Research on the Development Strategy, System and Evolution Trend of Military-industrial Intelligent Manufacturing in Foreign Countries

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Abstract: The new round of technological revolution and military revolution are deeply intertwined. Intelligent manufacturing is profoundly reshaping the form of the military industry, serving as a key driving force for enhancing the actual combat capability of weaponry and consolidating comprehensive national defense strength. At present, major military powers around the world have elevated the construction of military-industrial intelligent manufacturing to a national strategic level. By improving supporting policies, strengthening research on core technologies, coordinating industrial linkage, and perfecting talent support mechanisms, they have established a systematic development framework to accelerate the iterative upgrading of their domestic military manufacturing from digitalization to intelligence. Focusing on the United States, the European Union, Russia, Japan and other entities, this paper sorts out their strategic layout and operation system of military-industrial intelligent manufacturing, summarizes the development characteristics and future trends, judges the pros and cons of the external development situation on China's national defense science and technology industry, and provides theoretical basis and practical ideas for the intelligent upgrading of China's military industry.

Keywords: Intelligent Manufacturing; Development Strategy; System Construction; Evolution Trend; Science and Technology Industry

1. Introduction

At present, intelligent manufacturing technology is accelerating to penetrate into all links of military manufacturing, profoundly changing the whole process of weaponry R&D, production, testing, operation and maintenance support, and new business forms such as digital military industry are thus maturing. The level of intelligent manufacturing construction in the military field is directly related to a country's hard military power, scientific and technological innovation capability and comprehensive national strength, and has become a core game point in major-power strategic competition. Major military powers around the world have laid out in this field one after another. By formulating special development plans, improving policy support systems and increasing investment in scientific research funds, they promote the in-depth integration of intelligent manufacturing technology and the military industry, and build a development model and implementation system in line with their own realities. Studying the strategic deployment and operation system of foreign military-industrial intelligent manufacturing, and dialectically analyzing the opportunities and potential risks to China's national defense science and technology industry, are of great practical significance for breaking through the bottleneck of key core technologies and safeguarding national defense security. Based on existing academic achievements and the latest development practices of various countries, this paper sorts out the strategic framework and system characteristics of overseas military-industrial intelligent manufacturing, analyzes its dual impacts and puts forward corresponding countermeasures, so as to provide a reference for the quality and efficiency improvement of China's national defense science and technology industry.

2. Review of Development Strategies and Systems of Foreign Military-Industrial Intelligent Manufacturing

Taking into account their respective national

security demands, scientific and technological innovation capabilities, and industrial foundation, major global military powers have launched differentiated development plans for military-industrial intelligent manufacturing. They have established a comprehensive operational system integrating top-level policy support, research funding investment, industrialization of technological achievements, coordinated industrial development, and cultivation of professional talents. As shown in Table 1, the construction paths of the United States, the European Union, Russia and Japan are the most typical, and their strategic planning and systematic construction experience have a significant demonstration effect on the global development trend of military-industrial intelligent manufacturing.

Table 1. Comparison of Development Strategies and Systems of Military-Industrial Intelligent Manufacturing in Foreign Countries

Comparison Dimensions	United States	European Union	Russia	Japan
Development Strategy	Leading	Collaborative	Catching-up	Breakthrough
Core Objectives	Maintain technological advantages and consolidate military hegemony	Enhance regional defense autonomy and unify standards	Respond to NATO deterrence and make up for manufacturing shortcomings	Strengthen defense and build asymmetric advantages
Coordination Institutions	DARPA, DIU	European Defense Agency (EDA), NATO	Foundation for Advanced Research Projects, General Administration of Scientific Research and Innovation of the Ministry of Defense	Artificial Intelligence Strategy Group
Core Model	In-depth military-civilian integration, rapid iteration	Regional coordination, project-driven, unified standards	Military-civilian cooperation, focused breakthroughs	Military-civilian linkage, transformation of civil technology to military use
Key Fields	Digital twin, additive manufacturing, quantum computing	Additive manufacturing standards, Equipment interoperability	Military robots, digital production lines	Unmanned equipment, intelligent missiles, unmanned aerial vehicles

2.1 United States: Leading Strategy and Digital Military Industry Ecosystem

The United States has long held a leading position in global military-industrial intelligent manufacturing. To maintain its leading position in military technology, cope with strategic competition among major powers, and solve practical problems such as insufficient military production capacity and shortage of professional talents, the U.S. has successively issued a number of top-level planning documents, and built a flexible development model of military-industrial intelligent manufacturing centered on digital military industry with multi-party linkage. It is characterized by strategy first, technology leadership, military-civilian interoperability and rapid renewal[1,2].

In terms of strategic layout, the U.S. regards military-industrial intelligent manufacturing as a key means to promote the upgrading of its national defense industry and consolidate military advantages. It proposes to build a responsive, efficient and risk-resistant national defense industrial ecosystem by relying on digital engineering and intelligent manufacturing technologies. The U.S. Department of Defense emphasized in the 2025 Defense Manufacturing Report that it is necessary to promote the transformation of defense manufacturing mode through digital engineering, build an efficient and coordinated military production system, and incorporate digital twin technology into the core technical category supporting the construction of new combat forces. The total U.S. defense budget for fiscal year 2026 has exceeded one trillion US dollars, of which 3.3 billion US

dollars is specially allocated for additive manufacturing and digital and intelligent related projects, promoting intelligent technologies to run through the whole process of weaponry R&D, production, operation and maintenance. Various military services have also launched targeted special programs: the Army has fully implemented strategies related to digital engineering, and the Navy has launched the Hadrian Program to automate submarine manufacturing and alleviate the labor shortage in the military industry.

In terms of overall system construction, the United States has formed a complete operation mechanism with top-down overall promotion, multi-subject collaborative participation and efficient implementation of technological achievements. In terms of policy support, the U.S. has issued a series of programmatic documents such as the Digital Engineering Strategy, established professional institutions including the Defense Advanced Research Projects Agency (DARPA) and Defense Innovation Unit (DIU), and relaxed the threshold for military procurement through other transaction authorization models to attract more non-traditional military enterprises to participate in national defense construction projects. In terms of scientific research investment, the government continues to increase special financial support, and leverages social capital and venture capital institutions to participate in cutting-edge technology R&D, focusing on key directions such as digital twin, edge artificial intelligence, additive manufacturing and quantum computing. In fiscal year 2026 alone, DARPA has laid out more than 30 intelligent manufacturing-related projects, focusing on cutting-edge technologies such as quantum twin and on-site battlefield manufacturing. In terms of cultivating innovation subjects, the U.S. has gradually broken the industry monopoly of traditional large military enterprises, supported the growth of emerging technology enterprises such as SpaceX, and forced established military enterprises such as Lockheed Martin to transform to intelligence. In terms of military-civilian coordinated development, it actively applies mature intelligent manufacturing technologies in the civil field to military production, and drives the iteration of civil technologies with high-standard demand in the military field, realizing two-way empowerment of technological achievements and mutual benefits between military and civilian sectors.

2.2 European Union: Collaborative Strategy and Regional Integrated Development System

Based on the idea of regional integration, the European Union has launched a collaborative development strategy for military-industrial intelligent manufacturing. Its core goal is to strengthen the overall level of defense autonomy, solve the problem of fragmentation of military industries in various countries, and jointly respond to external security challenges. Thus, it has built an industrial operation model featuring multi-country linkage, project-driven, complementary advantages and unified standards, fully integrating the scientific research and industrial resources of member states to promote the overall improvement of regional military-industrial intelligent manufacturing[3,4].

In terms of overall strategic direction, the EU regards military-industrial intelligent manufacturing as an important starting point to accelerate regional defense integration and enhance independent national defense capabilities. It has issued a unified top-level plan to coordinate the development layout of various countries, avoid redundant construction and resource waste, and realize the co-construction and sharing of technologies, production capacity and funds. In November 2025, the EU released the Defense Industry Transformation Roadmap, setting a development goal of achieving independent control of 70% of military core manufacturing technical standards by 2030. With a total investment of more than 2.2 billion euros through the European Defense Fund, it promotes regional technology integration and unification of industry standards. NATO has simultaneously updated its artificial intelligence-related strategy, proposing to accelerate the implementation of intelligent technologies in military production under the premise of security and controllability, and improve the interoperability of equipment manufacturing technologies among allied countries. Core EU countries such as the UK, France and Germany have also formulated corresponding development plans separately: the UK issued a special national defense artificial intelligence strategy, France clarified the application direction of artificial intelligence technology in the national defense field, and Germany, relying on its industrial 4.0 industrial

foundation, vigorously promotes the in-depth integration of intelligent production technology and the military industry.

In terms of industrial system construction, the EU has gradually formed an operation pattern based on regional overall planning, driven by key projects and guided by unified standards. First, a cross-national coordination and cooperation mechanism: relying on the Council of the European Union and the European Defense Agency to coordinate the construction progress of military-industrial intelligent manufacturing in various countries, carry out in-depth cooperation in technology research, equipment procurement, talent training and other aspects, and break down technical barriers and industrial gaps between countries. Second, driving innovation implementation with key projects: the UK established the National Defense Artificial Intelligence Center, and France set up national defense innovation institutions as core platforms for R&D and application of cutting-edge technologies; many countries have also jointly launched cooperation projects such as defense innovation accelerators, for example, the UK and Estonia jointly built the DIANA project to accelerate the R&D, testing and actual combat verification of new military technologies. Third, coordinated construction of industry standards: in October 2025, ASTM and the European Machine Tool Industry Committee reached a cooperation agreement to focus on promoting standard unification, experience exchange and talent cultivation in the field of additive manufacturing; with the AMaze project to build a full-process certification specification, the EASA certification cycle for European military additive manufacturing parts has been shortened by 40%; the EDSTAR standard system of the European Defense Agency continues to be improved, absorbing mature specifications in additive manufacturing, digital intelligent testing and other fields, promoting 12 member states to achieve process unification and general interchange of parts for military mobile production equipment. Fourth, improving the transformation path of technological achievements: giving priority to applying relatively mature technologies such as digital twin and additive manufacturing to the upgrading and transformation of existing weaponry, while continuously laying out R&D of cutting-edge military intelligent technologies, forming a virtuous cycle where technological application forces R&D innovation and R&D achievements support practical application.

2.3 Russia: Catching-up Strategy and Military-Civilian Collaborative Development System

Compared with major European and American military powers, Russia has obvious gaps in core technologies of military-industrial intelligent manufacturing. Combined with its own national security needs and accumulated military industrial foundation, Russia has chosen a catching-up development path. Through unified national deployment, joint military-civilian R&D and focused breakthroughs in key fields, it focuses on laying out military robots, intelligent equipment manufacturing, digital production line transformation and other directions, and enhances overall national defense strength through a differentiated construction path.

In terms of strategic positioning, Russia regards the intelligent construction of the military industry as a key means to respond to NATO's military pressure, promote military modernization and make up for the weaknesses of traditional military manufacturing. It takes military robots and digital production lines as core construction contents to accelerate the intelligent transformation of weaponry manufacturing modes. Relying on the advantages of its traditional military industry, the country concentrates resources to tackle core technologies such as intelligent control, autonomous navigation and cluster collaboration, and deeply applies intelligent technologies to the production and manufacturing of traditional equipment to improve the production efficiency and combat performance of active equipment.

In terms of overall system construction, Russia has formed a unique model of highly centralized overall planning, in-depth military-civilian collaboration and priority promotion of key projects. In terms of top-level design, Russia established the Foundation for Advanced Research Projects, whose function is comparable to DARPA of the United States, specially responsible for the R&D of national-level cutting-edge basic, subversive technologies and military intelligent technologies; the Ministry of Defense has a competent institution for scientific research and advanced technological innovation to track the global development trend of military-industrial intelligent manufacturing in real time and provide support for technology

reserve and equipment R&D. In terms of scientific research collaboration, Russia has built an "Open Window" exchange platform open to local universities, research institutions and high-tech enterprises, introducing technical solutions and software/hardware achievements related to military intelligence in a market-oriented manner; meanwhile, it has built the "Era" Military Innovation Science and Technology Park, integrating national defense scientific research, test verification, mass production and talent training to provide an incubation platform for military intelligent technologies and new weaponry. In terms of practical application, the country gives priority to the R&D and deployment of equipment such as land combat robots, unmanned infantry formations and unmanned tanks, popularizes digital production lines in aviation, aerospace, weapons and other industries, transforms traditional production processes, improves production efficiency and product quality, and reduces labor dependence in manufacturing links.

2.4 Japan: Breakthrough Strategy and "Military-Civilian Linkage" Development System

Relying on its long-term accumulated high-level civil intelligent manufacturing industrial foundation, Japan has taken a breakthrough intelligent development path of feeding the military industry with civil technology. Aiming to enhance its defense strength, shape asymmetric military advantages and gradually relax restrictions under the Peace Constitution, Japan has formed an overall model of policy guidance, military-civilian industrial coordination and priority development in key fields, focusing on projects such as R&D of unmanned equipment, large-scale production of intelligent missiles and intelligent transformation of military digital production lines[5-7].

At the national strategic level, Japan has successively issued three versions of national strategies for artificial intelligence development since 2019. In 2022, Japan formally adopted three security strategy documents, identifying unmanned combat capability as one of the seven core areas for strengthening defense forces. In July 2024, Japan's Ministry of Defense issued the Basic Policy for the Promotion of Artificial Intelligence Utilization, clearly proposing to apply artificial intelligence and intelligent manufacturing technologies in the military industry and carry out corresponding weaponry R&D to improve equipment supply efficiency in wartime and strengthen its combat technical advantages.

In terms of specific system construction, Japan has built a complete layout from three levels: policy, industry and application. At the policy level, a special artificial intelligence strategy working group was established to integrate expert resources from the government, universities and leading enterprises, and coordinate the implementation of intelligent technologies in the military field; financial investment was increased through fiscal inclination, with 182.7 billion yen invested in fiscal year 2023 for the R&D and upgrading of unmanned equipment, focusing on completing the intelligent transformation of relevant production lines. At the military-civilian coordination level, it makes full use of its mature civil manufacturing technologies to promote in-depth cooperation between large enterprises such as Toyota and Panasonic and the Ministry of Defense, and rapidly transform advanced civil manufacturing technologies into military production capacity. At the technical application level, Japan continues to optimize the intelligent production process of missiles and anti-missile systems, upgrade the manufacturing mode of Patriot PAC-3 air defense equipment, and realize networked collaborative production of unmanned platforms and missile weapons; meanwhile, it improves the manufacturing capacity of network attack and defense and intelligence reconnaissance equipment with the help of intelligent manufacturing, builds production lines for long-endurance UAVs equipped with advanced sensors and intelligent algorithms, and realizes large-scale and high-efficiency production of reconnaissance equipment.

3. Evolution Trend of Foreign Military-Industrial Intelligent Manufacturing Development

Comprehensively sorting out the development strategies and implementation systems of military-industrial intelligent manufacturing in various countries, with the continuous iteration and upgrading of various technologies, the development direction of military-industrial intelligent manufacturing has become increasingly clear, as shown in Figure 1.

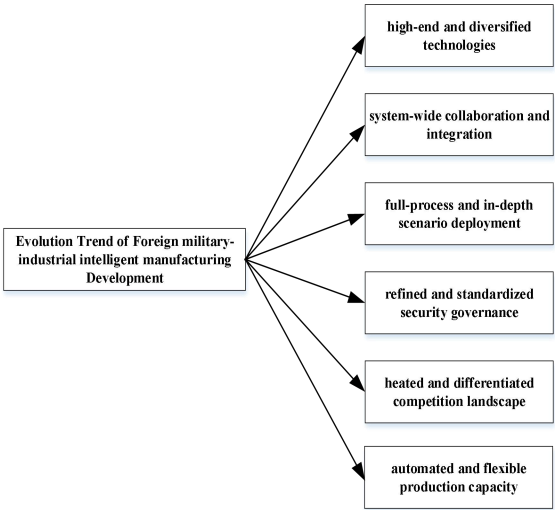

Figure 1. Evolution Trends of Foreign Military- Industrial Intelligent Manufacturing Development

In terms of technological development, it is no longer limited to breakthroughs in a single field, but steadily advancing towards high-end and diversified directions[8,9]. Emerging technologies such as generative intelligence, swarm intelligence and quantum twin have gradually become the core support of military-industrial intelligent manufacturing. Among them, generative AI, human-machine collaborative intelligence, quantum-level modeling and other technologies are mainly used to promote the upgrading of weaponry manufacturing modes, helping to achieve the leap from auxiliary decision-making to autonomous decision-making, from single-equipment intelligence to swarm intelligence, and from fixed production to in-situ manufacturing. Practical technologies such as battlefield in-situ manufacturing and adaptive production processes will also be gradually implemented.

In terms of system construction, it has broken the previous decentralized and fragmented development model and paid more attention to collaborative linkage and integrated promotion[10,11]. Countries have strengthened top-level design and coordinated cross-field and cross-departmental cooperation. On the one hand, they have improved technical standards and data sharing mechanisms to promote technological integration and resource interconnection in different fields; on the other hand, they have focused on building a unified collaborative development platform. The EU focuses on promoting the unification of regional technical standards, while the United States emphasizes strengthening technical coordination among allies, building an efficient and linked military development ecosystem by improving mechanisms and integrating resources.

The extension and deepening of application scenarios are also important development directions of current military-industrial intelligent manufacturing. Intelligent manufacturing technology is no longer limited to a single link, but fully penetrates into the whole life cycle of equipment R&D, production, testing and operation and maintenance, and can be seen from the design and testing of weaponry to the later operation and maintenance support. At the same time, it gradually expands to new fields such as space, deep sea and network, and realizes in-depth integration in multiple fields and scenarios combined with digital twin, big data and other technologies, forming an all-round and multi-level application pattern.

Security control and competition pattern also present new characteristics. With the wide application of intelligent manufacturing in the military field, issues such as data security, algorithm security and supply chain security have become increasingly prominent. Countries have improved relevant laws and regulations, strengthened the protection of core data and process specifications to ensure the security and compliance of technology application. Meanwhile, competition among major powers has become increasingly fierce. Countries have based on their own advantages, focused on characteristic fields, and formed a differentiated development pattern. The United States focuses on cutting-edge technological breakthroughs, the EU pays attention to regional coordination, and Russia focuses on catching up in key fields, building their own competitive advantages through their respective development paths.

In addition, capacity upgrading is also an important focus of military-industrial intelligent manufacturing. Facing the practical problem of labor shortage, countries are accelerating the automation transformation of production lines, building flexible production systems, breaking the limitations of traditional fixed production modes, and realizing rapid production of multi-variety and small-batch products, which not only improves production efficiency, but also enhances the rapid response ability to market and task demands, providing strong support for the sustainable development of the military industry.

4. Impact of Foreign Military-Industrial Intelligent Manufacturing Development on China

At present, the development of global military-industrial intelligent manufacturing is accelerating, and major developed countries continue to increase investment in technology R&D and industrial layout. For China, the rapid changes in the external environment are both rare development opportunities and undeniable practical challenges. This trend profoundly affects many dimensions of China's military field, such as technological innovation, industrial planning and layout, capacity construction, talent team building and national defense security guarantee, which requires comprehensive analysis and judgment combined with China's development reality and targeted measures to respond steadily[12-14].

In terms of favorable conditions, the practical experience accumulated by foreign countries in long-term development can provide an effective reference for China. The agile innovation model and digital twin implementation practice of the United States, the regional coordinated development and standard unification construction of the EU, and the military-civilian industrial linkage model of Japan can help China optimize the construction path of military-industrial intelligent manufacturing, improve the overall development system, reduce trial and error costs, and accelerate the intelligent transformation of the industry. Meanwhile, the increasingly fierce international technological competition forces China to increase investment in R&D of cutting-edge technologies such as digital twin, edge artificial intelligence and additive manufacturing, concentrate on breaking through the bottleneck of key technologies, promote the national defense science and technology industry to gradually transform from following to running side by side and leading in some fields, and effectively improve the independent control level of core technologies. In addition, the experience of automation and flexible production line upgrading of foreign military enterprises also provides a reference for domestic units to improve quality and efficiency. After many military enterprises introduced intelligent production equipment, production efficiency increased by more than 30%, product defective rate decreased by more than 20%, effectively reducing production costs and shortening equipment delivery cycles.

In terms of practical challenges, first, the development constraints caused by the core technology gap and external blockade. Western countries led by the United States have long maintained leading positions in key technologies such as high-end chips, core algorithms, precision sensors and quantum twin, and hindered the development of China's national defense science and technology industry through technical control, talent flow restrictions, allied joint monopoly and other means. At present, China still has a certain import dependence on software and hardware such as high-end sensors, intelligent control systems and core algorithms, and it is difficult to tackle key technologies independently, making it hard to achieve comprehensive catch-up in the short term. Second, the improvement of foreign military intelligence level has driven the accelerated mass production and deployment of intelligent weaponry, and the regional arms race has continued to escalate, forming an external strategic deterrent to China. This also requires China to speed up the intelligent upgrading of the national defense science and technology industry and enhance overall national defense strength to cope with the complex and severe international security situation.

5. Conclusion and Prospect

Globally, the intelligent transformation of military manufacturing is an inevitable trend in the development of the national defense industry. Major military powers have issued special plans in line with their own realities, built operation models meeting their own needs, promoted the deep embedding of intelligent technologies into the whole chain of military production, and explored distinctive construction paths. The rapid development of foreign military-industrial intelligent manufacturing, on the one hand, provides practical experience and reference ideas for the digital and intelligent construction of China's military industry; on the other hand, it brings practical problems such as technological blockade and suppression, intensified industry competition, shortage of professional talents and superposition of various security risks. Based on national conditions and relying on the steady improvement of China's scientific and technological innovation capability and the implementation of various construction

measures, the gap between China's military-industrial intelligent manufacturing and world powers will continue to narrow, and gradually complete the transformation from technological catching-up to parallel development and leading in some fields.

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