and become a productive factor itself. The adoption of AI will help industries shift up the value chain and drive innovation. It will offer entirely new paths toward growth for manufacturing, service, and other industries. Eighty-four percent of respondents believe that the focus of AI is now shifting from consumer intelligence to industrial intelligence, and it will enhance productivity, reshape economic structure, and bring new opportunities for society development.

Figure 2: China's AI Market Is Entering A New Epoch — Industrial AI



Base: A commissioned study conducted by Forrester Consulting on behalf of Huawei

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› **China's AI market is entering a new epoch - industrial AI.** In China, there are four major changes. First, AI is no longer used simply to improve sales, but supports value-driven digital innovation. Second, AI is no longer an isolated and limited piece of technology, rather, a full stack of integrated technology systems is taking shape. Third, the way AI is being applied is changing, from limited applications in special scenarios to extensive application across entire platforms. Fourth, the use of AI has been extended from inside the company to the entire digital ecosystem, including companies, customers, and partners. Eighty-six of respondents recognized these as positive trends.

INDUSTRIAL AI IS THE NEW DRIVER FOR DIGITAL TRANSFORMATION IN VARIOUS INDUSTRIES

AI is already deeply integrated into industries such as education, healthcare, government services, home appliances, eCommerce, and retail. It has disrupted traditional industries in a positive way. Many leading companies are now engaged in Industrial AI research and development (R&D). Seventy-nine percent of these R&D efforts are focused on using existing models to develop new technologies and services; 72% of R&D efforts involve these underlying models — strategy definition and algorithm ensembles. Industrial AI can help industries go digital by optimizing process management, products and services, and application experiences (see Figure 3).

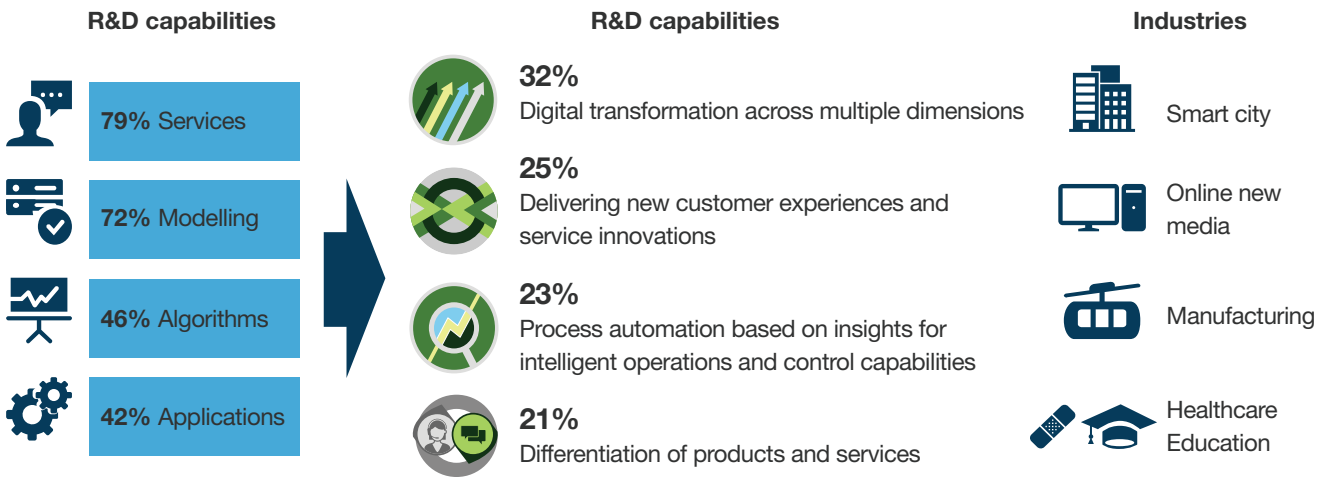
Companies urgently need a step up in digital transformation across many dimensions.

› **AI helps companies automate processes based on insights to improve operational and control capabilities.** In industries where internal processes are crucial, such as manufacturing and logistics, intelligent control capabilities are particularly important. Companies from these industries need to make their production lines more efficient, manufacture on demand with flexibility, speed up warehouse operations, and optimize warehouse layout. Using insights from internal and external data, AI can help companies automate processes, optimize resource deployment, and respond to external environments flexibly. With more efficient operations and lower costs, companies are able to differentiate themselves and gain competitive strength.

› **AI helps companies differentiate themselves by improving and reshaping products and services.** In industries driven by products and services, companies must be adaptable enough to catch up with the fast-changing and complicated markets and provide products and services that accurately fulfil customers' need to stand out from the competition. AI helps companies: 1) accurately collect customers' needs; 2) precisely calculate product costs and profitability; and 3) deliver more intelligent product features based on customers' feedback. This will enable companies to defend themselves against fierce competition.

› **AI helps companies deliver brand-new experiences and business innovations.** In industries driven by the customer experience, such as media, entertainment, and retail, the key to survival is responding continuously to the potential needs of consumers and delivering innovative experience. AI can help companies navigate the entire customer journey, from discovery and exploration, to purchase, use, inquiry, and interaction. It can also drive improvement in the customer experience. AI applications such as targeted recommendations, intelligent marketing, intent analysis, and intelligent customer services can give companies extra growth momentum.

Figure 3: Major R&D Capabilities And Goals Of Deploying AI



Application development: Horizontal applications, vertical applications, etc.
Service development: Technical/business services, atomic/complex services, etc.
Model development: Policy definition, algorithm portfolios, etc.
Algorithm development: Operator/algorithm basic mapping handling functions, operator portfolios

Base: 200 Digital strategy or technology decision makers in the target industries (manufacturing, online new media, healthcare, education)
Source: A commissioned study conducted by Forrester Consulting on behalf of Huawei (June 2018)

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› **AI helps deliver holistic digital transformation across many dimensions.** The development of a company or organization is a complex issue, touching on many different scenarios. In complicated business scenarios, such as the case of a smart city, AI can be used to deliver across-the-board improvements in processes, services, and user experience. It can optimize access to public services, ensure targeted urban management, enhance livability and smart infrastructure, and guarantee sustained cyber security. Thirty-two percent of respondents were primarily interested in using AI for a holistic digital transformation across many dimensions (Figure 3).

Challenges Remain Before Industrial AI Can Be Embraced More Broadly

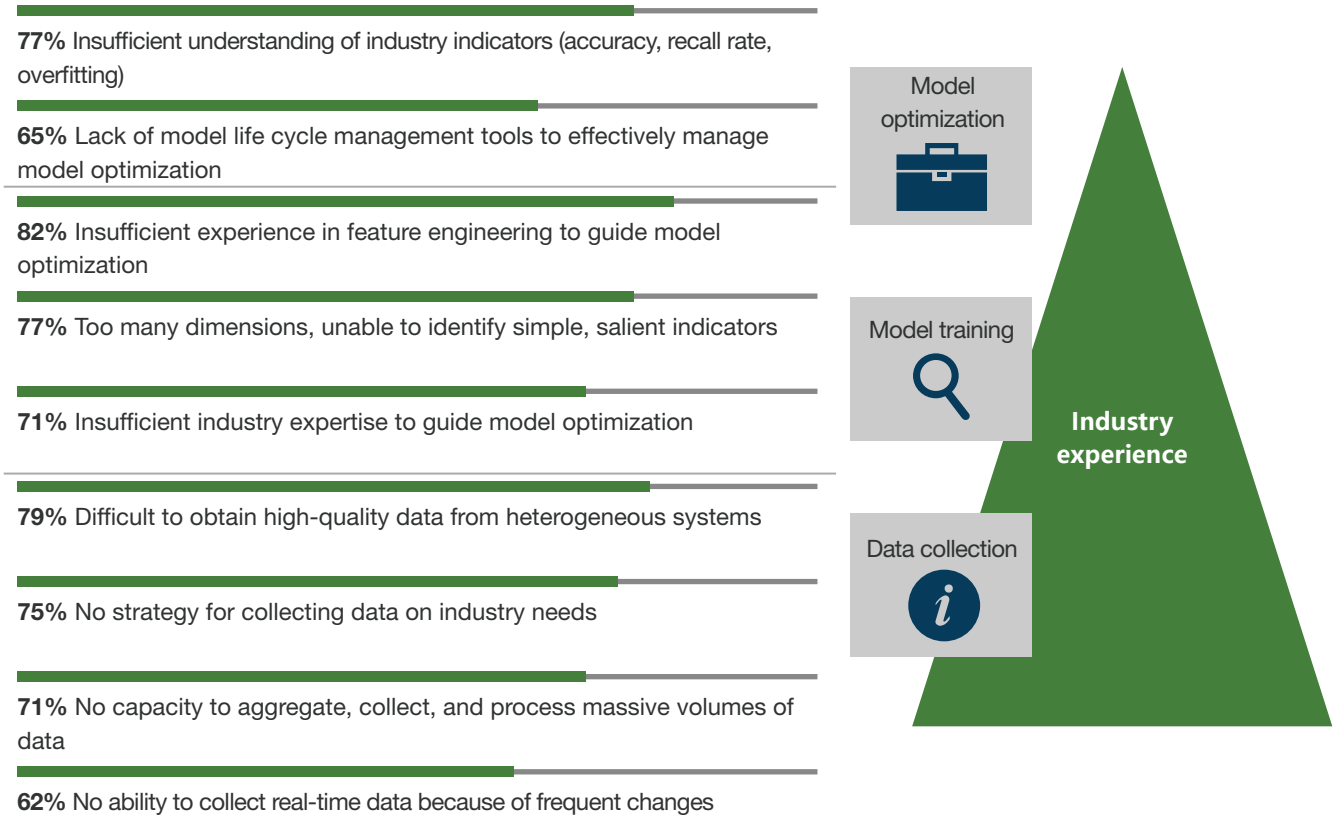
The report of the 19th National Congress of the Communist Party of China highlighted the importance of combining artificial intelligence technology with industries. The report emphasizes, “China will promote further integration of the internet, big data, and AI with the real economy.” China is a latecomer to the AI market, although it has some advantages. For example, China’s tech giants are proactive AI researchers; patent applications are on the rise; and there is a huge potential market. However, with the lack of AI expertise, insufficient experience with AI in main industries, inadequate research and development, and weak ecosystem, China is still facing major challenges in embracing industrial AI.

AI technology must combine industry knowledge and practices, which will help address challenges in data collection, model training, and model management.

AI TECHNOLOGY MUST COMBINE INDUSTRY KNOWLEDGE AND PRACTICES TO MAXIMIZE ITS PERFORMANCE

› **Data collection: Industry knowledge and practices can help transform data into features.** Embracing AI requires companies to develop more considered data collection strategies. However, our survey found that about three-quarters of companies did not have a well-defined strategy that specified their industry's data needs. Nearly 80% of respondents complained of the challenges in obtaining high-quality data with multiple standards and the difficulty of connecting data sets. The massive volumes of data and speed of change make it hard to collect and aggregate data in real time. As a result, industries lack the data resources they need. Seventy-five percent of respondents did not have a data collection strategy, and 71% lacked the expertise to process and analyze the data they collected (Figure 4).

Figure 4: Challenges When Deploying Industrial AI



Base: 200 Digital strategy or technology decision makers in the target industries (manufacturing, online new media, healthcare, education)
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- **Model training: Industry knowledge and practices are needed to define and optimize functions.** A clear optimization goal is the foundation for AI model training. Performance indicators must be decomposed, and precise optimization functions need to be set. But business operations vary greatly from industry to industry. Therefore, a holistic approach must be adopted: Salespeople need to work closely with data scientists to achieve the desired results. However, our survey found that 71% of respondents did not have the knowledge required to direct model optimization; and 87% did not have enough experience in feature engineering to guide model optimization (Figure 4).
- **Model optimization: Industry knowledge and practices are needed for model optimization and ensemble learning.** After data is collected and models are created, it is necessary to adjust model hyperparameters and continue to optimize these models. This is another major challenge for companies. Different industries have different requirements for accuracy, recall rate, overfitting, and other metrics. The manufacturing sector has some tolerance for overfitting; accuracy and recall rate are top priorities in risk control, criminal identification, and other related domains. What bothered 77% of respondents is that they did not have an in-depth understanding of their industry-specific indicators (see Figure 4). Model optimization and ensemble strategies should be customized for different industries. To make this happen, experts in these industries need to work closely with AI experts to effectively manage the model optimization process.

R&D REQUIRED IN FULL-STACK DEVELOPMENT FOR AI TECHNOLOGY IS OUT OF REACH FOR MOST COMPANIES

- **Deep engineering expertise is required for proficiency in AI operational platforms.** The engineering experience required for AI should include multiple dimensions, from hardware system (that includes chips, memory, storage, and networks) to software platforms and development architecture. In-depth engineering knowledge is needed in every area. Companies need extensive engineering experience in how to optimize algorithms for different scenarios and how to combine them into ensembles. This is a major challenge for all Chinese companies - 87% of respondents lack experience in multialgorithm ensembles, while 70% said they had trouble with hardware optimization (see Figure 5).
- **Solid knowledge of deep learning theory is needed for proficiency in AI algorithms.** Combining standard algorithms with newly-developed algorithms to produce usable ensembles is a major challenge, requiring thorough theoretical grounding and practical experience. Open-source frameworks for AI have now been widely adopted. But what companies need most are skilled engineers who are able to select the most suitable algorithms for a given data set and purpose. They need a deep understanding of algorithms so that they can innovate and optimize hyperparameters with skill, up to and including reconfiguring network architecture, rather than using brute force trial and error. According to our survey, 53% of companies said that they lacked employees with the required AI theory grounding (see Figure 5).

Companies do not get strong support from ecosystem partners in China or internationally.

› **Extensive experience in architecture is needed for proficiency in AI application systems.** Deploying AI systems is considerably more complex than buying hardware and software products. It requires extensive experience in architecture design across multiple domains to effectively deploy and use the full potential of AI systems. In particular, companies need to answer the following questions: How can they balance and best exploit internal resources, edge computing, public cloud, and hybrid deployments? How can they ensure process compliance in AI systems and protect user privacy? How can they guarantee the security of data and applications in AI systems? Over 50% of respondents did not have the expertise required for AI deployment, compliance, security, and privacy (Figure 5). Companies are facing great challenges in ensuring the security of data and applications.

Figure 5: Technical/R&D Challenges When Developing Industrial AI

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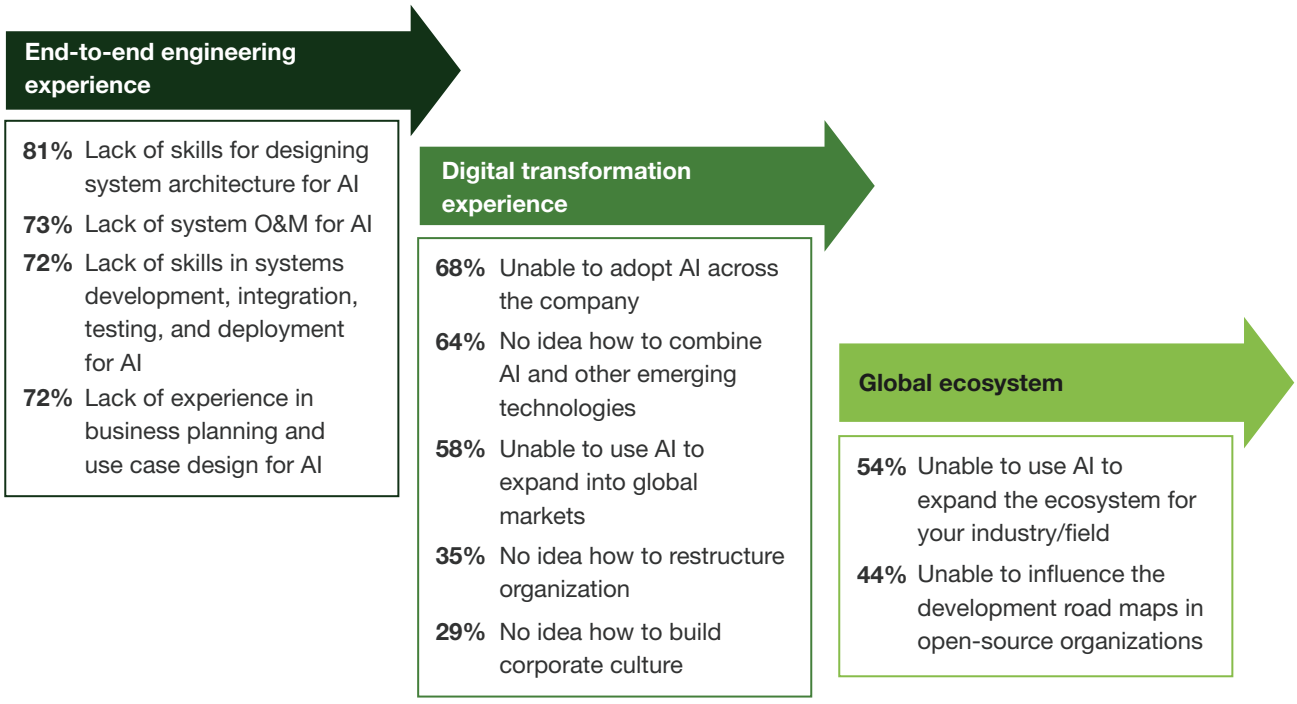
WEAK SUPPORT FROM ECOSYSTEM PARTNERS IN AND OUTSIDE CHINA IS SLOWING THE ADOPTION OF AI

› **Lack of end-to-end engineering experience.** Technology partners need experience delivering end-to-end AI projects. The process begins with business planning, use cases, and ideation, and subsequently involves solution design, modeling, coding, testing, deployment, optimization, and continuous iteration through O&M. However, Chinese companies are severely lacking in the skills needed to design AI system architecture. Eighty-one percent of respondents believed that this is the biggest challenge around ecosystem support (see Figure 6). More than 70% of respondents said that a lack of skills in systems development, integration, testing, and O&M is slowing the adoption of AI in the enterprise intelligence market.

Figure 6: Ecosystem Challenges When Developing Industrial AI



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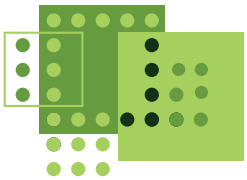
- **Lack of digital transformation experience.** Digital transformation needs buy-in from the leadership and a change in corporate culture. To truly go digital, companies need to effectively integrate AI with other emerging technologies. Most of the companies surveyed were not deploying AI broadly, nor did they know how to combine AI and other emerging technologies. As a result, they were not able to use AI to effectively grow their business in the global market. Creating the right organizational structure and corporate culture is essential to successful digital transformation. However, about 30% of respondents still have no understanding of these fields.
- **Lack of a global ecosystem.** In age of customer, open-source and ecosystem strategies are vital for any company seeking sustainable growth. First, open source is an important foundation for many emerging technologies, i.e., cloud computing, AI, and internet of things (IoT). Second, a dynamic global value network is taking shape. This network extends outward from the upstream and downstream supply chains, to connect enterprises, customers, and partners in many different ways and many different business scenarios, through APIs, data, and open-source frameworks. This network enables companies to pursue sustainable innovation. However, most Chinese enterprises face severe challenges in this field. They do not get sufficient support from ecosystem partners in China. More than half of companies are not using AI to develop their global ecosystem, and they do not have a voice in shaping the technical road maps of open-source organizations.

Full-Scale, Full-Stack, Globalized Industrial AI Will Accelerate Digital Innovation

To utilize the AI ecosystem to support industry innovation, the key is the selection of trusted partners offering the full stack of software and hardware technologies. The partners should be able to support businesses across all scenarios and help enhance their service capabilities and practical experience, with the goal of eventually realizing global value. Specifically, partners need to: 1) use industry knowledge to help companies understand their features and needs, and plan for how AI can be incorporated in terms of their business and technology; 2) build cloud platforms with all the enterprise intelligence capabilities required, to embed AI into the technology infrastructure; 3) leverage experience and R&D capabilities for engineering practice to build intelligence into specific industries and scenarios; 4) provide on-the-ground support to help companies build their own R&D and O&M capabilities, so that they can take control of AI operations; and (5) influence the international ecosystem to ensure the evolution of open-source ecosystems to better serve the future business needs of companies and build up the ecosystem into a value network for AI.



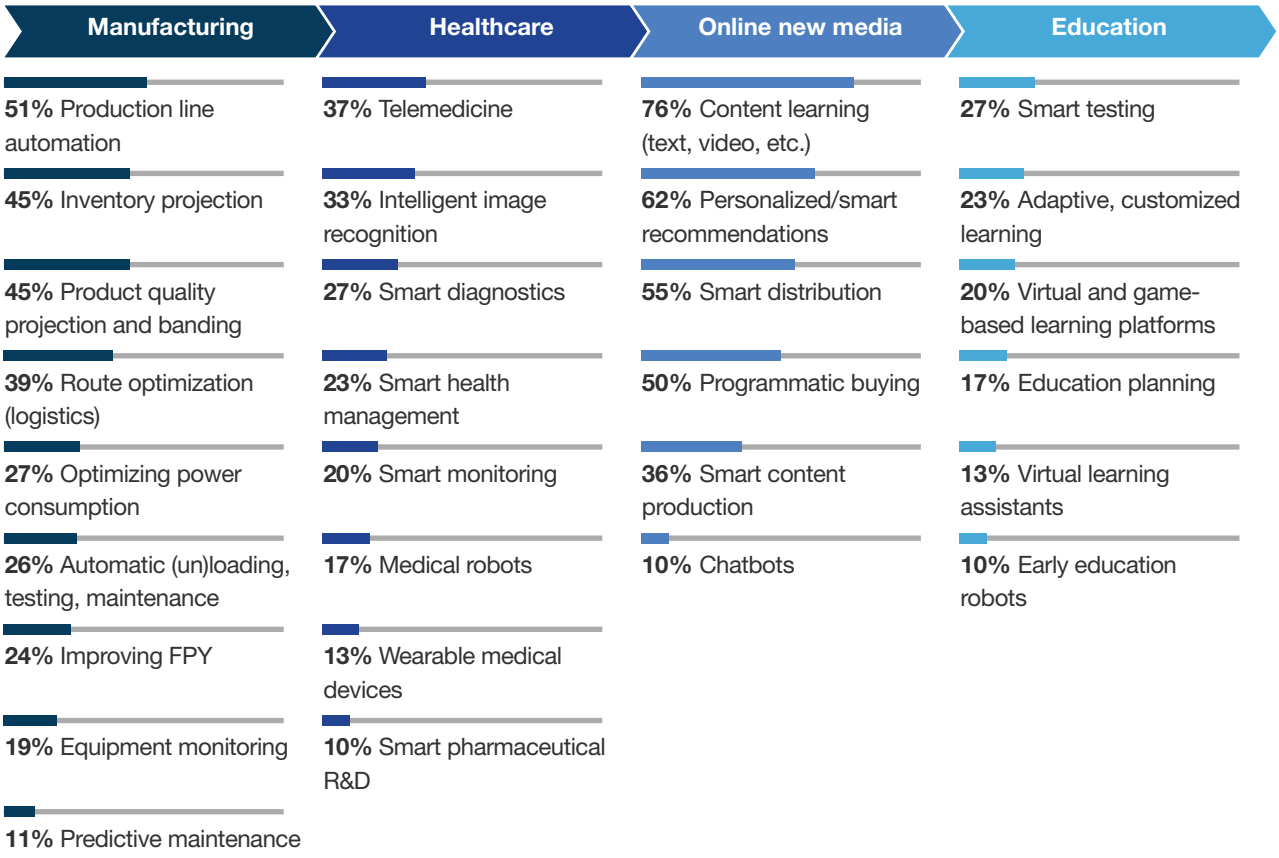
Companies should choose partners who can support every aspect of their business scenarios in order to accelerate innovation to a global scale.

INDUSTRIAL AI STRATEGY WITH ALL SCENARIOS: THE FOUNDATION FOR AI EVOLUTION

Companies first need to correctly recognize their own key features. They must identify whether their core competitive strength lies in their process management, products, or application experience. Then they must determine where AI can support their business and use targeted applications to spearhead the introduction of systemwide AI.

- **Process-driven industries need AI for operational insight and automation.** Our survey found that companies in these industries achieve higher efficiency at lower costs when they introduce AI. In the manufacturing industry (Figure 6), 51% of respondents planned to invest more in production line automation; 45% in inventory forecasting; and another 45% of companies planned to use AI to improve the prediction and management of product quality. In the logistics and transportation sectors, automated loading/unloading, transportation route optimization, and unmanned transportation are the current investment hotspots. Twenty-seven percent of companies are interested in how AI can reduce energy consumption, and 24% want to use it to increase their first pass yield.
- **Product-and service-driven industries need AI to differentiate their products and services.** AI can help reshape products and drive service innovation. In the healthcare industry, telemedicine can offer patients better access and new services. Smart image recognition can reduce misdiagnoses and improve existing services. Smart diagnosis and treatment and smart health management also attracted interest from 27% and 23% of respondents, respectively. In the education sector, 20% thought that the virtual and game-based learning platforms would improve the effectiveness of teaching and would be a service differentiator that could attract customers. This is another recent investment hotspot.
- **Experience-driven industries need AI for personalization. In these industries, customer experience is the differentiator.** AI can enable companies to deliver personalized experiences. For example, in the online new media sector, 76% of respondents planned to invest in content learning systems that could process text and video to learn more about their customers. Sixty-two percent had plans to make significant investments in personalized recommendation systems. Fifty-five percent of respondents expressed their willingness to invest in smart distribution. Programmatic buying was included in investment plans by 50% of respondents. In the education sector, intelligent testing is a way to shorten test times, and self-adaptive personalized learning can offer targeted teaching adapted to the student's individual needs. This can provide a revolutionary experience for learners and is the primary focus for investment in AI in the education industry.

Figure 7: Scenarios In Which Respondents Currently Expect To Invest In AI Solutions



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AI case studies:

Smart manufacturing	Online new media
One hi-tech manufacturer of electronic components used to need a large team to test its printed circuit boards (PCBs). This made the process slow, inefficient, and inaccurate, with frequent errors and omissions. The company introduced an edge AI platform with image capture, backhaul, and predictive modeling, and was able to fully automate the process, while improving detection of errors. First pass yield went from 99.2% to 99.5%. It saved costs and reduced the amount of work by 48%.	A website offering photographs had over ten million copyrighted images, which were often abused or used without copyright. The company needed to regularly sweep billions of images online to compare them against its inventory so that it could discover rights abuses and prevent losses. This task was obviously impossible using human labor; and the volume of images online grows explosively by the hour. Finding copyright violations was a major worry. AI, deep learning, and model training and deployment enabled a fast search function to be developed. Using this function, the company was able to massively improve its ability to identify and pursue copyright infringements, and its accuracy topped 99%.

Source: A commissioned study conducted by Forrester Consulting on behalf of Huawei

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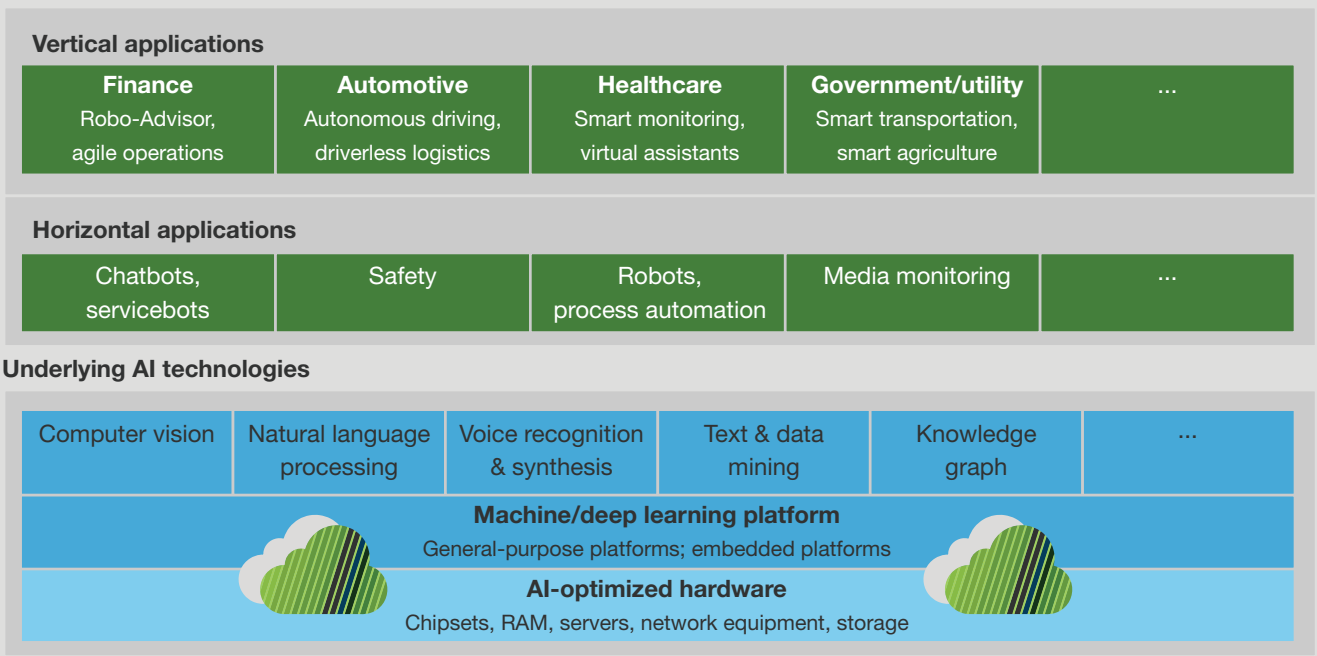
AI PLATFORM: FULL STACK OF SOFTWARE AND HARDWARE, EMBEDDING AT INTO THE TECHNOLOGY INFRASTRUCTURE

AI platform covers multiple software and hardware domains ranging from AI technology platforms to specialized applications. It needs to deliver capabilities across multiple areas, from computing power and business knowledge, to engineering experience. Local deployment from scratch is excessively complex and cannot meet the needs of customers that companies serve (see Figure 8). Public cloud has become a major platform for new technologies including AI. It can provide infrastructure resources with low costs and high flexibility through automation and resource abstraction, and flexible services at platform and application layers. Public cloud is a key driver for industrial intelligence as they help companies quickly build up their application capabilities and develop new intelligent applications. Edge computing can reduce service delays and network congestion, so it is a vital supplement to public clouds. Bringing AI to industries requires first establishing an advanced architecture, encompassing public clouds and the cloud edge, to deliver both highly responsive computing and centralized cloud management.

Figure 8: Hardware + Software Full-Stack Industry AI Platform



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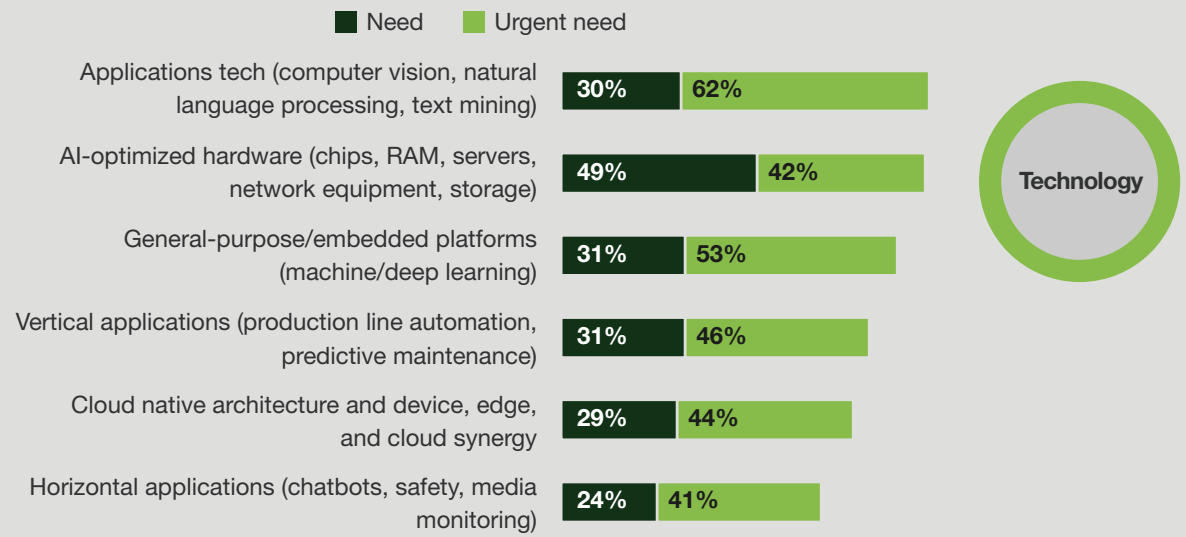
- **AI platform is the foundation that enables AI applications.** AI-optimized hardware provides the core infrastructure for AI applications. It includes AI chips (CPUs, GPUs, FPGAs); large-capacity, low-latency, and all-flash arrays and solid-state storage devices; high-performance, high-throughput, and highly scalable servers and network equipment. Turning data into descriptive, diagnostic, and predictive analytic insights requires a visualized modeling environment, a code testing environment, and a machine learning and deep learning platform configured for general AI applications or real-time embedded environments. Companies also urgently need technical support in the areas where AI is being applied: computer vision, natural language processing, voice recognition and synthesis, text mining and data mining, knowledge graph, etc. Public cloud is the best environment for the large-scale big data processing and heavy computing loads involved in model training for companies. Public cloud APIs can also help ease barriers to entry for developers of horizontal applications and AI infrastructure.
- **Specialized AI applications produce value faster.** Using an AI infrastructure platform, developers can create more horizontal industry applications. For example, 73% of respondents were interested in using underlying voice recognition and natural language processing technologies to make service robots which converse with customers, or to monitor social media; or horizontal face and object tagging applications based on image recognition technologies. And on this basis, 77% of respondents were interested in industry applications for specific verticals, such as predictive maintenance, coordinated resource planning, and robotic production automation (see Figure 9). For applications which need to be responsive in real time, cloud edge equipment may be deployed. How the public cloud coordinates with the edge must also be considered.

› **AI needs a platform with cloud native architecture that coordinates device, edge, and cloud.** AI and AI applications need an advanced enterprise architecture platform. Implementing AI requires an open architecture that can handle large-scale global deployment of applications. That means a container-based approach and a cloud native architecture with dynamic orchestration of microservices. On the infrastructure layer, it requires edge computing and micro-data centers integrated with public cloud. On the platform and application layers, the big data services and flexible service capabilities on public cloud will support the integration of enterprise applications with industry AI. Cloud-based develop operations (DevOps) services will help companies flexibly develop, deploy, and migrate their applications. This integrated AI engine will deliver the best possible customer experience. Seventy-three percent of respondents showed interest in this.

Figure 9: Selecting The Right Technology Partner



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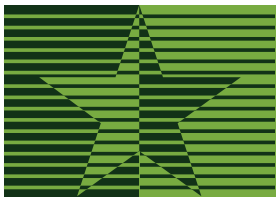
COMPREHENSIVE SERVICE CAPABILITIES AND PRACTICAL EXPERIENCE TRIGGER THE ADOPTION OF GENERAL TECHNOLOGIES TO SPECIFIC INDUSTRIES

AI-based digital transformation demands a deep understanding of business processes and powerful technologies. Most companies are not able to achieve significant results in the short term by working alone. There is a clear need to select partners with end-to-end service capabilities and extensive experience in digital transformation. Trusted AI partners will need the following:

- **Experience in digital transformation across all scenarios based on cloud platforms.** Natural growth and global technology trends are sweeping many companies into the cloud. Eighty-eight percent of respondents saw a partner's ability to support digital transformation with cloud as very important. Based on cloud computing, the more use cases and business scenarios a partner can support, the better they can deliver useful, targeted services for digital transformation. Seventy-eight of respondents hoped that their partner would be able to provide multilevel support and services for use cases across a number of different industries (Figure 10).
- **End-to-end services capabilities - from strategy planning and business consultancy to architecture design and O&M.** From setting the strategic vision and business process improvement, to the development, implementation, and launch of AI solutions, end-to-end service capabilities can guarantee service continuity and strategy execution. With multiple partners, there is a risk of disconnected processes which can lead to waste, and even the failure of the entire project. Ninety-three of respondents need a partner to provide end-to-end service capabilities (see Figure 10).

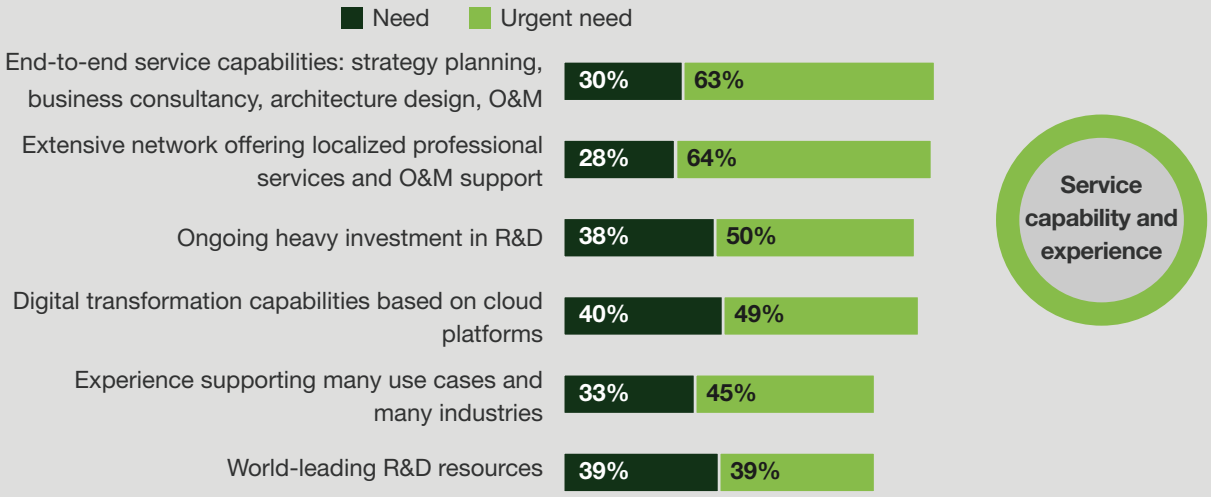


Companies need partners with demonstrated end-to-end service capabilities and experience in deep digital transformation across all scenarios

› **Cutting-edge, global research resources and ongoing investment in R&D.** As noted above, companies are facing various challenges in theoretical research and technology implementation when applying AI. Many of the key elements — theories, algorithms, hardware architecture —are rapidly developing and changing. To be competitive, technology partners will need deep technical resources and the capacity to continue to invest in R&D. Eighty-eight percent of respondents saw their technology partners' level of R&D investment as important (Figure 10).

› **Trusted, specialized global services and O&M.** In many situations, AI applications will have to adapt fast to changing business environments. Introducing AI solutions will not be a one-off process, but will require sustained updating and servicing. Partners with a global network of technical services and O&M will have a clear advantage. Ninety-two percent of respondents saw their technology partners' capacity to deliver O&M services as important.

Figure 10: Selecting The Right Service Partner



Base: 200 Digital strategy or technology decision makers in the target industries (manufacturing, online new media, healthcare, education)
Source: A commissioned study conducted by Forrester Consulting on behalf of Huawei (June 2018)

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EMBRACING GLOBAL ECOSYSTEM, OPEN NETWORK OF VALUE INNOVATION AND COLLABORATION FOR INDUSTRIAL AI

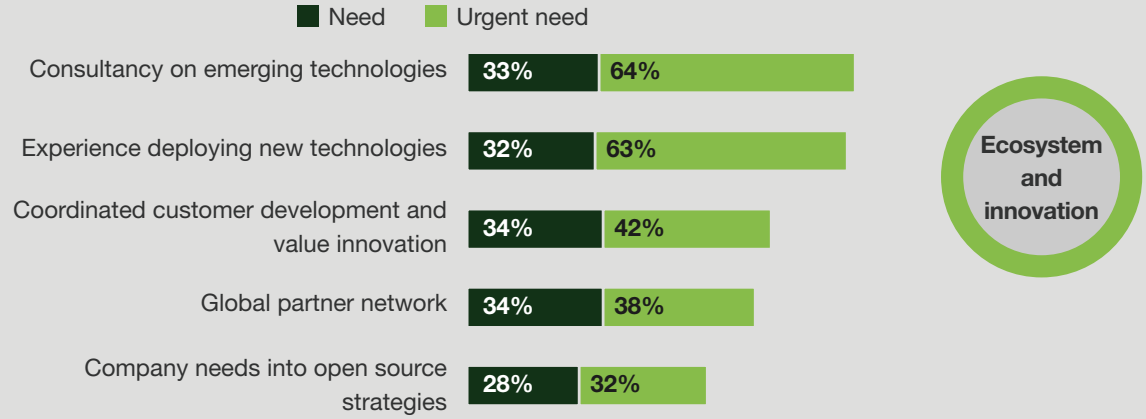
Disrupting a single market is only the first step in the digitization journey. Company decision makers also need to consider the three elements below when selecting their technology partners, so that they can fully embrace the new AI era and achieve sustainable innovation:

- **Strategically invest in open-source AI technologies, and help enterprises get their specific needs added to the open-source road map.** The open-source ecosystem is the primary field for activity in AI. More than half of respondents hoped that their technology partner would help them place their needs on the open-source road map (Figure 11).
- **Consultancy services support and implement new technologies and develop new digital models.** In the age of digitalization, all consultancy will be the new technology consultancy department. As the commercial landscape changes, companies need to keep evolving their business models. Ninety-seven percent of respondents saw their technology partners' capacity to deliver strategic consultancy services on new technology as very important. And 95% of respondents hoped that their partners would support them as necessary with new technologies (Figure 11).

Companies need partners' support on developing new digital business models to drive innovation.

› **Build connections with global partners and customers from various industries, and enable new synergies for value innovation.** The digital ecosystem is a vital part of any digital transformation project. In a globalized world, a global network of partners offers opportunities for synergies and value innovation across different industries. When selecting technology partners, more than 70% of companies saw a global ecosystem as being extremely important.

Figure 11: Selecting the right ecosystem and innovation partner



Base: 200 Digital strategy or technology decision makers in the target industries (manufacturing, online new media, healthcare, education)
Source: A commissioned study conducted by Forrester Consulting on behalf of Huawei (June 2018)

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Recommendations

Over the last few years, China's AI sector has developed at an incredible speed. New technologies are driving change, industries are exploring their value, and agglomeration effects are beginning to appear. AI is now an important pillar supporting digital transformation and business innovation. However, there are still significant challenges in the application of AI, notably in the areas of technology and ecosystem. Forrester believes that AI needs to be integrated into verticals in order to have the greatest impact. Many companies have not yet found the right technology partner to help them with data collection, management, processing, model optimization, and ensembles. Partners need to see the big picture. In particular, partners will need strong technology capabilities: deep expertise in engineering, fundamental research on algorithms, and extensive experience with architecture. These are the elements which company decision makers are seeking in an AI partner. The challenges they face include a lack of end-to-end engineering experience, a lack of experience with digital transformation projects, and a weak global ecosystem.

Choosing the right partner is therefore vital. Forrester has developed recommendations for companies looking for a partner, including their scope of operations, full-stack and globalized ecosystem, and their ability to support industry innovation. Specifically:

Industrial AI strategy with all scenarios: the foundation for AI evolution. Companies first need to correctly recognize their own key features. They must identify whether their core competitive strength lies in their process management, products and services, or customer experience. Then they can define a strategy for how AI can improve their processes, products and services, or customer experience.

AI platform: full stack of software and hardware, embedding AI into the technology infrastructure. When selecting technology partners, companies need to consider AI platforms that deliver a full architecture of device, edge, and cloud; and capacity across the full stack of functions, from computing power and specialist insights, to engineering experience.

Comprehensive service capabilities and practical experience trigger the adpotion of general technologies to specific industries. When selecting technology partners, companies need to consider whether the partner can deliver the full range of services, from strategic planning and business consultancy to system architecture design and O&M. Partners will need a comprehensive platform and experience in supporting multi-level digitization across all business scenarios.

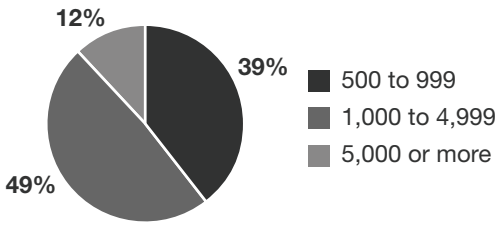
Embracing global ecosystem, open network of value innovation and collaboration for industrial AI. Companies should give priority to technology partners who are contributors to open-source technologies and can offer consultancy on emerging technologies. They will need a global network of partners to help find synergies for sustained value innovation.

Appendix A: Methodology

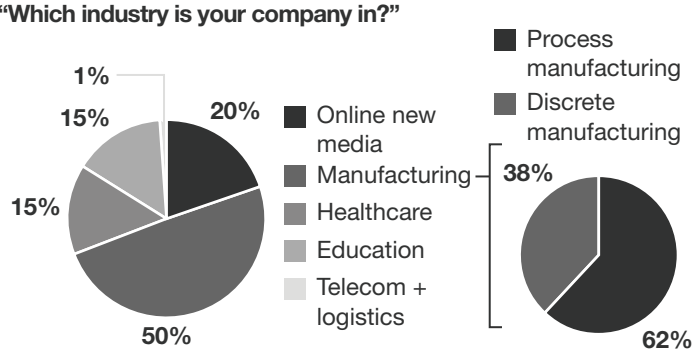
Forrester interviewed 200 large companies (from four industries: manufacturing, online new media, healthcare, and education) that are in the process of digital transformation to understand the latest trends and challenges in the application of AI technologies and to generate recommendations. Interviewees were generally digital strategy or technology decision makers in charge of digital transformation projects. The survey was conducted from June to September 2018.

Appendix B: Demographics/Data

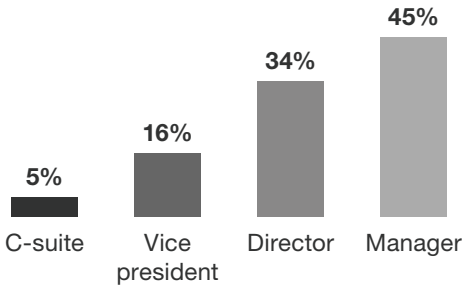
"How many employees does your company have globally?"



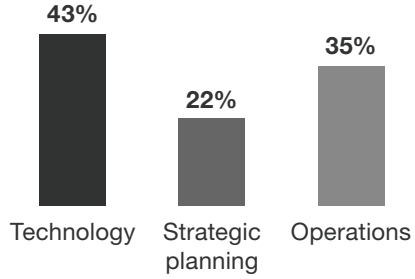
"Which industry is your company in?"



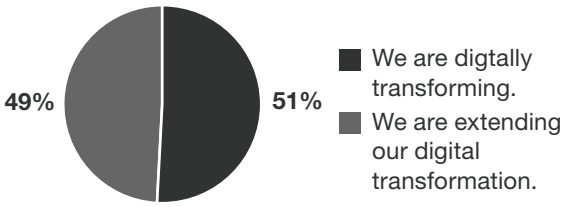
"Which of the following best describes your position?"



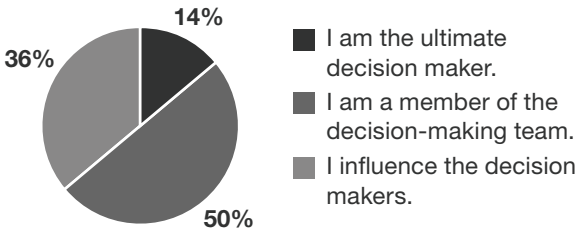
"Which of the following best describes your area of responsibility?"



"Is your company engaged in digital transformation?"



"What are your responsibilities in your company's digital transformation?"



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Appendix C: Supplemental Material

"The Top 10 Technology Trends To Watch: 2018 To 2020," Forrester Research, Inc., October 19, 2017.

Appendix D: Endnotes

[1] Source: Chinese State Council, "China's New-generation of Artificial Intelligence Development Plan," translated by Flora Sapio, Weiming Chen, and Adrian Lo, , July 8, 2017 (https://flia.org/wp-content/uploads/2017/07/A-New-Generation-of-Artificial-Intelligence-Development-Plan-1.pdf).