# RESEARCH BRIEF

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# Red, But More Expert: The Evolution of China's "Two Chiefs" Program Manager System

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This research brief examines the role of project management in China's defense research and development system, in particular its chief commander and chief designer system. Spurred on by technical failures over a 50-year period, China's space program leaders sought to address deficiencies by instituting reforms that gradually exerted more control and fostered better coordination. In doing so, China's space program has clarified the chain of command and reduced the role of pure political and administrative leaders in favor of managers who are both technically and managerially competent. The study concludes that for large defense programs to be successful, a strong systems management approach is required that entrusts a single person with the authority to run the program. In making this conclusion, it finds that since the 1950s China's defense research and development (R&D) management structure has moved to increase the authority of its program managers. This study aslo concludes that effective communication and coordination of knowledge flows facilitated by a single program office is essential to the success of large-scale R&D programs.

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## INTRODUCTION

Defense projects, especially aviation and space projects, can be complex endeavors that require large numbers of personnel from a variety of organizations working in a coordinated way to accomplish a common goal. The complexity of these projects requires a program management structure that can integrate numerous people and organizations into a multidisciplinary workforce capable of creating technologies to desired specifications and within the required budget and schedule.

The science and technology leaders who manage these efforts are an important part of this structure. These leaders must have a combination of technical and managerial skills necessary to understand the technology being developed, organize the technology development effort, and effectively interact with subordinates, superiors, customers, and stakeholders. Moreover, these leaders must be entrusted with the authority to make decisions and compel others to carry out those decisions.

## CHIEF COMMANDERS AND CHIEF DESIGNERS

China's program management system is bifurcated into chief commander and chief designer lines of authority that are loosely broken down between administrative and technical responsibilities. Under this system, chief commanders have overall responsibility for the program and report to the program's leading small group or lead organization. They are responsible for the management of the project, including financial and personnel management, scheduling, and overseeing the work of the chief designer. Chief designers, on the other hand, are responsible for technology development, including research, design, and manufacture.

Below chief commanders and chief designers are project-level chief commanders and designers. Project chief commanders have overall responsibility for their particular project within a program. They approve its design, plan, budget, and schedule and submit these for approval to the program's chief commander. The project chief designer reports to the program chief designer and is responsible for the design, testing, and manufacture of their particular system or subsystem.

The State Administration for Science, Technology, and Industry for National Defense (SASTIND) nominates and selects chief commander and chief designer candidates. Prime contractors nominate deputy chief commanders and deputy chief designers as well as project-level chief and deputy chief commanders and designers. These nominees are then selected by SASTIND.

In order to be eligible for a chief commander or chief designer position, candidates must have had prior experience as a project-level chief commander, deputy chief commander, chief designer, or deputy chief designer. They cannot be over the age of 65 at the time of appointment and they must step down from their position at age 70. Project-level commanders and chief designers must have participated in at least one complete project or participated in the important phases of two or more projects. Newly appointed project commanders and chief designers cannot be over the age of 56 at the time of appointment. Project chief designers must have also participated in the development of a system or subsystem, have demonstrated problem-solving skills, and have at least two years' experience as a deputy chief designer. The maximum age for project commanders and chief designers is 65.

A 2014 Chinese study of 84 chief commanders and chief designers revealed that the career paths of chief commanders and chief designers conform to the qualifications set forth above. The study reveals that all chief designers held a previous position as a deputy chief designer. Most commanders, on the other hand, had been laboratory directors. In addition, many commanders had experience as an institute director or deputy chief designer before becoming a chief commander. Probably reflecting the desire to balance managerial skill with technical competence, the quickest route to a chief commander position was to have previously served as a deputy chief designer, whereas those who mainly served in the command track had the longest road to becoming a chief commander.

Chief designers had two career paths. Again, reflecting the desire to balance managerial skill with technical competence, the path that led to the quickest promotion to chief designer involved managerial experience as a laboratory director before being promoted to a deputy chief designer and then chief designer. The other career path involved a career path entirely within the designer track as a lead designer, before becoming a deputy chief designer and chief designer.

Research was also conducted on the backgrounds of 42 chief commanders and chief designers who served in China's human spaceflight program from 1992 to the present. The average age of these program managers was 46 and they took an average of 21 years to reach their position. More than 50 percent have an M.S. degree, only two had PhDs, and just two had foreign experience, suggesting that benefits for China's space industry derived from foreign educated personnel may be limited.

There are, however, noticeable differences in the backgrounds of those who attained their positions in the 1990s and those who attained their positions in the 2000s. The average age of chief commanders and chief designers in the 1990s was 55, and they had been employed an average of 35 years before they reached these positions. Reflecting the overall decreasing age of China's defense in-

dustrial workforce, the average age of chief commanders and chief designers appointed in the 2000s was 45, and they had been employed just 20 years before they reached their positions. Moreover, whereas those program managers who attained their positions in the 1990s were educated at a variety of schools, those brought on in the 2000s were predominantly educated at Beijing University of Aeronautics and Astronautics, Nanjing University of Aeronautics and Astronautics, Harbin Institute of Technology, and the National Defense University of Technology, indicating the importance of these schools within the defense industrial system. No chief commander or chief designer had formal business education.

The hiring of a younger cohort of chief commanders and chief designers has introduced its own challenges, however. The rapid increase in the number of projects in the space industry since 2000 has led to the hiring of chief commanders and chief designers who lack managerial skills and have uneven levels of technical experience. Because of their inexperience, the ability of the two chiefs to recognize risk and to make timely decisions regarding risk remains a concern. To overcome these challenges, the China Aerospace Science and Technology Corporation introduced a training regimen for new project managers in which senior chief commanders and chief designers were asked to provide lessons from their experiences. This resulted in a series of courses covering 20 topic areas on lessons learned, best practices, and the "do's and don'ts" of project management.

## THE EVOLUTION OF CHINA'S PROJECT MANAGEMENT SYSTEM

The program manager system described above has been the result of more than 50 years of reform that has sought to give technically competent program managers more control within a streamlined program management system. During the 1950s, Chinese leaders' view of the country's strategic situation dictated that China needed to develop strategic weapons that were technologically complex and novel to China. China, however, lacked qualified personnel and the facilities to develop nuclear weapons and ballistic missiles as well as the capacity to manage programs involving hundreds of organizations and thousands of personnel.

At this time, the success of China's weapons programs hinged on the capabilities of a few top scientists who had extensive foreign experience and who had to rely on their own individual abilities, rather than a program management system, to bring projects to success. These massive programs spanned the breadth of China's R&D system and economy and also required a leader who had the authority that these scientists did not have to mobilize the country's resources. As a result, these programs were usually led by a party leader with little technical knowledge, who often made political decisions that interfered with the management of the research organizations.

This system's shortcomings were made evident when the first flight test of China's first ballistic missile in 1962 ended in failure. In the aftermath of that launch, the birthplace of China's space industry, the Ministry of National Defense Fifth Academy, established a set of regulations that formed a two line command system made up of an administrative commander and a chief designer. This provided the foundation for the current program management system as described earlier. The use of this system, however, was disrupted by the Cultural Revolution.

The system's reestablishment in 1984 is said to have improved the management of projects by shortening development times, saving money, and improving quality, but problems existed with the delineation of responsibilities and the lack of a formally designated program head. In fact, command of a project was shared between the administrative commander and chief designer. Moreover, the administrative commander and chief designer were often from different organizations with different chains of command whose organizational interests and views on how the work should be done often differed.

The effect of these deficiencies became evident in the mid-1990s with a series of launch failures that resulted in more than 60 internal investigations into the R&D system used by China's space industry. These investigations led to reforms that unified the two line command system. In doing so, it changed the name of the administrative commander to project commander and gave that position total responsibility for the project. The chief designer retained responsibility for technology development, but now explicitly reported to the chief commander.

To provide oversight of this system, each defense conglomerate within China's space industry as well as each academy, institute, and factory underneath these companies established a science and technology committee to oversee their respective role in a program or project. This system continues today and is reflected in the organizational structure for the human spaceflight program and the Chang'e-1 lunar exploration program.

China's human spaceflight program, also known as the 921 Program, is one of China's largest defense programs ever. The chief commander for the 921 program is the General Armament Department (GAD) commander, who is joined by the GAD political commissar and deputy chief program commanders from major stakeholders within the military, government, and industry to form the program's headquarters (see Figure 1). These include a deputy GAD commander, the SASTIND director, the

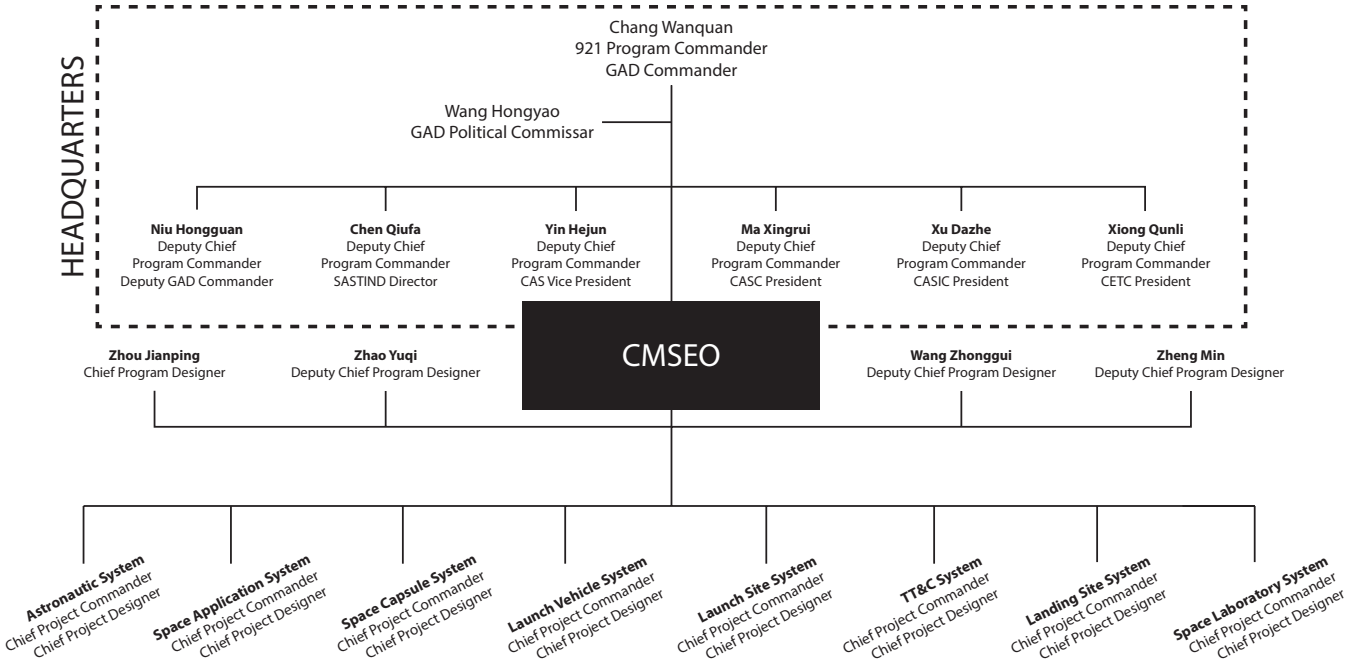


**FIGURE 1.** China's human spaceflight program management system

Chinese Academy of Sciences (CAS) vice president, and the presidents of the China Aerospace Science and Technology Corporation (CASC), the China Aerospace Science and Industry Corporation (CASIC), and the China Electronics Technology Corporation (CETC).

The role of the GAD commander as the 921 program's chief commander appears to be largely ceremonial. The actual running of the daily affairs of the program is done by a deputy chief commander from the military who outranks the other deputy commanders. The GAD commander, however, has the authority to mobilize organizational and material resources for the program when necessary from across China's military, industry, and government, due to his bureaucratic rank above even ministry leaders.

Below the deputy chief program commanders are the chief program designer and three deputy chief program designers. These individuals, along with the chief commander and deputy chief commanders, work out of the China Manned Space Engineering Office (CMSEO). The CMSEO is responsible for the management of the R&D and operation of China's human spaceflight program from project initiation to manufacturing to launch, flight, and landing. It is responsible for the overall technology development effort, coordinating with other organizations, and for international cooperation. In this role it serves as the administrative office of the chief program commander for planning, budgeting, and personnel work as well as the chief program designer's design bureau. The CMSEO also oversees the work on eight systems that are each led by a project-level chief commander and chief designer.

A look at leadership organization for the much smaller Chang'e-1 lunar exploration program reveals a different configuration (Figure 2). The Chang'e-1 program is headed by a chief commander, Luan Enjie, who was also a deputy director for the Commission for Science, Technology, and Industry for National Defense (COSTIND), the predecessor to SASTIND. Luan's work was overseen by the chair of the Lunar Exploration Program Leading Small Group, Zhang Qingwei, who was the COSTIND director. This leading small group also consisted of the vice president of CASC, the China National Space Administration director, GAD deputy directors, and a CAS deputy director.

These individuals as well as the chief and deputy chief commanders work out of the Lunar Exploration and Space Program Office, which, similar to the CMSEO, is the work office for the lunar exploration program. Beneath the Lunar Exploration and Space Program Office are the chief project commanders and chief project designers for the satellite, launch vehicle, launch site, telemetry, tracking, and control, and ground systems. It should be noted that the chief commander for the satellite system was also dual-hatted as the chief designer.

## CONCLUSION

This study identifies program management as a key enabler of successful R&D programs. Program management structures, however, must be tailored to the needs of a particular

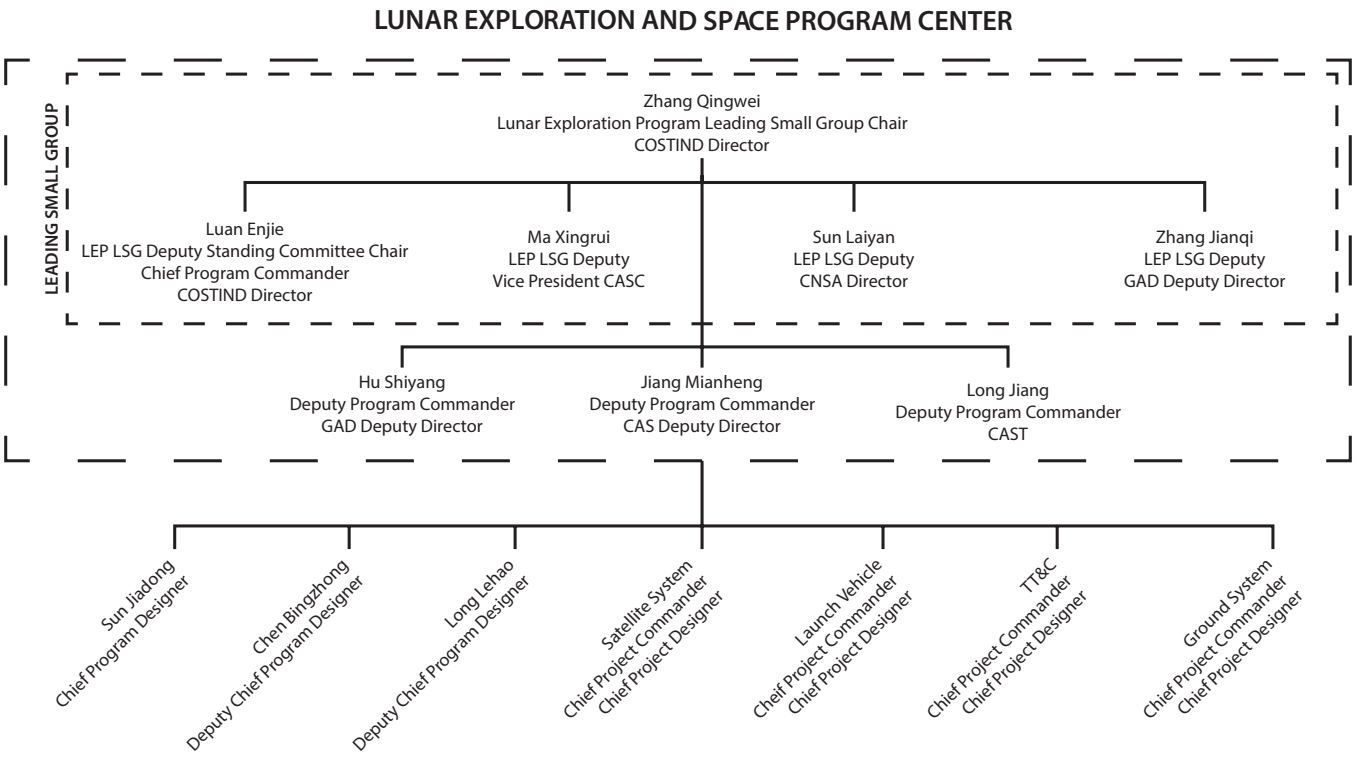


**FIGURE 2.** China's lunar exploration program management system

project. This study examines program management systems for large-scale space projects and concludes that these projects require clear lines of authority with formal and systematic delegation of responsibilities and processes. As a result, bureaucracy does not necessarily inhibit innovation. Systems management can provide a stable environment in which the sometimes chaotic processes of technology creation can flourish.

Although a seemingly obvious conclusion, the experience of the U.S. Air Force, NASA, and the European space program reveals that organizations new to running large-scale R&D programs tend to make them decentralized, ad hoc affairs, and it is only after technical failures or cost overruns that a more centralized and systemized organizational structure is established.

But this study also concludes that project management structures can and should vary according to industry, organization, and country. The U.S. Air Force and NASA used a system involving a strong manager supported by a deputy in which both were responsible for administrative and technical matters. China, on the other hand, decided to bifurcate the responsibilities of its managers along administrative and technical lines with a chief commander having overall responsibility for a project. Both systems appear to work. Nevertheless, the methods for organizing smaller R&D efforts, especially in the commercial sector, may differ substantially from the organizational structures discussed here. While keeping these limitations in mind, China has developed a method for organizing large-scale R&D projects that appears to be effective in producing technologies according to its own national situation.

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