

Some Solutions for Developing Scientific and Technological Human Resources to Accelerate Industrialization and Modernization

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Abstract: *Scientific and technological (S&T) human resources play a crucial role in advancing the cause of industrialization and modernization (I&M) in Vietnam. They drive the robust application of science and technology, foster innovation, and create breakthroughs in productivity, quality, efficiency, and competitiveness of the economy. In recent years, the Party and the State have placed significant emphasis on building and developing S&T human resources to meet the demands of accelerating I&M and integrating into the global economy. This article highlights the necessity of developing S&T human resources, evaluates the current state, and proposes a set of synchronized, consistent solutions for practical implementation. These solutions aim to achieve the I&M goals of transforming Vietnam into a fundamentally industrialized country by 2030 and a modern, developed industrial nation by 2045.*

Keywords: *human resources; science and technology; industrialization; modernization.*

1. Issues in developing scientific and technological human resources to accelerate I&M

S&T human resources

Article 3 of the 2022 Law on Science and Technology defines S&T activities as “scientific research, experimental research and development, technological development, technology application, S&T services, innovation, and other creative activities aimed at advancing S&T”⁽¹⁾ S&T human resources comprise individuals with qualifications from college or higher (professional or vocational colleges) working in the S&T field.

National S&T human resources include: (1) Researchers employed in public organizations (e.g., academies, research institutes, universities) holding academic titles such as research assistants, researchers, principal researchers, or senior researchers. (2) Technical and technological staff (e.g., technicians, engineers, principal engineers, or senior engineers) working in public organizations or S&T enterprises. (3) Civil servants engaged in S&T

management at central, provincial, and district levels, involved in or directing research to support policymaking and key S&T decisions. (4) Vietnamese intellectuals abroad and foreign experts working in S&T fields in Vietnam. (5) Individuals from all social classes passionate about science and technology who contribute innovations to apply S&T in daily life⁽²⁾.

S&T human resources are pivotal in building and developing the nation. They: provide scientific grounds for formulating national development policies, strategies, and plans; lead the way in researching, testing, and applying new technologies, tools, materials, and agricultural innovations; improve and systematize traditional technologies, enhancing capabilities across all sectors, leading to advancements in productivity, quality, and efficiency, particularly in export products, increasing the competitiveness and efficiency of the economy.

S&T human resources greatly help disseminate scientific knowledge and advanced technologies widely, fostering understanding and production capacity among workers and society; contribute to national defense and security through the design and improvement of weapons, high-tech equipment, and systems for information security and safety in cyberspace. S&T human resources represent a crucial factor in harnessing endogenous capabilities and creativity, mastering and applying advanced S&T knowledge to Vietnam's specific conditions. They form the backbone of building an advanced Vietnamese S&T foundation, effectively serving national development goals. Developing S&T human resources is a driving force and top priority for successfully accelerating industrialization and modernization.

Development of S&T human resources

Developing S&T human resources involves comprehensive activities in education, training, and workforce utilization to enhance the quality and effectiveness of S&T activities. These activities ensure that human resources are guided and oriented in their thinking; trained to acquire advanced expertise and skills; developed holistically in both capacity and character; and effectively utilized to meet socio-economic development requirements and the goals of industrialization and modernization. The development of S&T human resources includes growth in quantity, quality, and structure, with quality being the most critical factor.

Numerous factors affect the development of S&T human resources, including: policies and regulations of the Party and State; awareness and responsibility of relevant entities; quality and availability of educational inputs; infrastructure, financial resources, and the expertise of training and management staff at educational institutions; economic restructuring and regional development

plans; labor market development and management; advancements in science and technology, and so on. These factors can either create opportunities or pose challenges. To effectively develop S&T human resources, attention must be given to: enhancing awareness and accountability at all levels and sectors; refining mechanisms and policies; establishing comprehensive development plans; improving the quality of education and training; creating favorable working environments and implementing policies to attract and retain S&T talents.

2. Current state of S&T human resource development for industrialization and modernization

Over the years, efforts to develop scientific and technological (S&T) human resources have led to a continuous increase in quantity and improvements in quality, meeting the basic requirements of socio-economic development in the current era.

Regarding quantity, according to a 2019 survey by the Ministry of Science and Technology, Vietnam had 185,436 individuals engaged in research and development (R&D), an increase of nearly 7.4% (12,753 people) compared to 2017, and 10.54% (17,690 people) compared to 2015⁽³⁾. Among them, researchers accounted for the largest proportion, comprising 80.94%. Over four years (2015–2019), the number of R&D personnel grew by 10.5% (from 167,746 to 185,436 people), with a relatively stable structure: researchers made up about 80%, technicians about 6–7%, and the remaining were support staff⁽⁴⁾. The proportion of researchers with master's or doctoral degrees increased from 50% in 2015 to 57.3% in 2019. Notably, the proportion of doctoral researchers grew from 11% to 15⁽⁵⁾. By 2020, there were approximately 1.5 million individuals with a university or college degree or higher, including around 2,000 professors and associate professors, over 14,000 PhDs, and more than 11,000 master's degree holders. More than 34,000 individuals worked in the S&T field, over 42,000 were lecturers in universities, colleges, and vocational schools, and tens of thousands of S&T personnel were employed in various economic sectors⁽⁶⁾.

In terms of full-time equivalent (FTE) researchers, data from the 2020 survey by the National Agency for Science and Technology Information showed that Vietnam had 72,991 FTE researchers in 2019, an increase of 6,038 compared to 2017. On average, Vietnam had 7.6 FTE researchers per 10,000 people or 1.27 FTE researchers per 1,000 workers. Compared to other Southeast Asian countries, Vietnam ranked fourth in researchers per 10,000 people, after Singapore (69.2), Malaysia (23.6), and Thailand (12.1)⁽⁷⁾. Currently, many

Vietnamese S&T experts abroad are collaborating, advising, and consulting with ministries, sectors, and localities. The number of overseas Vietnamese intellectuals and experts returning to Vietnam to start businesses or work in domestic corporations and private companies, especially those established by overseas Vietnamese, is increasing significantly.

Regarding quality, overall, the quality of S&T human resources has steadily improved, with many scientists earning international recognition. Over 35 years of reform, S&T personnel have made significant contributions to the nation's development and defense. S&T human resources have helped increase labor productivity and product value. From 2016 to 2020, labor productivity grew at an average annual rate of 5.8%, higher than the 4.3% rate recorded between 2011 and 2015⁽⁸⁾. The contribution of total factor productivity (TFP) to growth increased from an average of 33.6% during 2011–2015 to 45.2% during 2016–2020, exceeding the target of 35%. The proportion of high-tech product exports in total export value rose from 19% in 2010 to approximately 50% in 2020⁽⁹⁾.

Human resources in social sciences and humanities have contributed to drafting key Party Congress documents and implementing major scientific programs, such as the project to research and compile the History of Vietnam and the Vietnam National Gazetteer. In fundamental sciences, S&T personnel have achieved significant results, as reflected in rankings and international publications. The number of international publications listed in the Web of Science (WoS) database increased more than 3.5 times, while publications indexed in SCOPUS grew over fourfold from 2017 to 2021. The outputs of ministry-level S&T projects and programs increased by an average of 25% annually⁽¹⁰⁾. Fields such as mathematics, physics, and chemistry continue to rank highly in the ASEAN region.

In public health, advanced technologies and techniques have been applied in diagnosis and treatment, improving service quality while reducing costs. Vietnam is among the top three ASEAN countries and one of 43 countries worldwide capable of producing vaccines for preventing and eradicating dangerous infectious diseases. The country has mastered high-level medical technologies and techniques. In national defense and security, S&T human resources have contributed to designing, developing, and improving high-tech weapons and equipment, as well as establishing monitoring and safety control systems in cyberspace. Notably, 85% of the weaponry and technical equipment used by the General Department of National Defense Industry originates from domestic research, meeting operational requirements⁽¹¹⁾.

3. Challenges and solutions for developing S&T human resources to accelerate industrialization and modernization in the future

Challenges in developing S&T human resources

First, developing S&T human resources must align with the shift from an extensive to an intensive growth model, relying primarily on science and technology, innovation, and high-quality human resources. It is essential to effectively seize the opportunities presented by the Fourth Industrial Revolution. S&T human resource development must “advance one step ahead” and remain practical, effectively addressing the requirements of S&T development at each specific stage.

Second, developing S&T human resources must link with the science, technology, and innovation strategy through 2030⁽¹²⁾. It is necessary to prepare S&T human resources for the future requires proactive measures. Strengthening education in science and technology, improving IT and foreign language skills, and fostering creativity are essential. Investments must be made to build a team of highly skilled S&T personnel. Efforts should focus on rapidly establishing leading scientists and progressively raising their standards to approach those of developed countries.

Third, comprehensive international integration necessitates S&T human resources equipped with global skills and the ability to stay updated with and adapt to new trends in S&T development. Furthermore, the free movement of S&T human resources into Vietnam presents both opportunities and challenges. It demands a well-prepared workforce with the knowledge, skills, attitudes, and psychological readiness to adapt to global integration requirements. Policies must also be implemented to attract Vietnamese S&T talent from abroad while addressing the risk of “brain drain.”

Fourth, developing S&T human resources must address existing shortcomings, such as insufficient attention to training, skill development, and ethics education. Common issues include a lack of direction despite having policies, an absence of action plans despite having resolutions, and insufficient resources to implement policies. Investments in S&T human resource development projects often prioritize land, capital, and technology over people, and there is a lack of comprehensive plans for S&T human resource development. The quality of S&T workforce training remains inadequate to meet the demands of accelerating industrialization and modernization.

Solutions for developing S&T human resources to accelerate industrialization and modernization

+ *Enhancing awareness and responsibility across sectors and levels*

Strengthen education and communication to create a profound shift in awareness at all levels, across sectors, and among the public regarding the role, importance, objectives, and directions of developing S&T human resources for the nation. Party committees, authorities, and each cadre or party member must fulfill their roles and responsibilities in fostering S&T human resources. Individuals working in S&T must recognize their critical role and responsibilities in the country's development during this new era. This should be seen as both an honor and a duty, motivating continuous improvement in professional qualifications, ethical standards, and capacity.

+ Innovating and refining policies and mechanisms for S&T human resource development

Policies must be relevant, feasible, and consistent with other science and technology policies. To create an effective system of mechanisms and policies, it is essential to fully grasp the Party and State's viewpoints and strategies on S&T human resource development. This includes developing the quality, quantity, and structure of S&T human resources simultaneously; ensuring the rights, obligations, and responsibilities of these personnel; and prioritizing investment while encouraging organizations and individuals to invest in research, development, and application of scientific achievements. The innovation and improvement of mechanisms and policies should cover multiple aspects, including education, training, working environments, employment policies, income, social security, housing, and living conditions. Special attention should be given to establishing mechanisms and policies to attract, utilize, and reward high-quality S&T personnel.

Developing plans for S&T human resources should align with the National Human Resource Development Strategy and the strategy for science, technology, and innovation in the new era.

Effectively implementing this solution will significantly address the current issues of shortages in quantity, limitations in quality, and structural imbalances in the S&T human resource pool, particularly in high-quality S&T personnel. Therefore, based on forecasts of demand and the national socio-economic development strategy, along with the National Human Resource Development Strategy and the direction for science, technology, and innovation development in the new era, organizations, agencies, units, enterprises, and localities need to formulate comprehensive plans for developing S&T human resources.

+ Improving the quality of S&T human resource training to meet societal and economic needs

Revamp training programs for S&T personnel at educational institutions to

meet labor market demands. Strengthen planning, forecasting, and regularly provide information on human resource needs, especially from organizations, enterprises, and localities, to appropriately adjust the scale, structure, and training levels. Innovate teaching methods and forms, standardize faculty teams, and ensure adequate physical and technical facilities for S&T human resource training. Foster stronger connections between educational institutions and organizations, enterprises, and units that utilize S&T personnel. Encourage research, application, and implementation activities within S&T enterprises.

+ Creating optimal working environments for S&T personnel

Develop policies that ensure S&T personnel benefit appropriately from their creative work, reflecting their contributions' value. Establish favorable conditions for training, research, application, and innovation in S&T. Provide the necessary resources, legal frameworks, and organizational support for talented scientists to innovate. Implement objective and fair assessments of contributions through systems evaluating degrees, achievements, and creative outputs. Recognize outstanding contributions with honorary titles and prestigious awards. Ensure adequate salaries, housing, and transportation conditions. Develop protective mechanisms to guarantee a safe, focused working environment for talent. Encourage external investment to enhance the physical and technical capabilities of S&T organizations, improving work conditions and fostering creativity to support industrialization and modernization.

+ Attracting and supporting overseas Vietnamese and international experts

Encourage overseas Vietnamese and foreign experts to participate in S&T activities in Vietnam, ensuring they receive full rights and incentives during their tenure, including appointments to leadership roles in S&T organizations, leading research tasks, and recognition for scientific and technological achievements. Provide incentives in salaries, immigration, residency, housing, and other legal benefits as stipulated by law. Recognize and reward significant contributions to Vietnam's S&T development by overseas Vietnamese and international experts through national honors and awards.

Industrialization and modernization based on advancements in science, technology, and innovation is a critical policy and mission in Vietnam's development. Developing S&T human resources is a top priority for the Party and State and a fundamental driver of socio-economic growth and national defense. Achieving a robust, high-quality, and well-structured S&T human resource base requires political responsibility, commitment, and concerted efforts across all levels, sectors, and the entire political system. This must be coupled with synchronized, flexible, and innovative implementation of practical

solutions to meet the goals of accelerating industrialization and modernization in the new era.

4. Recommendations

First, the Ministry of Science and Technology should prioritize research on developing models for research activities in universities and enterprises. Efforts should include planning for scientific research facilities, such as research institutes within enterprises and universities, while considering the establishment of networks linked to international research centers.

Second, enhance the connection and cooperation between educational institutions and industries to promote the commercialization of research results in production and business practices. Study and propose pilot mechanisms for developing S&T enterprises within research institutes and universities, following the “spin-off” enterprise model, to transfer research outcomes into practical applications.

Third, policies should be more flexible, granting young scientists greater autonomy and independence in conducting research activities. Allow young scientists to participate in government scholarship programs or work temporarily at foreign S&T organizations while maintaining their current positions in domestic institutions.

Fourth, continue to attract and reward highly qualified scientists from abroad by professional allowance regimes for positions requiring high-level and specialized S&T personnel.

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