



# INNOVATION, INFRASTRUCTURE AND IMPROVEMENTS IN CHINA'S SCIENCE SYSTEM

## AN INTERVIEW WITH CAO CONG

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### OBSERVATIONS

### N° 12

**A short interview with a distinguished scholar to showcase their career trajectory, expert knowledge, and current research interests in science and society in China.**

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Cao Cong (曹聪) is a professor in innovation studies at the Department of International Business and Management, Nottingham University Business School China, University of Nottingham Ningbo China and a senior advisor to the Lise Meitner Research Group (LMRG). Educated in China and the US, in both natural and social sciences, Cao Cong's research covers a wide range of topics within China's science and technology (S&T) system, including its reforms, innovation, entrepreneurship, bio and nanotechnology, the scientific elite, human resources, and returnees, among others. As a follow up to his Berlin Contemporary China Network talk on "China's Innovation System: Driving or Translating Global Technological Trends?" (February 8, 2023) members of the LMRG spoke to Cao Cong about his paper on large scientific infrastructures in China, his views on the term "indigenous innovation" and the distinctive features of China's S&T system, as well as the importance of studying China's science policy-making processes to understand its rise in the global system of science.

\*The interview for this publication took place on March 10, 2023. Cao Cong's responses have been shortened and edited for this publication, with the interviewee's approval.

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**LMRG: You have a background in both the natural and social sciences, please tell us about your academic trajectory and how it has informed your work.**

Cao: I did my undergrad studies in chemistry and was assigned to a toys research institute on plastic materials afterwards. After a few years, I wanted to continue my education and I enrolled in a masters program at the Institute of Scientific and Technical Information of Shanghai (ISTIS) where I focused on tech transfer and the absorption of foreign tech by Chinese companies. After working at the ISTIS for a few years, I applied for a PhD program at Columbia University to study the sociology of science. I was fortunate to have had the opportunity to study at a program where great scholars such as Robert K. Merton, Harriet Zuckerman, and Jonathan R. Cole were still active. By the time I started to consider potential PhD topics, around 1995, the Chinese Academy of Sciences (CAS) had resumed electing scientists to be part of new academic divisions, at the rank of academicians. Inspired by Harriet Zuckerman, who had worked on American Nobel laureates, I decided to write my thesis on academicians under the supervision of Jonathan R. Cole.

While the Chinese academicians were not the same “caliber” as the group of scientists Zuckerman had focused on, they were considered “elite” scientists in the Chinese context. With support from the US National Science Foundation (NSF), I went back to China to conduct interviews and found that it was easy to build connections with my interviewees due to my background in natural science. I also found that a significant number of them actually had experiences studying elsewhere, including those who studied abroad before 1940 and then returned to China. But there were also those who belonged to the first cohort of scientists who went abroad in the Reform era and were still relatively young at the time I started working with them. These scientists, old and young, made significant contributions to the overall national development of scientific research and national defense. I finished my PhD in 1997, but continued to work on the topic as a post-doc fellow at the University of Oregon under Richard (Pete) Suttmeier and then moved to the East Asia Institute at the National University of Singapore, where, in 2004, I finished my first book, *China’s Scientific Elite*.

**LMRG: Throughout your career, you’ve often returned to the relationship between global integration and indigenous innovation. At the end of your recent public lecture “China’s Innovation System: Driving or Translating Global Technological Trends?” you reached a cautious conclusion as to the current state of indigenous innovation in China. Can you share more about the background of your research in this area?**

Cao: Let me give you some background on my work in this field. When I was at the University of Oregon with support from the NSF, I shifted my focus from established academics to the “emerging elites,” or the recipients of the “Distinguished Young Scholar Program” (杰出青年科学基金) of the National Natural Science Foundation of China (NSFC). The program had been proposed by Chen Zhangliang (陈章良), at that time vice-president of Peking University, to attract scientists under 45, who had received research training abroad. The program was inspired by a US example in which various government agencies, including the NSF, supported a group of young, emerging scientists. It was through this research that I began to direct my attention to the role played by returnee

scientists. When I moved back to New York, I started working with Denis Fred Simon on the topic of “talent” more broadly, and this was around the time that McKinsey published its report “The War for Talent.” Denis and I studied not just China, but also Brazil, Russia, India, and Singapore, and compared talents in these countries in a report. We also eventually published *China’s Emerging Technological Edge* (2009), which included a chapter on the question of “brain drain, brain gain, and brain circulation.”

Returnees brought back knowledge they learned elsewhere and tried to integrate it into the Chinese system. I realized that, when these, mostly young people, returned around the mid-1990s and onwards, their most significant contribution was helping reshape the Chinese research system, which was still heavily impacted by the former Soviet system. They started to transfer what they had learned abroad, especially how their mentors ran research laboratories.

The knowledge transfer from returnees became evident, for instance, in my work on biotechnology and when interviewing scientists for the book *GMO China: How Global Debates Transformed China’s Agricultural Biotechnology Policies* (2018). I had started working on this topic back when I was in Singapore. This was at a time when the issue of genetically modified organisms (GMOs) got a lot of attention in the media, because the Chinese government and Chinese companies tried to

import large amounts of GM soybeans from the US, Brazil, and other South American countries. Quite a significant number of the scientists doing GMO research are returnees, including Chen Zhangliang and Zhang Qifa (张启发). Eventually their global connections played an important role in developing agricultural biotechnology in China.

In more recent years, I have developed a research interest in green innovation. And again, I saw a significant influence of global technological development on cases of green innovation in China. For example, returnees established many of the early photovoltaic companies. Karl McAlinden, one of my PhD students at the University of Nottingham in the UK, studied China’s carbon capture and storage policy and is now a Commercial Counsellor for Energy & Infrastructure at the British Consulate-General in Guangzhou. He found a significant transfer of foreign knowledge into China, for example in the case of the Administrative Center for China’s Agenda 21 and Shenhua, a leading Chinese energy company. In the context of its recent commitment to peak its carbon dioxide emissions by 2030 and strive for carbon neutrality by 2060, China has started to set up different kinds of carbon capture, utilization, and storage demonstration projects.



**Professor Cao Cong and Professor Wang Pinxian (汪品先), CAS academician at Tongji University. Cao interviewed Wang for his PhD research in 1998 Author: unknown, 2018.**

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**LMRG: “Chinese-style modernization” puts China’s science system on a specific trajectory. While its historical development was highly specific, are there any aspects of the science system that resulted from these developments that you would describe as “unique” or “exceptional” features of the science system in China?**

The question of where the uniqueness of the Chinese model comes from is a challenging one. As we can see, the Chinese science system has gone through a restructuring and taken inspiration from other places. In a recent discussion with Pete Suttmeier, an influential scholar in my academic career, he asked me to compare the Chinese case with other East Asian developmental states like Japan and Korea, and how we might theorize it. I think the uniqueness of China’s model, if there is one, lies in the size and the talent pool of the country. Among these three countries, China probably is the only country which can take advantage of not only its size in terms of the talent pool, but also the amount of investment made available and the large domestic market, which together can attract foreign investment while also support efforts to be indigenous.

Suttmeier and I were discussing the current restructuring of China’s S&T system, and how it will be similar to the American system, but with Chinese characteristics. We both see the necessity for China to have something like the Office for Science and Technology Policy (OSTP) in the US, in which a government agency is in charge of the policy making, resource allocation, but isn’t necessarily involved in distributing the money and administrating specific programs. The responsibility of running the programs would therefore, in China, fall on the specific ministries, for instance in critical areas like ecology and environment protection and agriculture, and also in information technology. There is now a new party organization, the Central Science and Technology Commission which is extending influence over the Ministry of Science and Technology (MOST). The MOST, probably no longer providing money or managing the programs, could therefore be in charge of policy making, program evaluation, and coordination. Of course, we don’t yet know how such a system will operate in practice.

**LMRG: In your recent research, you look at big science infrastructures in China and whether they raise the quality of indigenous science. Do you see the research interest in “quality over quantity” in science as a larger trend in the field of studying China’s science system?**

Cao: The particular *Science* paper “Remaking the Chinese Academy of Sciences” (Yang et al., 2023) resulted from a collaboration with two young scholars at ShanghaiTech University, which is part of CAS. They have been assessing big science projects and studying scientific infrastructures for quite some time. They use quantitative data to see whether the establishments of large science facilities in China really helped generate indigenous knowledge, and whether their researchers collaborated less with their foreign peers. We called this “indigenous” work. The *Science* paper is a byproduct of the collaboration in which we looked at the reform of China’s S&T system. We focus on CAS, which I have studied now for some thirty years, from its academicians for my PhD research, to an assessment of its Knowledge Innovation Program and Pioneering Initiative. There has been a huge discussion in the last five years about the role of national laboratories in the Chinese S&T system. We saw a rush to establish various kinds of regional laboratories in Chinese cities, such as in Shenzhen, Shanghai, Hangzhou etc. Local governments in different

provinces and cities established those labs to compete for the title of “national laboratory.” With the “national” title, many seem to hope that funding from the central government would increase.

CAS is in need to find a new way to position itself within China’s S&T system. There is a lot of redundancy between CAS and the universities, especially the leading ones. CAS has to show it has become a unique player, playing a more important role and becoming more focused. We are going to continue researching related issues

with different sources of materials, such as a combination of bibliometrics and with other sources, to better understand various dimensions of China’s large S&T infrastructures.



Professor Cao Cong in Shanghai. Author: Andrea Braun-Střelcová. May, 2023.

**LMRG: You are (co-)authoring a lot of exciting research which makes use of both quantitative and qualitative data. What is your secret recipe on doing insightful research on current developments, giving the challenges around data access and data reliability?**

Cao: I am trained in both qualitative and quantitative methods. I haven’t deployed many quantitative tools myself, but I understand their language. I can have a dialogue with my collaborators about their methods and explore what kinds of inquiry we can pursue together across various kinds of data. I am also in touch with science policy scholars and practitioners on an ongoing basis. These are all skills I bring to my collaborations.

On the topic of data access and reliability, I think most of the materials we use in our quantitative studies are from bibliometrics—scientometric data. We consider this raw source reliable and, if possible, we try to match bibliometrics with the CVs of scientists and other information. That is one approach we have been doing over the last five to ten years. We always try to see whether we can use data from different sources, compare and contrast them, and explore whether we can come up with more insights. Overall, I benefit enormously from working with other people by learning new methods and knowledge from them.

**LMRG: Where do you see key research puzzles that researchers interested in China’s science system should focus on in the near future?**

Cao: I think, the biggest question is how China will continue to improve its S&T system. There has been a lot of talk about, say, strategic S&T forces, national laboratories, the coordination of different players of doing science, the restructuring of the system, and the role of the market in innovation. I still try to understand what these terms actually mean, or rather, what meaning they will be given over time as many terms might not be clear even to people who initially formulate policies.

Within ten years, for example, the structure of the S&T system might be totally different again. We have seen this in the past, this sort of frequent restructuring and reform incurs tremendous costs and requires the mobilization of many resources. What we do not know is whether this sort of policy-making process includes heavy debates within the system, and by whom and how these policy changes are ultimately made. In certain areas it is possible to mobilize human and financial resources in a top-down fashion to advance a certain project, but it is impossible for a country to do everything based on this model.

In other words, we should study the policy-making process now and in what ways it is similar or different compared to ten, twenty years ago or the early Reform period. This will help us see how the concentration of resources and power works in China. The Chinese S&T system is still a work-in-progress, and there are many things that we still don't know, it's like the inside of a "black box". It's worth the effort to continue monitoring and studying it, and to reach a critical mass of people who understand it. There are many research opportunities in this field.

**LMRG:** Thank you so much, Cao Cong, for sharing your first-hand experiences and career trajectory with us.

## Books and Recent Publications

Sun Yutao and Cong Cao. *The Political Economy of Science, Technology, and Innovation in China Policymaking, Funding, Talent, and Organization*. (Cambridge University Press, forthcoming 2023).

Yang Xiyi, Xiaoyu Zhou and, Cong Cao. "Remaking the Chinese Academy of Sciences: Under Pressure to Reinvent Itself, the CAS Should Concentrate on Managing Large-scale Research Infrastructures." *Science* 379, no. 6629 (2023): 240-243.

Cao Cong. *GMO China: How Global Debates Transformed China's Agricultural Biotechnology Policies*. (New York: Columbia University Press, 2018).

Simon, Denis F. and Cao Cong. *China's Emerging Technological Edge Assessing the Role of High-End Talent*. (Cambridge University Press, 2009).

Cao Cong. *China's Scientific Elite*. (London, Routledge, 2004).

## More Information

Learn about Cao Cong:  
<https://research.nottingham.edu.cn/en/persons/cong-cao>

Find the paper online:  
<https://doi.org/10.17617/2.3514543>

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