Insight: Unable to copy it, China tries building own jet engine

David Lague and Charlie Zhu, Reuters

(Reuters) - China has designed nuclear missiles and blasted astronauts into space, but one vital technology remains out of reach. Despite decades of research and development, China has so far failed to build a reliable, high performance jet engine.

This may be about to change. China's aviation sector is striving for a breakthrough that would end its dependence on Russian and Western power plants for military and commercial aircraft.

Beijing is evaluating a 100 billion yuan ($16 billion) plan to galvanize a disjointed and under-funded engine research effort, aviation industry officials say. The giant, state-owned Aviation Industry Corporation of China (AVIC), China's dominant military and commercial aviation contractor, has been lobbying hard for the extra money, officials familiar with the details say.

AVIC, with more than 400,000 employees and 200 subsidiaries including 20 listed companies, has already set aside about 10 billion yuan of its own funds for jet engine development over the next three years.

The engine financing plan is under high-level discussion in Beijing, said Zhao Yuxing, an official at the securities office of Shanghai-listed Xi'an Aero-Engine Plc, a key military engine-making unit of AVIC. "What we know is our company has been included in the strategic program, which is designed to greatly develop and support the engine industry," he said by phone from his company's headquarters in the northwestern city of Xi'an.

China's military industry as a whole has suffered from Tiananmen-era bans on the sale of military equipment from the United States and Europe. Moreover, foreign engine-makers have been loath to transfer technology. That has prevented China from taking its usual route to closing a technology gap: copying it.

Some Chinese aviation industry specialists forecast that Beijing will eventually spend up to 300 billion yuan ($49 billion) on jet engine development over the next two decades.

"China's aircraft engines have obviously been under-invested," said Wang Tianyi, a defense sector analyst with Shanghai's Orient Securities. "One hundred billion yuan is not a huge amount of money in the engine world."

JEALOUSLY GUARDED SECRETS

While AVIC's long term priority is to develop high performance engines for military aircraft, it is also trying to design power plants for passenger aircraft in the world's fastest growing civil aviation market. Based on projected demand from Western aircraft manufacturers, engines for new passenger aircraft delivered in China could be worth more than $100 billion over the next 20 years.

"Historically, all major players in aerospace have possessed both airframe and engine design capabilities," said Carlo Kopp, the Melbourne, Australia-based founder of Air Power Australia, an independent military aviation think tank. "Until China can design and produce competitive engines, the performance and capabilities of Chinese aircraft designs will be seriously limited by what technology they are permitted to import."

For China's aviation engineers, the traditional short cuts of extracting intellectual property from foreign joint venture partners or simply copying technology from abroad have so far delivered minimal results.

Foreign engine manufacturers including General Electric, Snecma, a subsidiary of French aerospace group Safran, Rolls Royce Plc and Pratt & Whitney - a unit of United Technology Corp, jealously guard their industrial secrets, limiting the transfer of know-how and opportunities for intellectual property theft.

However, China may be poised to win access to technology from an expanding range of commercial aviation joint ventures with these companies. China's ability to develop engines for passenger aircraft could have considerable potential for technology transfer to the military, experts say.

THE BOTTLENECK IN ENGINES

Under AVIC's plan, fragmented engine research and development would be consolidated to minimize competition and duplication of effort.

A legacy of Maoist-era dispersal of defense industries, engine research institutes and aerospace manufacturing companies are scattered about the country in cities including Shenyang, Xi'an, Shanghai, Chengdu and Anshun.

AVIC plans to inject its major engine related businesses into Xi'an Aero- Engine as part of this consolidation, the listed company said in its 2011 annual report. "There is widespread consensus that engines have become a bottleneck constraining the development of China's aviation industry," the report said.

China faces a daunting challenge. Only a handful of companies in the United States, Europe and Russia have mastered this expertise.

"Modern jet engine technology is like an industrial revolution in power," said Andrei Chang, a Hong Kong-based analyst of the Chinese military and editor of Kanwa Asian Defence Magazine. "Europe, the U.S. and Russia have hundreds of years of combined experience, but China has only been working on this for 30 years."

Established manufacturers have labored on research and development since the 1950s to build safe and reliable engines with thousands of components that function under extremes of temperature and pressure. This involves state-of-the-art technologies in design, machining, casting, composite materials, exotic alloys, electronic performance monitoring and quality control.

Since then, the big players have collected vast stores of performance and operational data from existing engines that gives them a head start in designing new versions with improved fuel efficiency and reliability that airlines now demand. And, for commercial engines, all of the design and manufacturing processes must be carefully coordinated and exhaustively documented to satisfy aviation certification authorities.

"The reason so few can do it is because it is really, really difficult," says Richard Margolis, a former regional director of Rolls Royce in northeast Asia.

High performance military jet engines are crucial to Beijing's long term plan to increase the number of frontline fighters and strike aircraft in its air force and naval aviation units. These aircraft are a key element of a long term military build-up aimed primarily at securing military dominance over Taiwan and a vast swathe of disputed maritime territory off China's east and southern coasts.

Due to the export bans on military equipment to China, Beijing has been forced to rely on imported fighters from Russia, reverse engineered copies of these Russian aircraft, and some home-grown designs. This strategy has delivered rapid results. Since 2000, China has added more than 500 advanced fighters and strike aircraft with capabilities thought to equal all but the most advanced U.S. stealth aircraft. At the same time, it has also sharply reduced the number of obsolete aircraft based on Soviet-era designs, military experts say.

MANUFACTURING PROCESS

A clear example of this progress was on display recently when a Chinese-made J-15 jet fighter practiced "touch and go" circuits on China's first aircraft carrier, the newly commissioned Liaoning. These maneuvers suggest that J-15 pilots and crews will soon master take-offs and landings from the carrier at sea.

Foreign and Chinese military experts were quick to point out that the J-15, one of China's newest military aircraft, was powered by a pair of Russian Al-31 turbofans - they power almost all of China's frontline aircraft. Reports in the Russian media say Moscow has sold more than 1,000 engines from the A1-31 family to China with further, substantial orders in the pipeline.

While Chinese engineers have been able to reverse-engineer Russian airframes, the engines have been much more difficult to copy without access to the complex manufacturing processes. AVIC subsidiary and China's lead military jet engine maker, Shenyang Liming Aero-Engine Group Corporation, has been working on a homegrown equivalent, the WS-10 Taihang, but this power plant has so far failed to meet performance targets after testing on the J-15 and other fighters, Chinese and

Western military experts say.

The Chinese military is expected to introduce another 1,000 advanced fighters over the next two decades, according to Chinese defense sector analysts. However, anger over reverse engineering and wariness of China's growing military power has made Moscow reluctant to supply engines more advanced than the Al-31. Without imported or locally built versions of these engines, China will be unable to build aircraft that could compete with the latest U.S. or Russian stealth fighters, experts say.

While military jets are strategically important, the commercial market is potentially much bigger. Boeing forecasts China will need an extra 5,260 large passenger aircraft by 2031. Bombardier Inc. projects demand for business jets will reach 2,400 aircraft over the same period. With each aircraft requiring at least two engines plus spares, total demand could reach 16,000 engines with an estimated average cost of $10 million each at current prices.

China plans to compete for some of these aircraft orders with two locally built passenger aircraft, the 90-seat ARJ21 regional jet and the 150-seat C919. GE will supply engines for the ARJ21. CFM International, a joint venture between GE and France's Snecma, won the contract to develop new engines for the C919. Some of these engines will be assembled at joint ventures in China.

Despite the intensified research effort and potential for technology transfer from these ventures, some experts say foreign engines will continue to rule the skies in China. "This won't change for 10 or 15 years," says Chang from Kanwa Asian Defence Magazine.

(Editing by Bill Tarrant)

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