

Specialized Complementary Asset, Economies of Scale and Incumbents' Performance in Business Jet Industry

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This article examines the influence of specialized complementary asset and economies of scale on the performance of market leaders in the context of the world Business Jet Industry (BJI). This paper uses a combination of quantitative and qualitative analysis from 1930 to 2015. The research found that in BJI specialized complementary assets and economies of scale played a crucial role in reinforcement incumbents position.

JEL Codes: L11, L60 and O3

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1. Introduction

Business Jet is a typical Complex Product System (CoPS). It is based on high value engineering capital goods (Miller et al. 1995; Hobday 1998; Acha, Brusoni & Prencipe 2007), it require high knowledge and skills for its creation and development (Eliasson 1996). It is a result of the tacit processes of knowledge (Paoli & Prencipe 1999), moreover, it is characterized by complex knowledge bases and uncertainty in performance (Mowery & Rosenberg 1981). Prencipe (2001) categorized the capabilities of firms developing multi-technology products, the taxonomy includes: absorptive capabilities, integrative capabilities, co-coordinative capabilities and generative capabilities. In other words, the System Integrators have to know a lot more than they do (Paoli & Prencipe 1999). Bonaccorsi, Giuri and Pierotti (2005) highlighted the nature of competition in CoPS industries is ability to manage simultaneously the task of systems integration and the pace of technological advancement. Therefore, the barriers to entry into producing CoPS are very high and most, if not all, CoPS-producing industries tend to oligopoly (Hardstone 2004). Examples of CoPS industries tend to oligopoly are: aero-engine industries (Miller & Sawers 1968; Phillips 1971; Constant 1980; Vincenti 1986; Garvin 1998; Bonaccorsi, Giuri & Pierotti 2005), and commercial aircraft industry (Acha, Brusoni & Prencipe 2007; Phillips 1971; Mowery & Rosemberg 1982; Esposito 1996; Vicari 1991; Parazzini 2003).

It is clear that the academic studies on CoPS industries are focused on the role of knowledge as a key success factor; the present study extends previous approach including specialized collateral assets and economies of scale to a specific CoPS industry: BJI. The present study adopts the same approach as Phillips research (1994, 1971), which analyzed the role of specialized collateral assets and economies of scale to understand technology competition and market structure in BJI. The present study updates the study on technology competition and market structure in BJI from 1995 to the present.

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The article is organized as follows: in the next sections, the author presents research approach and hypotheses; then, he describes the data, methodology and results. The author concludes by discussing the article's contribution and future research.

2. Literature Review

The present research started from the study of Phillips (1994, 1971) on the role of specialized complementary asset and economies of scale to understand the technology competition and market structure in BJI.

Specialized complementary assets, innovation and market leaders' survival

Teece (1986) highlighted the importance of specialized complementary asset as a critical factor in determining who benefits from innovation. These assets are usually located in the downstream value chain or market-related activities and include: established reputation, detailed understanding of product usage, strong links to users and marketing, sales, after sales support, and large-scale distribution systems (Hill & Rothaermel 2003; Mitchell 1991, 1992; Rothaermel & Hill 2005). Specialized complementary assets are particularly valuable when the user base does not substantially change (Mitchell 1992; Rosenbloom & Christensen 1994).

Additionally, the preservation of downstream assets allows incumbents both users and other agents, including banks, employees, investors, trade associations, who take part in the downstream value chain activities and who allow the firm to be embedded in the corporate network of the market (Lynn, Reddy & Aram 1996). On this aspect, Mitchell and Singh (1996) prove that collaborative relationships for activities outside incumbents technological core activities enable incumbents to adapt better to the new technological stage, observing that marketing partners help incumbents "to gain a better understanding of the nature of the sudden environmental change and how to respond to it" (Mitchell & Singh 1996: 188).

Specialized complementary assets confer an advantage to incumbents because (unlike generic assets), they are difficult for new comers to imitate (Rothaermel & Hill 2005; Teece, Pisano & Shuen 1997). As Teece (1986) points out, specialized complementary assets, such as reputation or strong links with users, must be built over time. The impact of incumbents' ownership of complementary assets on firm performance has been analyzed in the extant literature. In the medical diagnostic imaging industry, Mitchell (1992) also tested that specialized complementary assets provide incumbents greater survival and market share advantages. Tripsas (1997), in the typesetter industry, concludes that specialized complementary assets protect incumbents from competence-destroying innovations. Therefore, the academic study highlight that specialized complementary assets play a powerful effect on incumbents position. According to these approaches, present research tests this hypothesis:

Hypothesis 1: Specialized complementary assets are positively related to incumbents' performance in BJI, they represent high barrier to entry and play a powerful effect on incumbents' survival.

Economies of scale and universal product

The aircraft is a typical universal product (Porter 1986; Yoshino 1987). These characteristic gives to the firms some benefits: 1) large volume amortize fix investments; 2) standardization of product 3) concentrating value-adding activities in a few countries; 4) adopting a uniform market positioning and marketing mix. In this industry, firm gains scale or learning curve advantage. In the market of scale economies, the focus of competition is based on lower cost and differentiation via minor design variations and strategic positioning tactics (Porter 1986). Present study verified the importance of scale economies, testing following hypothesis:

Hypothesis 2: *business jet is a universal product, so economies of scale represent high barrier to entry in the market, the incumbents focus competition on differentiation via minor design variations and strategic positioning tactics.*

3. The Methodology and Model

Data

To test research hypothesis the study adopts both qualitative and quantitative approach. It proposes an integrated analysis of technology competition and market shares (2002-2015) and historical data (1930-2002). It used several sources for the historical data: specialized magazines such as Business Jet, Flight International, Aviation Week & Space Technologies, Volare; Companies' web sites; Business Jet industry historical documentation (Phillips 1994, 1971; Izzo 2009). Quantitative data derived from General Aviation Manufacturing Association reports and Companies' web sites.

New product introduction and economies of scale

A useful indicator to know the technology innovation intensity and the competitors' product strategy in the industries history is the introduction of new models of product. A business jet is based on program, the latter is based on "core" technology platform, whereas jet versions are developed on the same programme through the modification of few characteristics. Other information comes from the introduction of new products is on the existence of economies of scale. Of course, data on the R&D costs would be more appropriate to estimate the existence of economies of scale, but these data are hardly made public by companies.

In literature, many authors are based on measures reach product family as an indication of existence of economies of scale: Sutton (1998) verifies the existence of economies of scope in aircraft design using data on non-recurring cost of B747; Mowery and Rosenberg (1982) show that in jet design the extension of the product family is obtained by extending the fuselage without changing the diameter of the section and the design of the wings; Rothwell and Gardiner (1989, 1990) found that the design of the RB211 jet engine made it possible to obtain different versions (RB211-524-535) with thrust and different consumption performance, only through the modification of some of the motor modules.

4. The Findings

The analysis of historical data (1930–2001) shows that:

- a) Market leaders were the following: Dassault, first mover in the Large Jet segment in 1965; Bombardier, first mover in the Medium Jet segment in 1962; Gulfstream, first mover in the Long Range Jet segment in 1968; Beechcraft (in 1964) and Cessna (in 1971) in the Light Business Jet segment;
- b) Reasons for the failure of potential entrants were the following: 1) scarce distribution network and customer support; 2) less competitive products; 3) smaller product portfolio than incumbents; 4) strong brand loyalty of incumbents; 5) high customer switching costs;
- c) The success factors of the incumbents were the following: 1) low cost of the product (purchase price and maintenance and operating costs were low due to economies of scale and the learning achieved; 2) ease of use of the product; 3) excellent and extensive network of customer service centers; 4) strong image and high brand loyalty; 5) connections with the Industrial Group that guaranteed access to knowledge and financial resources.

Data analysis conducted for 2002–2015 shows that incumbents maintain their dominant position in the market (Table 1). Moreover, the study of number of versions and programs (Table 2) confirms that main competitors extended their products portfolio using the same program; it is clear, therefore, the existence of economies of scale in the BJI. The study confirms the importance of belonging to a large industrial group (Table 3) for gaining access to knowledge, network and economic resources.

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Table 1: Companies' market shares in %: units sold 2002-2015

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Airbus	0	0	0	1	1	1	1	1	2	1	1	1	1	1
Avcraft	1	2	2	0	0	0	0	0	0	0	0	0	0	0
Boeing BJ	2	1	1	1	1	1	0	1	2	1	2	1	1	2
Bombardier BA	15	14	22	25	24	20	19	20	20	26	27	27	28	28
Dassault FJ	10	9	11	7	7	6	5	9	12	9	10	11	9	8
Embraer	1	3	2	3	3	3	3	14	19	14	15	18	16	17
Emivest	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gulfstream AC	13	14	13	12	13	12	12	11	13	14	14	21	21	21
Honda AC ONE	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aviation Corp	0	0	0	0	0	9	12	0	0	0	0	0	2	1
Beechcraft	14	19	19	19	16	14	12	11	10	7	5	1	0	0
Cessna	45	38	31	33	35	34	35	33	23	26	27	21	22	23

Table 2: Number of product versions and programs 1994-2015

Company	Models	Programmes
Airbus	6	1
Avcraft	1	1
Boeing Business Jets	7	1
Bombardier Business Aircraft	10	1
Dassault Falcon Jet	15	1
Embraer	7	1
Emivest (prev. Sino Swearingen)	1	1
Gulfstream Aerospace Corporation	4	1
Honda Aircraft Company	1	1
ONE Aviation Corp. (prev. Eclipse Aero)	2	1
Beechcraft	7	1
Cessna Aircraft	20	1

Table 3: Incumbents' Industrial Group

Incumbents	Industrial Group	Business of Industrial Group
Bombardier	Bombardier	aerospace, transportation
Dassault	Groupe Dassault Holding	aerospace, avionics, systems, immobilière, press, artcurial
Gulfstream	General Dynamics	information system and technology, combat systems, marine systems, aerospace
Beechcraft Cessna Aircraft	Textron Aviation	helicopter, aviation, industrial, systems, finance

The present research confirms the results of Phillips studies (1994, 1971) on technology competition and market structure in BJI. He proved that specialized complementary assets and economies of scale played a crucial role in the reinforcement of the incumbents' position and present study finds the same results. In fact, the present research finds the following:

- I. Specialized complementary assets (brand loyalty, switching cost, customer support) characterize historically BJI competition, they are high barrier to entry in the market and play a powerful effect on incumbents' survival, in fact, there are not relevant new entry (Hp1t is confirmed);
- II. The study on programs and versions of products and the market shares highlight the existence of economy of scale in the BJI, the incumbents extended their products portfolio, penetrating other segments using the same program (Hp2t is confirmed);
- III. All incumbents belonging to Industrial Group, which had assured the access to skill, knowledge and financial resources needed to generate and develop aircraft product;
- IV. Therefore, the study highlights that in the BJI there are high barrier to entry: specialized complementary assets and economies of scale.

5. Summary and Conclusions

Present research analyzes the effects of specialized complementary assets and economies of scale on the incumbent's performance in the BJI. The study confirms the results of previous studies conducted by Phillips (1994, 1971) on technology competition

and market structure in BJI. Jet is a typical CoPS, it is characterized by complex knowledge bases and uncertainty in performance, the academic studies are focused on the role of knowledge about the nature of competition in the CoPS market; whereas, the present research extend this approach including specialised collateral assets and economies of scale.

The study highlights that in the BJI there are high barrier to entry as well as management of CoPS: specialized complementary assets and economies of scale. Research proposed is undoubtedly a contribution of great importance to understand the sources of competitive advantage of the major players in the BJI, moreover they are not available detailed empirical analysis and long-term (1930-2015) as the one proposed.

An interesting aspect to be explored in future research is how market-supporting institutions influence the stock of complementary assets of incumbents. Finally, the major limitation, which can be the starting point of future research, is its inability to study the success factors of Embraer's strategy, a unique successful case of a recent new entrant in the BJ market.

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