



Institute on Global Conflict and Cooperation  
University of California

**Title:**

Specialist Communities: People and Cultures in China's Defense Science and Technology System

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**Publication Date:**

January 2015

**Series:**

[SITC Research Briefs](#)

**Permalink:**

<https://escholarship.org/uc/item/2f7872rr>

**Keywords:**

China, defense innovation, research and development, science and technology, defense policy

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# RESEARCH BRIEF

2015-11 January 2015

## Specialist Communities: People and Cultures in China's Defense Science and Technology System

Alanna KROLIKOWSKI

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**T**his brief examines communities of professional experts in defense science and technology (S&T) and their role in policy. After introducing the concept of 'specialist community,' this brief discusses the existence and significance of specialist communities in China's defense S&T system. Illustrations of the concept with examples from the aeronautic and space sectors follow. The final part of this brief discusses the impact of specialist communities on policy in China.

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*The Study of Innovation and Technology in China (SITC) is a project of the University of California Institute on Global Conflict and Cooperation. SITC Research Briefs provide analysis and recommendations based on the work of project participants. Author's views are their own.*

*This material is based upon work supported by, or in part by, the U.S. Army Research Laboratory and the U.S. Army Research Office through the Minerva Initiative under grant #W911NF-09-1-0081. Any opinions, findings, and conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the U.S. Army Research Office.*

## THE SPECIALIST COMMUNITY: A WORKING DEFINITION

A “specialist” is an individual professional who possesses specialized knowledge or subject-matter expertise. A specialist community is a collective of professionals who share technical knowledge and basic assumptions about technology and the world around it. These assumptions are often so widely accepted that they do not require explicit articulation. Because of their often-tacit nature, these assumptions are called “background knowledge.” They form the bedrock of the specialist community’s culture. Members express and reinforce their background knowledge in a wide range of daily professional practices, including habits of speech and writing. Experts’ shared technical and background knowledge, expressed in common practices, constitute a community’s specialist culture.

Defense S&T comprises several specialized sectors, whose experts form distinct specialist communities. Examples might include the submarine design community, the cybersecurity community, and the nuclear weapons community. The specialist culture shared among community members may transcend national boundaries, language barriers, and occupational differences. Emails, print, and podcasts can carry representational practices across continents, diffusing them throughout a transnational specialist community, even while members are dispersed.

Within every high-technology sector, certain experts do not share the community’s dominant stock of background knowledge and practices. In spite of such detractors, a dominant specialist culture is usually distinguishable within a community. When specialists differ on merely the specifics of policies or programs, rather than their basic direction, their disagreement is usually predicated upon their common acceptance of more fundamental assumptions.

Specialists describe and define their sector and its policy needs for policymakers. Policymakers rarely have any direct experience of the particular sector or devices at stake, so they rely on specialists to represent these to them. Specialists depict, characterize, and explain their sectors to policymakers.

When specialists represent their sector in speech or writing, they rely on a set of representational practices—or habits of expression—shared within their community. These representational practices reflect and convey the underlying philosophical assumptions tacitly shared within their specialist community. Representational practices are important because they “anchor” other practices, such as programmatic and regulatory practices.

Specialist communities make an impact on the defense S&T system through their practical constitution of distinct sectors as sites requiring particular types of policies. In the process of depicting their sector to policymakers, then, specialists also impart basic philosophical assumptions that tacitly lend support to some policy measures over others. Sectoral specialists define their sectors as targets of policy. Their acts of speech and illustration are not merely representational, but also productive of their sectors and technologies.

## EXISTENCE IN CHINA’S DEFENSE ESTABLISHMENT

China’s defense S&T system is a likely home for specialist communities with distinct internal cultures. At least five conditions conducive to the formation of such communities are present within China’s defense technology establishment.

- Barriers to the free circulation of ideas between sectoral experts and outsiders foster an insular specialist culture. Examples include secrecy rules and the task-specificity of technical knowledge.

- Barriers to the entry and exit of individual professionals preserve a specialist community’s internal culture.
- Sectors dominated by large firms and organizations, such as large defense-industrial groups, are more likely to have robust internal cultures than sectors fragmented into many smaller entities. Large organizations are effective vehicles for the maintenance and propagation of cultures.
- Large organizations with hierarchical cultures are even more conducive to the emergence and consolidation of specialist cultures. Hierarchies supply role models and reward individuals for their correct performance of a community’s culture.
- Organizations within which professional training and interaction take the form of master-apprentice relationships (for example, supervisor-student, laboratory director-technician, administrative patron-client) are effective at socializing new entrants into their culture. Technology-intensive defense industries feature such interactions.

## POLICY SIGNIFICANCE

Specialist communities have an impact on policies and programs in China’s defense S&T system. Several conditions contribute to this situation.

- Mechanisms exist to channel expert advice to policymakers and decision-makers. China’s policymaking bureaucracies tap experts to define problems and policy options and to recommend possible courses of action.
- Since the early years of the People’s Republic, individual elite scientists and engineers have had the ear of top leaders.

- Scientific and technical elites derive power and influence from their very status as experts. Expertise and credentials confer authority upon these figures and afford them influence over policies and programs.

### CASE ILLUSTRATIONS: SPECIALIST COMMUNITIES IN AIR AND SPACE

The concept of specialist community captures aspects of China's defense S&T system. Two dual-use, strategic sectors illustrate this situation: civil-commercial aircraft manufacture and civil-commercial spacecraft manufacture. Although these sectors are nominally outside the defense sector, the major industrial actors within them are formally part of China's defense-industrial system, affording a glimpse into this realm.

#### ***Communities of Practice in the Air and Space Sectors***

China's aeronautic and space experts belong to two distinct transnational specialist communities, each of which is held together by a particular internal culture. As aeronautic and space experts represent their sectors to policymakers, they also implicitly convey distinct policy preferences.

China's strategies for developing the aeronautic and space technology sectors differ markedly. The strategy for developing aircraft manufacture is far more oriented toward trade and industrial collaboration with foreign firms. The spacecraft manufacture strategy emphasizes autonomously developing critical systems at home and the domestic vertical integration of the industrial base. In large part, these differences reflect the distinct opportunities for trade and foreign collaboration available to Chinese firms and agencies: in aeronautics, these are far more numerous and substantial than in space. But these different international landscapes are also interpreted in fundamentally

distinct ways by the aeronautic and space specialists who advise policymakers. These two groups bring different assumptions about the nature of technology and the basic characteristics of the international system to their interpretation of global developments in each sector. In other words, Chinese aeronautic experts' assumptions are more similar to those of international aeronautic experts than to those of Chinese space experts, and vice-versa.

#### ***Aeronautic Specialists and Sectoral Policy***

Chinese aeronautic experts belong to a larger transnational community of aeronautic specialists, sharing its basic assumptions and discursive practices. Within China, aeronautic specialists are found in a range of organizations in state-owned enterprises, namely Aviation Industry Corporation of China (AVIC), government agencies, the military, and technical universities. These individuals constitute a reservoir of technical expertise for policymakers to consult. Policymakers draw on their insights when they make, evaluate, and reform policy for the sector. Experts contribute to these processes through several channels. They brief, write reports, and present at conferences for policymakers who prepare plans and strategies for the sector. Through their representations, aeronautic specialists not only depict their sector, but also produce it as a site of state action and an object of policy.

Aeronautic specialists in both China and the United States tend to convey agential conceptions of human nature and an instrumental view of technology. In their accounts of aeronautic history, pioneers and engineers initiate and direct technological processes, controlling technology's diffusion to new settings. Technology transfers are chosen and deliberate, rather than inevitable. Aeronautic specialists also share an understanding of their operational environment

as benign. They envision global air-space as a single, transboundary domain. In describing air transportation systems and infrastructure, these experts produce the sector as a natural site of global trade and integrated production.

Widely repeated by authoritative figures in China and abroad, these representations effectively define the air sector as requiring national policies consistent with these features. Experts depict as natural that the sector should be a site of unfettered global trade. Their representations, at once descriptive and prescriptive, recommend facilitating international transactions and harmonizing global standards for products. Described as incompatible with restrictions on the transboundary movement of aircraft articles, the sector takes on a need for policies that permit and smoothen the worldwide movement of goods and people. Experts define aircraft as naturally composed of components designed and made in different countries.

As Chinese experts circulate these representations, they foster agreement among policymakers that the sector requires policies conducive to global trade, industrial integration, and civil cooperation. Their conceptions support a sectoral strategy with particular features. First, the goal of China's sectoral strategy is integrating Chinese firms into transnational industrial networks at optimal nodes. This approach stands in contrast to one aiming at the total vertical integration of aircraft manufacture within domestic firms. This strategy does not aim at straightforward import substitution, as indicated by the long-term targets of 10–30 percent indigenous content on the ARJ21 and C919 domestic airliner programs. Inserting Chinese firms into transnational networks requires their selective specialization in high-value-added products for both domestic and global markets, alongside the importation and outsourcing of other components and

services. The desired end-goal is a qualified substitution of high-value-added imports with indigenous products in combination with imports and foreign-based industrial collaboration. In this vision, AVIC will develop the regionally and globally distributed production processes of today's global top-tier aircraft manufacturers. Within this sectoral strategy, the measure of success is twofold: both the technological output and export success of Chinese firms matter. For these experts, domestically producing viable aircraft is the priority of this approach, but emphasis is also placed on making AVIC entities into profitable, export-oriented businesses.

### **Space Specialists and Sectoral Policy**

Within China, most space specialists belong to the two major state-owned industrial groups, China Aerospace Science and Technology Corporation (CASC) and China Aerospace Science and Industry Corporation (CASIC), and related universities and research facilities. Space experts in China, the United States, and other major space-faring states belong to their own distinct transnational specialist community. Sharing basic assumptions, Chinese and U.S. space experts engage in a dialogical process of threat construction. As they perform common representational practices, they discursively aggravate China-U.S. security tensions in space. This occurs because Chinese space experts have a voice in the making of national policies and programs through formal and informal mechanisms that convey their input to decision-makers.

In contrast to aeronautic experts, space specialists express deterministic and structural assumptions about space technology and its societal impact. They often represent technical processes as eluding human control. While recognizing that technical change has many sources, space experts assume that at least one of them is a momentum internal to technology itself. Technological change proceeds

according to its own internal logic, which largely resists management by humans. Technology advances and the social environment around it responds.

These ideas also imply a theory of world politics, within which technological factors decide interstate struggles for security and dominance. Technological breakthroughs are the engines of world history and advances in space systems are chief among these, bringing revolutionary changes to international politics. For example, in this view, the advent of space weapons fundamentally transformed the international system, creating runaway dynamics escaping the control of governments and militaries. The global proliferation of dual-use space technologies is impossible to prevent because technologies diffuse automatically within and across societies from their place of origin. By implication, technology transfers are difficult to control or manage, requiring tight restrictions on any form of international trade, industrial collaboration, or technical exchange.

When experts in both China and the United States look beyond their own borders, they see a hierarchical system of national industrial bases, each one's position dictated by its mastery of critical technologies. National power and the strength of industry are intertwined in this view, so industrial bases remain divided by national boundaries. The natural state of affairs in the space sector is for firms to engage in research, development, and production activities within the borders of the country in which they are headquartered and with partners from the same country or, at most, close allies. National industrial bases compete on all fronts.

With this hostile landscape in view, Chinese specialists interpret the 1999 tightening of U.S. export controls on space items as part of a U.S. strategy to suppress China's peaceful rise. In this view, the 1999 controls are not just a denial of trade opportunities, but one facet of a larger U.S.

effort to block China's national rejuvenation: a "space containment policy" targeting China's core development and security interests. This "space embargo" constrains China's economic advance by excluding it from world markets for high-technology goods and, worse, stifles its defense modernization. These depictions underpin and rationalize policies to rapidly and autonomously develop capabilities in civil, commercial, military, and intelligence space.

In these experts' depictions, the prognosis for the global space sector is its inevitable and persistent fragmentation into distinct national industrial bases. Given the sector's strategic role, a rising power must assure its independent access to and utilization of the space environment. The long-term ideal, then, is national control over all critical processes in satellite and launch vehicle manufacture. The situation demands the total vertical integration of manufacture within a national system of firms. The goal of sectoral policy is building a holistic industrial base within China, while selectively pursuing international cooperation projects where they bring significant benefits, but carry few risks. Foreign partners' inputs can supplement, but never substitute for or interfere with, homegrown capabilities. Success for CASC and CASIC means mission success and its corollary, technological achievement. Business performance is a distantly secondary objective. Reforms of these conglomerates serve the objective of enhancing their technological output, rather than their profitability or corporate governance for its own sake. Exports are sought and represent industrial achievements, but are not fundamental goals of the overarching sectoral development strategy.

### **IMPACT ON POLICY OUTCOMES**

Specialist cultures exert a diffuse and indirect impact on long-term trends in policy for defense S&T. Experts

participate in policymaking as authorities on their subject matter. In the process, they perform representational practices that produce and sustain certain policies as necessary for their sector. These practices communicate not only experts' technical knowledge, but also tacit policy recommendations.

As they perform representational practices, aeronautic and space specialists constitute their sectors as objects requiring specific policies. In the air sector, these policies foster global trade and cooperation. In the space sector, they constrain trade and coop-

eration, but foster security tensions and mistrust.

Through their representations, aeronautic and space experts create the conditions of possibility for the policy outcome that prevails in each sector. Specialists define the range of policies and outcomes that policymakers in their sector consider plausible and feasible, in the process setting parameters upon developments in the bilateral relationship. They characterize their sectors as targets of state action in ways that render some policies feasible and desirable to policymakers, while locating oth-

ers outside the range of policies under their consideration.

In other words, specialists produce agreement on the ends and means of sectoral policy in their distinct discourses. Without the shared understandings that specialists maintain in their habits of speech and writing, decision-makers in air and space over the past two decades would not have adopted the policies that they did with the rationales that they did.

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