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The formation of higher engineering education system in new China: Transformation, establishment and adjustment of engineering colleges

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ABSTRACT

At the beginning of New China, the Communist Party of China (CPC) and the government attached great importance to the establishment of an independent industrial system of their own and industrialization, in order to cope with the extremely difficult situation that the domestic economy was on the verge of collapse and foreign hostile forces were suppressing our country. Higher engineering education faced the important mission of directly cultivating talents for industrial construction at the forefront of transformation and development of the whole higher education. Based on the economic situation in the early days of the People's Republic of China, the international environment, the condition of higher education, and the strategic decision made by the Party Central Committee to give priority to the development of heavy industry, we elaborate the process of the initial formation of China's higher engineering education system from the perspective of the transformation, establishment, adjustment and tracking of the frontiers of engineering technology in engineering universities. The forepart takes Tsinghua University and Harbin Institute of Technology as examples, to introduce the situation of the new people's regime in taking over and transforming the old universities. Taking Dalian Institute of Technology and Military Engineering College of the Chinese People's Liberation Army as examples, we show the course of our Party's founding of engineering universities before and after 1949. The latter part discusses the process of establishing a group of engineering colleges with distinctive industry characteristics and optimizing the regional layout of engineering colleges through the adjustment of colleges and departments and the relocation of Jiaotong University to western China. Through the establishment of the University of Science and Technology of China and the establishment of computer, semiconductor, radio electronics, automation and other majors, we present the efforts made by the universities to track the frontiers of engineering science and technology.

Keywords: history of engineering education, higher engineering education system, engineering college

INTRODUCTION

The afternoon of October 1, 1949, 300,000 soldiers and civilians gathered solemnly in Tiananmen Square, Beijing, to celebrate the founding ceremony of the People's Republic of China. From that moment, a new chapter began in the history of the Chinese nation. However, at this very time, China was still devastated by years of war, having suffered long-term plunder by imperialist powers and the oppressive rule of the

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domestic feudal landlord class and bureaucratic bourgeoisie. The country lay in ruins, and the task of national reconstruction was both urgent and immense.

At the time of its founding, New China was a typical agrarian country with low levels of productivity and very limited modern industry. In 1949, the output of machine-based large-scale industry accounted for only 17% of the total gross output of industry and agriculture, while agriculture and handicrafts made up 83% (State Economic and Trade Commission of the People's Republic of China, 2000). That same year, just 12.6% of national income came from industry, whereas 68.4% came from agriculture (Zheng, 2019). By 1952, 83.5% of the economically active population was employed in the primary sector, with only 7.4% working in the secondary sector (Zheng, 2019). In June 1954, Mao Zedong remarked during the 30th meeting of the Central People's Government Council, "What can we manufacture now We can make tables and chairs, teapots and bowls, we can grow grain and grind it into flour, we can even make paper. But we cannot produce a single automobile, airplane, tank, or tractor" (Mao, 1999a). In 1949, China's total industrial output was approximately 14 billion yuan, a 50.1% decrease compared to 1936, before the outbreak of the War of Resistance Against Japan. Compared with the peak pre-liberation production levels, output of major industrial products had fallen drastically: electricity was down 27.7%, coal 50.0%, crude oil 61.9%, pig iron 86.1%, steel 82.9%, cement 71.2%, cotton yarn 26.4%, cotton cloth 43.6%, machine-made paper 34.5%, cigarettes 32.3%, flour 47.2%, and sugar 51.9% (Wu & Dong, 2001). The steel industry had only 7 blast furnaces, 12 open-hearth furnaces, and 22 small electric furnaces, with production capacity nearly exhausted. Total installed capacity of power generation equipment was only around 1.146 million kilowatts. The total value of all industrial fixed assets had dropped to just 12.4 billion yuan (Zeng, 1999). National infrastructure was also in disarray: most highways were severely damaged; no railway line was fully operational from end to end, with only about 11,000 kilometers barely usable. Coastal shipping routes were largely blocked by the Nationalist navy. Several long-distance telecommunication trunk lines were damaged, and the communication network had been fragmented into disconnected segments. Most factories were suffering from capital shortages and raw material depletion, resulting in shutdowns, bankruptcies, and mass unemployment. Nearly half of all industrial workers were jobless and struggling to meet basic living needs (Pang, 2020a). The industrial layout at the time was also highly imbalanced, with the bulk of industrial production concentrated in eastern coastal areas. More than half of the factories were located in just a few cities, including Shanghai, Tianjin, Qingdao, and Guangzhou (Zheng, 2019).

At the founding of New China, the general consensus within the Party was that China's economy was backward, its industrial base weak, and funds scarce. Priority should therefore be given to developing agriculture and light industry, which required less investment and produced quicker results, so as to accumulate capital for the later development of heavy industry, which demanded larger investment and longer construction periods. However, the outbreak of the Korean War forced China to rapidly change its extremely weak industrial foundation—especially the inability to produce large-scale equipment such as tanks and aircraft—in order to confront the imperialist threat of invasion. From a global perspective, newly independent late-developing countries after World War Ⅱ faced a common challenge: whether they could quickly catch up with advanced industrial nations. This was a matter of national and ethnic survival, and China was no exception. Moreover, China already had a certain foundation in light industry, and organizing peasants into cooperatives could help increase grain production to some extent. The Soviet Union's experience of rapidly achieving industrialization through prioritizing heavy industry also provided valuable lessons (Pang, 2020a). Article 3 of the Common Program of the Chinese People's Political Consultative Conference clearly stated the national construction goal, "Develop a new-democratic people's economy and steadily transform the country from an agricultural to an industrial one" (The Party Literature Research Office of the Central Committee of the Communist Party of China, 2011a). Therefore, after repeatedly weighing the pros and cons, the Central Committee of the Communist Party of China (CPC) made the strategic decision to prioritize the development of heavy industry. In December 1952, the Central Committee emphasized in its "Instructions on Preparing the 1953 Plan and the Outline of the Five-Year Construction Plan", "The speed of industrialization depends primarily on the development of heavy industry, so we must focus large-scale construction efforts on developing heavy industry... We must first ensure the basic construction of heavy industry and defense industry, especially those key projects that play a decisive role in the nation, and that can quickly strengthen the country's industrial foundation and defense capabilities (The Party Literature Research Office of the Central Committee of the Communist Party of China, 2011b).

Before the founding of New China, higher education in the country was not only small in scale but also structurally unbalanced. In 1949, there were a total of 205 institutions of higher education on the mainland, among which 28 were engineering colleges. The total number of enrolled students was 117,000, with 30,414 in engineering, accounting for 26%. Among the engineering students, there were 23,118 undergraduates, 7202 junior college students, and only 94 graduate students (Department of Planning of Ministry of Education of the People's Republic of China, 1984; Editorial Office of China Education Yearbook, 1984). The distribution of higher education institutions was also highly uneven. Provinces and municipalities with more higher education institutions included Shanghai, Sichuan, Beijing, Jiangsu, Guangdong, Tianjin, Hebei, and Hubei. Those with larger student populations included Shanghai, Beijing, Sichuan, Jiangsu, Liaoning, Heilongjiang, and Guangdong. Most of these provinces and municipalities are located in the eastern part of the country, especially along the coast. In contrast, provinces in the central and western regions, such as Shanxi, Henan, and Xinjiang, had only one or two universities, and those were relatively small in scale. Some provincial-level regions like Inner Mongolia, Tibet, Qinghai, and Ningxia did not have any universities at all.

In the data for each province, the number above represents the number of higher education institutions, and the number below represents the number of enrolled students.

Faced with domestic poverty and underdevelopment, as well as the blockade and threat of aggression from imperialist powers, accelerating the establishment of an industrial system and realizing industrialization became one of the most urgent tasks after the founding of New China. The rapid development of industry created a pressing demand for a large number of highly trained professionals, especially in engineering and technology. As a result, prioritizing the development of higher engineering education became the foremost goal of the higher education system. By implementing a series of measures—including reforming pre-existing universities, establishing new engineering institutions, restructuring and developing industry-specific colleges with distinct characteristics, optimizing the geographical distribution of engineering schools, promoting basic sciences, and launching emerging disciplines—New China succeeded in building a relatively complete higher engineering education system within just a few years after its founding.

REFORM OF PRE-EXISTING UNIVERSITIES

In 1949, among the 205 institutions of higher education in mainland China, there were 124 public universities, 60 private universities, and 21 universities run by religious missions (Liu, 1993). Most of the public universities had been established by the former Nationalist government, with only a few founded by the Chinese Communist Party in the revolutionary base areas or liberated zones. The Party adopted the general policy of "maintaining the original institutions with necessary and possible improvements" (Central Archives, 1992) to ensure that these universities could serve the needs of New China and contribute to cultivating talent for socialist construction. The first step was to take over the public universities formerly affiliated with the Nationalist government, to regain educational sovereignty by assuming control over universities that had received foreign subsidies, and to convert private universities into public ones through government takeover (Hao *et al.*, 2011). On this foundation, a comprehensive reform of pre-existing universities was carried out. Among them, Tsinghua University and Harbin Institute of Technology (HIT) stood out for their high academic standards and significant influence. The reform processes of these two institutions serve as representative examples of the transformation from pre-1949 universities into socialist universities.

Reform of Tsinghua University

Tsinghua University originated from Tsinghua Xuetang, founded in 1911 by the Qing government as a preparatory school for students planning to study in the U. S., funded by a portion of the Boxer Indemnity refunded by the U. S. government. In 1912, it was renamed Tsinghua School. A university division was added in 1925, marking the beginning of its four-year undergraduate programs. In 1928, it was officially renamed National Tsinghua University. After the full-scale outbreak of the War of Resistance Against Japan in 1937, the university was relocated to Changsha, where it joined Peking University and Nankai University to form the National Changsha Temporary University. The following year, the university moved again to Kunming and was renamed the National Southwest Associated University. In 1946, Tsinghua returned to its original campus in Beijing and was reorganized into five schools—Arts, Law, Science, Engineering, and Agriculture—offering 26 academic departments (Tsinghua University, 2020). On January 10, 1949, the Military Control Commission of the People's Liberation Army (PLA) in Beijing formally took over Tsinghua University and declared it to be "a university of the people" (Chen, 2002).

After becoming a "university of the people", Tsinghua University actively undertook reforms in various areas to meet the needs of the country and its people. In March 1949, the Beijing Municipal Committee of the Chinese Communist Party submitted a proposal to the Central Committee to reorganize higher education institutions in Beijing into a structure of "four universities and two colleges". According to this plan, Tsinghua University would serve as the foundation for a new engineering-focused university, by merging science and engineering departments from other institutions. The Central Committee approved this general direction for the adjustment but emphasized the importance of carrying out proper mass mobilization work and waiting until conditions were appropriate before implementing the reorganization (Chen, 2002).

In accordance with decisions from the North China Higher Education Commission and in line with its own institutional characteristics, Tsinghua University undertook partial internal adjustments as an initial step in its broader reform. For example, the Department of Anthropology was merged into the Department of Sociology; the Department of Law was closed, with its students transferred to Peking University; and the School of Agriculture was relocated and merged with the agricultural colleges of Peking University and North China University to form what later became Beijing Agricultural University (Tsinghua University School History Research Office, 2005a). In addition, new departments were established to support national needs: the Department of Geology was added to the School of Science; the Department of Mining Engineering was established within the School of Engineering; and a Petroleum Refining section was created under the Department of Chemical Engineering. Tsinghua also hosted specialized training programs at the request of relevant government departments, such as intensive courses for chemical engineering cadres and water conservancy technicians (Tsinghua University School History Research Office, 2005a). In December 1949, the university's Executive Council stated: "Tsinghua University was originally a comprehensive university tasked with cultivating talent for various sectors of national development. However, based on its historical trajectory and existing resources, it should develop a clear focus. Therefore, while continuing to emphasize the training of personnel for economic development—primarily through strengthening the schools of science and engineering—this focus should not come at the expense of the humanities and social sciences. These fields should also be enhanced and reformed to align with the needs of the people, and to train talent for economic, political, and cultural development" (Tsinghua University School History Research Office, 2005a). This policy demonstrates that the purpose of Tsinghua's restructuring was to meet the demands of national construction in the new China, aligning closely with the Party's principles for adjusting higher education institutions in Beijing.

One of the most notable developments in Tsinghua University's curriculum reform was the introduction of new political courses, aimed at ideological transformation and the establishment of a revolutionary outlook on life. To oversee this effort, the university established the Teaching Committee on Dialectical and Historical Materialism, commonly referred to as the "General Lecture Committee". The committee was convened by renowned sociologist Fei Xiaotong, and its members included prominent scholars such as Wu Han, Zhang Dainian, as well as faculty and student representatives. The political course curriculum was divided into multiple units, each comprising three key components: lectures, group discussions, and Q&A sessions. The teaching was organized in several formats: large lectures (general lectures), class meetings, and small group discussions. All students attended the large lectures, which were delivered by either Tsinghua professors or invited external experts. For example, on October 17, 1949, the first large lecture was given by Wu Zhao, titled "An Introduction to Dialectical and Historical Materialism". Over 2300 students and 600 faculty, staff, and their families attended the session. The lecture was broadcast *via* loudspeakers to the university's main auditorium and four large classrooms simultaneously—an unprecedented move in Tsinghua's history. Each class meeting included 100 to 200 students, with the entire university divided into 15 to 20 such classes. Each class was assigned a class instructor, selected from the university's faculty. These instructors collected and summarized students' questions and submitted them to the General Lecture Committee for discussion. Based on the committee's responses, the instructors would then provide explanations and lead class discussions. Study groups, composed of 10 to 20 students, were led by students themselves. These groups organized their own study and discussion sessions based on assigned reading materials and discussion outlines provided by the committee. To facilitate communication between faculty and students, the General Lecture Committee also published a study bulletin, which served as a platform for exchange of ideas and feedback (Tsinghua University School History Research Office, 2005a).

Another important aspect of Tsinghua University's reform was the mobilization of faculty and students to actively participate in social practice. Between February and March 1950, and again from the winter of 1951 to the spring of 1952, Tsinghua organized nearly 600 faculty members and students, including several professors, to take part in land reform work in Beijing's suburbs and various regions across the country. These fieldwork assignments lasted anywhere from a month or two to as long as half a year. Through their participation in the land reform movement, the university community made significant progress in several areas: developing a class-based perspective, strengthening emotional ties with the working people, consciously learning from workers and peasants, deepening their understanding of the Communist Party, and improving their sense of discipline and organizational responsibility (Tsinghua University School History Research Office, 2005b).

The CPC takeover and transformation of Tsinghua University serves as a microcosm of the Party's leadership in the people's revolution and national construction during the New Democratic Period. There are several key experiences from this era that are worth summarizing and learning from.

First, prioritizing cultural and educational undertakings. As one of China's ancient capitals and a vital cultural and educational hub, Beiping (now Beijing) received exceptional protection from the CPC. The Party made every effort to achieve the peaceful liberation of the city. Furthermore, the People's Liberation Army (PLA) deliberately avoided universities and historical sites during combat to preserve the city's cultural and educational infrastructure, ensuring a solid foundation for the development of New China.

Second, upholding Party leadership in higher education. Once the Beiping Military Control Commission took over Tsinghua University, it immediately secured leadership and personnel authority. Although many newly appointed members of the University Administrative Committee and executive leaders were not Party members, they were politically progressive and supported the Party's leadership. This alignment ensured that the Party's principles and policies were effectively implemented on campus.

Third, creating a stable environment for development. Stability is a prerequisite for the growth of higher education. Prior to the takeover, underground Party organizations worked tirelessly to protect school assets and retain faculty members. Post-takeover, while the Party moved resolutely to remove reactionary personnel and abolish regressive systems, other institutional aspects were kept stable for the time being. This approach facilitated a smooth transition and paved the way for future growth.

Fourth, aligning higher education with national construction. Under the Party's guidance, Tsinghua University centered its efforts on cultivating talent for the construction of New China. The university actively carried out the reorganization of academic departments, curriculum reforms, and the ideological transformation of faculty and students. In the process of serving national construction, the university also achieved rapid development itself.

Reform of HIT

The predecessor of HIT was the Harbin Sino-Russian Industrial School, established in 1920 with the purpose of training engineering and technical personnel for the Chinese Eastern Railway. The school operated according to the Russian educational model, with a four-year program taught entirely in Russian. In 1922, the school was renamed the Sino-Russian Industrial University, extended its program to five years, and graduates were awarded the title of engineer. In 1928, the school was officially named HIT and was jointly managed by China and the Soviet Union, with Zhang Xueliang serving as chairman of the board. After Japan's invasion of Northeast China, the school was completely taken over by the Japanese by 1935. It was renamed the National Harbin Higher Industrial School, operated according to the Japanese system, and taught in Japanese, enrolling only Chinese and Japanese students. In 1938, the school restored its name to HIT. Following Japan's defeat in 1945, Soviet troops stationed in Northeast China, and the Chinese Eastern Railway was renamed the China Changchun Railway, jointly managed by China and the Soviet Union. HIT was under the leadership of the China Changchun Railway Bureau and had departments including Civil Engineering and Architecture, Electrical Machinery, Engineering Economics, Mining, Chemical Engineering, and Oriental Economics, as well as a preparatory course (Harbin Institute of Technology, 2023a).

Around 1948, the People's Army led by the Chinese Communist Party gained the initiative in Northeast China. The Soviet side realized that the management of the China Changchun Railway and HIT needed to strengthen cooperation with the Chinese Communist Party. In the spring of 1949, Feng Zhongyun, a former commander of the Northeast Anti-Japanese United Army and then chairman of the Songjiang Provincial Government, concurrently took on the role of president of HIT. He was the 11th president of HIT and the first president after the founding of the People's Republic of China. Upon taking office, Feng Zhongyun discovered that most of the faculty and students at HIT were Soviet nationals, including the cleaning staff, and that instruction was conducted in Russian. He believed that to successfully run HIT, the first step was to build a teaching and administrative team primarily composed of Chinese personnel. He reported to the provincial party committee and assembled a full staff of cadres from the party branch secretary to department heads. At the same time, he sent cadres to newly liberated cities such as Hangzhou, Shanghai, Nanjing, and Beijing to recruit highly qualified teachers (Huang, 2014). Feng personally invited the teachers recruited from the south to his home for meals to build rapport (Huang, 2014). Under Feng Zhongyun 's leadership, HIT expanded its Chinese preparatory student division during the summer of 1949, planning to enroll 800 preparatory students annually, recruiting eligible youth from Beijing, other cities, and liberated areas. Starting from the summer of 1950, HIT also expanded enrollment of Chinese graduate students. Feng often visited students to give talks, discuss ideals and studies, understand their situations, and solicit feedback (Huang, 2014).

After considerable efforts, the proportion of Chinese teachers and students at HIT increased significantly. This not only deepened their influence on the school's culture and atmosphere but also began to affect the decision-making of the Soviet railway authorities. The Soviet side indicated that it was no longer convenient to directly assign teachers to work at HIT (Huang, 2014), but they would support it if the Chinese government formally requested to hire Soviet professors. Feng Zhongyun immediately reported this to the Northeast Bureau and suggested that the Chinese government formally request the Soviet government to send Soviet experts to work at HIT and to adopt the Soviet five-year model for science and engineering universities to rebuild and expand HIT, aiming to train faculty for science and engineering universities nationwide. After approval by the Northeast Bureau and submission to the central government, these suggestions were adopted (Huang, 2014; Ma, 2000).

In June 1950, the Central Committee of the CPC sent a telegram to the Northeast Bureau stating: "The China Changchun Railway has decided to hand over the management of HIT to the Chinese government". At the same time, the Central Committee instructed that HIT "should focus on recruiting lecturers, assistants, and graduate students from science and engineering faculties of domestic universities. They should primarily study Russian and graduate in two years to be assigned to teach at various universities". This marked an important milestone for HIT's return to the embrace of the new China and the beginning of its comprehensive transformation and expansion (Harbin Institute of Technology, 2023b).

When HIT was transferred to the Chinese government, it was still a small institution. To develop HIT into a new, comprehensive industrial university modeled after the Soviet socialist higher education system, the Party and the state implemented a series of major measures. First, they strengthened the Party's leadership over the university. The central government successively appointed several cadres with rich revolutionary experience to leadership positions at the school. After Feng Zhongyun stepped down, in April 1951, Dr. Chen Kangbai, a chemistry PhD who had studied in Germany, became president; in October 1953, Li Chang, Secretary of the Communist Youth League Central Secretariat, took office as both president and Party committee secretary. Second, the university fully embraced the educational experience of Soviet universities. Between 1951 and 1960, HIT hired 77 foreign experts, 74 of whom came from the Soviet Union. These experts played a vital role in the university's development. From 1951 to 1957, a total of 608 students graduated under the direct training or guidance of Soviet experts, including 235 graduate students and 373 students from the five-year undergraduate program. At that time, the university had 37 professors and associate professors, thirteen of whom were trained by Soviet experts. The school also held five teaching and research conferences and, entrusted by the Ministry of Higher Education, organized two national conferences on mechanical and electrical engineering specialties to summarize and exchange the experience learned from the Soviet Union (Ma, 2000). Third, central leadership attached great importance to addressing major issues during the university's development. The Ministry of Education, in collaboration with the university, drafted reform plans. In April 1951, the Ministry submitted a report titled "Proposal on the Improvement Plan of HIT" to the central authorities, stating that HIT's educational policy and mission were to "model itself after Soviet industrial universities, cultivating engineers for heavy industry and science and engineering faculty for domestic universities". This report was circulated among top leaders including Mao Zedong, Zhu De, Chen Yun, and Li Fuchun. Liu Shaoqi commented on the report, noting: "It is very necessary to run a university like this well" (Ma, 2000).

HIT holds a unique position in China's higher engineering education system. Its establishment and early operations were primarily aimed at training engineering and technical personnel for the China Eastern (Changchun) Railway. The school was specifically managed by the railway authorities, with a clear engineering focus, tightly integrating engineering theory with practical applications. In its first 30 years, HIT largely followed the Soviet model of education, with nearly a decade influenced by the Japanese system. At the same time, China's higher engineering education was mainly influenced by British and American models, which highlighted HIT's distinctive educational features. Once the Chinese Communist Party assumed leadership of HIT, it rapidly developed its own faculty and administrative staff, expanded the enrollment of Chinese students, and facilitated the university's "Sinicization", ensuring a smooth transition to a Chinese-run institution. Due to HIT's historical ties with the Soviet Union and its high educational standards, the central government designated it as a window for studying Soviet higher education practices and a key base for training science and engineering faculty for universities nationwide. Thus, HIT made invaluable contributions to China's higher engineering education system. In March 1953, the Ministry of Higher Education held a symposium on the issues of HIT. Yang Xiufeng, Vice Minister of the Ministry of Higher Education, noted that HIT had essentially been transformed into a new type of university adopting advanced Soviet teaching systems, which should be acknowledged. HIT played a pioneering role, and its status was recognized by universities nationwide (Ma, 2000). In 1954, HIT, along with institutions like Renmin University of China, Peking University, Tsinghua University, Beijing Agricultural University, and Beijing Medical University, was listed as one of the first batch of national key universities (China National Institute for Educational Research, 1984).

THE ESTABLISHMENT OF NEW UNIVERSITIES

The Chinese Communist Party has always attached great importance to the development of human resources. During the periods of the Land Revolution, the War of Resistance Against Japan, and the Liberation War, a large number of schools were established in revolutionary base areas to quickly train senior cadres and specialized personnel in the form of short-term training programs to meet the needs of the revolutionary war. At the eve of the founding of the People's Republic of China and in the early years following the establishment of the new government, after the Party gained political power, several formal universities were established to train specialized personnel needed for economic and national defense construction. Among them, Dalian Institute of Technology and The China PLA Military Engineering Academy serve as strong representative examples.

The establishment of Dalian institute of technology

On August 15, 1945, Japan announced its unconditional surrender. On August 22, the Soviet Red Army entered Lüshun and Dalian, disarming the Japanese forces. In October of the same year, the Northeast Bureau of the Central Committee of the Chinese Communist Party established a Party organization in Dalian and began its work. From then on, Dalian ended its colonial history and became a special liberated area under the leadership of the Chinese Communist Party.

In the winter of 1947, the Party's medical expert Shen Qizhen learned that Dalian, which was under Soviet military occupation, had a relatively stable environment and was in a good position to establish a formal university. He proposed the idea of founding a university to Zhou Enlai (Sun, 1989). In September 1948, the Northeast Bureau reported to the Central Committee the request from the Lüda Party Committee to establish Dalian University. The Central Committee attached great importance to this proposal and quickly approved it, stating, "Agreed to establish Dalian University" and instructing that "the university's educational policy and plan must be submitted to the Central Committee for approval" (Sun, 1989). By the end of October and early November, the Lüda Party Committee approved the establishment of the Dalian University Party Committee and the formation of a Dalian University Preparatory Committee. Preparations for the university began immediately, and two aspects of this work would have a profound impact on the school's later development.

The first key task was the recruitment of teachers. At that time, most of China's scientific and technological talent was concentrated in the areas controlled by the Nationalist government. Not only did the establishment of Dalian University require a large number of talented individuals, but attracting patriotic scientific and technological experts to the liberated areas also held significant strategic importance. To address this, the Central Committee assigned Shen Qizhen, who was responsible for intellectual work, to Dalian University. He was also stationed in Hong Kong, where he secretly recruited scientific and technological talent from the Nationalist-controlled areas and arranged for them to be transported by sea to the northeastern liberated areas. After the liberation of major cities such as Beijing and Shanghai, Dalian University sent personnel to recruit teachers. Some engineering and technical experts, along with faculty members, were escorted by underground Party members, crossing multiple blockade lines to reach the liberated areas. In less than a year, Dalian University successfully recruited 93 teachers from areas under Nationalist control, including 13 renowned experts and 25 professors and associate professors. Among them was Wang Daheng, a prominent figure who later received the "Two Bombs, One Satellite Meritorious Medal". He is an outstanding representative of the university's early recruitment success (Sun, 1989).

The second key task was the incorporation of the "South Manchuria Railway Co. Central Experimental Institute" and the Health Research Institute, both of which had originally belonged to the China Changchun Railway. The former was a chemical research institution established in 1908, which became an important consulting body during the Japanese occupation of China. After Dalian University took over these institutions, they were transformed into the university's research institutions. The university also showed respect and care for the few Japanese scientific and technical personnel who remained, leveraging their expertise. As a result, the university achieved significant progress in over ten research projects (Sun, 1989).

On April 15, 1949, Dalian University held its founding ceremony. The university was organized into several faculties, including the School of Engineering, School of Medicine, and a Department of Russian. The School of Engineering offered nine departments: Applied Mathematics, Applied Physics, Chemical Engineering, Mechanical Engineering, Shipbuilding Engineering, Electrical Engineering, Telecommunications Engineering, Civil Engineering, and Metallurgical Engineering.

In his speech at the founding ceremony, the university's first president, Li Yimang, stated: "As Chairman Mao pointed out, 'Winning national victory is only the first step of the long march; we still need to resolve the issue of China's independence and self-reliance, achieve broad economic development, and transform China from a backward agrarian country into an advanced industrial country'. Our university's mission is to contribute to the construction of industry, which is a national basic task, by training a large number of engineering cadres for various industrial sectors and a significant number of medical and health personnel needed across all fronts" (Sun, 1989).

In August 1949, the Northeast Bureau of the Central Committee of the CPC and the Northeast Administrative Committee issued the "Decision on the Rectification of Higher Education", which called for the establishment of a unified formal education system. The decision aimed to transform the previous short-term training programs into formal higher education institutions, tasked with cultivating highly specialized personnel who possessed revolutionary ideology and modern scientific and technical knowledge (Kang & Lu, 1989).

Dalian University's second president, Lv Zhenyu, following the directives of the Northeast Bureau and the Lüda Party Committee, proposed that the university adhere to the principles of "combining science with politics", "serving the people", and "integrating with the people". He emphasized the educational guidelines of "unity of teaching and learning", "unity of theory and practice", and the importance of both teaching well and learning well. The university adopted the principle that theory and practice should align. The Provisional Charter of Dalian University also stipulated that "This university is a formal people's university, dedicated to researching advanced scholarship and training high-level specialized personnel required for the construction of the new democratic society, who possess the spirit of serving the people, have a high level of cultural education, and are equipped with a rich knowledge of science. The goal is to study and master the essence of Marxism-Leninism and Mao Zedong Thought". Additionally, the School of Engineering was set with a four-year curriculum, where the first three years focused on basic and specialized courses, and the final year was dedicated to practical factory internships (Sun, 1989).

In July 1950, following the advice of Soviet experts, the Northeast People's Government decided to dissolve the structure of Dalian University. The university's School of Engineering, School of Medicine, and Department of Russian were reorganized into Dalian Institute of Technology, Dalian Medical University, and Dalian Russian Language College, respectively, in order to emphasize specialized education. Afterward, Dalian Institute of Technology underwent a series of administrative and departmental adjustments. By 1954, the institute retained its original nine departments, while strengthening its Mechanical Engineering, Chemical Engineering, and Water Conservancy departments. As a result, it became a specialized, mono-disciplinary industrial college. Additionally, its management was transferred to direct supervision by the Ministry of Heavy Industry of the Central People's Government (Kang & Lu, 1989; Sun, 1989).

As a new type of formal university founded by our Party, Dalian Institute of Technology and its predecessor, the School of Engineering of Dalian University, took serving the country's industrial development as their primary mission from the very beginning. The institute inherited the excellent traditions of the Party's educational work in the old liberated areas, such as serving the people and linking theory with practice. At the same time, the university emphasized formalization, focused on institutional development, strengthened the faculty team, and established clear admission requirements for students to ensure high educational quality. The establishment and development of Dalian Institute of Technology demonstrate the Party's strong commitment to cultivating talent for the construction of New China through formal higher education, as well as its ability to run well-established, high-level universities.

The establishment of the China PLA Military Engineering Academy

In the fall of 1950, the so-called "United Nations Army", led by the United States, invaded Korea and brought the war to the Yalu River, which borders China. China decided to send volunteer troops to participate in the Korean War to fight against U.S. forces. The Soviet Union had originally agreed to provide air support but later withdrew, citing that they were not yet prepared for deployment. However, Stalin still agreed to accelerate military training and equipment support for the Chinese Air Force and also advised China to establish a military engineering academy as soon as possible to train military engineers to meet the demands of the war (Teng, 2012). In the Korean War, the PLA faced one of the most industrialized and militarily powerful nations in the world at the time. Although China emerged victorious, it paid a tremendous price. This highlighted even more the urgency of training military engineering and technical cadres.

In March 1952, Nie Rongzhen, the Vice Chief of Staff, and Su Yu, the Deputy Chief of Staff, submitted a report titled "Proposal on the Establishment of the Military Engineering Academy" to Mao Zedong, Zhou Enlai, Zhu De, and Lin Biao. The report stated that the rapid development of China's special forces had led to increasingly complex equipment, yet the technical capabilities were still far behind the needs of the military. Furthermore, the supply of specialized weapons could not rely on Soviet assistance in the long term. The report emphasized that "we must focus on building our own defense industry and cultivating our own technical personnel, gradually developing the capability to repair and assemble equipment ourselves, and eventually cultivate military industrial design engineers". The report also included a preliminary plan for the establishment of the Military Engineering Academy, which had been discussed with Soviet advisors. This plan proposed that the academy be named China PLA Military Engineering Academy and outlined the organizational structure, departments, admission plans, and the proposed location in Harbin. Mao Zedong quickly gave his approval, stating: "Agree" (Teng, 2003).

In June, Zhou Enlai sent a letter to Bulganin, the Deputy Chairman of the Soviet Council of Ministers and Minister of Defense, requesting the Soviet Union to send experts to assist in the establishment of the Military Engineering Academy. In July, the Central Military Commission appointed Chen Geng as the first president of the PLA Military Engineering Academy. Shortly after, Chen Geng accompanied a Soviet expert delegation led by Major General V. I. Orekhov, the Deputy Director of the Leningrad Mozhaysky Military Aviation Academy, to visit several Chinese cities, including Shanghai, Nanjing, Dalian, Shenyang, and Harbin, to survey China's military education system and further determine the location for the academy. The Soviet experts believed that China already had the faculty and resources necessary to establish higher military education. They also agreed that Harbin was an ideal location for the Military Engineering Academy. Harbin was part of the old liberated areas, with a solid political and popular base; it hosted important military industrial enterprises, and institutions such as HIT represented a high level of engineering education. Additionally, the Songhua River, with its abundant water resources, could be utilized for naval engineering studies (Teng, 2003). As a result, the newly established Military Engineering Academy became commonly known as "Harbin Military Engineering College" or "Ha Jun Gong".

In August, the Central Military Commission approved the establishment of the Military Engineering Academy Preparatory Committee. On September 5, Zhou Enlai chaired a meeting that was attended by key figures, including Chen Yi, Commander of the East China Military Region, and leaders from the State Finance and Economics Commission, the Central Organization Department, the Ministry of Education, the Ministry of Construction, and the four main headquarters of the PLA. The commanders of the five major military branches—the Air Force, Navy, Artillery, Armored Forces, and Engineering Corps—were also present. During the meeting, Zhou Enlai further emphasized the importance of establishing the Military Engineering Academy and called on all departments to generously support the construction of the academy. He urged them to work quickly to get the university up and running so that it could provide much-needed talent for the modernization of national defense (Teng, 2003).

On September 1, 1953, the China PLA Military Engineering Academy held its grand inauguration and the opening ceremony of its first academic term in Harbin. Mao Zedong personally signed the "Central People's Government Revolutionary Military Committee's Instruction"(hereinafter referred to as the "Instruction". The Instruction stated, "The establishment of the China PLA Military Engineering Academy is of utmost significance to our country's national defense. To build a modernized defense, our army, air force, and navy must be fully equipped with mechanized weapons and devices, all of which depend on complex specialized technologies. What we urgently need today is to train a large number of individuals who are capable of mastering and harnessing these technologies, so that our technical capabilities can be continuously improved and advanced. The purpose of founding the Military Engineering Academy is to address this urgent and honorable task" (Teng, 2003).

The establishment of Harbin Military Engineering College (Ha Jun Gong) from the initial planning to the official opening took just a year and a half, which can be considered a remarkable achievement. The founding of Ha Jun Gong received significant attention and support from the Party and the government, with contributions from various sectors. This level of coordination and assistance is rare in the history of higher engineering education in China. In its relatively short period of operation, Ha Jun Gong also created many valuable experiences and lessons for the development of higher engineering education in the country.

First, the department and discipline setup not only met the immediate needs but also laid a solid foundation for long-term development, while emphasizing strengths and special features. The founding plan for the Military Engineering Academy, developed in 1952, proposed that, given the shortage of resources and the fact that each military branch could not independently establish engineering schools, the Military Engineering Academy should be a comprehensive engineering institution. In the early stages, five departments were set up based on the military branches: Air Force Engineering, Naval Engineering, Artillery Engineering, Armored Forces Engineering, and Engineer Corps Engineering, along with 23 specialized courses focused on military equipment. Each department was intended to eventually develop into independent engineering institutions for the corresponding military branch. The Soviet Chief Advisor, Orekhov, commented, "According to this plan, we will build a university with 'departments within departments, and colleges within colleges'. Such a military technology institution does not exist in the Soviet Union, nor has it ever existed anywhere in the world" (Teng, 2003).

Second, teachers were seen as the core of the university. Not only were efforts made to attract talent from all over, but intellectuals were also given full trust and care. Zhou Enlai personally convened meetings with responsible leaders from various departments and organizations to plan the recruitment of professors for Ha Jun Gong. Chen Geng took charge of the task of recruiting professors and experts, searching for candidates everywhere. In 1952, 78 professors and experts were selected from across the country. More than half of them had studied abroad and earned doctoral or master's degrees (Zhao, 2003). At a meeting of all party members and cadres at the academy, Chen Geng stated, "Our academy has both veterans who endured the Long March with their 'eight-cornered hats', and those who spent ten years in hard study with their 'four-cornered hats'. The 'eight-cornered hats' have been to Jinggangshan, and the 'four-cornered hats' have been to San Francisco. These are the treasures of the country, the wealth for national construction. To build a good Ha Jun Gong and complete the tasks entrusted to us by the Central Committee, we must rely on both the older cadres and the experienced professors. We must insist on having both the 'two olds' run the academy" (Wang, 2015). Chen Geng's speech provided the faculty with full trust and greatly motivated them. Especially in the specific social context of the time, within such a confidential educational and research institution as Ha Jun Gong, these statements were particularly valuable. It represented a groundbreaking implementation of the Party's policies towards intellectuals.

Third, the academy adhered to a teaching-centered approach, with high standards and strict requirements to cultivate outstanding talent needed for military construction. In March 1953, Chen Geng led the development of one of Ha Jun Gong's most important early foundational documents, the "Decision on Key Issues in Carrying Out Educational Tasks" (hereinafter referred to as the "Decision". The first point clearly stated, "The central task of the academy is to complete national defense technical education and train senior technical personnel for various military branches. Under the unified leadership of the Party committee, strengthening teaching work should be the central task of all departments". The Decision also outlined Ha Jun Gong's training objectives, "First and foremost is 'utmost loyalty to the Party', followed by 'a high sense of organization and discipline', as well as being 'proactive, courageous, and steadfast in work', while simultaneously being 'technically proficient'" (Commission for History Compilation and Review of National University of Defense Technology, 1993). Ha Jun Gong adopted a "strict entry, strict exit" policy. Not only were the admission standards high, but the academy also maintained a relatively high elimination rate throughout the training process. From 1953 to 1965, Ha Jun Gong enrolled 13 undergraduate cohorts, totaling more than 18,000 students. Over 2000 students transferred with their departments as the academy expanded, and more than 12,000 students graduated (Commission for History Compilation and Review of National University of Defense Technology, 1993). This means that Ha Jun Gong's undergraduate graduation rate was about 75%, which is significantly lower than the graduation rates of many universities in China today.

Fourth, the strengthening of practical training was another major highlight of Ha Jun Gong's talent cultivation approach. The practical training included teaching internships, production internships, military internships, and graduation projects. In the early four-year education program, practical training totaled 30 weeks, accounting for 17% of the total instructional hours. In the subsequent five-year or five-and-a-half-year program, the practical training ranged from 35 weeks to more than 60 weeks, representing 16% to 26% of the total instructional time (Commission for History Compilation and Review of National University of Defense Technology, 1993). The academy invested considerable effort into building laboratories and practical training bases. Each major had its own laboratory, and the academy also had production internship factories and outdoor operation fields (Commission for History Compilation and Review of National University of Defense Technology, 1993).

UNIVERSITY RESTRUCTURING

In the early years of the People's Republic of China, while the People's Government took over, received, assumed responsibility for, and transformed existing universities while establishing new ones, it also faced the urgent task of restructuring the entire higher education system—particularly the departments and spatial layout of universities.

Background of university adjustments

The primary driver was the nation's economic development needs. In May 1953, the governments of China and the Soviet Union signed the Agreement on the Assistance of the Government of the Union of Soviet Socialist Republics to the Government of the People's Republic of China in Developing the National Economy of China in Moscow. This agreement specified Soviet assistance for the construction and renovation of 91 industrial projects in China (State Council of the People's Republic of China, 2019). Together with the 50 projects previously confirmed by the Soviet government and the 15 additional projects added in 1954, these constituted the 156 key projects commonly referred to as the Soviet-assisted projects during China's First Five-Year Plan period (as shown in Table 1). These projects formed the core and backbone of China's industrial development in the 1950 s, with heavy industry accounting for a significant proportion (Pang, 2020a).

After the large-scale economic construction is launched, a large number of specialized talents are urgently needed. In June 1950, Zhou Enlai said at the first National Higher Education Conference, "Now our country's economy is in the recovery stage, and we need people to be urgent and specialized" (Zhou, 1984). It is estimated that during the "First Five-Year Plan" period, about 300,000 engineering and technical personnel were needed in the fields of industry, transportation and geological exploration, while there were only 148,000 related talents, which was 150,000 less than demand. At that time, the engineering and technology departments of engineering colleges and comprehensive universities enrolled 16,000 students each year. During the First Five-Year Plan period, 40,000 to 50,000 graduates could be sent to the country, which could only meet about 30% of the actual needs (Hao *et al.*, 2011). Therefore, the country has determined the talent training plan for universities during the "First Five-Year Plan" period, among which the number of talent training for professionals directly serving heavy industry such as manufacturing and metallurgy is relatively large (Table 2).

Second, the need for industrial structural adjustment. In the early years of the People's Republic of China, industrial enterprises were primarily concentrated in Northeast China and the southeastern coastal regions, resulting in an extremely uneven distribution. In July 1955, Li Fuchun stated in his "Report on the First Five-Year Plan for the Development of the National Economy" at the Second Session of the First National People's Congress that efforts should be made to rationally utilize the industrial bases in Northeast China, Shanghai, and other cities while simultaneously actively constructing new industrial bases in North China, Northwest China, Central China, and initiating partial industrial development in Southwest China. Over the five years beginning in 1955, 472 of the 694 industrial projects exceeding the designated scale that commenced construction were located in the interior regions (State Council of the People's Republic of China, 1955).

The gradual shift of industrial development focus to the interior also stemmed from national defense strategic considerations. In March 1955, Mao Zedong stated in his speech at the Party's National Representatives Conference, "Imperialist forces still surround us, and we must prepare to deal with possible sudden incidents. Should imperialism launch a war in the future, it is highly likely to employ a surprise attack similar to that during World War II. Therefore, we must be prepared both mentally and materially so that we are not caught off guard when sudden events occur" (Mao, 1999b). It was precisely based on this consideration that 35 of the 44 military industrial projects among the 156 projects assisted by the Soviet Union were located in the central and western regions, with 21 of them assigned to Sichuan and Shaanxi provinces (Liu, 1999).

Third, the higher education system inherited from old China failed to meet the requirements of "new democratic, that is, national, scientific, and popular cultural education". Not only did higher education disproportionately emphasize humanities and law over science and engineering, but the distribution of universities also starkly contrasted with the layout of key projects. In 1951, the nation (excluding Taiwan Province) had 206 higher education institutions, with 48% located in eastern regions and 36% in central and western regions. Among the 156 key projects assisted by the Soviet Union, 55% of the 147 projects initiated during the First Five-Year Plan were located in central and western regions, while only 6% were in eastern regions (Figure 1). According to 1955 statistics, higher education institutions in 17 coastal or near-coastal cities—including Beijing, Tianjin, Shanghai, Hangzhou, and Guangzhou—enrolled nearly 160,000 students, accounting for 61.9% of the national total. These institutions employed over 4700 professors and associate professors, representing 61% of all faculty holding these titles nationwide. From 1949 to 1954, newly constructed campus buildings in these cities accounted for 61.5% of the total new campus construction nationwide, while the value of newly added equipment represented two-thirds of the national total (Mao & Shen, 1989). Consequently, the First Five-Year Plan stipulated that "the development of higher education must align with the requirements of socialist construction and coordinate with the national economic development plan. The distribution of institutions should avoid excessive concentration, and the scale of institutional growth should generally not be overly large. Engineering-focused higher education institutions should gradually integrate with industrial bases" (State Council of the People's Republic of China, 1955).

In June 1951, Ma Yinchu assumed the position of President of Peking University. He recognized that while the university's faculty were eager to embrace new ideas and transform the old Peking University, their ideological landscape remained complex, hindering educational reform. This situation was prevalent among intellectuals at the time. Ma Yinchu, together with twelve professors,

Table 1: Department distribution of key engineering projects in the "First Five-Year Plan"

Department	Key project Number of items	Total number of projects Proportion of (%)
Military industry	44	28.2
Of which: aviation	12	
Electron	10	
Weapon	16	
Aerospace	2	
Ship	4	
Metallurgical industry	20	12.8
Of which: steel	7	
Nonferrous metals	13	
Chemical industry	7	4.5
Mechanical processing industry	24	15.4
Energy industry	52	33.3
Of which: coal	25	
Electricity	25	
Petroleum	2	
Light industry and Pharmaceutical industry	3	1.9
Other	6	3.9
Total	156	100

Source from Dong (1999).

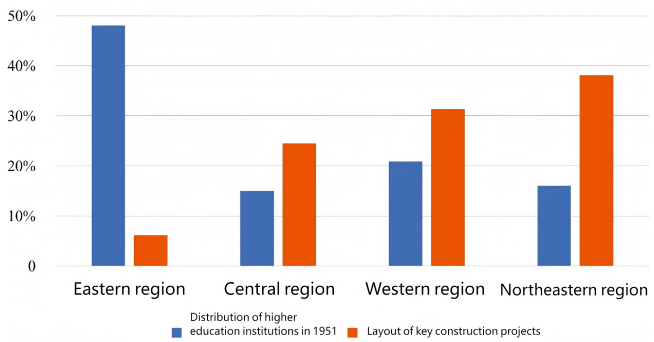

Figure 1. Comparison of the distribution of colleges and universities and the layout of key construction projects.

decided to launch a political study campaign among the faculty and wrote to Zhou Enlai, inviting leading comrades from the Central Committee to deliver lectures at Peking University. In September, entrusted by the CPC Central Committee, Zhou Enlai delivered a report titled "On the Transformation of Intellectuals" at a study session for university faculty in the Beijing-Tianjin region. Drawing on his own revolutionary experiences and insights into ideological transformation, he addressed issues related to the ideological reeducation of intellectuals. Subsequently, the entire education sector launched a study campaign centered on Marxism-Leninism and Mao Zedong Thought. This initiative not only fostered ideological shifts among faculty and students but also propelled reforms in the school education system (Pang, 2020a).

Forth, there was the comprehensive adoption of Soviet experience. After the CPC led the people to seize state power, it lacked extensive experience in economic construction and social governance. Compounded by an international environment highly unfavorable to China, the Party and government adopted a "one-sided tilt" policy, with all sectors comprehensively learning from the Soviet Union—higher education being no exception. Soviet higher education prioritized specialized training and emphasized planned development, enabling the rapid cultivation of professionals aligned with economic needs. This approach significantly influenced China's higher education in numerous aspects, including departmental restructuring, program design, curriculum content and teaching methods, as well as instructional organization and management.

The emergence of industry-specific engineering institutions

The restructuring of higher education departments during this period unfolded in three distinct phases: From late 1949 to 1951, pilot programs were implemented at select institutions while formulating adjustment plans and laying the ideological groundwork. Between 1952 and 1954, comprehensive restructuring took place, primarily reorganizing university departments to align with industrial development needs. From 1955 to 1956, further adjustments were made within a defined scope, emphasizing regional industrial distribution and addressing the imbalance in the number of institutions between coastal and inland areas.

Table 2: "First Five-Year Plan" Project for the Training of Engineering Sub-Professional Talents in Colleges and Universities

Professional	Enrollment within five years		Graduation within five years		Number of students enrolled in 1957		1957 grew compared with 1952 (%)
	Number of people (ten thousand people)	Account for (%)	Number of people (ten thousand people)	Account for (%)	Number of people (ten thousand people)	Account for (%)	
Geology and exploration	1.75	8.1	1.00	10.5	1.25	7.1	119.2
Mining and management of mineral deposits	1.60	7.4	0.76	8.0	1.24	7.0	158.8
Power	1.55	7.2	0.75	7.9	1.33	7.5	132.8
Metallurgy	1.00	4.7	0.32	3.4	0.89	5.0	298.4
Machine manufacturing and tool manufacturing	5.41	25.2	1.93	20.4	4.61	26.0	295.2
Motor manufacturing and electrical equipment manufacturing	0.94	4.4	0.17	1.8	0.88	5.0	770.2
Chemical technology	1.06	5.0	0.51	5.4	0.91	5.1	119.3
Forest logging and wood processing in the paper industry	0.07	0.3	0.06	0.6	0.06	0.3	27.1
Light industry	0.44	2.0	0.33	3.4	0.36	2.0	38.0
Surveying, mapping, meteorology, hydrology	0.46	2.2	0.21	2.3	0.35	1.9	173.0
Construction and municipal engineering	3.74	17.4	2.51	26.4	2.82	15.9	63.5
Transportation and postal services	0.96	4.5	0.47	5.0	0.85	4.8	100.5
Other	2.48	11.6	0.47	4.9	2.21	12.4	306.2
Amount to	21.46	100	9.49	100	17.76	100	166.8

Source from State Council of the People's Republic of China (1955).

The pilot phase involved multiple engineering universities and the engineering faculties of comprehensive universities. In September 1950, the Civil Engineering Department of Anhui University was transferred to the College of Engineering at Nanjing University (Anhui, 2020). In March 1951, the aeronautical engineering departments of Beiyang University, Northwest Institute of Technology, and Xiamen University were transferred to Tsinghua University, merging with its existing aeronautical engineering department to form the School of Aeronautical Engineering. Yunnan University's aeronautical engineering department was incorporated into Sichuan University's aeronautics department. The aeronautical engineering program of Southwest Industrial College was merged into the engineering college of North China University to establish its aeronautics department (Beihang University, 2017). In June 1951, the Textile Department of Jiaotong University, the Private Shanghai Textile Engineering College, and the Textile Department of Shanghai Industrial College merged to establish the East China Textile Engineering College (Donghua University College of Textiles, 2020). Concurrently, the Civil Engineering Department of Fudan University was incorporated into the Civil Engineering Department of Jiaotong University (Shanghai Jiao Tong University, 2020). In September 1951, Beiyang University and Hebei Institute of Technology merged to form Tianjin University (Li, 2002).

In May 1952, the Ministry of Education formulated the "Plan for the 1952 Adjustment of Departments and Faculties in National Higher Education Institutions" and the "Scheme for the 1952 Adjustment and Establishment of Higher Education Institutions", clarifying the guiding principle for departmental restructuring, "Prioritize cultivating talent for industrial construction and faculty development, expand specialized colleges, and reorganize and strengthen comprehensive universities" (Hao *et al.*, 2011).

The comprehensive restructuring of university departments commenced in the Beijing-Tianjin region and subsequently unfolded across major administrative zones including East China, Southwest China, South-Central China, Northeast China, and Northwest China. The focus centered on reorganizing engineering faculties within comprehensive universities and independently established engineering institutions. Among these, the restructuring of Peking University, Tsinghua University, and Yenching University undoubtedly constituted the most significant undertaking and received high-level attention from the central government. In November 1951, the Party Leadership Group of the Ministry of Education submitted restructuring proposals for the three institutions to the Party Leadership Group of the State Council's Cultural and Educational Commission and the Central Committee. Leading comrades including Mao Zedong, Zhou Enlai, and Li Fuchun provided directives on these proposals (Chen, 2002). Nanjing University and Zhejiang University, originally comprehensive universities with relatively complete disciplines, underwent large-scale restructuring in 1952, which had a significant impact at the time. The restructuring also established a number of specialized engineering colleges. By 1953, there were 38 engineering universities nationwide (as shown in Table 3).

These engineering colleges include 6 multi-disciplinary universities, 29 specialized institutions, and 3 vocational colleges, covering various engineering specialties such as machinery, electronics, civil engineering, and chemistry. They have formed a complete and comprehensive disciplinary structure. Especially the specialized institutions, which are directly oriented towards key national construction industries such as aviation, steel, geology, and water conservancy, are the backbone of industry development. Therefore, they have distinct industry characteristics and a strong sense of mission.

Among the 38 engineering colleges, 16 are newly established institutions. Apart from one junior college, all others are specialized schools formed by the merger of similar departments within existing universities. The remaining 22 institutions have undergone various degrees of adjustment. Some have transformed from comprehensive universities into polytechnic engineering colleges, or their engineering colleges have been separated out as independent entities; others have seen a change from polytechnic engineering colleges to specialized schools. Among them, Beijing Institute of Technology originated from the Natural Science Academy during the Yan'an period, while Dalian Institute of Technology and Shandong Institute of Technology were founded by the CPC on the eve of the establishment of New China. The red gene is a common pride among them. Other institutions emerged from higher education in old China and, after major adjustments of departments and faculties, they have caught up with the pace of the times and become the main force in building a new China.

The scope of the departmental reorganization from 1952 to 1953 was very broad, involving three-quarters of all institutions nationwide. Through this adjustment, similar disciplines were relatively concentrated, and resources such as faculty, books, and equipment were effectively utilized, greatly enhancing the ability of higher engineering education to cultivate talents. In 1953, there were 81,170 students enrolled in engineering programs, an increase of 1.67 times compared to 1949; among them, there were 1195 graduate students and 79,975 undergraduate and junior college students, which increased by 11.71 times and 1.64 times respectively compared to 1949. The proportion of higher engineering education in the total scale of higher education rose from 26% in 1949 to 37.5% in 1953 (Editorial Office of China Education Yearbook, 1984). Since then, China's new higher engineering education system began to be established, providing strong support for laying the industrial foundation of the country and accelerating the industrialization process. It was also from this point that China's higher engineering education developed significantly over the following 70 years, becoming the most important and active force in the entire higher education system, and occupying an increasingly important position in global higher engineering education.

The relocation of Jiaotong university to the west

After the adjustment of departments and colleges from 1952 to 1953, the problem of unbalanced distribution of higher education institutions was still not resolved. Therefore, the First Five-Year Plan required, "The construction of higher education must meet the requirements of socialist construction and must be coordinated with the development plan of the national economy. The setting and distribution of schools should avoid excessive concentration, and the scale of school development generally should not be too large. Engineering colleges should gradually be combined with industrial bases" (State Council of the People's Republic of China, 1955).

In accordance with the needs of industrial construction, national defense construction, and the development of higher education, after approval by the State Council, the Higher Education Ministry decided to adjust the establishment and distribution of colleges, departments, and specialties in higher education institutions. The adjustment plan for 1955–1957 proposed that some similar majors and departments from coastal areas be relocated to the inland to establish new schools or strengthen existing ones there, to relocate all or part of some schools to the inland to build new ones, and to expand the scale of existing schools in the inland and add new specialties (China National Institute for Educational Research, 1984). The relocation of Jiaotong

Table 3: Engineering universities formed by the adjustment of departments from 1952 to 1953

No.	Name	Adjustment or Establishment Situation
1	Tsinghua University[a,d]	In 1952, the Departments of the School of Engineering at Peking University and Yenching University, along with the Law and Business Schools, were reorganized and transferred.
2	Beijing University of Technology[b,d]	In October 1952, the Departments of Aeronautical Engineering from Tsinghua University, Sichuan University, and Beijing University of Technology were merged to form what is now Beihang University.
3	Beijing Institute of Aeronautics[b,e]	In October 1952, the School of Engineering at North China University was renamed, now Beijing Institute of Technology.
4	Beijing Institute of Geology[b,e]	In November 1952, the Departments of Geology from Peking University, Tsinghua University, Tianjin University, and Tangshan Railway Institute were merged. Now known as China University of Geosciences.
5	Beijing Iron and Steel Institute[b,e]	In August 1952, the Departments of Mining and Metallurgy from Tsinghua University, Tangshan Railway Institute, Shanxi University, Beijing University of Technology, Northwestern Polytechnic University, and Beiyang University were merged. Now known as University of Science and Technology Beijing.
6	Beijing Petroleum Institute[b,e]	In October 1953, the Department of Petroleum Engineering from Tsinghua University and relevant departments from Peking University, Tianjin University, Dalian Institute of Technology, and others were merged. Now known as China University of Petroleum.
7	Beijing Mining Institute[b,d]	In September 1953, China Mining Institute was renamed, and the Mining and Metallurgical departments from Beiyang University, Tangshan Railway Institute, and Tsinghua University were incorporated. Now known as China University of Mining and Technology.
8	Beijing Railway Institute[b,d]	In 1952, Beifang Jiaotong University was abolished, and two independent colleges were established. Now known as Beijing Jiaotong University.
9	Tianjin University[a,d]	In September 1951, Beiyang University and Hebei University of Technology were merged. In 1952, the School of Engineering from Nankai University and the School of Engineering from Jingu University were incorporated.
10	Taiyuan Institute of Technology[b,d]	In September 1953, Shanxi University was dissolved, and its engineering school became an independent university. Now known as Taiyuan University of Technology.
11	Tangshan Railway Institute[b,d]	In 1952, Beifang Jiaotong University was abolished, and two independent colleges were established. Now known as Southwest Jiaotong University.
12	Harbin Institute of Technology[b]	From 1938 to 1959, no adjustments were made.
13	Northeastern University[b,d]	In 1952, several departments from Tsinghua University, Northeastern University, Harbin Institute of Technology, Shandong University, Northwestern Polytechnic University, Qingdao Institute of Technology, Taiyuan Industrial College, North China University of Technology, Tongji University, Nankai University, Fudan University, Xiamen University, and other universities were merged, and some departments were transferred. Now known as Northeastern University.
14	Dalian Institute of Technology[b,d]	From 1952 to 1954, some departments were transferred in and out. Now known as Dalian University of Technology.
15	Dalian Maritime Academy[b,e]	From March to August 1953, the Northeast Navigation Institute, Shanghai Navigation Institute, and Fujian Maritime College merged to form this institution. Now known as Dalian Maritime University.
16	Northeast Geology Institute[b,e]	In 1952, the Northeast Geological College, along with the Geology departments from Shandong University and parts of the Geology and Physics departments from Northeastern University's Changchun branch, were merged. In June 2000, it was incorporated into Jilin University.
17	Jiaotong University[a,d]	In 1952, some departments were transferred in and out. Now known as Xi'an Jiaotong University and Shanghai Jiaotong University.
18	Tongji University[b,d]	From 1951 to 1952, some departments from the College of Engineering, College of Sciences, and other institutions were transferred in, and civil engineering departments from Jiaotong University, Fudan University, St. John's University, and 11 other schools were merged.
19	East China Textile Engineering Institute[b,e]	In June 1951, the Department of Textile Engineering from Jiaotong University, Shanghai Textile Engineering College, and the Textile Department of the Shanghai Municipal Industrial College merged. Now known as Donghua University.
20	East China Chemical Engineering Institute[b,e]	In October 1952, the Chemical Engineering departments from five universities, including Jiaotong University, Fudan University, Datong University, Dongwu University, and Jiangnan University, were merged. Now known as East China University of Science and Technology.
21	Nanjing Institute of Technology[a,d]	In 1952, the Department of Electrical Engineering, Mechanical Engineering, Civil Engineering, Architecture, Chemical Engineering, and others from Nanjing University, along with departments from Nanjing University and Jinling University, were merged. In 1953, some departments from Zhejiang University and Shandong University were incorporated, and other departments were transferred.
22	East China Water Conservancy Institute[b,e]	In 1952, the Water Conservancy departments from Nanjing University, Jiaotong University, Tongji University, and Zhejiang University, along with other related departments, merged to form this institute. In 1953, additional departments from Xiamen University, Shandong University, and others were incorporated. In 1955, the Department of Waterway and Port Engineering from Wuhan Water Conservancy Institute was merged. Now known as Hohai University.
23	East China Aviation Institute[b,e]	In 1952, the Aeronautical Engineering departments from Jiaotong University, Zhejiang University, and Nanjing University merged to form this institute. In October 1957, it was incorporated into Northwestern Polytechnical University.
24	Nanjing Aviation Institute[c,e]	Established in October 1952. Now known as Nanjing University of Aeronautics and Astronautics.
25	Zhejiang Universit[a,d]	In 1952, four departments from the School of Engineering, including Aeronautical Engineering, Chemical Engineering, Civil

(To be Continued)

(Continued)

		Engineering, and Mechanical Engineering, were retained, while other departments were transferred. Some departments were later incorporated.
26	Qingdao Institute of Technology[b,e]	In 1952, the Civil Engineering departments from Shandong University and Shandong Institute of Technology merged to form this institution. It was abolished in 1956.
27	Shandong Institute of Technology[b,d]	In June 1951, Shandong Provincial Industrial College was renamed. In September 1952, departments of Civil Engineering, Textile, Mechanical Engineering, Electrical Engineering, and Radio were incorporated into Jinan Aviation Industry School. In 1953, the departments of Mechanical Engineering and Electrical Engineering from Shandong University were incorporated. In 1958, some departments from Jiaotong University were incorporated. In July 2000, it was merged into Shandong University.
28	Southern Jiangsu Industrial College[c,d]	In 1951, the Jiangsu Provincial Suzhou Industrial College was renamed. The Mechanical Engineering Department from East China Railway University was incorporated. From 1953 to 1956, departments were gradually incorporated into or involved in the establishment of other institutions. The college was dissolved.
29	Huainan Coal Mining College[c,d]	In 1949, Anhui Provincial Industrial College was renamed. Now part of Hefei University of Technology and Anhui University of Science and Technology.
30	Central China Institute of Technology[b,d]	In 1952, the Mechanical Engineering departments from Wuhan University, Hunan University, Guangxi University, and Nanchang University, along with parts of other departments, merged to form this institution. Now known as Huazhong University of Science and Technology.
31	Wuhan River Transport Institute[b,d]	In 1952, Wuhan Transportation College was renamed, and some professional and organizational changes were made. In May 2000, it merged with Wuhan University of Technology.
32	South China Institute of Technology[b,e]	In November 1952, five departments (Civil Engineering, Chemical Engineering, Mechanical Engineering, Electrical Engineering, and Architecture) from the School of Engineering at Sun Yat-sen University, along with departments from other universities, merged to form this institute. In 1953, additional related departments from Wuhan University, Hunan University, Guangxi University, and Nanchang University were incorporated. Now known as South China University of Technology.
33	Central South Mining and Metallurgical Institute[b,e]	In 1952, departments from Wuhan University, Hunan University, and Guangxi University in Mining and Metallurgy, along with departments from Nanchang University and Beijing University of Technology, merged to form this institution. In April 2000, it merged with Central South University.
34	Central South Civil Engineering and Architecture Institute[b,d]	From 1953 to 1954, Hunan University was dissolved, and three schools were merged into four colleges (Electrical Engineering, Mechanical Engineering, Chemical Engineering, Civil Engineering). Now known as Hunan University.
35	Chongqing University[a,d]	From 1952 to 1956, apart from some departments from the School of Engineering, other departments were transferred.
36	Chongqing Civil Engineering and Architecture Institute[b,e]	In October 1952, the Civil Engineering and Architecture departments from seven colleges, including Chongqing University, Southwest Industrial College, Northwest University, Chuan Nan Industrial College, Chengdu Art College, Transportation College, and Southwest College, were merged. In 1953, the Civil Engineering departments from Yunnan University and Guizhou University were incorporated. In April 2000, it was merged into Chongqing University.
37	Sichuan Chemical Industry Institute[b,e]	In 1952, the Chemical Engineering departments from ten colleges, including Sichuan University, Chongqing University, Southwest Industrial College, Zhonghua College, Southwest Agricultural University, Leshan Technical College, Chuanbei University, Southwest Industrial College, and Xichang Technical College, were merged. In June 1954, it was merged into Sichuan Chemical Industry Institute.
38	Northwestern Polytechnic University[b,d]	In 1952, the Mining and Metallurgical departments were transferred to relevant institutions. Now known as Northwestern Polytechnical University.

Source from China National Institute for Educational Research (1984). a, multidisciplinary universities; b, specialized colleges; c, vocational colleges; d, institutions formed through adjustments; e, newly established institutions.

University to Xi'an was the most representative among the departmental adjustments during this phase and is an important event in the history of contemporary Chinese higher education.

In 1896, Sheng Xuanhuai, a famous modern industrialist and educator in our country, founded Nanyang Public School in Shanghai, which was renamed Jiaotong University in 1921. Jiaotong University formed its unique "science, engineering, and management" characteristics in the 1920 s and 1930 s and was once hailed as the "Massachusetts Institute of Technology (MIT) of the East" (Xi'an Jiaotong University, 2020). After the founding of the People's Republic of China, through the departmental reorganization from 1952 to 1953, Jiaotong University became a multidisciplinary engineering university.

At the end of March 1955, the Party Group of the Higher Education Ministry submitted a report to the State Council titled "Report on the Handling Plan for the Basic Construction Tasks of Higher Education Institutions in Coastal Cities for 1955" proposing that "the mechanical and electrical engineering majors from Jiaotong University should be relocated to the northwest to establish a branch of Jiaotong University (the specific location will be agreed upon with the Shaanxi Provincial Committee), preparing to move out completely within two to three years" and "the telecommunications engineering-related majors from South China Institute of Technology, Nanjing Institute of Technology, Jiaotong University, *etc*., should be transferred to Chengdu to establish a Telecommunications Engineering College". Chen Yi, Chen Yun, Liu Shaoqi, Zhu De, Peng Zhen, Deng Xiaoping, and other central leaders successively reviewed and agreed to the report of the Higher

Education Ministry (Ling, 1995).

In early April 1955, the Higher Education Ministry called to inform Tsinghua University of the spirit of its relocation to the west. The president and party secretary Peng Kang immediately convened a party committee meeting and a school affairs committee to convey the message. Many well-known professors present at the meeting expressed their support for Tsinghua University's relocation plan (Liu & Chen, 1996). From mid-April to May 1958, Peng Kang led relevant school officials and five first-level professors who served as department heads to scout potential sites in Xi'an (Liu & Chen, 1996). In April 1958, the school affairs committee officially made a "Resolution on the Relocation Issue" and announced the relocation plan, deciding that students and related faculty admitted in 1955 and 1956 would start teaching at the new site in Xi'an from the 1956 academic year, while the remaining staff and students would essentially complete their move before the summer vacation of 1957. In October 1955, construction of the new campus began (Liu & Chen, 1996).

In August 1956, the first batch of over a thousand students, faculty members, and their families moved to Xi'an, while more than 2000 newly admitted first-year students reported directly to Xi'an (Liu & Chen, 1996). On September 10th, 1956, the Jiaotong University held its opening ceremony in Xi'an. By this time, the relocation of Jiaotong University had progressed very quickly and smoothly, with a campus of nearly 6000 people established in the ancient city of Xi'an, including 3906 students, 815 faculty members, and 1200 family members (Liu & Chen, 1996).

During the relocation process of Jiaotong University, some incidents also occurred. In April 1956, Mao Zedong published his famous "On the Ten Major Relationships",making a judgment that the international situation was easing. One of the reasons for the relocation of Jiaotong University to the west became less sufficient, and some different opinions began to emerge. After research by the Shanghai Municipal Committee and the Higher Education Ministry, it was suggested that Jiaotong University should still relocate according to the original plan, but leave some educational resources for mechanical and electrical majors in Shanghai, which would be managed by Jiaotong University to establish a new university specializing in these fields (Ling, 1995). Chen Yi and Zhou Enlai subsequently approved this suggestion.

In February 1957, Mao Zedong delivered his speech "On the Correct Handling of Contradictions Among the People" at the 11th (Enlarged) Meeting of the Supreme State Council. As the "Great Debate" unfolded nationwide, opposition to the westward relocation grew within Jiaotong University, gradually gaining the upper hand. Upon learning of the situation, Zhou Enlai personally heard the views of Jiaotong University's leadership and professors, convening a special meeting to discuss the university's relocation. Zhou proposed multiple options, including relocating entirely, or partially relocating with a partial return to Shanghai, and provided detailed analyses of the advantages and potential difficulties of each approach (Ling, 1995). Zhou emphasized that the relocation should not be forced, leaving the decision to Jiaotong University for faculty and students to deliberate and decide. He further stressed that the overarching principle was to seek a reasonable arrangement, and the fundamental policy of supporting the northwest must remain unchanged (Ling, 1995). Meanwhile, prominent alumni including Qian Xuesen, Li Zhaohuan, and Wu Tegong voiced support for the relocation. Leaders from the Ministry of Higher Education, Shanghai Municipality, and Xi'an Municipality held discussions with faculty and students on campus. University administrators at all levels worked to understand the practical difficulties faced by faculty and sought solutions. Many renowned professors and Party members also took the lead in relocating to Xi'an.

Through these concerted efforts, the majority of faculty and students reached a unified understanding. In July 1957, Jiaotong University submitted a new relocation plan to the Ministry of Higher Education. Its core proposal was to divide the university into Xi'an and Shanghai campuses, both remaining under unified leadership as a single institution. The Xi'an campus would focus on establishing comprehensive mechanical and electrical engineering programs, gradually adding new technology and science disciplines, appropriately balancing quantity with quality improvement, and developing into a science and engineering university. The Shanghai campus would focus on excelling in its existing mechanical and electrical programs while prioritizing teaching quality (Ling, 1995). In August, the Ministry of Higher Education submitted this proposal to the State Council along with recommendations for related institutional adjustments (Ling, 1995). In September, the State Council approved the relocation plan for Jiaotong University and the associated institutional realignments (Ling, 1995).

By the summer of 1958, the relocation of Jiaotong University to the west was fully completed. Sixty-one point three percent of the faculty registered at the end of 1955 and seventy percent of those registered at the end of 1956 had moved to Xi'an. Approximately eighty percent of new faculty members who graduated in 1956 and 1957 were assigned to work in Xi'an. Eighty-one point one percent of students from the 1954 and 1955 cohorts successively relocated to Xi'an for their studies and graduation. All students from the 1956 cohort reported to Xi'an, though 17.3% returned to Shanghai after one year. By late October 1957, 73.9% of Jiaotong University's library materials had been moved to Xi'an (Ling, 1995). This demonstrates that the core of Jiaotong University had effectively relocated to Xi'an.

In July 1959, the State Council approved the separation of Jiaotong University's Shanghai and Xi'an campuses into independent institutions: Shanghai Jiao Tong University and Xi'an Jiaotong University (Ling, 1995). Prior to this, both campuses were designated among the 16 key universities for development by the central government.

After years of development, Xi'an Jiaotong University has evolved into a comprehensive research university with distinctive strengths in science and engineering, enjoying high renown both domestically and internationally. The successful relocation of Jiaotong University to the west holds significant importance for optimizing China's higher engineering education structure, perfecting the higher engineering education system, and promoting the development of western regions. In June 1986, Peng Zhen emphasized during a meeting with senior professors from Xi'an Jiaotong University, "The westward relocation of Jiaotong University was correct and successful; history will record this achievement". Relevant leading comrades also evaluated the relocation as "a successful example of China's strategic adjustment in higher education", noting that Xi'an Jiaotong University "has made significant contributions to the socioeconomic development of Northwest China, particularly Shaanxi Province" (Zhu, 2006). On April 22, 2020, General Secretary Xi Jinping visited Xi'an Jiaotong University to tour an exhibition showcasing the pioneering journey and remarkable achievements of the university's westward relocation. He met with 14 senior professors who had participated in the relocation. Addressing them, he stated, "Moving from the banks of the Huangpu River to the shores of the Wei River, you packed your bags and set out, sacrificing your personal interests for the greater good. The westward relocation of Jiaotong University holds profound significance for the entire nation and its people, as well as for the strategic development of the western region" (The State Council of China, 2020). The "Spirit of the Westward Relocation"—embodying "a broad perspective, selfless dedication, upholding traditions, and pioneering hard work"—has become a shared spiritual legacy within China's higher engineering education community. It authentically reflects the enduring commitment of higher engineering education to serving national needs and cultivating talent for the country.

TRACKING THE FRONTIERS OF ENGINEERING AND TECHNOLOGICAL DEVELOPMENT

Formulating long-term plans for scientific and technological development

The Outline of the Long-Term Plan for the Development of Science and Technology (1956–1967) (hereinafter referred to as the "12-Year Science and Technology Plan") was the first science and technology plan formulated and implemented by New China based on its own actual conditions, drawing on and learning from Soviet experience. It had a profound impact on the development of science and technology in China.

From the 1940s to the 1950s, a new wave of scientific and technological revolution, represented by atomic energy, space technology, and computers, emerged in Western developed countries and spread globally. During this period, China's science and technology lagged significantly behind the world's advanced levels. Many cutting-edge technological fields were virtually unexplored, and several important basic disciplines required substantial strengthening and improvement. To rapidly catch up with the world's advanced scientific and technological standards, the Central Committee of the CPC and the State Council decided to formulate a long-term plan for scientific and technological development. In January 1956, Zhou Enlai stated in his political report at the Second Plenary Session of the Second National Committee of the Chinese People's Political Consultative Conference, "The starting point of this long-range plan is to introduce the most advanced achievements of world science into our country as quickly as possible, according to our needs and capabilities. We aim to fill the most critical gaps in China's scientific endeavors as rapidly as feasible. By building upon existing global scientific accomplishments, we will organize and plan our scientific research efforts. Our goal is to bring China's most urgently needed scientific sectors close to the world's advanced level by the end of the Third Five-Year Plan period" (Zhou *et al.*, 1956).

In March, the State Council established the Science Planning Committee, chaired by Chen Yi with Li Fuchun, Guo Moruo, Bo Yibo, and Li Siguang as vice-chairs, to oversee the formulation of the Twelve-Year Science and Technology Plan. A total of 757 scientists and technical experts from 23 institutions nationwide participated in drafting the plan, including all members of the Chinese Academy of Sciences (CAS) natural science divisions—representing China's foremost scientific and technological talents at the time. After six months of effort, the draft 12-Year Science and Technology Plan and its four appendices were completed. Following extensive consultations, repeated discussions, and revisions, the plan commenced full implementation in 1957.

The overarching policy for developing science and technology outlined in the 12-Year Science and Technology Plan was "Prioritize Key Areas to Catch Up", with the fundamental principle being "Advance Disciplines Through Task-Driven Approaches". The entire plan encompassed 57 scientific and technological tasks across 13 fields, with foundational theoretical research—difficult to integrate into specific tasks—

designated as a separate task. From these, 12 key tasks were identified, addressing critical issues urgently needed for national economic development and safeguarding public health. The Science Planning Committee also proposed the "Urgent Measures Plan for Developing Computing Technology, Semiconductor Technology, Radio Electronics, Automation, and Remote Control Technology" (later known as the "Four Major Urgent Measures") to accelerate progress in these four emerging fields and rapidly close the gap with international standards. The 12-Year Science and Technology Plan also established general provisions for the national science and technology work system, the cultivation and utilization of scientific talent, and the establishment of research institutions (Luo & Zhao, 2020).

Establish university of science and technology of China

The University of Science and Technology of China (USTC) is a comprehensive university that focuses on frontier science and high-tech, with medical, distinctive management, and humanities disciplines. The school is affiliated with the CAS and was established in Beijing in September 1958, before moving to Hefei, Anhui in 1970 (University of Science and Technology of China, 2020).

Among the 57 tasks outlined in the 12-Year Science and Technology Plan, 87.7% were assigned to the CAS as the primary responsible entity, joint responsible entity, or primary collaborating entity (Fan, 1999). However, the Academy faced severe talent shortages. In 1958, its institutions collectively required 2049 newly graduated university students, yet the national plan allocated only 1062 graduates (Ding & Ding, 2018). Consequently, scientists and leading comrades proposed establishing a university leveraging CAS's strengths to rapidly cultivate urgently needed talent in frontier scientific fields and fundamental disciplines. At a CAS executive meeting, President Guo Moruo suggested, "To cultivate cadres, we could consider establishing a higher education institution affiliated with the Academy. This would facilitate cadre training and enable us to select the best students—the central solution to our cadre shortage" (Ding & Ding, 2018).

The CAS's proposal to establish a university received high-level attention from the central government. When Vice Premier Nie Rongzhen, who oversaw science and technology affairs for the State Council, reported the Academy's proposal to Zhou Enlai, the latter immediately expressed his approval. The Secretariat of the Central Committee decided to approve the Academy's university initiative, with Central leaders including Liu Shaoqi and Chen Yun also endorsing it through written directives (Archives of University of Science and Technology of China, 2013a). From the CAS's formal proposal to the Central Committee on May 9, 1958, to the commencement of classes at the University of Science and Technology of China (USTC) on September 20 of the same year, the process took just over four months.

At the inauguration and opening ceremony of USTC, Nie Rongzhen outlined the innovative educational approach, "This university integrates with research institutions, selects outstanding high school graduates, provides them with rigorous training in fundamental scientific knowledge and technical skills, and in their third and fourth years, allows students to participate in practical work at relevant research institutions. This enables them to rapidly master professional knowledge, accelerate their training progress, and within a certain period, help the nation's most urgently needed, weak, and emerging scientific fields catch up with the levels of advanced countries (Archives of University of Science and Technology of China, 2013b). This became the guiding principle and distinctive feature of USTC's education for over 60 years.

First, the principle of "the entire Academy running the university, integrating institutes with departments" was implemented, fostering the organic integration of teaching and research. At the university's founding, 11 of the 13 department chairs were directors or deputy directors of relevant CAS institutes, while the other two were also renowned scientists. In the early years, scientists from the CAS delivered lectures at the university totaling 300 person-times annually. A cohort of China's most esteemed scientists—including Ma Dayou, Bei Shizhang, Yan Jici, Hua Luogeng, Qian Xuesen, Wu Youxun, Liu Dagang, Zhao Jiuzhang, and Zhao Zhongyao—personally took to the podium to teach. These scientists also undertook a series of tasks: justifying the establishment of academic programs, formulating teaching plans, compiling syllabi, and writing lecture notes.

Secondly, the university implements an integrated approach combining science and engineering, fostering students' broad and solid theoretical foundations, proficient experimental skills, and innovative thinking. At the founding ceremony of USTC, Guo Moruo stated, "I hope every student at our university can become a versatile individual. We must not only master cutting-edge knowledge but also possess a deep foundation, extensive knowledge, and diverse skills (Archives of University of Science and Technology of China, 2013b). USTC was the first university in China to emphasize cultivating broadly skilled talent, dedicating 3.5 years of its five-year program to foundational coursework. Senior students conducted research practice or wrote theses at relevant institutes of the CAS, receiving early scientific training to enhance their ability to independently engage in research. At its founding, USTC offered 41 majors, all positioned at the forefront of contemporary scientific development or within foundational disciplines where China faced relative weaknesses. These included nuclear physics, space technology, computer technology, radio electronics, automation, chemical physics, and modern mechanics (Archives of University of Science and Technology of China, 2013b). These programs balanced emphasis on fundamental disciplines with broad practical applications, faithfully reflecting the university's founding vision.

USTC stands as a distinctive institution within China's higher education landscape and constitutes a vital component of the nation's advanced engineering education system. Unlike traditional engineering, modern engineering increasingly involves translating scientific principles into practical applications, placing heightened demands on engineering professionals in fundamental theoretical knowledge. Consequently, USTC's emphasis on strengthening foundational courses, developing applied sciences, and promoting the integration of science and engineering has become a key pathway for advancing higher engineering education. In the late 1950s, USTC pioneered specialized programs in cutting-edge scientific fields that were then unexplored in China. This targeted cultivation of talent played a crucial role in rapidly narrowing the gap between China's scientific capabilities and global standards, thereby enhancing the nation's overall economic and defense strength. The institutional experience gained by USTC during this period remains highly significant today. Emphasizing foundational course instruction to build students' solid theoretical foundations has been a tradition and strength of China's higher engineering education. We must deeply consider how higher engineering education can further optimize foundational courses, enhance teaching efficiency and effectiveness, and strengthen the integration of fundamental theory with engineering practice while preserving this tradition and strength.

Establish specialties in cutting-edge fields of engineering and technology

Following the introduction and implementation of the 12-Year Science and Technology Plan and the Four Major Urgent Measures, the CAS swiftly mobilized its resources to establish relevant research institutions. Certain universities also built upon their existing foundations to create corresponding specialized departments or programs, undertaking talent cultivation and scientific research.

Computer science program

In the Twelve-Year Science and Technology Plan, one of the measures for developing computing technology was to establish programs in computational mathematics and computer science.

In 1956, Tsinghua University established an electronic computing program within its Department of Radio Engineering, transferring second- and third-year students from the Departments of Electrical Engineering and Power Machinery into this program. To accelerate computer talent cultivation, fourth-year students from the Electrical Engineering Department of Jiaotong University were also transferred to Tsinghua to study computer science. Combined with first-year students admitted that summer, the Electronic Computer program at Tsinghua University started with nearly 200 students across all four grades (Tsinghua University Department of Computer Science and Technology, 2018).

In 1955, the Institute of Mathematics at the CAS began establishing computational mathematics research as a foundation for the "Two Bombs" project. That same year, Peking University established China's first university-level Computational Mathematics Teaching and Research Section and admitted its first cohort of students to a six-year Computational Mathematics program. When the 1954 and 1955 cohorts advanced to their third year, some students also specialized in computational mathematics. Among them was Wang Xuan, recipient of the National Top Science and Technology Award and known as the "Father of the Chinese Character Laser Typesetting System" (Xu, 2015).

HIT admitted its first cohort of computer science students in 1956. In 1958, it transferred additional students from the 1955 and 1956 cohorts across other disciplines into the computer science program (Xu *et al.*, 2004). Unable to recruit Soviet computer experts, HIT established its computer science program entirely through its own efforts. In 1956, HIT also launched a graduate program in computer science, recruiting students from other disciplines to serve as teaching assistants and graduate trainees (Xu *et al.*, 2004).

From 1956 to 1965, a total of 14 universities nationwide admitted students to computer science programs. Among them, nine institutions—including Tsinghua University, Harbin Military Engineering Institute, and HIT—admitted over 6000 students combined. These graduates later became the backbone of China's computer industry (Xu, 2015). Notably, between 1956 and 1962, the Institute of Computing Technology (ICT) of the CAS collaborated with Tsinghua University, Peking University, and the USTC to organize four training sessions before and after its establishment. These sessions cultivated approximately 700 computer professionals, including both current university students and graduates assigned to work at ICT. Consequently, ICT is often referred to as "the cradle of China's computer industry.

Semiconductor specialization

In September 1955, the Ministry of Higher Education dispatched a five-member delegation led by Tsinghua University President Jiang Nanxiang to the Soviet Union for study and observation. Upon the delegation's return, Jiang Nanxiang authored the Report on the Higher Education Delegation's Visit to the Soviet Union. The report proposed establishing new specializations at Peking University and Tsinghua University, recommending the creation of ten new specializations at Tsinghua University focused on cutting-edge scientific and technological fields, including semiconductors and dielectrics. The proposal was promptly approved by the Ministry of Higher Education (Dai & Ye, 2003).

Experts including Professor Huang Kun from Peking University's Physics Department—who had participated in formulating the "12-Year Science and Technology Plan" and the "Four Major Urgent Measures"—urged the rapid cultivation of specialized semiconductor talent. Given the challenges of undertaking this task at any single institution under the prevailing conditions, the Ministry of Higher Education decided to consolidate faculty members and fourth-year undergraduates and graduate students from the physics departments of Peking University, Fudan University, Nanjing University, Xiamen University, and Northeast People's University at Peking University's Physics Department starting from the summer of 1956. Together, they established China's first specialized semiconductor program. Over 30 faculty members and laboratory technicians from the five universities collaborated to develop a comprehensive curriculum. Students studied both traditional foundational physics courses and specialized semiconductor subjects, with significant emphasis placed on experimental and research components. In 1958, Huang Kun and Xie Xide co-authored Semiconductor Physics, China's earliest monograph in the field. Recognized internationally for its high academic standards, it became a widely adopted textbook for semiconductor programs. The joint program across five universities produced over 240 graduates, who became the first generation of core personnel driving China's semiconductor development. They played a pivotal role in establishing and advancing China's semiconductor science, technology, and industrial infrastructure from scratch. Building on this foundation, numerous universities subsequently established semiconductor departments or specialized programs, scaling up the cultivation of semiconductor professionals (Chen, 2006).

Radio electronics and automation programs

Unlike computer science and semiconductor programs, which were virtually built from scratch, radio electronics and automation programs already possessed a certain foundation during the 1952 university restructuring. Following the inclusion of radio electronics and automation science and technology in the "Four Major Urgent Measures" of the 12-Year Science and Technology Plan, these two disciplines experienced rapid development.

Radio electronics-related programs in Chinese universities trace back to the Radio Departments established at Jiaotong University in 1917 and Southeast University in 1924 (Steering Sub-committee of Electronic Information Science and Engineering Programs, 2006b). During the 1952 university restructuring, the telecommunications divisions of the electrical engineering departments at Tsinghua University and Peking University merged to form Tsinghua University's Department of Radio Engineering (Tsinghua University Department of Electronic Engineering, 2020); Nanjing Institute of Technology, spun off from Nanjing University, established a Department of Telecommunications Engineering; The Department of Radio was established at South China Institute of Technology, formed by merging relevant programs from Sun Yat-sen University, Lingnan University, and South China United University. Subsequently, several specialized institutions focused on radio and communication technologies emerged, including Beijing Institute of Posts and Telecommunications, Chongqing Institute of Posts and Telecommunications, Chengdu Institute of Telecommunication Engineering, and Xi'an Institute of Telecommunication Engineering. The talent cultivated by these programs and specialized institutions provided robust support for China's electronic industry development (Steering Sub-committee of Electronic Information Science and Engineering Programs, 2006a).

The establishment and development of automation programs in higher education followed two main trajectories. The first was industrial automation, primarily designed to meet industrial construction needs. Though renamed multiple times, it consistently emphasized "application-oriented and heavy electrical engineering" characteristics. The second was automatic control, addressing defense and military requirements as a classified discipline characterized by "theory-oriented and light electrical engineering" focus (Dai, 2004). It wasn't until 1995 that these two specializations merged into a unified automation program (Dai, 2004). The Industrial Automation program originated from the Industrial Enterprise Electrification program established during the 1952 university restructuring. That year, with assistance from Soviet experts, HIT founded this program. Subsequently, several other institutions also established this program (Steering Sub-committee of Automation Programs, 2006). The early Automatic Control program followed the Soviet nomenclature as the Program of Automation and Telecontrol. In 1955, Tsinghua University's Department of Electrical Engineering added this program, enrolling two cohorts of freshmen that year and the next. Additionally, over 100 third- and fourth-year students were transferred from other programs, forming China's earliest four-year cohort in automatic control (Tsinghua University Department of Computer Science and Technology, 2018). Subsequently, a number of key universities successively established automatic control programs and formed departments of automatic control (Steering Sub-committee of Automation Programs, 2006).

CONCLUSION

The 1950 s marked a period when China achieved decisive victories in its New Democratic Revolution and transitioned toward a socialist society, while also witnessing rapid strides in economic development. The nation's economic and defense development urgently required large numbers of specialized professionals. Coupled with the powerful coordination capabilities demonstrated by the planned economy, higher engineering education achieved unprecedented growth. Concurrently, higher engineering education fulfilled its mission: the professionals it cultivated became the backbone of national construction during that era and for decades thereafter. Moreover, higher engineering education itself began to form a comprehensive system with a rational structure across disciplines, laying a solid foundation for further development in the future.

Reflecting on this period's development of higher engineering education yields two crucial lessons.

First, upholding the people-centered nature of education. The Common Program of the Chinese People's Political Consultative Conference established that "the cultural and educational system of the People's Republic of China shall be one of new democracy, namely, national, scientific, and popular". The report to the 20th CPC National Congress emphasized, "We must develop education with the people at the center, accelerate the building of a high-quality education system, develop quality education, and promote educational equity" (Xi, 2022). Over more than 70 years of history, our Party's fundamental requirements for education have remained unchanged. From the outset of its governance, the Party transformed existing universities into institutions serving the people; it established new universities and enhanced educational quality through standardized operations. Simultaneously, it continuously strengthened Party leadership over schools, placed high importance on ideological and political education for faculty and students, and fully mobilized the enthusiasm of both teachers and cadres. These actions concretely embodied the commitment to education serving the people.

Second, upholding the commitment to serve the nation. Academic analyses of the 1950s university restructuring have noted certain adverse effects on higher education. For instance, the separation of science, engineering, and liberal arts disciplines resulted in losses for universities like Tsinghua, Nanjing, Zhejiang, Sun Yat-sen, and Xiamen, which possessed high standards and unique strengths. Additionally, the narrow disciplinary focus and limited professional coverage of specialized colleges constrained their development. Viewed through today's lens, these issues certainly warrant reflection. Yet under the historical conditions of the time, the nation's most urgent task was accelerating industrialization. Therefore, concentrating limited resources to rapidly cultivate large numbers of specialized engineering and scientific professionals aligned with national needs was an unavoidable responsibility for higher education institutions. Beyond this, the relocation of departments and programs from universities like Jiaotong University to central and western regions—a move symbolized by its westward migration—required many faculty members to sacrifice personal interests. To rapidly establish emerging and cutting-edge disciplines urgently needed by the nation, numerous universities and scholars also made arduous efforts. The higher engineering education system of New China was established to serve the nation and developed precisely through this service.

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Author contributions

Lei Q and Zhao YQ developed the concept for the manuscript, reviewed the literature, collected the historical data, and conducted analyses. Both authors read and approved the final manuscript.

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