What kind of innovation ecosystem is needed for achieving self-reliance and self-improvement in science and technology?

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At present, profound changes are evolving rapidly in the world, the scientific and technological revolution and industrial transformation are deepening, and major-power rivalry in the field of science and technology (S&T) is becoming increasingly fierce. The Chinese economy is in a critical period of shifting the core growth model, optimizing the economic structure and transforming the growth drivers. This has raised an unprecedented strong demand for self-reliance and self-improvement in S&T. Fully harnessing the underpinning and steering role of science, technology and innovation (STI) and achieving independent innovation have become a common goal for the S&T community and industry.

Self-reliance and self-improvement in S&T require not only more organized efforts to overcome challenges, but also the support of a sound innovation ecosystem. An innovation ecosystem is formed based on the interaction of various factors related to innovation activities. Through effective institutional arrangements, it can promote the diversification of innovation actors, stimulate their vitality and facilitate the movement and systematic allocation of innovation factors. China has made some progress in the building of an innovation ecosystem, but also faces challenges.

With the escalation of the China–US technology competition, the traditional path of innovation is no longer sustainable, further exposing underlying problems.

I. Current challenges in China’s innovation ecosystem

In terms of innovation actors, their diversification is slow, and the cultivation of innovation actors, such as new research institutions and S&T service institutions, is inadequate. The number of leading STI enterprises with an ability to acquire resources is small, and the R&D strength needed to break technological bottlenecks is still limited. The development of innovation clusters of enterprises with different ownership and types is unbalanced. The construction of emerging innovation actors, such as new R&D institutions and innovation and venture capital alliances, is inadequate. Besides,

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with limited abilities to deliver professional services, existing S&T service institutions have not been able to fulfil their role as intermediaries and bridges.

In terms of innovation capacity, the insufficient supply of human capital, knowledge, technology and other factors driving STI progress results in limited innovation. The habitual practice of ‘tracing and imitating’ is out of step with the uncertain prospects and accelerated iterations of future technologies. Technology R&D is not putting enough emphasis on industrial bottlenecks and major development needs. The pragmatic tendency of ‘putting application before basic research’ has led to a lag in investment in basic science research. At the source, universities and research institutes lack high-quality innovation results that can be transformed into applications. They have little interest in technology transfer and have not established in-depth cooperation with industries. This has resulted in a significant gap between S&T results and the demands of enterprises and the market. For strategic emerging industries, in particular, universities and research institutes are slow in making innovations and transforming them into real-world applications.

In terms of innovation resource allocation, the flow of innovation resources is not smooth, and the optimal allocation is yet to be realized. The government remains the main allocator of innovation resources, and the market has not yet fully played its basic role. The chain of innovation and entrepreneurship is fragmented, the national and regional STI information networks are not adequately developed, and the channels for the movement of innovation factors, such as human capital, knowledge and technologies, are not smooth, making it difficult to shift between and integrate various innovation actors efficiently. Further, the S&T financial system is yet to be improved. Venture capital tends to put innovation in modality before innovation in technologies and favours short-term interests over long-term strategies. As a result, although the collaborative innovation of industries, universities and research institutions has been successful in producing technologies, the transformation of research outcomes has been constrained by the lack of capital. The pattern of open sharing of STI resources with society-wide participation and diversified promotion has not yet materialized.

The causes of the above problems include the following:

- **Unclear positioning and overlapping functions of innovation actors.** The absence, overstepping and misalignment of government functions still exist, and enterprises are yet to become major players in technological innovation. As a result, the vitality and primary role of technological innovation have not been fully realized.

- **Inadequate STI systems and a lack of policy coordination between different departments.** The incentives, evaluation, research management and talent-training mechanisms for STI activities are not yet adequate, and the systems for the protection, use and management of intellectual property have not been fully established. The lack of coherence and stability between innovation policy and science policy, and technology policy and industrial policy, as well as the lack of systematic, targeted and effective policies, have hindered the enthusiasm and vitality of innovation actors.

- **The failure of innovation actors to establish close cooperative relationships and build a strong self-organization ability.** Due to unclear positioning and cooperation goals, a highly coupled synergistic ecosystem has not formed among the innovation actors. The lack of open sharing among innovation actors, the lack of a conceptual basis for the sharing of innovation resources, and the absence of effective sharing mechanisms and relevant system safeguards have impeded the flow of S&T resources and weakened appropriate resource allocation.

### 2. Suggestions for overcoming current challenges

In future, STI activities will become more diversified and integrated, both the innovation paradigm and the research organization are undergoing great changes, and the role of the innovation ecosystem is becoming more important. How to stimulate the vitality of innovation actors, pool innovation factors together and
promote the self-reliance and self-improvement of S&T is an urgent problem that needs to be addressed for the building of an innovation ecosystem in China.

Efforts should be made to optimize the innovation ecosystem and create a level playing field for market competition. We need to deepen the reform of the S&T system, facilitate market mechanisms, create a market environment of fair competition and stimulate varied enterprises to invest in the R&D of technologies. We need to improve the scientific research management system and empower scientific research institutions with the right to independent innovation. We need to break down administrative barriers, encourage the flow and sharing of innovation factors and enhance the coupling between innovation systems. We need to make full use of modern information technologies to establish efficient information-dissemination mechanisms and develop approaches for the open sharing of S&T resources to accelerate their diffusion. We need to participate in the global governance of innovation ecosystems, build a platform for open and shared innovation, actively promote international innovation cooperation and exchange and encourage international STI cooperation.

It is also important to unlock the passion for innovation and boost the inner vitality of the innovation ecosystem. We need to strengthen the originality of universities and research institutes and accelerate the building of a national strategic S&T force. We need to explore the establishment of a market-oriented scientific research system, increase the diversity of innovation actors, foster new types of institutions for the conversion of R&D and S&T outcomes, and strengthen the institutions and mechanisms of national laboratories and new R&D institutions. We need to train professionals in technology-transfer services at a faster pace, encourage high-end professionals to enter innovation fields and promote the optimal allocation of capital, personnel and S&T resources. We need to optimize and effectively implement the incentive systems, improve national income-distribution mechanisms and increase the weight of innovation factors in income distribution to incentivize S&T innovators. We need to fully mobilize the innovation initiative of private enterprises, make good use of the steering role of government funds, increase support for the STI efforts of private enterprises and encourage private universities and enterprises to set up scientific research institutions. We also need to improve innovation and entrepreneurship policies to support the development of innovation-based business start-ups.

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