Article

Economic Rivalry, Technological Change and Japan's Industrial Policy for Aerospace

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Abstract

Change in technology and in the policy environment can provide opportunities for firms to enter new markets by leveraging competencies in a new market place. This paper examines the apparent renaissance of Japan's aerospace industry. For decades, Japanese aerospace has failed to attain the international market share enjoyed by Japanese automobiles, machine tools, computer equipment or consumer electronics. Part of this failure relates to the industry's ties to the American aerospace sectors, which constrained the growth options for major firms. However, a new policy environment, motivated in part by China's growth, as well as technological change, it opening up competitive opportunities for Japanese firms, most notably Mitsubishi.

I Introduction

Japan remains the world's second largest economy, and some of its firms enjoy strong competitive positions. However, the country has been afflicted by sluggish growth for the best part of twenty years and the rise of China and other emerging markets have underlined the vulnerability of Japan's highly-skilled industrial base as Japanese firms move production offshore. Though Japanese firms appear to create considerable amounts of intellectual property – as measured by patents, for example – the ability of firms to translate these ideas into viable products and services has been criticised. There is a widespread perception that Japan has ceded design and market leadership to foreign firms in areas such as consumer electronics, semiconductors and computer peripherals.

The relative inability of Japanese firms to adapt to new technologies or seize new market opportunities has been extensively studied in the management literature and both firm-level and national-level explanations have been offered. For some, the primary problem lies inside Japanese firms, where organizational routines and culture inhibit adaptation. Japanese firms are said to embrace a culture of risk aversion and consensus that does not offer the firm the ability to change direction quickly. Collinson and Wilson (2006), for example, suggest that some Japanese firms are 'ill-equipped' to cope with changes in the international business world, reliant as they are on certain organisational routines. Other scholars point to problems with a conservative and over-dominant industrial policy bureaucracy. In her study of the computer software industry, Anchordoguy (2000) explains Japan's failure to develop a world beating software sector as an institutional failure. In this instance, the Japanese government's emphasis on manufacturing excellence led important officials within MITI to disregard the importance of software. For some other authors, the crisis results from a system-level inability of the Japanese developmental state to compete with the more free-market oriented economies of the United States and Europe. Yamamura and Streeck (2003) refer to a 'deep and lasting performance crisis' afflicting Japan as the

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Japanese model of nonliberal capitalism comes under pressure from neoliberal capitalist forces. Witt (2006) examines the extensive social networking among industry personnel and suggests that the incentives created by this system can reward risk aversion and strategic isomorphism. Okada (2006) offers a particularly stark assessment: 'Mechanisms and institutions that brought Japan prosperity in the 1970s and 1980s have become dysfunctional and less useful'.[1]

This paper seeks to add to this debate about the innovation gap among Japanese firms via an analysis of an industrial sector where Japanese firms are aiming to innovate: aerospace. In doing so, the paper shows how the interaction of external events and the internal development of capabilities in a major Japanese firm interact to produce new capabilities. The evidence presented here suggests a more nuanced picture of Japan's industrial landscape. Incumbent firms are taking advantage of changes in the marketplace and doing so by leveraging internal capabilities.[2] This paper suggests that the Japanese manufacturing model may not be a rigidly path-dependent as sometimes portrayed, but rather mixes continuity with important elements of flexibility and openness.[3] What is interesting about the aerospace industry is that it is undergoing considerable technological change, perhaps even a period of technological discontinuity. As such, the ability of an incumbent firm to innovate is noteworthy.[4]

Japan's aerospace industry is small by comparison with other national aerospace sectors but there are indications that Japanese aerospace will see significant expansion in the coming years. Honda, for example, has developed a small jet designed for commuter work. Most significant, however has been the development of a new regional jet by Mitsubishi Heavy Industries (MHI). Announced in 2007, the jet is planned to compete against Embraer and Bombardier in the 100 seat jet aircraft market. This announcement was significant in several respects. First, it would mark the first attempt by Japan to develop a complete aircraft since the YS-11 programme almost 30 years ago. For most of its existence, Japan's aerospace industry has been a subcontractor – mainly to US industry. Second, Mitsubishi made much of the advanced technology embodied in the aircraft; the fuselage would be primarily constructed of carbon fibre and the new engines would anticipate more stringent EU noise and pollution regulations due to come into force in 2009. Finally, the Ministry of Economy, Trade and Industry (METI) acknowledged that the Japanese state would meet 50 per cent of the development costs. METI's strong support of the programme was seen as a clear indication of a renewed interest by METI in pushing Japanese companies to the forefront of airliner technology.

Japan is only one of several countries looking to develop an aerospace sector. China, Russia and even India have all launched serious efforts to enter the market traditionally dominated by European and American firms. The success of Canada and – more importantly – Brazil in the regional market has shown that medium-sized economies are able to support successful aerospace industries. More generally, the evolution of the sector toward greater modularisation and the adoption of new technologies in the face of environmental pressures may represent a point of 'discontinuity' where incumbent firms face threats to their survival.[5] EADS Chairman, Louis Gallois, forecast a 'rupture' in the design and manufacture of aircraft in the face of advances in process and product technologies.[6]

The argument explored in this paper is whether a combination of technological change and rivalry with China are inducing profound change in Japan's sectoral innovation system for aerospace – and that one firm, Mitsubishi, has seized this opportunity. For most of the past five decades, aerospace production was concentrated in Europe and the United States, and this dominance was underpinned by production processes that militated against new entrants and the kind of dispersed production seen in other industries. However, as the industry moves to embrace new product and process technologies, opportunities open up for previously 'second-tier' players such as Japan. In terms of technology, Japan's strength in both composite materials and production technologies has given its firms key roles in new Boeing programmes. This paper

explores whether Japan will build on this strong position to develop a fully-fledged aerospace sector.

A related development concerns the emergence of China as a regional rival to Japan. For decades, it was simply not cost effective to produce civil aircraft in more than one location. In sharp contrast to other manufacturing industries, aerospace was almost bereft of foreign direct investment. Firms were international in the sense that they sold aircraft globally and used international supply networks; none of Airbus, Boeing, Bombardier or Embraer had a production facility outside their home nation (or region in Airbus' case). This is changing. Airbus is committed to building a narrow-body production facility in China, and both Bombardier and Embraer are developing deep cooperative efforts with Chinese producers. The industry may be on the brink of profound shifts in the business model, with equally profound implications for domestic firms and governments. For Japan, China's emergence as a potential Asian rival for aerospace related work and investment would seem to have significant policy considerations. Japanese firms have carved out significant roles in civil programmes but their military capabilities remain modest. Given the flow of technology between civil and military aerospace, this may be problematic – particularly given China's dramatic increase in military spending.

Ⅱ Methodology

Research that touches upon the political process can present problems for researchers. Firms are often unwilling to discuss their activities and access to policymakers can be difficult.[7] Triangulation of data is important to mitigate these problems. Following Eisenhardt's work on case study research this paper draws on a variety of sources for data.[8] Published data in the specialist aerospace press, companies and trade associations offer a detailed timeline for the development of the MRJ project. The paper also makes extensive use of government documents relating to Japanese technology policy and aerospace; importantly, the paper utilises published minutes of the METI committee charged with developing and implementing policy for the MRJ project. Finally, several interviews were conducted, in English and Japanese, between October 2007 and June 2008 with aerospace industry personnel and serving and former METI officials. Most of these were conducted in Tokyo, but one was conducted in the United Kingdom. These interviews were semi-structured in design and detailed notes taken. Interviewees preferred not to be recorded and their names are not used in the text. Interviewees were selected in a non-probabalistic manner appropriate to research where knowledge of the dynamics and detail of a case is important rather than organisational status, per se.

Ⅲ From exceptional to normal: technological change in aerospace

From its inception, aerospace was regarded as an economically exceptional case, justifying government intervention. Moreover, firms in the sector employed relatively specific assets and technologies in product development, which spawned particular forms of economic organization. This may be changing. The emerging model differs from the old in being more decentralised, with greater emphasis on collaboration, as well as technological underpinnings that have both shifted and become more varied. Product improvements in aerospace have generally been incremental, with gradual changes in design; the sector has not seen the dominant design challenged since the dawn of the jet age in the 1950s.[9] Competition in the sector is thus marked by strategic isomorphism, with Boeing and Airbus offering remarkably similar products to customers.[10]

This incremental innovative process has been under pressure in recent years. In terms of production processes, aerospace has come to look much more like other manufacturing industries, with an emphasis on lean production techniques. Starting with the 767 and 777 programmes, Boeing has been increasingly willing to shift away from a hierarchical product development process to a

collaborative network, with much greater involvement of suppliers as designers.

An important change has been the increased use of composite materials in preference to metal. This trend is part of the second pressure facing aircraft makers; incremental technological innovation in aerospace is not delivering the increases in economy and environmental compliance that stakeholders are demanding.[11] As demands on manufacturers have become more numerous and complex, so has the technical challenge of making the aircraft. The response has been to develop increasingly modular modes of production. The drive for weight reductions and environmental compliance has reinforced the specialisation of the supply networks. Key suppliers now take on considerable risk, not just for product but for research and development. More importantly, increasing technological specialisation tilts the power relationship between suppliers and the final assembler. Finally, the importation of lean production techniques and the more general trend toward modular production in the industry has benefited firms that have considerable exposure to non-aerospace activities. Mitsubishi is one such firm.

1 Evolution of Japan's aerospace industry

After 1945, Japan's aerospace industry was effectively placed under the control of the US, which for the first eight years after the end of the war, banned any Japanese manufacture of aircraft. Once the ban was lifted, the United States encouraged the development of some indigenous aerospace capability and the sector's commercial and technological development fell under the aegis of the Ministry of International Trade and Industry (MITI), which was reorganized in 2001 as the Ministry of Economy, Trade and Industry (METI). Aerospace and Defence Industries Division (ADID) of Manufacturing Industries Bureau at METI has a responsibility to promote both the civil and defence aviation industries as well as the space industry. The legal foundation of the industry policy for the aviation industry is the Aircraft Industry Promotion Law of 1958 (Kokuki Kogyo Shinko Ho, No. 150). Beginning in the 1960s, Japan attempted to develop a civil airliner programme designed to act as a technology driver in much the same way as other policies for other sectors, such as memory chips, flat panel displays or supercomputing (Fong, 1998). Though the resulting programme, the YS-11, was a commercial failure, it did little to temper MITI's eagerness to support the sector. Attention was shifted to the creation of co-production agreements with foreign – mainly American – partners. Though Japanese firms gradually increased their workshare on many American (mainly Boeing) civil aircraft programmes, there were suggestions that the relationship militated against Japanese firms from gaining the requisite expertise to develop the capacity to design, build and market their own aircraft.[12]

For most of its history, the Japanese aerospace industry produced military aircraft. This is true to the current day, with some 61 per cent of the industry's turnover generated by military sales – effectively procurement by Japan's Self-Defence Forces.[13] Japanese aerospace firms, like their American counterparts, benefited greatly military procurement, both by providing revenues from procurement but also in allowing a degree of technological development.

The development of the F-2 (FS-X) indigenous fighter is perhaps the best example of the use of a military programme as a platform for technological development. The F-2 programme was conceived in the 1980s as a way for Japan to lessen its dependence on the US for military equipment. The F-2 differs from other Japanese military programmes in not being a licensing agreement: Japanese firms have extensive responsibility for design, as well as production. The programme had been dogged by controversy for years – and the first fighters only became operational in 2004. The F-2 makes much greater use of composite materials in its construction, as well as having more sophisticated computerised flight controls and an indigenously produced source code. A key technological advance is the composite wing – made by Mitsubishi – which dramatically reduces weight and aids manoeuvrability. MHI used the F-2 programme as a test bed for its composite materials design and

production processes. The programme, 'has given MHI hands-on experience in working through difficult composite design and production problems that will serve it well as it undertakes the commercial assignment of producing composite wingboxes for the Boeing 787'.[14] The company, however, also benefited from military research and development funding investigating the use of composite materials for large scale, load-bearing aeronautical structures.

Though military procurement and R&D support was important to Japanese aerospace, the limitations are also noteworthy. Japan's constitutional limits on defence spending never allowed the massive, military-led subsidies enjoyed by US firms during the Cold War. As noted earlier, unlike the US industry, Japan has few specialist aerospace firms; the key firms are all integrated manufacturers with interests in several industries.

Ⅳ The rising challenge from China

On March 12, 2007 Xinhua news agency reported China's plans to produce its own large commercial jet by 2020 and so challenge the dominance of Boeing and Airbus initially in the domestic Chinese market which is booming, and eventually globally. A more serious challenge, however, is presented by China's emergence as an important subcontractor – potentially in preference to Japan – for major western firms and the Chinese' clear plans for an indigenous regional jet. Rather like Japan decades earlier, China is utilising a mix of indigenous technological development and links with western firms such as Boeing to build capability and credibility.

China has long had ambitions in aerospace. A fifty-seat turbo-prop engine regional aircraft was developed in the 1960's.[15] Efforts were stepped up in the 1980's with the reverse engineering of the Boeing 707 to form the Y-10 and development of the Y-7, a turbo-prop regional aircraft. However both models were market failures with insufficient demand in both domestic and export markets. The Y-10 was fuel inefficient relative to the Boeing 707 and the Y-7 faced safety failures. In 2000 the MA-60 (or Xinzhou 60 as it is known in China) was launched, a 56–60 turboprop with an extended fuselage, lighter frame and longer range. The emergence of high-speed rail links made the aircraft uneconomic.[16] China is also developing the 95–100 seater ARJ21 in conjunction with US suppliers such as GE and Honeywell. Whilst about 70 aircraft have been sold, this has been predominantly with domestic sales.[17]

Chinese efforts have been hampered by poor supply chain management and a non-existent capability to market and support the aircraft in the international market. However there are signals on the horizon that things appear to be changing. By making greater use of collaborative agreements with western firms the Chinese buy both technology and market credibility. As important there are indications that the Chinese industry is developing significant research and development capabilities. An indicator of China's emerging scientific strength in the area, 'in 2004 39% of Aerospace Engineering authors were from China although remarkably lower in the case of the Journal of Aerospace Engineering'.[18] So whilst perhaps not reaching world-class levels of either scientific (via publications) or technical (via patents) advancement, China is taking cumulative, incremental steps both in general technological progress and the specific area of aerospace.

As in Japan, military procurement offers Chinese firms a way to develop. China successfully makes transport planes and an array of sophisticated warplanes harking back to their close relationship with the former Soviet Union which enabled China to manufacture several thousand jet fighters and bombers within a large-scale military aircraft industry.[19] Chengdu Aero-engine Company was the largest supplier of jet fighter engines and is a subcontractor of Pratt and Whitney and Rolls Royce, whilst Xi'an Aero-engine Company was historically the location for Spey engines manufactured under license from Rolls Royce and in 1997 it entered a joint venture with Rolls Royce to produce turbine blades.[20] China reached a milestone when the Chinese National Space agency successfully

completed its first manned space capsule in 2004 and China's maintenance, repairs and overhaul (MRO) sector has been opened to foreign investment.

1 Relationships with International Aerospace companies

Overall, China has been a subcontractor for a vast array of parts: doors, wing section, turbine disks, blades, bores, rings, atmosphere instruments, meteorological radar, general radar instruments, pumps and valves. Earlier subcontract work for McDonnell-Douglas in the mid 1980's and 1990's transferred much needed competencies whilst the engine manufacturers GE, Pratt and Whitney, Rolls Royce all continue to do small scale subcontracting work in China.[21]

China has a long history with Boeing having provided parts since 1979, which now include doors, wing panels, vertical fin, horizontal stabilizers and entire tail section for the 737, wing-ribs for the 747 – all large aluminium structures.[22] Additionally, whilst its capabilities in the technological area are limited, China makes the composite rudder for the new 787. Indeed Boeing is China aerospace's largest foreign customer having purchased about a billion dollar's worth of hardware and further orders to the value of $2.5 billion.[23]

Airbus's association with China is shorter with agreements that China would participate in the development of its A318 programme, that work on doors and fin fairings for a number of models and the A320 wing components would be given to China (Nolan and Zhang, 2002). In 2005 Airbus announced its commitment of a 5% risk-sharing partnership stake for the Chinese in the A350 project and plans to establish a training facility in Beijing. In time, the company plans to open a final assembly facility in China.[24]

2 Demand led industrial growth

Perhaps the greatest factor which supports China as a potential competitive threat in the long-run is the enormous growth of demand for aircraft in its domestic market increasing. Airbus, for example, forecasts demand for passenger travel in China increasing 6.8 per cent per year from 2007–2026.[25] Regional jets account for just 12% of the total fleet whilst the world average is 35% and Embraer believe China could buy 635 jets between 2004–2023.[26] The increased commitment of resources to China of the global aircraft players as reported above reflects their strategic aims to capture a proportion of this market potential.

V Aerospace and Japan's Industrial Future

Developments in the aerospace sector cannot be understood outside a more general review of Japan's competitive position conducted by the Japanese government in late 1999 and early 2000. It was against this background that METI embarked on the review of both the long-term technological outlook and the assessment of the role of METI in industrial innovation in general and R&D assistances in particular. The result was compiled in 2001 as "Focus 21," a new policy framework for METI's R&D initiatives. The emergent consensus among policymakers and business leaders was[27]:

(1) The Japanese industries have several areas of competitive strength. These include Bio technologies, Information and Communication Technologies, Environmental Technologies, and Nano-technologies[28];

(2) While the auto industry may lead the manufacturing industry for some time, other sectors of the manufacturing industry must develop innovative technologies in the strategically important areas to make themselves competitive;

(3) The budgetary distribution during the pre-Koizumi government was dysfunctional, resulting in thinly distributed grants to too many projects, may need to be replaced by a more focused approach. The criteria should be twofold. One is whether new initiatives fall under the four priority areas of research. Another is whether the R&D efforts would lead to commercial success in a relatively short period.

In the area of civil aircraft manufacturing, ADID

sought to implement Focus 21's priorities by championing the development of a Japanese passenger aircraft and an aircraft engine programme. ADID develops policies with the close consultation with the Aircraft Committee (Kokuki Iinkai) of the Industry Structure Council (Sangyo Kozo Shingikai). The committee was formally launched in September 2001, succeeding the Aircraft Industry Council (Kokuki Kogyo Shingikai).[29] The Council generally embraces ADID's policies. It also provides valuable insights into latest industry developments. Since its launch, the Committee met at least ten times; once a year in 2001 and 2002, and then twice a year since 2003. It is a closed meeting and the public has limited access to the agenda and the minutes. At its eighth meeting, held on February 4, 2005, the Committee decided to set up a special task force called the "Development Project Promotion Special Committee (Kaihatsu Jigyo Suishin Senmon Iinkai)" with the express purpose of overseeing the regional jet project. Its first meeting was held on March 17, 2005.[30]

In its operation, ADID operates in a manner strikingly consistent with the classic Japanese model of coordination among firms and METI. ADID has three main tools to achieve its policy objectives: Information gathering, analysis and sharing; indirect intervention such as "guidance"; and direct intervention through subsidies. However, Japan's budgetary situation has had an impact in the manner in which METI supports industrial policies across sectors. Broadly, tight budgets placed an emphasis on the ability of sectors to 'sell' their ideas in competition with other programmes.[31]

1 METI, MHI and the MRJ Project

The new emphasis on aerospace technologies and their importance to Japan can be seen in the development of the Mitsubishi Regional Jet (MRJ) project. METI and the Japanese manufactures shared a strong and long-lasting desire to develop a civil aircraft manufacturing industry. By the early 2000s, a number of developments changed the landscape for the civil aviation industry policy: During the 1990's, the regional jet market grew rapidly and was soon dominated by two manufacturers: Bombardier and Embraer.[32] It was increasingly seen as promising especially to a new entrant given that the market was still growing, the most powerful players in the industry, Boeing and Airbus, were absent. Like most other states, Japan took the view that the entry costs of taking on Boeing and Airbus were prohibitive, but the regional jet market looked much more promising. At the same time, there were potential new entrants, namely AVICI of China with its ARJ21 project and Sukhoi of Russia with its RRJ100 project. There was concern at METI that it would be difficult for a Japanese manufacturer to enter the market if Russia and China managed to enter the market earlier.[33] Domestic considerations also played their part; a new market for smaller jets was anticipated with the expansion of Tokyo's Haneda domestic airport. For the first time, there was a chance for regional jets to serve the capital by linking with secondary cities.

The decision was also assisted by concerns that Japan's traditional reliance on Boeing for subcontract work exposed Japanese firms to risk; they are hostage to Boeing's product planning processes. In response, Japanese firms including MHI began to diversify their international linkages.[34] By the early 2000s, Boeing's next project was also unclear making the Japanese manufacturers including MHI to grope many options about their next international cooperation projects, including the regional jet project. The dramatic slowdown in international jet orders after September 11th 2001 also served to remind the industry of its over-reliance on its American partner for business. Though pleased with their status on the Boeing 787 programme, Mitsubishi managers were nonetheless concerned that there would be no new Boeing programmes that would enable the company to develop its capabilities in design and composite manufacturing processes. The regional jet project was a way to develop Mitsubishi's capabilities, without offering a product to compete with Boeing.[35]

Mitsubishi Regional Jet (MRJ) Project of Mitsubishi Heavy Industry (MHI) was started in May 2003 as the "Environmentally Friendly High Performance Small Aircraft Project" of METI

(Ministry of Economy, Trade and Industry). It is a direct R&D grant project administered by METI's NEDO (New Energy and Industry Technology Development Organization) starting in FY 2003 for 8 years.[36] The project is two-phased; the first phase would last for five years till the development of a test plane, followed by the second phase that would cover the initial production of a commercial plane. The project was aimed at assisting a private sector research and development of a technologically advanced (esp. in addressing the issues of the environment and the fuel efficiency) next generation regional jet capable of carrying 30 to 50 passengers.

NEDO's specification for the new aircraft anticipated demand for more cost effective and environmentally-friendly products. It also reflected an interest in process technologies that would enhance speed to market. As such, better fuel economy through weight and drag reduction were to be achieved by the development of material-related technologies including composite materials and enhanced computational fluid dynamics to speed the design process.[37]

Though the grant application process at NEDO was open, it was understood that only MHI (Mitsubishi Heavy Industry) applied and was granted the development money. MHI formed a consortium with FHI (Fuji Heavy Industry), JADC (Japan Aircraft Development Corp) and JAXA (Japan Aerospace Exploratory Agency) for the project. METI will subsidize up to 50 percent of the R&D cost. The total development cost was reportedly initially estimated at 50 billion yen[38].

MHI proposed a major revision of the original plan in 2005 by shifting the target from a 30-to-50 seat plane to a 70-to-90 seat plane. The change was based on the latest market research conducted by JADC and by the strong pressure of the two Japanese airlines, JAL (Japan Airlines) and ANA (All Nippon Airways), the potential customers.[39] The importance that Mitsubishi assigned to the project was evidenced in a significant corporate reorganization that occurred in 2007, which enhanced the position of the aerospace division in the corporate structure. MHI reorganized (upgraded) its corporate structure in October 2007 by appointing Mr. Kazuyuki Kato as the GM (General Manager) and Mr. Masakazu Niwa as the deputy GM of the MRJ Project, reporting directly to Mr. Nobuo Toda, MD (Managing Director) of MHI and GM of its Aerospace Headquarters.

METI officials confirmed that their immediate goal of the MRJ project was not directly aimed at maximizing Japan's national security but to promote the aerospace industry as one of key industries.[40] They insisted that having a world class aircraft manufacturing industry is by itself an important national interest. However, they also pointed out that promoting the industry should be a critical and integral part of the foundation of Japan's national security, complete with the expectation that the plane would be bought by Japan's military and coast guard. It also anticipated that the Japanese airlines would become the major customers.

2 Analysis

Four characteristics separate the MRJ project from the past METI projects. First, ADIA clearly set a policy goal to help the Japanese aircraft industry achieve a commercial competitiveness in the global market; second, ADIA took a risk to allow MHI, not the Japanese industry consortium, to pursue the project as a fully responsible project owner; third, ADIA was determined to break the budgetary status quo of METI by positioning the project as a high national priority requiring substantial initial investment by the government; and finally, ADIA was flexible to support MHI to change the project focus from a 30-to-50 seat plane to a 70-to-90 seat plane.

ADIA took advantage of the changing policy environment by positioning the regional jet project as critical in gaining the competitive advantage in the environmental technology, which would set MHI apart from its rivals, and commercially feasible and viable in a relatively short (within 10 years) period. In this way, ADIA was willing to ride the wave within METI in breaking the budgetary status quo by positioning the project as one of top R&D priorities requiring substantial initial investment by the government.

ADIA's bet on MHI was also unprecedented. Not only in the aerospace industry policy, but also in the industry policy in practically all the industrial areas, METI has been involving major Japanese firms that represent their respective industries rather than choosing some of them over the others. In certain cases, this inclusive approach was successful as METI carefully introduced a competitive mechanism by forming groups of firms that would compete against each other.[41] However, in this instance, there were only three major firms, and it would be difficult for METI to introduce a competitive mechanism to them. This point was well demonstrated in the past efforts; The consortia for YS-11, YX, YXX, and YSX were equally criticized for their inefficient management of the projects based on the absence of ownership and leadership of key players.[42] For the first time, ADIA agreed that MHI would take the full control and ownership in pursuing the project.

MHI itself, however, had positioned itself over time to take advantage of this kind of policy environment. The company had developed the skills essential for any new foray into aircraft manufacturing. Foremost, it had developed capabilities in the design and manufacture of load-bearing composite materials. As noted earlier, this capability was developed by the company during its work on the F-2 fighter. However, the experience with designing and manufacturing large composite sections for Boeing's 787 finally convinced MHI executives that the company could leverage its composite capabilities outside of its relationship with Boeing.[43] Second, the aircraft industry is capital-intensive and customer expectations of after-sales support are crucial elements of the marketing of the aircraft. METI officials were clear that Mitsubishi was effectively the only diversified manufacturer with sufficient resources, including capital, and market credibility to make a sustained assault on the regional aircraft market.[44]

Equally important, ADIA was flexible enough to support MHI to change the project focus from a 30-to-50 seat plane to a 70-to-90 seat plane. Initially, METI and MHI agreed to pursue a 30-to-50 seat plane project. However, from the beginning, the two Japanese airlines, the key potential customers, raised their concerns that the proposed plane size would be too small for them because of the Japanese regulatory constraint.[45] It triggered the project team to undertake a comprehensive market research and the study concluded that the market for a 30-to-50 seat plane would be fast saturating, while that for a 70-to-90 seat plane would continue to grow. Mitsubishi's market analysis was sufficiently convincing that METI officials acceded to the request to change the project specification.[46]

Although ADIA labelled the project as an R&D project for environmental technologies which are acutely needed for the aircraft industry, it is actually pursuing a relatively straightforward industry policy to help MHI gain its competitive advantage in the global marketplace. At least from the late 1980's through to the 1990's, METI did not introduce an industry policy openly aimed at helping a Japanese industry achieve its globally competitive position.[47] This was partly because of the bilateral trade friction between the US and Japan during the period. For example, the TRON project, the fifth generation computer project and other IT projects were severely scrutinized by the US government and forced to scale down or internationalize. The formal launch of WTO in 1994 and METI's policy shift to more actively use a market mechanism reduced the role of the traditional industrial policy.[48]

In the past, METI's industry policy was generally aimed at helping the target firms develop necessary technologies. This time, the METI officials acknowledged that the technological competence was one of many critical success factors. They viewed that the Japanese manufacturers have already accumulated most of the technologies necessary for them to develop and manufacture the proposed aircraft, and that they are competent in developing necessary technologies.[49] However, the METI officials conceded that the Japanese firms may be weak in the project management and the system integration capability to manage diverse technology suppliers and orchestrate the entire process from R&D to manufacturing and assembly, an observation made in other studies.[50]

Ⅵ Conclusion

Changes in Japanese policies for the aerospace industry have emerged from a complex interplay of factors, some external to Japan, others internally-generated. It is clear that industrial rivalry has influenced Japanese policymakers. China is developing exactly the same sort of relationships with Western firms that Japan enjoyed for many years. Concern about Japan's slippage in international manufacturing, combined with concerns about the increased technological capabilities in many countries, allowed METI to catalyse a new, stronger technological orientation to industrial support policies. The process analysed here suggests elements of continuity with past practice. For example, METI continues to be keenly interested in manufacturing, perhaps still neglecting innovation in services. The bureaucracy is also active in developing policy and overseeing its implementation. Again, these characteristics are well known to observers of the Japanese developmental state. However, changes are also noteworthy. The close involvement of Mitsubishi in the early phases of the project and its dominance of the development phase are strikingly unlike earlier Japanese efforts in aerospace. METI's more competitive internal processes seem to have resulted in a 'selecting out' of less well-resourced and capable firms at an earlier stage. With less money to devote to a project, the safer route appears to have been chosen.

That said, MHI was well placed to both facilitate and benefit from this policy shift. METI's renewed interest in aerospace as a technology driver coincided with a re-evaluation within the firm about its prospects in the sector. The firm has developed considerable technical expertise in composite construction thanks to its involvement with Boeing and with military procurement, as well as its acknowledged programme management skills acquired across a range of sectors. These capabilities emerged over many years, but global concerns about fuel efficiency in aircraft have provided the firm with a key competitive capability. The MHI case also throws some doubt on bald statements concerning the inability of large Japanese firms to develop new capabilities. Aerospace is entering a period of change, as the dominance of Western firms erodes as new markets and new technologies evolve.

Finally, what does this case tell us about change in Japan's economy? Similar to observations made by Storz and Collinson and Wilson, the paper outlines a situation where Japan seeks to adapt and evolve to economic and technological change.[51] The latter authors suggest that 'a large proportion' of Japanese firms still lag in their innovative capability.[52] Clearly a single case study cannot provide a complete answer, but the data here suggest more room for optimism. Technological developments are not linear, and can evolve in unexpected ways. Japan leads the world in the development of composite technologies because of earlier efforts in textiles, not aerospace; yet Mitsubishi has looked to build on composite's increasing importance to aerospace. This suggests a level of dynamism and flexibility in one of Japan's most established firms.

Notes

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