Annex 3

Intelligent robot key technology industrialization implementation plan

In order to promote the deep integration of the Internet, big data, artificial intelligence and the real economy, improve the technical level and core competitiveness of the intelligent robotics industry, this program is formulated in accordance with the Three-Year Action Plan for Enhancing the Core Competitiveness of the Manufacturing Industry (2018-2020)

I. Development context

After years of efforts, China's robotics industry has made great progress in the development of the overall quality has been significantly enhanced. The development of key industrial robot parts and integrated application capacity has been significantly improved, and the demonstration and application of machine products have been steadily promoted. Service robots in the ascendant, in public service, medical rehabilitation and other fields to develop a series of representative products and realize the application. Standardized testing and certification system was initially

established, in regulating the healthy and orderly development of the industry has carried out fruitful exploration and practice.

China's robotics industry development has made a breakthrough, but the comprehensive competitiveness compared to the world's robotics powerhouse still has a certain gap. The industry's integrated innovation capability is insufficient, and the construction of key common technology platforms such as robot operating system and cloud service platform is lagging behind. The consistency and reliability of industrial robot products are difficult to fully meet the needs of downstream applications, and we need to rely on technology accumulation to improve product performance. Service robot product intelligence level needs to be improved, there are obstacles to the promotion of large-scale, the need to integrate new technologies to accelerate the demonstration of application. The construction of quality infrastructure still needs to be strengthened, and the testing and evaluation work and certification system needs to be improved.

In the face of the new situation of the new era of the development of the robotics industry, new tasks and new requirements, we must focus on breakthroughs in a number of key technologies to achieve industrialization, accelerate the promotion and application of typical products, optimize the environment for industrial development, and effectively strengthen the core competitiveness of the industry, and promote the industry to the high-end of the global value chain.

II. Main tasks and expected goals

(i) Enhancement of key common technology integration and innovation capacity

Integrate the resources and advantages of industry associations, industrial chain backbone enterprises, relevant research institutes, focusing on the development of basic, relevant, systematic, open key common technologies, the formation of upstream and downstream close collaboration, benefit-sharing robotics integration and innovation platform, to break the major technological bottlenecks restricting the high-end development of the industry.

Intelligent robot operating system. Research on real-time task segmentation and communication technology, real-time data distribution and interaction technology that support multi-core heterogeneous hardware architecture operating

system and networked distributed processing; support technology for a variety of mainstream hardware architectures and intelligent hardware acceleration chips; device plug-and-play dynamic configuration technology, robot functional component standardization technology, robot application framework description technology.

Intelligent robot cloud service platform. Construct an open-source and shared cloud database based on the Internet, break through the massive data acquisition and cloud storage technology of robots' working environment, service goals and solutions, as well as data mining technology such as autonomous reasoning and planning, and autonomous learning. Construct a safe and reliable robot cloud service platform, implement robot online environment modeling, scene understanding, situational awareness, and behavior generation and optimization technologies, and carry out application verification.

(ii) Promoting intelligent transformation of production processes in typical manufacturing areas

Improve the handling robots, welding robots, assembly robots, spraying robots, clean robots and other machine series of product development capabilities, continue to deepen the demonstration of new energy, automotive, electronics, light industry, textiles, pharmaceuticals, metallurgy, building materials, civil explosives, hazardous chemicals and other industries, and prioritize support for the implementation of the digitalization of the working environment is poor, labor-intensive, safety accidents in the manufacturing sector to improve Enhance production efficiency and product quality.

(iii) Accelerating the popularization and application of intelligent service robots

Focusing on the field of intelligent service robots with large market potential, good industrial foundation and obvious spillover effect, the company will continue to focus on modularization, networking and intelligence as the key development direction, improve the product quality and comprehensive competitiveness of special service robots, medical rehabilitation robots, public service robots and personal service robots, and accelerate the promotion and application of the products.

Special service robots. Focus on the development of special service robots for disaster relief and rescue, anti-terrorism and

explosion-proof public security fields, as well as intelligent and unmanned maintenance robots for railroads, electric power, bridges, petrochemicals and other industries under special geological and climatic environments, and promote the engineering and application of 5-8 types of special service robots to achieve sales of 1,000 units.

Medical rehabilitation robots. Focus on the development of medical rehabilitation robots for minimally invasive surgery, natural cavity surgery, puncture biopsy and diagnosis, orthopedic surgery and diagnosis, rehabilitation training, etc., and improve the ability of the products in terms of in-depth learning of complex surgeries and autonomous programming, etc., and prioritize the support for the industrialization of surgical robots that have already obtained a medical device license or that have already entered into the clinical testing stage with a high degree of maturity of the products, and actively promote the scale of clinical application of typical products.

Public service robots. Focus on the development of automated reception for financial institutions, museums, hospitals, shopping malls and other areas, as well as for airports, communities and other public facilities.

Public service robots for security and cleaning, enhance the ability of the product to serve complex scenes, broaden the field of application of the product, and improve the quality of public services.

Personal service robots. Focusing on the development of learning and education, drones, balanced vehicles and other service robot products, promoting the in-depth fusion of artificial intelligence technology with service robot products, improving the intelligent human-machine interaction capability of products, enhancing the adaptability and planning capability of products in changing natural or social environments, and fostering a number of internationally renowned brands.

(iv) Research and layout of new-generation intelligent robots

Closely track the latest development of the global intelligent robot industry, comply with the development trend of personalized customization and flexible production, improve the safety, ease of use and environmental adaptability of robots, research and layout of fully autonomous programming industrial robots, human-machine collaborative robots, dual-arm robots and other new-generation intelligent robots, to seize the commanding heights of industrial

development.

Fully autonomous programmable industrial robots. Deep learning, big data, cloud computing and other technologies are gradually applied to robot control to develop industrial robots with intelligent process expert systems that can automatically acquire information to generate operating programs and meet the requirements of complex operations such as welding, painting, polishing and grinding.

Human-robot collaboration robot. Breakthroughs in institutional design, multi-dimensional perception, three-dimensional vision, force feedback and other key technologies, the development of human-machine collaborative robots suitable for non-structural environments, with high flexibility, agility and precision, which can be detached from the restrictions of the guardrail and can share the space with the employees and work together to satisfy the needs of the production and operation of the electronics, medicine, precision instruments and other industries.

Dual-arm robots. Breakthroughs in motion trajectory planning, dual-arm coordination control algorithms, operating force or torque control and other key technologies to develop a single-arm 6 degrees of freedom or more, with high flexibility.

Active, safe, autonomous obstacle avoidance, rapid configuration and other characteristics, able to adapt to the complex tasks of the two-armed robot, to meet the typical industry flexible production and intelligent manufacturing needs.

(v) Strengthening capacity building for testing and certification

The National Center for Robotics Testing and Assessment (hereinafter referred to as "NRTAC") will further enhance the professionalism of its testing business, focus on the research and formulation and revision of basic robot standards, related product standards and testing and assessment methods, and carry out basic research and practical operation to fill the gaps in the relevant fields, with an emphasis on the testing of robots with artificial intelligence and human-computer interaction. Focusing on the basic research and practical operation of the testing of artificial intelligence and human-machine interaction of robots, and filling the gaps in the related fields. To further enhance the recognition and credibility of China's robot certification, based on the National Evaluation Center and the Robot Testing and Certification Alliance, we will develop targeted certification projects, formulate certification programs, and actively carry

out relevant international exchanges to continuously improve the level of autonomous and specialized certification technology, establish the basis for China's robot quality assessment, and improve the robot quality certification system. By guiding the credit agencies to adopt the relevant testing and certification information, to achieve social governance and departmental supervision, the establishment of a fair market competition environment, and promote the healthy and orderly development of the industry.

III. Safeguards

(i) Strengthening guidance for industrial development

Development and reform departments at all levels should take into account the conditions of industrial foundation, human resources, market demand and other factors, plan scientifically and rationally, promote industrial development in an orderly manner, and prevent low-level repetitive construction. Industry associations, industry alliances and national assessment centers should strengthen the monitoring and analysis of industry operation, enhance the accumulation, management, analysis and application of industry data resources, establish an efficient docking channel between industry third-party service supply and enterprise business demand, and provide guidance for industry development.

Citing, advising on enterprise development, and rationally guiding the investment of social capital.

(ii) Optimizing financial support

Coordinate the use of relevant national special funds to support intelligent robotics major core technology research, key common technology platform construction and demonstration applications in key areas. Local governments can formulate supporting policies in accordance with local realities, and support major projects for the industrialization of key technologies of local intelligent robots. Actively promote the Advanced Manufacturing Industry Investment Fund and other government-funded industrial investment funds to increase support for the intelligent robotics industry, guide and drive the investment of social capital to accelerate the industrialization of key intelligent robotics technologies to achieve breakthroughs. Encourage all kinds of financial institutions to innovate business models and increase support for the intelligent robotics industry.

(iii) Integration of testing and certification

Relying on the organizational structure of the National Evaluation Center, strengthen the work of relevant departments, industry associations and the National Evaluation Center, and promote the construction of China's

robotics industry standard testing and certification system in a coordinated manner. Give full play to the platform role of quality infrastructure, through the establishment and implementation of unified technical standards and certification implementation rules, and continuously improve the quality of independent brand robot products, especially the level of safety and reliability, to comprehensively support the orderly and healthy development of China's intelligent robotics industry.

(iv) Improving the environment for industrial development

Develop and improve the robot certification and credit system, and actively promote the use of certification results in the relevant national special projects, financial credit, tax exemptions and other areas of credit. Actively promote the inclusion of robot quality certification information into the national credit information sharing platform, through the interoperability and sharing of quality and credit information to guide market behavior, industry self-regulation and social governance. Strictly implement the relevant provisions on bidding management, prohibit the establishment of restrictions on the participation of autonomous brand robots in bidding or other

Discriminatory provisions.

(v) Strengthening organizational coordination and management

The National Development and Reform Commission, in conjunction with the relevant departments, has strengthened the organization and coordination of the implementation of the programme, entrusted the relevant units with the establishment of a tracking and assessment mechanism for the implementation of the programme, and coordinated the resolution of problems in the implementation process in a timely manner. Development and reform departments at all levels are required to carry out dynamic supervision of the construction of projects in their regions, and to improve their daily management and random inspection systems.

(vi) Strengthening international exchange and cooperation

Combined with the implementation of "Belt and Road" and other major strategies, promote the establishment of intelligent robotics industry.

Dialogue and exchange platforms, build a long-term mechanism for international cooperation, promote international exchanges of robotics industry technology and capital, focusing on the development of standards for

intelligent robots, certification systems, intellectual property rights, talent training, product demonstration and application, and other aspects of strategic cooperation. Encourage domestic institutions to actively participate in the development of international standards and certification rules, accelerate the standardization of standards, and carry out mutual recognition of certification in due course.

附件 3

智能机器人关键技术产业化实施方案

为推动互联网、大数据、人工智能和实体经济深度融合，提高智能机器人产业技术水平和核心竞争力，根据《增强制造业核心竞争力三年行动计划（2018-2020 年）》，制定本方案。

一、发展背景

经过多年努力，我国机器人产业发展取得长足进步，整体素质显著增强。工业机器人关键零部件研制和集成应用能力明显提升，整机产品示范应用稳步推进。服务机器人方兴未艾，在公共服务、医疗康复等领域研制出一系列代表性产品并实现应用。标准化检测认证体系初步建立，在规范行业健康有序发展方面开展了卓有成效的探索实践。

我国机器人产业发展虽取得阶段性突破，但综合竞争能力相比世界机器人强国仍有一定差距。行业集成创新能力不足，机器人操作系统、云服务平台等关键共性技术平台建设滞后。工业机器人产品一致性和可靠性难以全面满足下游应用需求，需要依靠技术积累提升产品性能。服务机器人产品智能化水平有待提升、规模化推广存在障碍，需要融合新技术加快示范应用。质量基础设施建设仍待加强，检测评定工作和认证采信制度有待完善。

面对新时代机器人产业发展的新形势新任务新要求，必须集中力量突破一批关键技术实现产业化，加快典型产品推广应用，优化产业发展环境，切实增强产业核心竞争力，推动产业迈向全球价值链中高端。

二、主要任务及预期目标

（一）提升关键共性技术集成创新能力

整合行业协会、产业链骨干企业、相关科研院所的资源和优势，重点开发具有基础性、关联性、系统性、开放性的关键共性技术，组建上下游紧密协作、利益共享的机器人集成创新平台，破除制约行业高端化发展的重大技术瓶颈。

智能机器人操作系统。研究支持多核异构硬件架构的操作系统与网络化分布处理的实时任务分割与通信技术、实时数据分发与交互技术；对多种主流硬件体系结构和智能硬件加速芯片的支持技术；设备即插即用式动态配置技术、机器人功能组件标准化技术、机器人应用框架描述技术。

智能机器人云服务平台。构建基于互联网的开源共享云端数据库，突破机器人工作环境、服务目标、解决方案等海量数据获取与云端存储技术，以及自主推理与规划、自主学习等数据挖掘技术。构建安全可靠的机器人云服务平台，实现机器人在线环境建模、场景理解、态势认知以及行为产生和优化技术，并开展应用验证。

（二）推动典型制造领域生产过程智能化改造

提高搬运机器人、焊接机器人、装配机器人、喷涂机器人、洁净机器人等整机系列化产品开发能力，继续深化在新能源、汽车、电子、轻工、纺织、医药、冶金、建材、民爆、危险化学品等行业示范应用，优先支持对工作环境差、劳动强度大、安全事故多的生产制造环节实施数字化改造，改善提升生产效率和产品质量。

（三）加快智能服务机器人推广应用

聚焦市场潜力大、产业基础好、外溢效应明显的智能服务机器人领域持续发力，以模块化、网络化、智能化为重点发展方向，提升特种服务机器人、医疗康复机器人、公共服务机器人、个人服务机器人产品质量和综合竞争力，加快产品推广应用。

特种服务机器人。重点发展用于救灾救援、反恐防爆等公共安全领域的特种服务机器人，以及特殊地质及气候环境下铁路、电力、桥梁、石化等行业智能化、无人化维护作业机器人，推动 5-8 种特种服务机器人工程化应用，实现千台级规模销售。

医疗康复机器人。重点发展微创手术、自然腔道手术、穿刺活检与诊疗、骨科手术与诊疗、康复训练等医疗康复机器人，提升产品在复杂手术深度学习和自主编程等方面的能力，优先支持已取得医疗器械许可证或已进入临床测试阶段的产品成熟度较高的手术机器人产业化，积极推动典型产品规模化临床应用。

公共服务机器人。重点发展面向金融机构导服、场馆导览、医院导服、商场导购等领域自动接待，以及用于机场、社区等公共设

施安保清洁的公共服务机器人，提升产品复杂场景服务能力，拓宽产品应用领域，改善公共服务质量。

个人服务机器人。重点发展学习教育、无人机、平衡车等服务机器人产品，推动人工智能技术与服务机器人产品深度融合，提高产品智能人机交互能力，提升产品在多变的自然环境或社会环境中的适应和规划能力，培育一批国际知名品牌。

（四）研究布局新一代智能机器人

密切跟踪全球智能机器人行业最新发展动态，顺应个性化定制和柔性化生产的发展趋势，提高机器人安全性、易用性和环境适应性，研究布局全自主编程工业机器人、人机协作机器人、双臂机器人等新一代智能机器人，抢占产业发展制高点。

全自主编程工业机器人。将深度学习、大数据、云计算等技术逐步应用于机器人控制中，开发具有智能工艺专家系统，可自动获取信息生成作业程序，满足焊接、喷涂、抛光、打磨等复杂作业要求的工业机器人。

人机协作机器人。突破机构设计、多维感知、三维视觉、力反馈等关键技术，开发适用于非结构环境，柔性、灵活度和精准度较高，可脱离护栏限制并与员工共享空间、协同作业，满足电子、医药、精密仪器等行业生产操作需要的人机协作机器人。

双臂机器人。突破运动轨迹规划、双臂协调控制算法、操作力或力矩控制等方面的关键技术，开发单臂 6 自由度以上，具有高灵

活性、安全性、自主避障、快速配置等特点，能够适应复杂任务的双臂机器人，满足典型行业柔性生产及智能制造需求。

（五）加强检验检测认证能力建设

进一步提升国家机器人检测与评定中心（以下简称“国评中心”）检测业务的专业化水平，着力开展机器人基础标准、相关产品标准、检测评定方法标准的研究和制修订工作，重点针对机器人人工智能、人机交互等方面的检测开展基础性研究工作和实践操作，填补相关领域空白。进一步提升中国机器人认证的认知度和公信力，以国评中心和机器人检测认证联盟为依托，有针对性地研发认证项目、制定认证方案，并积极开展相关国际交流，不断提升自主化、专业化的认证技术水平，建立我国机器人质量评定依据，健全机器人质量认证体系。通过引导征信机构采信有关检测认证信息，实现社会共治和部门协同监管，建立公平的市场竞争环境，推动行业健康有序发展。

三、保障措施

（一）加强产业发展指导

各级发展改革部门要统筹考虑产业基础、人才资源、市场需求等要素条件，科学谋划、理性布局，有序推进产业发展，防止低水平重复建设。行业协会、产业联盟、国评中心等要加强产业运行监测分析，强化行业数据资源积累、管理、分析和应用，建立行业第三方服务供给与企业业务需求的高效对接通道，为行业发展提供指

引，为企业发展提供咨询，合理引导社会资本投向。

（二）优化资金支持方式

统筹利用国家相关专项资金，支持智能机器人重大核心技术攻关、关键共性技术平台建设和重点领域示范应用。地方政府可结合本地实际制定配套支持政策，支持本地智能机器人关键技术产业化重大项目。积极推动先进制造产业投资基金等政府出资产业投资基金加大对智能机器人产业的支持力度，引导带动社会资本投入，加快推动智能机器人关键技术产业化实现突破。鼓励各类金融机构创新业务模式，加大对智能机器人产业的扶持力度。

（三）统筹检测认证工作

依托国评中心的组织架构，加强有关部门、行业协会与国评中心的工作对接，统筹推进我国机器人行业标准检测认证体系建设。充分发挥质量基础设施的平台性作用，通过建立和执行统一的技术标准和认证实施规则，不断提升自主品牌机器人产品质量特别是安全性、可靠性水平，全面支撑我国智能机器人产业有序健康发展。

（四）完善产业发展环境

制订完善机器人认证采信制度，积极推动认证结果在国家有关专项、金融信贷、税收减免等领域的采信使用。积极推动将机器人质量认证信息纳入全国信用信息共享平台，通过质量和信用信息的互通共享引导市场行为，实现行业自律和社会共治。严格执行招投标管理有关规定，禁止设立限制自主品牌机器人参与投标或其他的

歧视性条款。

（五）强化组织协调管理

国家发展改革委会同有关部门加强对方案实施的组织协调，委托有关单位建立方案实施的跟踪评估机制，及时协调解决实施过程中的问题。各级发展改革部门要对本地区项目建设情况进行动态监管，健全日常管理和随机抽查制度。

（六）加强国际交流合作

结合“一带一路”等重大战略实施，推动建立智能机器人产业对话交流平台，构建国际合作长效机制，促进机器人产业技术和资本的国际交流，重点围绕智能机器人标准制定、认证制度、知识产权、人才培养、产品示范应用等方面开展战略合作。鼓励国内机构积极参与制定国际标准和认证规则，加快推进标准对标，适时开展认证互认。