

Flying without succeeding? Assessing the future of the civil aviation manufacturing sector in the People's Republic of China

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Abstract

The future of Chinese aviation manufacturing features more and more prominently in the popular press. Opinions as to its prospects vary widely. Optimists point to the advantages China could apply to producing aircraft; low labor costs, the world's second-largest domestic market, a state dedicated to nurturing strategic high technology industries, and sheer macroeconomic momentum. Pessimists argue that many of these advantages are, in fact, mirages. They argue that what genuine advantages China enjoys have been squandered before and may be squandered again.

In this paper I clarify the basis for both positions and explain why Chinese efforts in this sector have, to date, yielded little success. First, strategic industrial policies adopted during the Mao era deprecated airplane manufacturing. The result was that Chinese aircraft manufacturing did not, in fact, enjoy much support during its critical incubation period. Second, the Reform and Opening Movement policies crippled central planner's control over the sector without replacing the Plan with market-oriented incentives. Therefore Chinese factories built airplanes neither the People's Liberation Army Air Force nor the Chinese civil airlines could be compelled to buy. Third, China, like many other countries, was unable to overcome the financial, managerial, and technological challenges endemic to aircraft manufacturing. The result was that Chinese aircraft were mostly unsafe, overpriced, obsolete, or all of the above.

Taking the historical, institutional, and sectoral factors into account, I analyze recent developments and weigh their significance. I conclude that while recent developments in the past two years are, in fact, genuine signs of progress towards resolving previous problems, it is not enough. The challenges that remain are the most difficult to resolve; they are endemic to the aviation market, and therefore

the least subject to institutional control. They cannot be overcome passively, by national pride, or by sheer macroeconomic prowess. China also sits at a strategic nexus. She must decide whether to continue to pursue the goal of a completely domestic aircraft, adopt the Japanese component-first model a.k.a. "succeeding without flying", or settle for a more cautious branding approach that satisfies national pride without endangering the status quo in one of the most politically sensitive industries in the world.

1. Introduction

To a large extent, the history of civil aviation manufacturing in the People's Republic of China has been characterized by conflict, contradiction, inefficiency, and failure. China's comparative advantages in this sector have been squandered or offset by peculiarities of her political economy, by strategic mistakes, and by particular challenges of the sector itself.

Recent developments, however, have inspired some observers to reevaluate China's prospects. While Chinese state-controlled press coverage of domestic airplane programs like the ARJ-21 regional passenger jet has been largely upbeat, a quick review of more recent headlines in the foreign press reveals a rising tide of agreement. "China's Aircraft Industry Gets off the Ground!" claims *Time Magazine*.ⁱ "China's plane ambitions take off!" writes the *BBC*.ⁱⁱ In a recent article in *Aviation Week*, William C. Parr, an aviation analyst, agrees that China is well on its way to success. "For aerospace companies, China offers wages which can be as low as 25 cents per hour, as well as potent tax inducements to attract investment. Its growing role as a customer—witness recent orders for Boeing and Airbus jets—has created a strong and sustained pressure to set up local production to meet "offset" requirements. The new aircraft orders are likely to be a sustained pattern."ⁱⁱⁱ

Such enthusiasm is not universal. Aviation consultant Richard Aboulafia, for one, argues that China's success is a "mirage"^{iv} and that it has not, in fact, been able to effectively leverage its market potential to encourage local production and technology transfer. He points out that the \$100 million Airbus and Boeing spend on contracting in China annually is actually a negligible amount. "After all the talk," he says, "this is an absurdly low volume—around one-fifth of 1% of the total

world jetliner value chain. *This work bears no relation to the volume of Chinese jet orders.* If there's a Chinese official mandating industrial work in exchange for orders he fell asleep at the switch long ago."^v Jonathan Pollack, a professor at the Navy War College and author of numerous critical works on Chinese airplane manufacturing, expressed his opinion thus: "Count me as a skeptic on the feasibility of China building a full-sized commercial aircraft."^{vi}

This paper begins by explaining why making planes is so difficult. I then argue that China has a good market case for making its own airplanes nevertheless. I discuss the key historical and institutional factors that have inhibited the growth of this sector in China to date, paying particular attention to the consistent rejection of Chinese aircraft by Chinese aircraft consumers. I argue that recent developments, when considered in the historical context, are significant improvements which do support increasing optimism regarding the industry's prospects, because they indicate fundamental positive changes in attitudes, institutions, and strategic approaches. This conclusion should by no means be construed as a prediction of inevitable success. Significant obstacles still remain. They cannot be overcome passively, by national pride, or by sheer macroeconomic prowess. China also sits at a strategic nexus. She must decide whether to continue to pursue the goal of a completely domestic aircraft, adopt the Japanese component-first model, or settle for a more cautious branding approach that satisfies national pride without endangering the status quo in one of the most politically sensitive industries in the world.

2. The challenge of airplane manufacturing

Aviation is an expensive, difficult business, even in highly developed economies. Making planes requires high fixed capital investments, the development and retention of skilled staff,

and rigorous quality control. These high costs require a large, profitable airline market to serve to make the investments worthwhile. Unfortunately, the commercial airline market that aviation manufacturers serve tends to enter recession first and exit last. During such recessions, struggling airlines frequently cancel contracts and/or pour used aircraft back into the market.

Airplanes have long production cycles. This presents a particular requirements management challenge; product managers must not only understand customers' current requirements, they must also predict their future demand, sometimes a decade or more in advance.

In addition, aircraft customers are often foreign governments, who have historically imposed their own competitive burdens on foreign aircraft manufacturers. Despite the ability of aircraft to fly over national boundaries, aviation markets are still relatively protected.

All of these factors deter to profit-maximizing firms. Since 1960, only one new country, Brazil, has managed to produce a successful large airplane manufacturer. Appreciation of Brazil's success must be tempered by the fact that the Brazilian aircraft manufacturer, Embraer, only narrowly avoided complete bankruptcy in the 1990s, and tempered again by the possibility that luck played a large role. Embraer's ERJ commuter jet program was started in 1989, years before the hub-and-spoke airline model began driving demand for smaller commuter jets to "feed" passengers to larger airports. Nine years later, when the ERJ finally came to market, demand for small commuter jets had begun to explode. There was no market case in 1989 for the ERJ; Embraer had developed much of the capabilities to produce such a plane (including the deployment of a CAD/CAM design system) due to a state mandate to work on a joint jet fighter project with Argentina, which

ultimately failed. In short, Embraer owes a degree of its success to a mistake.^{vii}

3. The market case for Chinese aviation manufacturing

Despite the challenging nature of aircraft manufacturing, China has many advantages that would support such an endeavor.

First, China could be its own best customer. Unlike smaller countries, China does not have to export its product to be successful. At present, China is the world's second largest aviation market. A Boeing report predicts that China will spend \$213 billion on planes in the next 20 years.^{viii} One Chinese industry blogger, arguing in support of the domestic production of aircraft, writes that "the Chinese aviation market is so [vast in] potential that it is impossible for Chinese aviation industry to surrender it submissively."^{ix}

From the defense perspective, China needs military aircraft and yet has experienced financial and political difficulties purchasing the most advanced aircraft abroad, which means that the potential Chinese defense market is also quite large. Given the dual-use nature of aircraft manufacturing technologies, satisfying defense demand would strongly stimulate the development of civil capabilities. Since the end of the Second World War, China has been developing its military industrial complex in which it retains direct ownership.

As far as civil industrial policy is concerned, China follows the "national champion" model of development, in which the state supports giant state-controlled firms in identified key sectors ("pillar industries"). This model is not without its flaws, yet aviation's sectoral characteristics encourage gigantism, consolidation, and strong state support. During Airbus' incubation stage, for example, Airbus enjoyed 100% government

repayable investment in new aircraft programs.^x While the WTO has modified the parameters of government support, it has hardly eliminated its presence. If any industry calls for incubation by the state, airplane manufacturing does.

Aviation leads to technological advancement. China has long sought technology transfer and knowledge spillover in its core industries. Aviation can be a powerful contributor to such a strategy as many technologies employed in aircraft can be reused to develop other products. As a recent industry report notes, “aviation is a potential technology driver for manufacturing techniques that also pulls along other high-technology sectors such as electronics, advanced materials, and sensors.”^{xi} At the State Council Executive meeting, Chinese Premier Wen Jiabao, endorsing China’s latest wide-body jet project, proclaimed that aviation manufacturing will “enhance China’s overall international competitiveness and help transform the nation’s economic growth pattern.”^{xii} “A home-made large aircraft may inspire the nation like the country’s manned spacecraft program,” Liu Daxiang, deputy head of the Department of Science and Technology Development under China Aviation Industry Corporation I (AVIC I), recently told Xinhua news. “The project will also speed technology advance in China’s aviation industry and promote the development of secondary sectors.”^{xiii}

4. The history of failure

Chinese leadership realized the case for building aircraft domestically and attempted to do so quite early. However, their repeated attempts failed for several reasons. First, strategic industrial policies adopted during the Mao era deprecated airplane manufacturing during its key incubation phase. Second, the Reform and Opening Movement policies applied to the sector crippled central planner’s control over the sector without replacing the Plan with market-oriented incentives.

Therefore, China was unable to overcome the financial, managerial, and technological challenges endemic to aircraft manufacturing. The result was that Chinese aircraft were, as a rule, of unsafe, overpriced, obsolete, or all of the above.

However, the most curious historical phenomenon, and the one which has caused the most confusion, is the fact that Chinese state-controlled airlines (and the military) have repeatedly refused to buy Chinese state-built aircraft. To those who consider the Chinese state an effective authoritarian developmental bureaucracy, it makes no sense that China has not simply ordered domestic aircraft customers to buy local in order to recoup the large sums of capital spent building aircraft factories and executing aviation projects. Yet while the Chinese central government retains nominal control of aircraft purchases by means of a central purchasing authority, the China Aviation Supplies Import and Export Group (CASG), CASG has rarely exercised control of fleet purchases to benefit either domestic aircraft programs or joint ventures. In the 1990s, a McDonnell-Douglas executive, commenting on the rejection of the MD-90 joint venture program, complained that “Chinese airlines simply do not want to buy an airplane that’s been manufactured in China . . . It’s totally amazing that the Chinese system permits this.”^{xiv}

And yet the confusion persists. For example, Time Magazine’s 2007 article quotes Richard Pinkham, an industry analyst at the Centre for Asia-Pacific Aviation, a Singapore-based consultancy. “The government still controls fleet purchases,” Pinkham told Time. “That will provide a big boost to marketing efforts.”^{xv}

4.1. The Post-War/Mao Era

The Mao Era (1949-1976) was a critical incubation period for Chinese airline manufacturing. It was critical because this was

the period in which the Chinese command economy could have most effectively protected its domestic market and used this protection to incubate a domestic aircraft manufacturer.

4.1.1. The strategic weapons debate

Given the dependence civil aviation has on defense demand, civil aviation projects depended heavily on the development of the People's Liberation Army Air Force (PLAAF). However, Chinese defense industrial policy was not originally based on air power, but rather on nuclear missiles. Given resource constraints, China decided to sacrifice conventional readiness for nuclear deterrent.

The argument for missiles had an economic dimension. At the CCP's Beidaihe conference in 1961, Marshall Nie Hongzhen and his supporters argued that not only would an emphasis on missiles serve China's security interests, it would also incubate related civil industries such as optics. His proposal met significant opposition, headed by the famous revolutionary general Peng Dehuai, who was vice premier at the time, but the compromise reached, in which both bombers and missiles would be developed in tandem, was symbolic. There was no compromise on implementation. Aircraft manufacture slowed significantly, as did the development of other conventional forces, as the military industrial complex focused on missile development. "As with all of China's strategic technology programs," argues Dan Feigenbaum, "political support proved crucial in the start-up phase, and in the period after 1959-60, bombers simply did not receive the all-critical political backing" that the missile programs did.^{xvi} The result was an aviation industry dedicated to the air force customer . . . who was not, in fact, in a position to invest in airplane development.

For this reason, China's rocket industry is far more advanced than China's airplane industry. China launched its first satellite in 1970;

Chinese craft may well land on the moon before they land in New York.

4.1.2. The Sino-Soviet Split, the Great Leap Forward and the Cultural Revolution

The Great Leap Forward in 1958 and the ensuing Sino-Soviet Split further damaged aircraft manufacturing, particularly since the Soviets withdrew the technical advisers responsible for guiding Chinese managers through the process of assembling Soviet airplane kits.

The "Third Front" strategy, in which Mao dispersed key industries throughout the country for defensive and development purposes, did further damage. "Though this programme received the biggest chunk of financial assistance and consequently strived to link the remote with the urban regions of China," argues defense analyst Deba Mohanty, "it was a failure simply because of the fact that it neither catered to domestic military needs nor did it provide a viable long term solution to China's future military needs."^{xvii}

The Cultural Revolution, which began in 1966, was little help. According to Mohanty, some thirty aviation projects, initiated under revolutionary enthusiasm, failed due to mismanagement.^{xviii} At the same time, domestic civil air traffic collapsed as Red Guards seized control of airports, attacked military units, and subjected passengers to harangues on Mao Zedong thought.^{xix}

4.1.3. The Y-10

Nevertheless, China still managed to break ground on one large civil aircraft project: the Y-10 program. Essentially a reverse-engineered version of the Boeing 707s that China acquired from the United States following Nixon's visit in 1972, the Y-10 was a large jet airliner (178 passengers) with dual-use potential. Mao Zedong and Deng Xiaoping both publicly endorsed the program.

However, by the time the Shanghai Aircraft Manufacturing Corporation (SAMC) delivered the Y-10 in 1980, it was no longer completely Chinese. It relied on salvaged Pratt and Whitney engines and was obsolete as far as the export market was concerned. Nevertheless, one prototype made numerous successful flights. The other sat on the tarmac as a testament to the weakness and strength of Chinese aviation. Weakness, because the Y-10 demonstrated the flaws of Chinese aviation manufacturing: slow development, inability to build engines and power plants, and safety problems. Strength, because China had successfully designed and assembled a large passenger aircraft and flown it. Regardless, both the PLA and the Chinese government declined to purchase the airplane or continue the program.

4.2. The confusion of reform

Deng Xiaoping was rehabilitated after the Cultural Revolution in the late 70s and led the country in a new direction. One of his themes was economic development by the most practical means available. His tool was the Reform and Opening Policy, which attempted to combine internal reform with external trade. However, once the Reform and Opening process began, China's ability to leverage domestic market potential atrophied rapidly. And as the following chapter will illustrate, the Reform and Opening policies applied to domestic manufacturers did not encourage market efficiency or competitiveness.

4.2.1. Defense conversion

In terms of defensive investment in aircraft, the reforms had no noticeable effect. While Deng did deemphasize strategic weaponry in favor of conventional forces, this did not imply a newfound enthusiasm for domestic aircraft production. Deng did not believe that technology spin-off from military industries could drive the economic growth he wanted.^{xx} Instead, he went on a foreign technology-

shopping spree.^{xxi} To this end, in 1979 the Ministry of Aviation established the China National Aero-Technology Import and Export Corporation (CATIC) to handle overseas purchasing and technology acquisition, which included importing foreign planes. CATIC ultimately became CASG.

At the same time, Deng began a process by which defense industries began converting to civilian manufacture. This included the creation of the Commission of Science, Technology, and Industry for National Defense (COSTIND), a military/civilian management agency charged with overseeing defense industry production. However, much of the COSTIND leadership hailed from the strategic weapons side of the military industrial complex. They had no reason to reorient their sympathies towards the aircraft bureaucracy with which they had previously been competing for resources.^{xxii}

Thus Chinese aviation manufacturing did poorly by the defense conversion process. Since the PLAAF retained its relatively low rank in the Chinese military, equivalent to a provincial defense command, aircraft manufacturers lacked a strong patron. Nevertheless, the sector was not converted per se, rather maintained as a defense industry serving a defense market that couldn't afford to invest heavily and that also rejected much of what it produced. At the same time, the airplane factory managers had no contacts in the emerging civil airline sector and no knowledge of that market's specific requirements; instead, they built according to the command economy plan. As one industry source told Mark Dougan, "it is precisely because the plan continues to play the dominant role in civil aviation production that the industry is producing a range of civil aircraft that nobody in the home market really wants."^{xxiii}

This rejection by the PLAAF and the Chinese airlines was far from petty bureaucratic infighting. In the 1970s, quality, production

and maintenance problems resulted in the recall of entire classes of Chinese aircraft to the factories, including the grounding of all 64 Y-7 civil jetliners after one exploded in midair in 2000.^{xxiv} When aircraft were finally delivered, it was generally too late. Like the Y-10, the AVIC-designed J-10 fighter, which entered service in 2004, took 18 years to develop. Rejected by the PLAAF, it is now being sold to the Pakistani air force.^{xxv}

4.2.2. The quasi-market

As far as the airline customer was concerned, Deng's inconsistent implementation of market incentives in the aviation sector produced a "quasi market" in which both political institutions and market forces collaborated to produce irrational and inefficient results. In the areas where aviation manufacturers most needed state support, they were exposed to market forces. Where market forces could have stimulated efficiency and competition, the manufacturers were directed to abide by the plan.

The core problem lay in the fact that instead of "grasping the large and releasing the small," the Chinese government attacked the inefficiency of the airlines and the aircraft manufacturers by dividing the industry into smaller units. This furthered the institutional separation of the producer from the customer i.e. the factories from the airlines. However, since these units remained under state control, they remained insulated from market forces.

The process began with the reduction of CAAC to a regulatory authority and the spin-off of the central airline into smaller airlines. The central government permitted a mixture of market entry into the airline sector from other State Owned Enterprises (SOEs), including banks, provincial governments, and other state-linked actors. Jae Ho Chung's analysis of the political economy of airline manufacturing argues that the reformers originally believed that "localization of control [was] a panacea for all the problems of state

enterprises."^{xxvi} The result, unfortunately, was ludicrous and unproductive overinvestment and fragmentation. The number of airlines increased from one to 41, yet the large airlines retained the overwhelming majority of the passengers while the small airlines flew near-empty (foreign) planes.

On the manufacturing side, the central government created the Aviation Industries of China (AVIC), a single entity intended to make the Chinese aviation sector, both defensive and commercial, a global competitor. However, Beijing did not apply the lesson from its experiment with the airlines to AVIC. In 1999, the government divided AVIC into two separate competing groups (AVIC I and AVIC II). As Peter Nolan pointed out at the time, "while the world's leading aerospace corporations are in the midst of an unprecedented epoch of merger and acquisition, the Chinese aircraft industry is being divided into even smaller components," reducing its responsiveness to the state and the market.^{xxvii}

4.3. The joint ventures

The Y-10 debacle was not a complete loss. In order to better compete with Boeing, McDonnell Douglas decided to enter the Chinese market. The Chinese government leveraged its market power to require McDonnell Douglas to local-source production of the aircraft it intended to sell in China. The wreckage of the Y-10 program would be used as fertilizer. "Design and assembly of the Y-10," argues Peter Nolan, "helped rapidly push SAMC from being a purely aircraft repair into a major assembly company. This in turn helped decide that the assembly of the McDonnell-Douglas aircraft would take place at the site."^{xxviii}

Therefore in 1985 McDonnell-Douglas awarded SAMC a contract to assemble 34 MD-82/83 aircraft, some 29 of which were sold to domestic airlines. This provided precious revenue for reinvestment in machine

tools and other capital goods. It also involved knowledge transfer as Chinese technicians learned how to assemble an FAA-certified aircraft.

The next two ventures were for more sophisticated craft. Satisfied, if not pleased, with the Chinese response to the MD-82, McDonnell Douglas looked to extend the relationship to its next generation, the MD-90 series, proposing to build 150 of the planes, produce them in China and sell them there. At this time Boeing, Airbus, and McDonnell Douglas began to compete in earnest for market share in China. The first cracks in the unified Chinese façade promptly appeared. By the time the MD-90 contract was signed, CAAC only committed to buying 40 of the planes, 20 of which were to be built in the US. CAAC fought off attempts by AVIC to increase the order amount, even rejecting a proposal that AVIC create its own airline to purchase the craft. According to reports, negotiations between AVIC and airline representatives were openly hostile.^{xxxix}

Obviously this reduction damaged McDonnell Douglas' competitive position. When Boeing acquired McDonnell Douglas soon afterwards, it promptly killed the MD-90 program entirely, and with it, China's best chance to take a step up the value chain into more advanced airplane design.

The AE-100 program was a similar joint-venture program signed with Airbus in the early 90s. Again CAAC refused to help. According to industry sources, CAAC executives ridiculed the proposal because they did not believe AVIC could actually build the plane.^{xxx} No advanced orders were placed, and Airbus scrapped the program in favor of a purely European vehicle, the A-318, which Air China promptly purchased.^{xxxii}

According to Nolan, the “double blows” of the start up and subsequent rejection of the two programs devastated the manufacturing sector, which had sunk significant irrecoverable investments preparing to

produce the planes. “Many people in the Chinese aircraft industry felt that it had been let down not only by Boeing and Airbus, but also by CAAC.”^{xxxiii}

Why did the airlines reject the joint ventures? Possible explanations vary. First and most importantly, it is likely that China did not, in fact, have a cost advantage when it came to selling planes. Given the endemic liquidity challenge of airline operations, credit, leasing, and buyback services are vital. Usually planes are leased or provided on easy payment plans. Frequently loans and other incentives are provided to the customer by the manufacturer itself, or by its host government.

However, at the beginning of the reform period, the Chinese domestic credit market was not in a condition to provide massive credit lines and easy payment plans for AVIC customers. The international aircraft leasing consortia, on the other hand, were able to take advantage of international tax loopholes to depreciate the value of the planes they leased in multiple countries concurrently. Thus Chinese aircraft were, in fact, more expensive (and far more risky) than foreign craft, since the Chinese manufacturers required cash payment upfront.^{xxxiiii} Indeed in one case an American company purchased a number of Chinese-made MD-82s, then turned around and re-leased them back to a Chinese airline, leading other Chinese airlines who had paid sticker price for Chinese MD-82s to accuse AVIC of price-gouging.^{xxxv}

Pettier concerns also played a role. For example, the AVIC factories had little to offer airline purchasing managers in the way of boondoggles like foreign travel. McDonnell Douglas' Gareth Chang, a connected Shanghaiese in charge of the joint venture project, could have offered such perks. Instead he bypassed the local purchasing managers and went straight to the Deng Xiaoping, who he knew through his father, to authorize the project, allegedly angering many of the airline managers, who were being

romanced by Boeing on the side. The result was that while Chang's top-down strategy successfully jump-started the MD-82 project, it also added to the already existing bad blood between AVIC, CAAC, and the airlines.^{xxxv}

Therefore most of China's attempts to affect sustainable technology transfer through joint ventures were either stillborn or failed to gain traction.

However, the joint venture period is not over. Embraer has entered the Chinese market through joint venture with AVIC II's Haerbin plant. At the same time, AVIC I's once purely-domestic ARJ-21 project has become a joint venture with Canada's struggling Bombardier. Both projects will compete against each other in the domestic market. They will be discussed further in this paper.

4.4. Post Deng: the ascendance of outsourcing

Following the absorption of McDonnell Douglas by Boeing, Boeing and Airbus began competing directly for Chinese market share without the confusion of a local alternative. Like McDonnell Douglas, they allowed for offsets, subcontracting, and research and development activities to be conducted in China in order to gain sales leverage.

In 2006, Boeing announced some \$600 million in procurement contracts from various Chinese suppliers and trumpeted the \$730 million it has already spent. The new head of Boeing China, David Wang, was frank in describing his expectations of quid pro quo. "We have not demanded more orders . . . but we think that because we work closely with the Chinese, we will get our fair share."^{xxxvi} However, this sum should be compared to the \$7.2 billion bill Boeing recently presented to China for 60 new Dreamliner jets.^{xxxvii}

At the same time, Airbus committed to assembling 150 A-320 aircraft in a plant in Tianjin for sale into the Chinese market.^{xxxviii}

Boeing's Wang snorted at the proposal. "We do not believe symbolic investments lead to good business partnerships," he said.^{xxxix}

Is Airbus' investment, in fact, symbolic? Airbus estimates that just 5% of the plane's components will be produced by Chinese companies, comprising exit doors and engine mounts.^{xl} Nevertheless, assembling aircraft is not symbolic as the integration of the disparate systems and components is a key skill for an independent manufacturer.

The substance of Boeing's Chinese supplier relationships, on the other hand, may also be questioned. According to Boeing's backgrounder, in addition to producing doors and engine mounts for the 737, Chinese contractors are providing the rudder, wing-to-body-fairings, and vertical fin leading edges for the Dreamliner. However, on Boeing's corporate website, while other international development team members are listed by country and firm, no Chinese manufacturers are mentioned. Credit for the allegedly Chinese components is given to Boeing Fabrication.^{xli} Explanations for this vary; Boeing may be wary of advertising Chinese participation in its most advanced program. One industry source suggested that Boeing concealed its Chinese components due to security concerns, but this is not credible since a) Boeing advertises the components elsewhere and b) Boeing is obligated to inform the US government about Chinese participation.^{xlii} Another pervasive industry rumor suggests that Boeing does not, in fact, actually use the components Chinese companies provide, but instead sends them directly to the warehouse, sparing itself the trouble of testing them.^{xliii} There is no evidence to support this rumor, however if it is true, it might explain why Boeing does not declare the usage of Chinese components in the Dreamliner; such statements might be considered fraudulent under US law.

5. Key recent developments

The Chinese civil aviation manufacturing sector's recently enjoyed several boosts which are particularly significant in light of the history of the sector. The developments include the following:

1. **Market protection:** In 2007, the Chinese central government imposed a freeze on aircraft purchases on domestic airlines, *unless those aircraft are Chinese*. This policy may benefit the ARJ-21 (Asian Regional Jet for the 21st Century) program. Depending on interpretation, it may also include support for the ERJ-145 joint venture. This development must be considered in the light of the recent contract China signed with Airbus to purchase 160 A320 jets.^{xliv}
2. **Ownership consolidation:** In 2006 the Xi'an Aircraft Corporation announced a deal to purchase the ARJ-21 factories from its AVIC-I parent company using a publicly traded stock swap.^{xlv} This may indicate the ultimate reversal of previously mandated fragmentation and over-diversification by means of the stock market. It also means the control of the ARJ-21 program has finally been rendered to Xi'an, which is allegedly the most sophisticated factory in the country.^{xlvi} Additionally, the utilization of the international stock market should improve management transparency and accountability. Similarly, China announced plans to create a new company to build its proposed jumbo jet program. This new company's shares will be jointly held by AVIC I, AVIC II, and unspecified airlines.

Liang Zhenhe, vice-president of AVIC II, told the China Daily that the new project "must give full play to the initiatives of both central and local authorities. It also needs to stimulate

the enthusiasm of Chinese airlines because they will be the end users."^{xlvii}

This statement is significant in two ways. First, Liang is reassuring local factories and airlines, who have resisted central control in the past, that their independence will be preserved. At the same time, by distributing shares more widely, China hopes to resolve the previously existing incentive disconnect between the airlines and the AVICs through shared ownership, as opposed to bureaucratic authority.

3. **Domestic market support:** In 2006 Hainan Airlines purchased 50 ERJ-145s, half of which will be produced in China. The sale was announced at a political summit; therefore it is unclear whether the driver behind the order was politics or business.^{xlviii}
4. **Credit and financial services development:** China's capital surplus has contributed to the development of a domestic airplane leasing service sector, which has begun to lease domestically-manufactured airplanes.
5. **Key foreign collaborations:** As noted previously, China has contracted with Bombardier to produce the ARJ-21 series. This may ameliorate management and quality control challenges, and the presence of a Canadian partner may also improve the program's lobbying position vis-à-vis the American Federal Aviation Administration certification process. Without such approval, the program will continue to face challenges recovering its initial investment.^{xlix}
6. **Management:** The aforementioned Airbus assembly plant in China will provide Chinese managers a key opportunity to study the most modern management, integration, and quality control techniques. At the same time

China announced its intention to purchase more Airbus jets, Airbus announced more investments in Haerbin to build components.¹

7. Institutional empowerment: It appears that at long last the aviation manufacturers have been cleared to partner with domestic carriers and thus influence their purchasing decisions.^{li} This is a wild card factor which may or may not ultimately prove significant, but it does indicate a new level of political support as such proposals were rejected in the past.
8. Relaxation of military control of airspace: One of the largest problems shared by both the Chinese airplane manufacturers and the airlines is the current near-monopolization of airspace by the PLAAF. One of the reasons the Chinese government is restricting airplane purchases is not because there is no demand for the planes, but rather because there is little room to fly them in.^{lii} This cramped China's market potential. However, China's General Administration of Civil Aviation recently announced its intention to align China's civil airspace allocations with international norms by 2010.^{liii}

6. Remaining Obstacles

6.1. The WTO

The ARJ-21 700 is a niche aircraft, designed for China's uniquely high, hot, and short runways. This may explain the lack of foreign objections to the program. However, the jumbo jet liner envisioned in the current 5 Year Plan and the second generation ARJ-21 900 project are both intended to compete directly against foreign manufacturers. If China successfully brings such planes to market, and attempts to grant them protection

and subsidies, protests will likely be lodged with the WTO.

The liberalizing effect of the WTO regime is buttressed by the realities of the industry. Given the quid pro quo involved in joint ventures, offsets, and subcontracting, China must allow room for foreign competitors/collaborators to sell into China in order to secure the technology and managerial skills it needs. In order to balance this equation, the AVICs also need to sell into foreign markets.

While I argue that the current protective restrictions on new aircraft purchases are significant, these restrictions expire in 2010. The ARJ program needs 15 years to break even.^{liv} In short, the window for more significant state incubation is closing rapidly. This means that what is to most observers China's most obvious advantage—its large domestic market—is now at least partially a mirage.

6.2. Management

An examination of AVIC management is particularly critical. While the improvements listed above are all significant, none of them implies that there has been a sea change at the level of management competence, where it is most grossly needed. As one frustrated foreign executive once griped, "we gave them the tools in 1986 and they are *still* not managing."^{lv} While China has had little difficulty producing engineers, the AVICs have been unable to hire and retain experienced management.

While it is difficult to establish which managers in the 560,000 employee AVIC behemoth are actually producing aircraft (non-aviation products comprise more than 80% of AVIC revenues^{lvi}), several sources agree that most AVIC management lacks appropriate qualifications. "Most of them will have a bachelor's degree; some of them on paper will have a master's degree . . . more honorary than anything else. They spend most

of their time, if they're getting further education, at the Party School or at a General Electric two week management program.”^{lvii} The source argued that lack of business acumen was a decisive difference between the highly successful Chinese shipbuilding sector and AVIC. The source claimed that China State Shipbuilding Corporation management was staffed by MBAs and engineers, whereas AVIC remains “a ministry masquerading as a corporation,” headed by politically connected bureaucrats with no business management experience.^{lviii}

However, AVIC management behavior is not irrational in context. Faced with a strong mandate to produce revenue and avoid debilitating layoffs, and understanding quite well the difficulties they face in finding customers for their airplanes, the decision to make refrigerators instead is logical. Refrigerators are quicker, easier, and more profitable to produce.

The management problems are not insuperable as they have been resolved before. For example, by the end of the McDonnell Douglas joint venture, McDonnell Douglas had cut back its American management complement from 110 down to 16, the FAA required minimum. However, the retention of such experienced managers remains a human resource challenge. Aviation talent is a highly fungible commodity, which reduces China's cost advantage.

6.3. Competition

In addition to the aforementioned challenges, the regional jet market in which China is choosing to compete is rapidly saturating. Russia and Japan are also entering the fray. Japan's Mitsubishi, the erstwhile producer of the Zero fighter craft (and of the failed civil aircraft programs in the 60s), is reentering aircraft manufacturing after a long hiatus; its Mitsubishi Regional Jet (MRJ) will compete directly against the ARJ-21, the ERJ series, and the Russian Sukhoi 100. “There remains

the question,” notes Aero News, “of whether the regional market is healthy enough to support another entry.”^{lix}

7. Conclusion

The Chinese government's newfound support for airplane manufacturing in terms of policy and rhetoric is helpful, even if its greatest effect is improved morale. The utilization of the stock market to facilitate the rationalization of sector's ownership and management structure is significant. Increasing orders from domestic airlines indicates improvements in marketing strategy, political leverage, and/or credit services. Given China's capital surplus, domestic aircraft leasing industry may well prove to be a key player in the years to come. The quality of foreign joint ventures may still be questioned, but the fact that China continues to extract local sourcing agreements from foreign partners indicates the attraction the Chinese domestic market continues to yield.

As argued, many of the “boosts” may be short-lived. Sustained protection of the domestic market will impede exports. Unfortunately, it is precisely this inability to sell planes abroad that engenders a domestic marketing problem; no one trusts the AVICs' internal quality control. Airlines have little incentive to risk their FAA certifications to help the AVICs. Foreign approval will engender domestic acceptance, not the other way around.

Second, the condition of the manufacturing sector is still dependent on the yet-to-be realized rationalization of the Chinese airline sector.

Third, the goal of producing a 100% domestic plane is itself increasingly obsolescent. Whether the ARJ-21 and the ERJ-145 joint ventures are accepted by the market or not, the key metric is the net economic value added to aircraft by Chinese factories. Doors, fairings, wingtips, and foreign-directed assembly services are lower on the value chain

than radar, control systems, and engines, and have much less spin-off potential. However, so far the ARJ-21 and the ERJ-145 remain highly dependent on higher-value foreign components.

The Chinese government is not ignorant of these challenges. In an article in the *China Daily*, the responsible government officials acknowledged the challenges and recognized the window of opportunity is closing. Liu Daxiang, the previously quoted head of AVIC I, told the *China Daily* that “if China does not roll out its own trunk liner by 2020, then the country will not succeed in 2030 or 2040. So it is really a rush.”^{lx} An unidentified source quoted in the article claimed that the government had received a report on the industry that argued that management skill development is more important than the acquisition of the most advanced technologies. It is likely, therefore, that the previously mentioned policy changes were made with this sense of urgency in mind.

What would a successful Chinese competitor mean? For China, pride, profit, and technological advance. For China’s competitors, increased economic and military competitiveness. Civil aviation is one of the few sectors in which the US still enjoys a decisive trade advantage over China. The dual-use capability of long-range aircraft would also help China to address a significant military deficiency: a lack of long-range bombers that could project power across the Pacific Ocean. A China that successfully produces a 100% domestically-sourced aircraft would indeed impact stability and could affect the security status quo.^{lxi}

However, we must allow for three distinct definitions of success. The first is China’s formal goal: an airplane designed and assembled from the ground up by Chinese firms, made up of entirely Chinese components.

The second is Japan’s definition of success. To date, Japan has not designed and

assembled a large civil aircraft. Its strategy has been called “succeeding without flying,” because it measures the success of the program by the economic value added to aircraft by Japanese component manufacturers. This strategy has developed a powerful Japanese aviation component industry; Japan is now building some of the most sophisticated components in Boeing’s latest 787 jetliner, and there are compelling arguments that it is Japan, not China, who is best positioned to compete with Boeing and Airbus in the near future.^{lxii}

However, the definition of success that China appears to have adopted for the time being is more brand-oriented; the production of civil aircraft that has “Made in China” stamped on the wings yet relies on foreign components to perform the most sophisticated functions. This strategy may produce a plane that flies and sells well, but in the short term it will provide more pride than profit, and little technology transfer. Therefore the impact of such success on China’s competitors would be less drastic. While it might position China to compete directly with Airbus and Boeing’s design, integration, and assembly services, it would not position China to compete in the most sophisticated part of the market. It is also important to remember that neither the ARJ-21 nor the ERJ-145 is an original Chinese design.

Nevertheless, the temptation to call such a strategy “flying without succeeding” must be resisted. First, China must remain particularly wary of a pyrrhic victory in aviation. Direct economic competition with the US and Europe in the aviation sector carries other risks, particularly given that the US aviation sector is already shedding jobs.^{lxiii} Chinese leadership is also aware that unlike Japan, increased Chinese outbound direct investment in foreign component manufacturing clusters would be subject to particularly rigorous security review, which may be why China did not include a single Chinese aviation manufacturer on its 2007 investment tour of

Washington State, the heart of the US aviation cluster.^{lxiv}

Therefore a strategy that produces a plane of which China can be proud without further aggravating dialogues with the US and Europe is not without its advantages. China does, after all, have other sectors in which it can invest its capital surplus, and it must also consider the demand for improved public goods from the impoverished interior. In short, while China's new strategy may well produce a plane that flies, the dream of a 100% domestically sourced aircraft will most likely remain on the ground.

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