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Review of Significant Strategic Plans and Frontier Issues of Global Engineering Science and Technology in Major Countries

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Abstract: This study examines recent significant strategic plans for engineering science and technology of several major countries around the world, and briefly analyzes the current development status of important fields. Through a comparison and analysis of the goal, route, and content of current planning in different countries, this study draws a relationship diagram and depicts the focus and frontier issues of global engineering science and technology planning.
Keywords: engineering science and technology; major countries; significant strategic plan; frontier issue; focus

1 Introduction

The development of scientific and technological innovation (STI) is one of the most important of the factors that have a profound influence over human civilization and progress. In a sense, it determines the rise and fall of a country and its nation. Surging waves of STI are being witnessed across the world. Major countries are vigorously planning strategies for the development of science and technology in the medium- and long-term, with an aim to accurately and promptly identify STI directions and focus areas so as to gain first-mover advantage and development [1]. This paper reviews significant strategic plans and measures of the world's major countries in the fields of engineering science and technology in recent years, and presents a brief analysis of the current status of important engineering and technology fields and their respective levels of development. It also makes a comparative analysis of the target, route, and content of important engineering technology strategies of the world's major countries before putting forward cutting-edge issues and development trends in existing fields of engineering technology.

2 Significant strategic plans on engineering science and technology of the world's major countries

An important means by which the world's major countries promote technological and industrial innovation is to concentrate their respective strengths on delivering significant strategic plans on engineering science and technology. This provides a strong support for the realization of national strategic targets. This paper reviews significant strategic plans on engineering science and technology issued by the world's major countries in recent years, and analyzes the main areas of focus among frontier issues and technology directions.

2.1 United States

In the United States (US), one part of its significant strategic plan on science and technology is made at the national level, while the other part is drawn from consultancy reports and suggestions put forward by various think tanks. Both parts underpin a series of plans on science and technology that embody national strategic intents.

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In recent years, relevant national departments, such as the White House Office of Science and Technology Policy (OSTP), the National Science and Technology Council (NSTC), the Defense Advanced Research Projects Agency (DARPA), and the Center for Strategic and International Studies (CSIS), as well as McKinsey and other consultancy companies, have released several types of significant strategic plans and research reports on science and technology [2–4]; the main areas of focus and technology directions are shown in Table 1.

In addition to the aforementioned significant strategic plans on science and technology, the US has released several development plans on specific areas and industries, such as *Advanced Manufacturing: A Snapshot of Priority Technology Areas Across the Federal Government*, *Quadrennial Technology Review*, *Brain Research through Advancing Innovative Neurotechnologies Initiative*, *Materials Genome Initiative,* and *Vision 2050: An Integrated National Transportation System*. Generally speaking, the US has deployed strategic plans in the field of engineering science and technology at various levels, and directed much attention to advanced manufacturing, clean energy, precision medicine, big data, and advanced computing technology, among others.

2.2 Europe

In 2013, the European Union (EU) wrapped up the "Lisbon Strategy" and launched "Europe 2020." The new research and innovation framework plan "Horizon 2020," which was one of the main operating tools for the EU to implement its development strategy, was officially launched on December 11, 2013 for a duration of 7 years (2014–2020). "Horizon 2020" focuses on three strategic objectives: forging scientific excellence, assuming global industrial leadership, and successfully facing societal challenges. It relies on STI to realize a "smart, inclusive, and sustainable development" growth model. The deployment plans in related fields of engineering science and technology are shown in Table 2 [5].

In conclusion, the EU's STI framework covers all the areas of innovation, such as: population health; food safety; sustainable agriculture; ocean and maritime research; safe, clean, and efficient energy; smart, green, and integrated transportation systems; climate change; and social security. Relatively greater attention is directed towards related fields of industrial technologies.

In every manner, RAND Corporation (Europe) believes that digital technology and socio-economic development are increasingly interconnected. The research outlines 10 topics closely related to digital technology that are key to shaping and improving the EU's R&D and innovation capability as described in "Horizon 2020"; it also analyzes future trends, as shown in Table 3.

In 2002, the United Kingdom (UK) began its third round of technology foresight, and in 2010, issued *Technology and Innovation Futures: UK Growth Opportunities for the 2020s*. This report presents systemic foresight of the UK's technological development toward 2030 and highlights 53 critical technologies in four main areas as shown in Table 4 [6].

Germany has also introduced several research and innovation plans in recent years, including the Copernicus plan on energy transformation, an IT security research plan, and a research plan on the influence of new genome editing methods on society. In 2010, Germany introduced *2020 High-tech Strategy for Germany: Idea, Innovation, Growth*, and in 2013, the country released a new high-tech strategic plan, "Industry 4.0," supporting the R&D and innovation of a new generation of revolutionary technologies in the field of industry, and seizing opportunities from the new round of industrial revolution as early as possible.

Table 1. Significant strategic plans on science and technology and focused fields and technology directions in the US.

Significant strategic plans	Focused fields and technology directions
A Strategy for American Innovation	Advanced manufacturing; precision medicine; brain initiative; advanced vehicles; smart cities; clean energy technologies and advancing energy efficiency; educational technology; space exploration; and new frontiers in computing
Disruptive technologies: Advances that will transform life, business, and the global economy	Mobile Internet; advanced robotics; automation of knowledge work; 3D printing; autonomous and near-autonomous vehicles; cloud technology; next-generation genomics; Internet of Things (IoT); energy storage technology; advanced materials; advanced oil and gas exploration and recovery; and renewable energy
A 21st Century Science, Technology and Innovation Strategy for America's National Security	Military science and technology; homeland security; intelligence; manufacturing; advanced computing and communications; resilient, clean, and affordable energies
Defense 2045	Advanced computing technologies/artificial intelligence technology; additive manufacturing; synthetic biology technology; robot technology; nanotechnology and materials science
DARPA's "Wait, What?" Future Technology Forum	Space; transportation and energy; medical and health; materials and robots; network and big data
Emerging Science and Technology Trends: 2016–2045, by the US Army	Robotics and autonomous systems; additive manufacturing; analytics; human augmentation; medicine; mobile and cloud computing; cyber security; IoT; energy; smart cities; food and water technology; quantum computing; social empowerment; advanced digital; blended reality; advanced materials; technology for climate change; novel weaponry; space technology; and synthetic biology

Table 2. Deployments of engineering science and technology in the EU's "Horizon 2020."

Frameworks and initiatives	Specialized plans	Objectives
Industrial leadership	Leadership in enabling industrial technologies	Dedicated support are provided for research, development and demonstration, and, where appropriate, for standardization and certification on information and communications technology (ICT), nanotechnology, advanced materials, biotechnology, advanced manufacturing, processing, and space. Leadership in the field of industrial technologies will be established, and support will be provided for interactions and convergence across the different technological fields
Societal challenges	Population health, demographic change, and well-being	Vigorous efforts are being made to establish links with the activities of the "European Innovation Partnerships (EIP)" and enable common development
	Food security, sustainable agriculture, marine and maritime affairs, and bioeconomy	
	Secure, clean, and efficient energy	
	Smart, green, and integrated transport	
	Climate change, efficiency of energy utilization, and raw materials	
	Inclusive, innovative, and security societies	

Table 3. Ten themes & trends about digital technology from RAND Corporation (Europe).

Themes	Trends
Digital agriculture and food	• Precision agriculture with sensors, robots, drones • Big data
The emerging consumption model and Internet economy	• Creation and innovation for consumption model • Big data • Hyperconnectivity and e-commerce
Individuation and self-adaption	• Machines design • Machine learning • Exponential increases in computational speed
The evolution of learning and education	• Gamification • Online and distance learning • Big data and learning analytics • Blurring of formal / informal education
The evolution of network architecture: IoT	• Explosion in number of interconnected devices • Cheaper, smaller, smarter devices • Advanced wireless communication technologies • Global IoT coverage
New economic models	• Sustainability • 'Me' economy and 'Peer-to-peer' economy • Innovation for distributing modern
Individualized manufacturing: 3D printing and additive manufacturing	• Individualized manufacturing • Transition to mass customization • Local manufacturing • Freedom to create or obtain 'whatever, wherever, whenever'
The societal and economic impacts of automation and robotization	• More adoption of industrial robots • Wider use of outdoor robots and humanoid robot • Globalization of automation equipment • More robots-related patents, products, and crowd-funded projects globally
Digital art and science	• More open access to scientific publications and data • Crowdfunding, citizen science, and co-creation • Large and collaborative research projects
Governance and policymaking	• e-Government: user-centric and user-driven public services • More open and collaborative governance • More communication and coordination in design and provision of services

In May 2015, France put forward the "Industry of the Future" strategy encompassing nine projects, including new types of logistics, new energy, sustainable development cities, ecological travel and future transportation, future medical care, data economy, intelligent object, familiar security, and intelligent diets. In July of the same year, the country launched *Energy Transition*

Table 4. Potential growth areas for the UK in 2020s.

Areas	Technologies
Materials and nanotechnologies	3D printing and personal fabrication; building and construction materials; carbon nanotubes and graphene; metamaterials; nanomaterials; nanotechnologies; intelligent polymers ("plastic electronics"); active packaging; smart (multifunctional) and biometric materials; and smart interactive textiles
Energy and low carbon technologies	Advanced battery technologies; bioenergy; carbon capture and storage; nuclear fission; fuel cells; nuclear fusion; hydrogen; microgeneration; recycling; smart grids; solar energy; intelligent low-carbon road vehicles; marine and tidal power; and wind energy
The biotechnological and pharmaceutical sector	Agricultural technologies; medical imaging; industrial biotechnology; lab-on-a-chip; nucleic acid technologies; Omics; performance enhancers; stem cells; synthetic biology; tailored medicine; tissue engineering; modeling human behavior; brain-computer interface; and e-Health
Digital and networks	Biometrics; cloud computing; complexity; intelligent sensor networks and ubiquitous computing; new computing technologies; next generation networks; photonics; service and swarm robotics; searching and decision-making; secure communication; simulation and modeling; supercomputing; surveillance; analysis of very large data sets; and bio-inspired sensors

for Green Growth Bill, which plans to limit nuclear power output, reduce the consumption of fossil fuels, increase the proportion of renewable energy in total energy consumption, and cut energy consumption by half by 2050.

2.3 Japan

Japan has begun to organize the world's first large-scale technology foresight. Since 1971, the country has made a technology foresight every five years, and each time, the outcome was used to support Japan's formulation of significant strategic plans for science and technology. In 2015, Japan carried out the 10th technology foresight survey, laying the groundwork for Japan's *5th Science and Technology Basic Plan (2016–2020)*, which was reviewed and approved by the Japan Council of Ministers on January 22, 2016. This plan outlines the STI policies to be vigorously promoted and implemented over the next 10 years, and aims to build Japan as "the one country in the world that is most conductive to innovation" [7]; it mainly includes the following aspects.

2.3.1 Super-intelligent society

In the context of the 4th global industrial revolution, Japan will take manufacturing as the core to apply ICT in a flexible way and build the world-leading "super-intelligent society (Society 5.0)" based on the Internet or IoT. Japan will give priority to the construction of the following 11 systems established in the *Comprehensive Strategy on Science, Technology and Innovation of 2015* : an optimized system of energy value chain; an information platform for the earth's environment; a maintenance, management, and renovation system of efficient infrastructure; a social system against natural disasters; a traffic system for expressways; a new type of manufacturing system; a development system for integrated materials; a local governance system; a workflow management system; an intelligent food chain system; and an intelligent production system.

2.3.2 R&D of generic technologies

According to its government, Japan will continue to improve its intellectual property regime and the strategy of international standardization, promote cyber security, construct the system of IoT, boost big data analysis, build service platform of artificial intelligence, and carry out the necessary R&D of generic technologies. At the same time, it will enhance Japan's international competitiveness by advancing core and advantageous technologies that create new values, and which include robotics, sensors, biotechnology, nanotechnology and nanomaterial, and light quantum. I will also set challenging medium- and long-term development goals, and ensure that it works hard to achieve them.

2.3.3 Active stance on tackling socio-economic challenges

To solve Japan's domestic and global socioeconomic challenges as early as possible, the government has chosen 13 key policy issues to be solved through STI, as shown in Table 5.

In April 2016, Japan's Cabinet Office and the Japan Science and Technology Agency (JST) jointly promulgated the "Impulsing Paradigm Change through Disruptive Technologies Program (ImPACT)" [8], which contains 16 fields of integrated STI. In June of the same year, Japan's National Institute of Advanced Industrial Science and Technology (AIST) released *Research Strategy for 2030*, which underlines the key directions of Japan's industries and STI [9], as shown in Table 6.

From these significant strategic plans on science and technology in Japan, we can see that the focus of Japan's engineering science and technology development in future years is mainly concentrated on intelligent industries, energy resources, health care, and population health.

2.4 China

The 18th National Congress of the Communist Party of China put forward the strategy of innovation-driven development, with an aim to promote STI as the core of its comprehensive innovation. Subsequently, a series of national strategies were rolled out, including "Made in China 2025," "Internet Plus," Cyber Power, Maritime Power, Aerospace Power, Healthy China, Civil-Military

Table 5. Thirteen key policy issues to be solved through STI in Japan.

Objectives	Issues
Sustainable growth and self-sustaining regional development	Ensuring stable energy supply and improving energy efficiency Ensuring stable resources and their cyclical use Ensuring stable food supply Forming a healthy, long-living society with world-leading medical technology Building infrastructure for sustainable cities and regions Strategies for extending service life for efficient, effective infrastructure Improving competitiveness in manufacturing
Ensuring safety and a high-quality, prosperous way of life for nation and its citizens	Addressing natural disasters Ensuring food safety, living environments, and occupational health Ensuring cyber security Handling national security issues
Addressing global challenges and contributing to global development	Tackling climate change at the global level Tackling biodiversity

Table 6. Key directions of Japan's industries and STI.

Directions	Research contents
Super-intelligent industries	Expansion of human perception and control Innovation in the hardware and software of artificial intelligence Technology for data flow security Intelligence exchange equipment and efficient network New-generation manufacturing system Innovative measurement technology for digital manufacturing
Sustainable social development	Promote extensive use of renewable energy Develop new energy Develop energy-saving and storage technology Realize a hydrogen energy society Promote the development and recycling of environmental protection resources Develop environment-friendly synthesis technologies for new catalysts and chemicals
Living matters and construction of life	Measurement technology at ultra-micro scale New functional materials High value-added materials Equipment of new principles and new functions Innovation in synthetic technology Physiological structure analysis Biochip and health visualization
Enhancement of social safety	Assess and reduce the risks of natural disasters New measurement technology Visualization of geological information New system for ensuring stable water supply

Integration, The Belt and Road Initiative, Coordinated Development of the Beijing-Tianjin-Hebei Region, and Plan on Yangtze River Economic Belt. The government also approved the implementation of comprehensive plans on STI to promote innovation-driven development. In 2016, the central government issued the *Outline of the National Strategy on Innovation-driven Development*, which explicitly outlines the strategic target of building a country with expertise in science and technology. Additionally, the State Council released the *National Science and Technology Innovation Plan for the 13th Five-Year Plan Period*, which identifies the overall thinking on STI, development goals, main tasks, and major initiatives in the same period. This plan sets detailed arrangements of electronic information, advanced manufacturing, energy, environment, agriculture, biomedicine, and the exploration and utilization of space and oceans [10]. Moreover, a number of significant scientific and technological programs and engineering projects for 2030 have been highlighted to fulfill national strategic demands. Thus, a systemic policy framework has been established with a dual focus on both short- and long-term pursuits through coherent policy sequences (Table 7).

3 Comparative analysis of the world's significant strategic plans in engineering science and technology

To explore the common areas of interest and respective focus on engineering science and technology of the global major countries, a representation based on cluster analysis is made (Fig. 1) on the significant strategic plans in science and technology for the US, Europe, Japan, and China.

As shown in Fig. 1, these countries (regions) have common

Table 7. China's STI toward 2030: significant projects on science, technology, and engineering.

Significant projects on science and technology	Significant engineering projects
Aircraft engines and gas turbines	Homegrown innovations in seed industry
Deep-sea space stations	Clean and efficient utilization of coal
Quantum communications and quantum computers	Smart grid
Brain science and brain-like research	Integrated space-ground information network
National cyberspace safety	Big data
Deep space exploration and in-orbit service of spacecraft and system maintenance	Intelligent manufacturing and robotics
	R&D and application of major new materials
	Integrated environmental governance in the Beijing-Tianjin-Hebei region
	Health care security

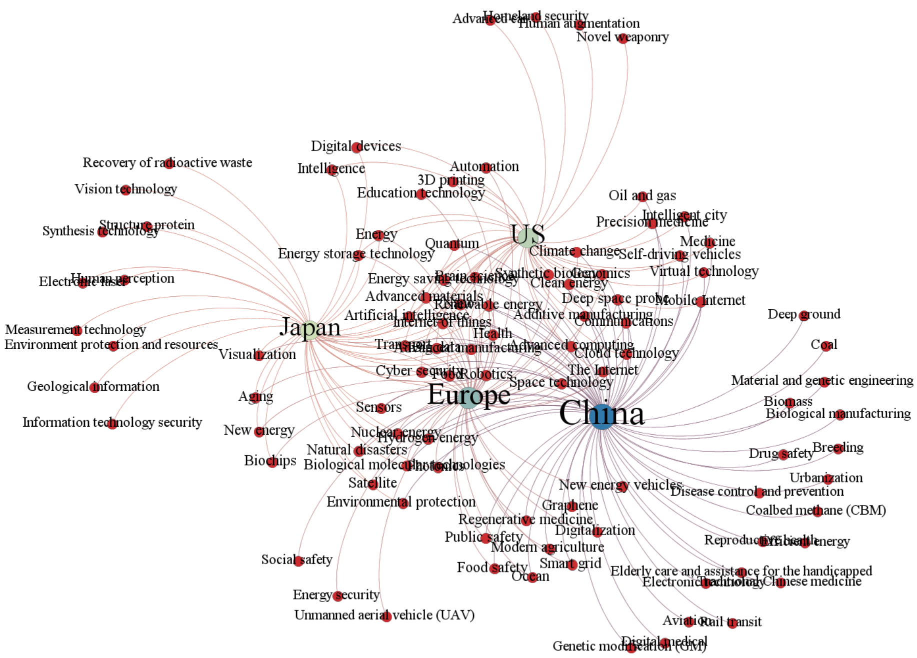

Fig. 1. Diagram of cluster analysis on the global significant strategic plans on engineering science and technology.

areas of interest in four main fields: information, advanced manufacturing, energy, and biotechnology. In the field of information, extensive attention has been given to big data, cloud technology, artificial intelligence, and quantum technology. At the same time, the development of big data creates demand for advanced computing technology, and the rapid development of the Internet and IoT raises issues of cyber security, which are common concerns for all countries. In the field of advanced manufacturing, intelligent sensing and sensor technology, robot technology, and personalized 3D printing technology are under the spotlight. With regard to energy, the future direction is mainly in renewable energy and clean energy technology. All of these countries stress the importance of deploying renewable and clean energy, direct some attention to developing hydrogen and nuclear power technologies, and highlight technologies for energy conservation and storage. In biotechnology, the attention is focused on synthetic biotechnology, genomics, and molecular biotechnology, while the research on brain science is receiving greater attention.

With the deployment of significant strategic plans in engineering technology, each country has its own characteristics. The US has highlighted security technologies and made arrangements for technologies related to homeland security, new weapons, and intelligence. As for Japan, due to its peculiar natural and geographical conditions, great attention has been devoted to technologies related to disasters and geology, as well as nuclear waste recycling. When it comes to Europe, generally speaking, its significant strategic plans on engineering science and technology basically conform to international trends, while each European country has a differentiated focus. China, as a large agricultural country, stresses modern agriculture, genetic modification, and breeding technologies, as well as technologies for coal and coal-bed methane. The basis of China's technology has been relatively weak, resulting in barriers that restrict the development of its science and technology. As a result, electronic technology has been another priority and the country is committed to the R&D of integrated circuits and electronic chips, among other relevant areas. In addition, China is also investing more in other domestically advantageous technologies, such as rail transit and traditional Chinese medicine.

4 Global frontier issues and development trends in the field of engineering science and technology

Currently, the world is witnessing an era of intensive innovations with a growing impetus for industrial transformation. Every field of engineering science and technology is advancing at a faster pace given the dual momentum provided by technological development and consumer demand. Based on the review of significant strategic plans in science and technology of the world's major countries, this section summarizes frontier issues and development trends in various engineering fields.

4.1 Intelligent, green, and efficient technological development promotes the clean utilization of fossil fuels, economization of new energy, and intelligentization of energy service

Coal exploitation is becoming safer, greener, more efficient, and more intelligent. Coal utilization is becoming more clean and efficient, with a focus on energy and water saving. Both unconventional oil and gas and deep-sea oil and gas have become new growth sources in the global oil and gas reserves and production. Efforts for the exploration and exploitation of oil and gas have reached the bottom of the deep sea, and become more intelligent and integrated. Greater emphasis has been placed on the safety and sustainability of nuclear power development. The technological R&D of renewable energy tends to focus on large-scale, efficient, and low-cost power generation, while renewable energy sources are increasingly complementary to each other, featuring cogeneration or combined cooling heating and power (CCHP) and integrated utilization. Power engineering technology is characterized by safety, reliability, cost-effectiveness, high-efficiency, intelligence, and openness. Future trends include smart grids, accessing technology of large-scale renewable energy networks, micro grid technology for integrated distribution of renewable energy, and DC power or AC/DC power grid patterns. The non-energy mining sector will move to realize the safe exploitation of deep resources and efficient recycling.

4.2 As the impacts of environmental quality on human health are noted, integrated pollution control and collaborative ecological remediation are going to be trends

At present, eco-environmental issues with varying characteristics coexist at different stages and levels around the world. Regions hosting heavy industries are faced with issues of traditional heavy industrial pollution, new types of pollution, and multi-compound pollution. Industrialized areas have to deal with the difficult tasks of enabling in-depth improvement of the eco-environment, and a general improvement of the global environment. The key to improving environmental quality is to cut pollution at its source and realize clean production, while the key to solving problems of point source and non-point source pollution lies in compound and high-efficiency treatment of new pollutants. Greater attention will be directed to large areas, watershed ecology, and large-area soil remediation. Environmental benchmarking and research on the impact on human health will also become a focus of attention. Large-scale environmental monitoring, early warning, and emergency response technologies are expected to make rapid progress.

4.3 Information technology will need to overcome barriers of measurement, perception, computation, and enabling technology and system; ubiquitous intelligence and mobile Internet are being promoted vigorously

Currently, the three pillars of electronic information technology—taking measurement, communications, and computing—face constant demands for greater precision, speed, breadth, and depth. A new generation of measurement standards and high-precision measurement technology has rapidly advanced. Perception technology is heading for systemic innovation, high performance, and intelligent perception. Enabling material and device technology stimulates constant industrial upgrade. Network and communication technology presents a scenario of "ternary interconnectivity: 100 billion of people-Internet-things." Computing technology is being developed for higher performance, lower power consumption, higher throughput, and multiple computing paradigms. Software technology is becoming more intelligent, integrated, and adaptable.

4.4 Materials' development will tend to be increasingly integrated in terms of structure and function, and materials are becoming an integral part of devices; Nano and composite materials also present future directions, supporting innovation in product function and optimizing of performance

Countries around the world attach great importance to innovation and R&D of new materials, seeking to hold their own ground in future international competition in the fields of new energy materials, materials for energy conservation and environmental protection, nanomaterials, biological materials, medical and health materials, and information materials. New materials are constantly being upgraded. The development of silicon materials has substantially raised the level of microelectronic chip integration and the processing speed of information, leading to constant cost declines. Wide-band gap semiconductors made of silicon carbide and gallium nitride materials have opened up broad market prospects for a new generation of devices featuring high-energy efficiency and high power. Important breakthroughs in the R&D of technology related to low temperature co-fired ceramic (LTCC) have made it possible to integrate a large number of passive electronic components on one substrate. In addition, the R&D models of transformative new materials have gradually become the focus of attention.

4.5 In-depth integration between manufacturing technology and information technology promotes intelligent equipment manufacturing

The integration of artificial intelligence, IoT, and automation has provided new impetus to the traditional manufacturing industry. Increasingly, artificial intelligence and robotics are being applied more widely. Additive manufacturing is ushering in new production and business modalities. Instruments are increasingly becoming miniature, multi-functional, and intelligent. All these developments have promoted the 4th industrial revolution symbolized by network-based intelligent production.

4.6 The process industry aims to become low-carbon, circular, and highly efficient with low emissions; most have established ecological industrial links and developed intelligent factories

The process industry is becoming greener and more eco-friendly through the establishment of extensive eco-friendly industrial links and the reduction of fossil fuel consumption and pollutant emissions. It is constantly improving industry efficiency through intelligent engineering. In the future, various sectors of the process industry will further adjust its structures for business, process, resource, and energy consumption, improve energy efficiency, and realize economical and efficient production.

4.7 Intelligent cities with infrastructure that is strong, safe, and high quality are being developed with a focus on low energy consumption, high reliability, and greenness

Human society has recently entered the “century of cities” in the real sense. Green building design and urban design are receiving extensive attention, and intelligent cities are becoming a new engine for the urban development of the world’s major economies. New structural systems continue to emerge, and we have achieved some success in realizing reliability, durability, and the concept of whole-lifespan design in engineering structures. The safeguard system of water security presents a trend of globalization and diversification. Intelligent water systems and water resource regeneration technology have continued to gain attention.

4.8 Efforts are being made to build integrated transport systems capable of proactive control, and to bolster the development of intelligent vehicles, traffic facilities, and coordinated management services

Along with transformative changes taking place in technology groups characterized as “green, smart, and ubiquitous,” transportation has become a main domain for the application of emerging technologies of big data, cloud computing, mobile Internet, intelligent manufacturing, new energy, and new materials. Transport means are becoming more energy-saving, eco-friendly, highly efficient, intelligent, safe, and convenient. The theme of technological innovation in high-speed railway systems is transitioning from functional design to the guarantee of safe structures and operation, and enhanced operational quality and maintenance. Integrated transport systems that are interconnected, coordinated, and intelligent are gradually being formed. Accurate, real-time, and efficient search and rescue systems of traffic emergencies and safety guarantee systems have also received growing attention.

4.9 Technology for the exploration and utilization of ocean and space: go wider, deeper, and more precise

Ocean and space are still strategically the summit of competition for major countries in the world. Countries strong on aerospace exploration are building up transport capacities of space-ground roundtrips based on high reliability and cost-effectiveness. All major countries support manned space probes and deep space exploration. With the efficient and ubiquitous use of space information, efforts have been made to develop space-ground integrated systems of satellite application and services. The 3D integrated ocean environment observation and intelligent service system is receiving extensive attention. The prospecting and development of marine resources are becoming more diversified and precise, and are reaching out to the deep sea. Efforts continue to be made in the technological R&D of the efficiently integrated utilization of the seawater resource and ocean energy.

4.10 Biotechnology and information technology promote the green revolution in agriculture, and substantial momentum is driving the development of accurate, intensive, and high added-value agricultural production technology

Modern agricultural biotechnology and information technology are rapidly advancing as important engines of modern agricultural development. The new green revolution is promoting the transformation and upgradation of traditional agriculture technology, which is becoming more biological, integrated with information technology, eco-friendly, circular, and standardized. Developed countries have started a new round of strategic deployment of precise agriculture, with intensive and high value-added production. The protection and innovation of germplasm resources have become part of the forward-looking strategies of the world’s major countries. Biological genomics has become a commanding ground in the competition in the international seed industry. Countries attach great importance to the impact from significant animal epidemics and zoonoses. Developed countries are in a leading position in the biotechnological prevention and control of major animal and plant epidemics. The world is turning its eyes toward technologies for the efficient utilization of agricultural resources, the circular economy, and eco-environmental protection. The development of engineering science and technology for intelligent agriculture has come to the forefront of modern agricultural technology development. Globally, the industry for processing agricultural produce is moving towards multiple fields, multiple levels, and high technology.

4.11 Health is a priority and prevention is the key: efforts have been made to promote precision medicine, regenerative medicine, and research on drug innovation, with an aim to enhance the level of health care information technology

Since the beginning of the 21st century, medical researchers have paid more attention to research on human health; thus, the focus has shifted from diagnostic medicine, which is "to treat diseases and save lives," to preventive medicine, which stresses "prevention and fitness." The prevention and control of chronic disease have become a global strategic action, and new technologies for prevention, control, diagnosis, and treatment of infectious diseases are a long-term hotspot for the international community. Omics and big data analysis promote the development of personalized medicine and holistic integrated medicine. Regenerative medicine is becoming a research focus for life science and clinical medicine, and is expected to bring good news to those who suffer from diseases that are difficult to treat. Cognitive and behavioral science research provide brand new technologies for the prevention and treatment of mental and neurological diseases, and will stimulate further development of artificial intelligence. Genetic screening and cell therapy have been identified as important areas of reproductive medicine research. Gene regulation and gene engineering will lead to new revolutions in drug engineering. The protection of traditional Chinese medicine (TCM) resources has become imperative, as has the application of advanced biotechnology to underpin the development and modernization of TCM. We envisage disruptive changes in the medical and health care fields brought about by engineering technologies for digital medicine, biological 3D printing, minimally invasive treatment, and precision medicine.

4.12 Utilizing prevention, response, and resilience as the core to boost public security towards risk integration, forecast professionalization, high-efficiency disposal, and integrated guarantee

Driven by globalization, new technology, and changing roles of individuals and the society, public security has gradually risen to national strategic heights for the world's major countries. Nowadays, the comprehensive guarantee of public security stresses monitoring, early warning, and emergency response collaboration, and is moving in the direction of intelligence and automation. Transport security is evolving towards systemic security and reliability. Safety research of hazardous chemicals is focusing on every link in the lifecycle, while technologies for the entire chain of large-scale water safety management remain the focus of attention. Anti-terrorism science and technology is another important concern.

5 Conclusions

To strengthen and centralize the advancement of significant technological breakthroughs, major countries across the globe have drawn up development strategies and significant strategic plans in science and technology in order to realize the national strategic target, promote socio-economic progress, and gain advantage in global competition. This paper reviews significant strategic plans of the world's major countries in science and technology over recent years, and analyzes the focus fields and deployment of engineering technology. Currently, in terms of STI, China has entered into a new stage of being a follower in some fields, and either a parallel-runner or frontrunner in other fields. Therefore, it is of great significance for the country to comprehend developments and trends of the world's scientific and technological frontiers, and ensure its own STI advancement in time. Such efforts would enable China to create its scientific and technological blueprint and blaze its own trail of scientific and technological development.

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