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Issue Brief

EMBRAER: Brazil's Aviation Success Story

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S*ummary*

Compared to EMBRAER, HAL has had to contend with the requirements of the Indian Air Force for large numbers of combat aircraft. This has inevitably had implications for HAL's priorities and the company has made minimal efforts in respect of civil aircraft, with the attendant lack of market presence and penetration. HAL's ventures with producing the HS.748 and Dornier Do.228 were largely for the Indian military market, with few being sold to civilian airlines. It is difficult for India's aviation sector to replicate EMBRAER's success without perhaps a reorientation of priorities.

The Brazilian aviation company EMBRAER has carved out a niche for itself in the turbo-prop trainer and civil aviation markets. Since its founding in 1969, EMBRAER has made a concerted effort to produce civilian aircraft as well as to seek export markets for its products. With respect to both civil aviation and training aircraft, the company has been able to secure an impressive share of the global market. However, it is to be noted that EMBRAER's military aircraft design and production capabilities are very modest, a reflection of the priority given to transport aircraft for the civilian market.

Government to Private Company

Brazil made several efforts in the 1940s and 1950s to initiate a domestic aviation industry but it was only in 1969 that the Empresa Brasileira de Aeronáutica (EMBRAER) was formed. In stark contrast to India's Hindustan Aeronautics Limited (HAL), EMBRAER was never tasked with nor given responsibility for designing, developing or licence-producing advanced combat aircraft for Brazil's air force. This trend continues to the present day. EMBRAER has the ability to upgrade the Força Aerea Brasileira's (FAB) fleet of F-5s but has not manufactured either engines or advanced avionics for combat aircraft.

EMBRAER started off as a government entity, but was sold on 7 December 1994 as part of a broader sale of government assets during a period of economic turmoil and hyper-inflation, though the Brazilian government holds *golden shares* ensuring veto power.¹ The sale also allowed EMBRAER to narrowly avoid bankruptcy. In 2000, the company made initial public offerings on both the New York Stock Exchange and Brazil's Bovespa, and its ownership is as follows: Bozano Group 11.10 per cent, Previ 16.40, Sistel 7.40, [Dassault Aviation](#) 2.1, [EADS](#) 2.1, [Thales](#) 2.1, [Safran](#) 1.1, [Government of Brazil](#) 0.3, Oppenheimer Funds, Inc. 12.29, pt:Caixa de Previdência dos Funcionários do Banco do Brasil 6.71, Baillie Gifford 6.46, and BNDESPAR 5.31 per cent.²

Privatisation has meant that the profit motive has become important for EMBRAER. Its development projects and production processes are calculated to deliver products on a cost-effective basis rather than seeking to develop a holistic aircraft design and manufacturing capacity through technology transfer and licence-production. However, the Government of Brazil has continued to subsidise the company despite its private nature. This led to a number of World Trade Organisation (WTO) disputes

1 R. A. G. Monks, N. Minow, *Corporate Governance* (John Wiley & Sons: New Jersey, 2008) pp. 356–59.

2 EMBRAER Investor Relations, "Capital Ownership," at <http://ri.embraer.com.br/show.aspx?idCanal=ltPlKaoPDWiQ1uj7aoUw6Q==&linguagem=en> (Accessed 1 July 2017).

involving EMBRAER and Bombardier of Canada, which resulted in both countries being deemed to have run illegal subsidy programmes for their aviation industries.³ These disputes cover the period 1999-2000 and involved cross complaints by the respective parties. Since then, it does not appear that the subsidies have been reinstated and EMBRAER functions as an entirely private entity that receives orders from the Brazilian government.

Product Mix: Civil Success

The most prolific project to date undertaken by EMBRAER was the assembly of Piper light aircraft from knocked-down kits. Over three decades, starting in 1974, well over 2000 Pipers of various types had been manufactured in Brazil. The demand for these aircraft was extensive in Latin America where light aircraft form a crucial component of the transport and communication system – over 1000 Pipers were sold in Brazil alone within four years of the venture starting.⁴ This emphasis on civilian and dual-purpose aircraft allowed EMBRAER to develop a broad customer base as well as to satisfy the modest requirements of the FAB for transport aircraft.

EMBRAER's first indigenous design venture was to set the stage for its development path. Rather than opting for combat aircraft or even trainers, EMBRAER chose to produce the EMB-110 Bandeirante, a turboprop regional airliner which was designed in 1965 by a French engineer – Max Holste.⁵ This aircraft established EMBRAER as a reliable manufacturer of cost-effective transport aircraft. Between 1968 and 1990, over 500 of these aircraft were produced. Today, 38 survive in service with 14 airline operators, alongside 48 with the FAB.⁶ A maritime patrol variant, the EMB-111, achieved limited export success with the navies of Chile and Argentina. This was followed by a larger version – the EMB 120 – which again achieved commercial success with over 350 produced and sold.

Post privatisation, EMBRAER began to emerge as a manufacturer of regional jets and transport aircraft intended for the civilian and export markets. Variants of the EMBRAER Regional Jet (ERJ) (890 in service), the EMBRAER E-Jet (1317 in service) and the EMBRAER E-JetE2 (233 on order) families with capacities of between 37 and 146 passengers have proven to be an export success for the company.⁷ Its most

3 World Trade Organization, *Brazil – Export Financing Programme for Aircraft: Report of the Panel*, 14 April 1999, at https://www.wto.org/english/tratop_e/dispu_e/46r.pdf (Accessed 2 July 2017).

4 J.E. Austin, *Strategic Management in Developing Countries* (Simon & Schuster: New York, 2008), p. 609.

5 *Air International*, April 1978, pp. 163–164

6 Flight International, *World Airliner Census 2016*, at <https://www.flightglobal.com/asset/12798> (Accessed 1 July 2017).

7 EMBRAER order book as of 31 March 2017. See also, EMBRAER press release: “Embraer Delivers 18 Commercial and 15 Executive Jets in 1Q17,” 13 April 2017, at

ambitious effort – the KC-390 military transport – makes extensive use of expertise from Boeing and is currently in development.

The ERJ was EMBRAER's breakthrough product and represented an evolutionary process whereby the turboprop EMB 120 was transformed into a turbofan powered jet transport. The versatility of the basic design has been proven with military variants of the ERJ 145 being employed for the Airborne Early Warning (AEW) as well as maritime reconnaissance roles, though the number so used are modest.

Combat Aircraft: Modest capabilities – Trainer Success

In contrast to its diverse products in transport aircraft, EMBRAER's forays into the arena of combat aircraft have been very modest. For many years, 167 licence-built versions of the Aermacchi MB.326GC jet trainer – known as the AT-26 Xavante – formed the backbone of the FAB's combat force, with exports to Togo and Paraguay (and 11 ex-FAB aircraft being transferred to Argentina).⁸

The only other jet combat aircraft manufactured by EMBRAER was the A-1 version of the AMX fighter-bomber. This Italian-Brazilian joint venture clearly shows the willingness of EMBRAER to sacrifice work-share and technology transfer in order to obtain a cost-effective product. In terms of component manufacture, Italy's Aeritalia manufactured 46.5 per cent of the aircraft's components (central fuselage, stabilisers and rudders) and Aermacchi, also Italian, produced 22.8 per cent (front fuselage and tail cone), leaving Brazil's EMBRAER to perform 29.7 per cent of the work (wing, air intakes, pylons and drop tanks).⁹ What is significant is that there was no duplication of effort, with each component of the aircraft built at one source only, and deliveries began in 1989. The A-1 had a modest performance, comparable in some ways to the BAE Hawk, and this was further compromised due to differences in avionics and weapons between the Italian AMX and Brazil's less well-equipped aircraft. With some 60 aircraft still in FAB service, the type forms an important part of the country's air force.

In contrast to this modest, though by no means insignificant, jet combat aircraft, EMBRAER has achieved considerable success with its turboprop trainers – the EMB-312 Tucano and its successor the EMB-314 Super Tucano which are easily among the best of their type.

<http://www.prnewswire.com/news-releases/embraer-delivers-18-commercial-and-15-executive-jets-in-1q17-300439326.html> (Accessed 1 July 2017).

8 A.C. Alamino, "EMB-326GB AT-26 Xavante," *History of the Brazilian Air Force*, at <http://www.rudnei.cunha.nom.br/FAB/en/at-26.html> (Accessed 1 July 2017).

9 B. Gunston, and P. Gilchrist, *Jet Bombers: From the Messerschmitt Me 262 to the Stealth B-2* (Osprey: London, 1993), p. 289.

In the late 1970s, faced with an urgent need to replace its force of T-37 trainers, and also reeling from the impact of high oil prices, the FAB issued a requirement for a new trainer that would be cheap to operate, mimic the characteristics of jet aircraft and have ejection seats.¹⁰ The result was the turboprop EMB-312 Tucano which entered FAB service in 1983 as the T-27. The Tucano received a boost when the Royal Air Force procured a version modified by Short Brothers as the EMB-312S to fulfil its basic training role. An additional sale to France added to the attraction of the type. With two NATO air forces opting for the type, the Tucano was able to secure export sales throughout Latin America, Africa and the Middle East with 624 aircraft produced.¹¹

While a sound aircraft, the Tucano was unexceptional in performance. However, thanks to the FAB's requirement for a cost-effective strike aircraft, the T-27 morphed into the armed AT-27 counter-insurgency aircraft, with roles being interchangeable. Coming at a time when older aircraft such as the AD-1 Skyraider, AT-6 Texan and the T-28 Trojan were being phased out, the Tucano filled a void most admirably.

The Tucano's closest rival was the Pilatus PC-7. Although the Pilatus secured many successes as a trainer, Swiss restrictions on its use as a combat aircraft allowed the Tucano to secure customers interested in dual use capabilities. The FAB, for example, uses the Tucano extensively to patrol the Amazon region and intercept illicit flights.¹² Colombia turned the aircraft into a formidable strike aircraft in its long-running war against leftist guerrillas.¹³

In light of the Tucano's success, EMBRAER began work on an improved type which entered service in 2003 as the EMB-314 Super Tucano. Known in FAB service as the A-29, the Super Tucano was optimised to fill both the attack and training roles, with a single seat version known as ALX entering FAB service. With 200 aircraft already sold – winning the US Light Air Support aircraft competition for supply to the Afghan Air Force – the Super Tucano has established itself in Asia, Africa and Latin America as a combat aircraft with a secondary training role.¹⁴ As a light strike aircraft, the Super Tucano appealed to countries seeking to replace ageing assets such as the OV-10 Bronco and the Cessna A-37 Dragonfly with a cost-effective platform. To this

10 J. Frédriksen, *International warbirds: an illustrated guide to world military aircraft, 1914–2000* (ABC-CLIO: Santa Barbara, 2001), p. 102.

11 Flight International, *World Air Forces Directory 2011*, at <https://www.flightglobal.com/about-us/airspace-announcement/> (Accessed 2 July 2017).

12 J. Frederico, in O. Karina ed., "[A caça na Amazônia](#)" (PDF). *Aerovisão* July 2003 Rio de Janeiro, Brazil: Centro de Relações Públicas da Aeronáutica. 31 (207): 36–37. (Accessed 2 July 2017).

13 S. Roblin, "The Deadly Super Tucanos of South America," *War is Boring*, 10 September 2016, at <https://medium.com/war-is-boring/the-deadly-super-tucanos-of-south-america-32934b879627> (Accessed 2 July 2017).

14 D. Majumdar, "Super Tucano beats out AT-6 for Afghan Light Air Support tender," *Flight Global*, 27 February 2013, at <https://www.flightglobal.com/news/articles/super-tucano-beats-out-at-6-for-afghan-light-air-support-tender-382842/> (Accessed 2 July 2017).

end, it replaced the latter type in the Dominican Republic and the former type in Indonesia.

In FAB service, the aircraft has distinguished itself during Operations Agatha 1-3 in which its effectiveness in counter-narcotics operations was proven.¹⁵ Colombia, on the other hand, has turned the Super Tucano into a sophisticated strike aircraft, equipping it with laser-guided bombs to conduct precision strikes against FARC rebels.¹⁶ This flexibility augurs well for future sales of the type.

How did EMBRAER achieve success?

The inevitable question arises as to how a company with a hitherto limited repertoire could emerge as a major manufacturer of civilian airliners and establish itself as an exporter of basic training aircraft. In part, the answer lies in EMBRAER's ability to find a lacuna in the existing airline market and aggressively market its products to carve out a niche for itself. In the case of its basic training aircraft, a combination of a sound design and good timing enabled the company to capitalise on the bloc obsolescence of long-serving training aircraft as well as older piston-engine light strike aircraft. As will be noted, even from its earliest designs, EMBRAER has always sought civilian and export markets for its products. Exports were not an "optional extra" but a priority for the company from its inception. The privatisation of the company in 1994 gave a further impetus to a strong culture of seeking export markets which was assisted by an enhanced product range.

Another aspect is an incremental approach to the development of new aircraft – the EMB 110 being followed by the larger EMB-120 and thereafter by the turbojet ERJ family. A similar approach was followed in the case of the Tucano which evolved into the Super Tucano. In respect of combat aircraft, EMBRAER has been very careful not to overreach in terms of either design or manufacturing capabilities and to date its sole venture into the sphere of high-performance combat aircraft is the A-1/AMX.

Finally, EMBRAER has had no pretensions of trying to make Brazil self-sufficient in aircraft manufacturing technology – certainly not in combat aircraft. The company outsources supply and, through joint-ventures and subsidiaries, serves as an assembly and integrator of aircraft with materials, avionics, and engines all being sourced from abroad. EMBRAER has not needed to invest effort into indigenising components from foreign suppliers or paying licence fees for components and

15 "Brazilian Armed Forces Conclude Operation Agatha in Region Bordering Colombia," *Dialogo Americas.com*, 1 September 2011, at <https://dialogo-americas.com/en/articles/brazilian-armed-forces-conclude-operation-agatha-region-bordering-colombia> (Accessed 2 July 2017).

16 Op. cit. Note 13.

systems. As can be seen from the A-1/AMX project, EMBRAER has not been bothered with its relatively small proportions of the work-share in joint projects.

The combination of these factors has enabled EMBRAER to concentrate on being a design company which integrates and assembles aircraft rather than attempt to manufacture costly avionics, engines, and other subsystems. Its early emphasis on civil and military exports established the company first regionally and then globally, with export sales enabling the company to fund new design products. By eschewing costly attempts at indigenisation, the costs of EMBRAER's products became more competitive.

Lessons for India?

It is tempting to compare the success of EMBRAER as a major designer and exporter of aircraft with the much less successful efforts of India's HAL. However, it is suggested that such comparisons are not warranted as the two companies have had very different priorities, this being reflected in their product mix and the scope of work undertaken.

HAL has had, from its inception, a strong military bias, seeking to manufacture and indigenise combat aircraft, engines, avionics and subsystems. Through the licence production route, HAL has achieved a significant degree of indigenisation for combat aircraft – the Su-30MKI for example being 51 per cent indigenised by value (53 per cent in the case of the AL-31FP engines) and 73 per cent by component in 2014.¹⁷ Such figures are unheard of for any aircraft made by EMBRAER.

HAL's design efforts which produced aircraft such as the HF-24, the HJT-16 and the HPT-32 were not further developed and much of the company's design capabilities were lost – being only partially reconstituted in the Aeronautical Development Agency tasked with developing the Tejas Light Combat Aircraft. While HAL has achieved some degree of design and manufacturing success with the Dhruv helicopter and its variants, its successor to the HJT-16 (the HJT-36 Sitara) was a failure and the successor to the HPT-32 (the HTT-40) is a work in progress. While the HJT-16 could have achieved a degree of export success (its Mk.2 variant being similar in performance to the BAE Strikemaster), no efforts were made to effectively market or promote the product past a single appearance at Farnborough in 1984.

In addition, compared to EMBRAER, HAL has had to contend with the requirements of the Indian Air Force for large numbers of combat aircraft (even now, the IAF

17 A. Shukla, "First Sukhoi-30 overhauled at Nashik, highlights HAL's growing capability," *Business Standard*, 23 October 2014, at http://www.business-standard.com/article/economy-policy/first-sukhoi-30-overhauled-at-nashik-highlights-hal-s-growing-capability-114102300636_1.html (Accessed 2 July 2017).

operates 10 to 15 times the number of supersonic combat aircraft with the FAB). This has inevitably had implications for HAL's priorities and the company has made minimal efforts in respect of civil aircraft, with the attendant lack of market presence and penetration. HAL's ventures with producing the HS.748 and Dornier Do.228 were largely for the Indian military market, with few being sold to civilian airlines.

It is difficult for India's aviation sector to replicate EMBRAER's success without perhaps a reorientation of priorities. Should India desire to develop a viable, export oriented civil aircraft design and manufacturing capability, consideration may need to be given to allow the private sector, as well as HAL, with incentives if necessary, to initiate work in this sphere with the freedom to outsource components and even design work where necessary without having to expend resources duplicating manufacture of such items.

EMBRAER has shown that this route can lead to success, albeit at the expense of indigenisation. It is submitted, however, that this ought not to be a consideration for civilian aircraft and should India wish to become a manufacturer and eventually an exporter of civilian aircraft this would appear to be the only viable path to take. Brazil's path to success in the aviation sphere demonstrates how a pragmatic approach to aircraft manufacture can lead to success provided that expectations are kept at realistic levels. By not choosing to "re-invent the wheel" and concentrating on making use of existing manufacturers of components, EMBRAER has established itself as a major player in the civil aviation market and its efforts are worthy of emulation.

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