中国新一代人工智能科技产业发展报告·2023

China's New Generation Artificial Intelligence Technology Industry Development Report 2023

建设具有全球竞争力的人工智能产业集群

2023·天津

Building the Artificial Intelligence Industry Clusters
with Global Competitiveness

中国新一代人工智能发展战略研究院
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内容提要

在人工智能科技创新和产业发展上，中国走在了世界前列。应用需求牵引、政府战略引领、平台主导的产业创新生态和创新系统的完善，是中国人工智能科技产业发展的关键驱动因素。面对美国技术封锁和经济智能化转型升级的迫切需求，如何建设具有全球竞争力的人工智能产业集群，构建自主可控技术体系和产业创新生态，加速人工智能技术升级和产业发展，是我国人工智能科技产业发展的战略方向。

人工智能企业及其创新活动构成了人工智能产业集群发展的微观基础。工业和信息化部统计数据显示，截至 2022 年 6 月，我国人工智能企业数量超过 3000 家，仅次于美国，排名第二，人工智能核心产业规模超过 4000 亿元。我国人工智能企业在智能芯片、基础架构、操作系统、工具链、基础网络、智能终端、深度学习平台、大模型和产业应用领域的创新活动，提升了产业的国际竞争力。平台企业、独角兽公司、中小企业、新创企业、研究型大学、科研院所和投资者之间相互协作，共同构建富有活力的产业创新生态，人工智能科技创新和产业发展表现出日益明显的集群化态势。

本报告认为，区别于一般的产业集群和创新集群概念，人工智能产业集群是基于网络空间发展的创新集群。前三次工业革命的产业集群和创新集群都是基于物理空间技术体系创新发展，对地理空间具有更强的依赖性，创新扩散的速度相对缓慢。第四次工业革命是基于网络空间技术体系的创新发展，创新集群更加依赖网络空间的发展，技术、产品和服务的创新速度更快，创新应用领域和地域更加广泛。

人工智能产业集群的基本构成要素包括企业簇群、创新资源、创新系统和网络空间产业生态。与前三次工业革命相比，网络空间产业创新生态是第四次工业革命背景下人工智能产业集群的独特要素。

产业国际竞争力的基础是创新能力的提升。我国的人工智能科技产业是深科技创新驱动的。面对美国技术封锁和经济社会智能化转型迫切需求，建设具有全球竞争力的人工智能产业集群的战略目标是构建自主可控技术体系和产业创新生态。充分利用高度开放的全球创新网络，以应用需求为牵引，通过政产学研协同实现基础研究和根技术创新，构筑自主可控技术体系和软硬件协同创新生态，是持续提高人工智能产业集群国际竞争力的基础。

本报告构建了包括 2200 家人工智能企业、5722 个投资者（投资机构和非投资机构）、438 所 AI 大学和 307 家非大学科研机构、967 家产业联盟、在中国境内召开的总计 2318 场会议、31 个省市自治区出台的 775 项相关政策和 3507 家人工智能产业园区规划建设情况在内的中国智能经济样本库。通过属性数据和关

系数据分析，研究我国人工智能产业集群的内在结构和发展趋势。

我国的人工智能产业集群表现为"新型创新区→城市→区域→全国→全球"空间结构特征。与传统工业园区和高科技园区不同，新型创新区一般位于科技创新资源和产业基础雄厚的大城市的中心区和次中心区，以人工智能产业化创新集群的发展为导向，强调依托狭小的物理空间打造无限的网络空间产业创新生态。

人工智能产业集群包括人工智能产业化创新集群和产业智能化创新集群。新型创新区是人工智能产业化集群及其产业创新生态的栖息地。人工智能产业化集群通过网络空间产业生态实现向地理空间分散的产业智能化创新集群赋能。人工智能产业化创新集群和产业智能化创新集群的良性互动，是建设具有全球竞争力的人工智能产业集群的关键动力和机制。

到目前为止，我国人工智能产业集群主要分布在京津冀、长江三角洲、珠江三角洲和川渝地区的重点城市。通过外部创新资源引入和内部创新资源激活，西部地区的西安，中部地区的武汉和长沙，东北地区的沈阳、大连和哈尔滨开始出现人工智能产业集群的雏形。

我国人工智能产业集群的价值网络结构是"极核"状的。平台及其主导的产业创新生态构成了我国人工智能产业集群发展的"极核"。从 2014-2022 年价值网络的结构性统计指标看，我国人工智能产业集群的簇群结构特征越来越明显。以华为、腾讯、百度和阿里巴巴为代表的超级平台是我国人工智能产业集群形成和发展的核心节点。近年来，超级平台在智能芯片、基础架构、操作系统、大模型、机器学习平台和应用软件领域的研发和产业化布局，为我国人工智能产业集群国际竞争力的提升奠定了坚实基础。

研究型大学和科研院所在基础研究、技术开发和人才培养领域的努力，持续提升我国人工智能产业集群的国际竞争力。包括清华大学和北京大学在内的国内 18 所高校成为全国首批集成电路科学与工程一级学科博士学位授权点。截至 2022 年 3 月，全国共有 440 所高校设置人工智能本科专业、248 所高校设置智能科学与技术本科专业、387 所普通高等学校高等职业教育（专科）设置"人工智能技术服务"专业。

创建新型创新组织激活政产学研用协同创新活力，形成基础研究、技术研发、应用创新和产业孵化无缝对接的新体制和新机制，是推动人工智能科技创新和产业发展的重要途径。截至目前为止，本报告共发现人工智能领域新型创新组织 347 家，广泛分布在京津冀、长江三角洲和珠江三角洲等地区。其中，以鹏城实验室、之江实验室和上海人工智能实验室为代表的人工智能实验室，成为人工智能产业化领域最为活跃的新型创新组织。

随着科技创新步伐的加快，人工智能和经济社会进入全面融合发展新阶段。在人工智能技术合作密度高的应用领域和产业领域，开始出现产业智能化创新集群。

基于 2200 家人工智能骨干企业的关系数据量化分析表明，我国人工智能已

经广泛应用在包括企业智能管理、智能营销与新零售、智能金融、智慧城市、智能医疗、新媒体和数字内容、智能制造、智能教育、智能交通、网络安全、智能物流、智慧文旅、智能政务、智能能源、智能硬件、智能网联汽车、智能家居、智能农业和智能安防在内的 19 个应用领域。排名第一的是智慧城市，占比 12.16%；排名第二的是企业智能管理，占比 12.10%；排名第三的是智能制造，占比 8.89%；排名第四和第五的分别是智能营销与新零售和智能网联汽车，占比 8.41% 和 8.07%。

在三次产业中，人工智能技术合作关系分布密度最高的是第三产业，占比 75.49%；其次是第二产业，占比 23.82%。在第三产业中，排名第一的是信息传输、软件和信息技术服务业，占比 28.46%；排名第二的是科学研究和技术服务业，占比 21.17%；排名第三的是租赁和商业服务业，占比 10.75%；排名第四和第五的分别是金融业、批发和零售业，占比 10.68% 和 9.62%。在第二产业中，制造业占比最高，为 87.36%。在制造业中，排名第一的是计算机、通信和其他电子设备制造业，占比 28.16%；排名第二的是汽车制造业，占比 25.41%；排名第三的是电气机械和器材制造业，占比 9.30%。

人工智能和经济社会的深度融合发展带动人工智能技术的体系化、复杂化和专用化。到目前为止，人工智能已经发展为包括大数据和云计算、物联网、智能机器人、智能推荐、5G、区块链、语音识别、虚拟/增强现实、智能芯片、计算机视觉、自然语言处理、生物识别、空间技术、光电技术、自动驾驶、人机交互和知识图谱 17 种技术在内的复杂技术体系。同时，随着人工智能在 19 个应用领域的创新应用，技术体系的演化日益表现出专用化趋势。

尽管取得了前所未有的成就，但是在建设具有全球竞争力的人工智能产业集群的过程中，我们还面临着美国技术封锁、技术体系存在短板和头部平台企业技术升级相对缓慢等挑战。加速发展具有产业赋能能力的新型平台及其主导的产业创新生态、高水平规划和发展新型创新区、建设高度开放的创新系统和加强场景创新，是应对挑战和加快提升人工智能产业集群国际竞争力的战略支撑。

Abstract

China is the global forerunner of innovation and industrial development of artificial intelligence (AI). The key drivers behind China's AI industry are the demand for practical applications, strategic guidance from the government, platform-led industrial innovation ecology, and the improvement of the innovation system. Facing the US technology blockade and the urgent need of transitioning to a digital economy, the strategic direction of China's AI industrial development is to build a globally competitive AI industrial cluster and construct an independently developed technological system and industrial innovation ecology, so as to fuel the AI technology upgrading and industrial development.

AI enterprises and their innovation activities have constituted the microfoundation of the development of AI industrial clusters. As revealed by the statistics from the Ministry of Industry and Information Technology, as of June 2022, the number of AI enterprises in China has exceeded 3,000, only second to the United States, with a core industry size surpassing 400 billion RMB. The innovation activities of Chinese AI enterprises in the fields of intelligent chips, basic infrastructure, operating systems, toolchains, basic networks, intelligent terminals, deep learning platforms, large models, and industrial applications have enhanced the international competitiveness of China's AI industry. Platform firms, unicorn companies, small and medium-sized enterprises, startups, research universities, research institutes, and investors collaborate to build a vibrant industrial innovation ecology, and AI technology innovation and industrial development demonstrate an increasingly prominent trend of agglomeration.

This report contends that AI industry clusters are innovation clusters based on the development of cyberspace, which are different from general industrial clusters and innovation clusters. The industrial clusters and innovation clusters formed in the first three industrial revolutions were based on the innovative development of physical space technology system, with a heavier reliance on geographical space, and a relatively slow pace of advancement. The fourth industrial revolution is fueled by the innovative development of cyberspace technology systems, and innovation clusters are more dependent on the development of cyberspace. The speed of innovation in technology, products, and services is faster, and the application fields and regions are more extensive.

The fundamental components of AI industrial clusters include enterprise clusters, innovation resources, innovation systems and cyberspace industrial ecology.

Compared with the previous three industrial revolutions, the cyberspace industrial innovation ecology is a unique element in the fourth industrial revolution.

The foundation of an industry's international competitiveness lies in its improvement of innovation capability. The AI industry in China is mainly driven by scientific and technological innovation. Confronted with the US technology blockade and the urgent need of transitioning to a digital economy and society, the strategic goal of building a globally competitive AI industrial cluster is to construct an independently developed technological system and industrial innovation ecology. Making the most of the highly open global innovation network, taking the application demand as the driver, realizing the innovation of basic research and core technologies through the collaboration of government, industry, universities, and research institutes, and building an independently developed technological system and a software-hardware collaborative innovation ecosystem are the basis for continuously improving the international competitiveness of AI industrial clusters.

This report creates a sample database of China's smart economy, which comprises 2,200 AI enterprises, 5,722 investors (investment and non-investment agencies), 438 AI universities and 307 non-university research institutes, 967 industry alliances, a total of 2,318 conferences held in China, 775 relevant policies issued by 31 provinces, municipalities, and autonomous regions, as well as the planning and construction status of 3,507 AI industrial parks. Through categorical data analysis and relational data analysis, the internal structure and development trend of China's AI industry clusters are studied.

The AI industrial clusters in China are characterized by the spatial structure of "new innovation zone → city → region → nationwide → worldwide". Unlike traditional industrial parks and high-tech parks, new innovation zones are generally located in the central and sub-central areas of big cities with abudant scientific and technological innovation resources and strong industrial foundation, guided by the development of AI industrial innovation clusters, emphasizing the creation of unlimited cyberspace industrial innovation ecology relying on limited physical space.

AI industrial clusters include AI industrial innovation clusters and industrial intelligent innovation clusters. The new innovation zone is where AI industrial clusters and their industrial innovation ecosystem thrive. AI industrial clusters empower the industrial intelligent innovation cluster scattered in geographical space through the industrial ecology of cyberspace. The sound interaction between AI industrial innovation clusters and industrial intelligent innovation clusters has become the key driver and mechanism for building globally competitive AI industrial clusters.

So far, China's AI industrial clusters are primarily distributed in key cities in the Beijing-Tianjin-Hebei Region, Yangtze River Delta, Pearl River Delta, and Sichuan-Chongqing Region. With the introduction of external innovation resources and the activation of internal innovation resources, AI industrial clusters are beginning to emerge in Xi'an in West China, Wuhan and Changsha in Central China, and Shenyang, Dalian, and Harbin in Northeast China.

The value network of China's AI industrial clusters is structured in a centripetal pattern. The platforms and their industrial innovation ecology are the core of the development of AI industrial clusters in China. According to the structural statistical indicators of the value network from 2014 to 2022, the clustering characteristic of China's AI industrial clusters tends to be increasingly significant. The mega-platforms represented by Huawei, Tencent, Baidu, and Alibaba are the core milestones for the formation and development of China's AI industrial clusters. In recent years, the R&D and industrialization layout of mega-platforms in the fields of smart chips, basic infrastructure, operating systems, large models, machine learning platforms, and application software has laid a solid foundation for the enhancement of the international competitiveness of China's AI industrial clusters.

The efforts of research universities and research institutes in the fields of basic research, technology development, and talent cultivation are continuously enhancing the international competitiveness of China's AI industrial clusters. The Integrated Circuit Science and Engineering major in 18 Chinese universities including Tsinghua University and Peking University has become the first level discipline authorized to offer doctorate degrees in the country. As of March 2022, 440 universities in China have set up artificial intelligence majors for undergraduates, 248 universities have set up intelligent science and technology major for undergraduates, and 387 higher vocational schools have set up the "artificial intelligence technology services" major.

Building new innovation organizations to spark the vitality of collaborative innovation between government, industry, universities, research institutes, and application, and the formation of a new system and mechanism that seamlessly integrate basic research, technology R&D, application innovation and industrial incubation play a crucial role in promoting AI technology innovation and industrial development. So far, this report has identified a total of 347 new innovation organizations in the field of AI, which are extensively distributed in the Beijing-Tianjin-Hebei Region, Yangtze River Delta, Pearl River Delta, etc. Among them, the AI labs represented by Pengcheng Laboratory, Zhijiang Lab, and Shanghai Artificial Intelligence Laboratory have become the most active organizations in the

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