

INTERNATIONALIZATION OF MANUFACTURING AND GLOBAL VALUE CHAINS: ANALYSIS OF MANUFACTURING PROFILES BETWEEN EMBRAER AND BOEING

INTERNACIONALIZAÇÃO DE MANUFATURA E CADEIAS GLOBAIS DE VALOR: ANÁLISE DE PERFIL DE FABRICAÇÃO ENTRE EMBRAER E BOEING

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RESUMO

Este artigo tem como objetivo apresentar as diferenças entre os perfis de manufatura e das cadeias globais de valor de duas empresas fabricantes de aeronaves: Embraer e Boeing. Após a revisão de literatura sobre as teorias de internacionalização de empresas, cadeias globais de valor e internacionalização de manufatura, este trabalho mostra que a Embraer comanda uma cadeia de valor do tipo Relacional, ao passo que a Boeing optou por uma cadeia Hierarquia após tentativa fracassada com a cadeia Relacional durante a fabricação do modelo 787 Dreamliner.

Palavras-chave: Internacionalização, Manufatura, Cadeia Global de Valor.

ABSTRACT

This article aims to present the differences between the profile of plants and the global value chains (GVC) of two aircraft manufacturers, Embraer and Boeing. After, literature review about the theories of internationalization, global value chains, and internationalization of manufacturing. It is concluded that Embraer leads a value chain called Relational. At the same time, Boeing opted for the type called Hierarchy after a failed experience with the Relational type of value chain during the development of the 787 *Dreamliner* model.

Keywords: Internationalization, Manufacturing, Global Value Chain.

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1 INTRODUCTION

In recent years, approaches to International Manufacturing Networks have gradually consolidated as a current of research in International Operations Management (FLEURY et al., 2014). Studies that combine both approaches are predominantly from developed countries, as in International Management.

This study aims to characterize the profiles of factories and their positioning in the global value chains of Embraer, a Brazilian aircraft manufacturer (EMNE), and Boeing, a North American aircraft manufacturer (DMNE). Therefore, an exploratory study was conducted based on primary and secondary data sources, making it possible to classify them according to the concepts developed by Ferdows (1997) and Gereffi, Humphrey and Sturgeon (2005).

2 LITERATURE REVIEW

2.1 Global Value Chains

The processes of globalization of the world economy, and increase in industrial capacity in emerging countries, and the vertical disintegration of multinational companies are redefining the essential competencies of corporations. Which have started to (i) focus on higher added value activities such as R&D, innovation, and marketing management, and (ii) decrease their direct involvement in non-core and low added value activities such as standardized activities. These two movements generated several configurations of manufacturing networks called Global Value Chains (GVC). Additionally, the governance (or command) of these networks becomes an essential topic of theoretical discussion, given the need to coordinate the activities of each participant in the value chain.

Gereffi, Humphrey, and Sturgeon (2005) developed a theoretical framework to understand governance patterns in global value chains better. The authors identify three important variables for determining the governance of GVCs:

- (a) Complexity of information and knowledge transfer necessary to support a transaction, particularly concerning the process and product specifications.
- (b) Extent to which these transactions may be encoded.
- (c) Competencies of current and potential suppliers about transaction requirements.

According to the same authors, based on the three variables above, there are five governance structures for global value chains, described below:

1. Market: When transactions are efficiently coded, product specifications are relatively simple, and suppliers can manufacture products with little input from buyers. Since the complexity of the transmitted information is relatively low, operations can be governed with

little explicit coordination. Transactions in this value chain are repetitive, and the cost of switching between peers is meager.

2. Modular: When the ability to code specifications extends to complex products, then the Modular-type value chain arises, which occurs if the product architecture is modularized and standards and techniques simplify interactions, reducing component variation, which leads suppliers to have the competence to produce complete packages and modules. Typically, modular chain suppliers make products according to customer specifications. However, complex information can be exchanged with little explicit coordination because of coding. Thus, the cost of switching to new partners remains low.

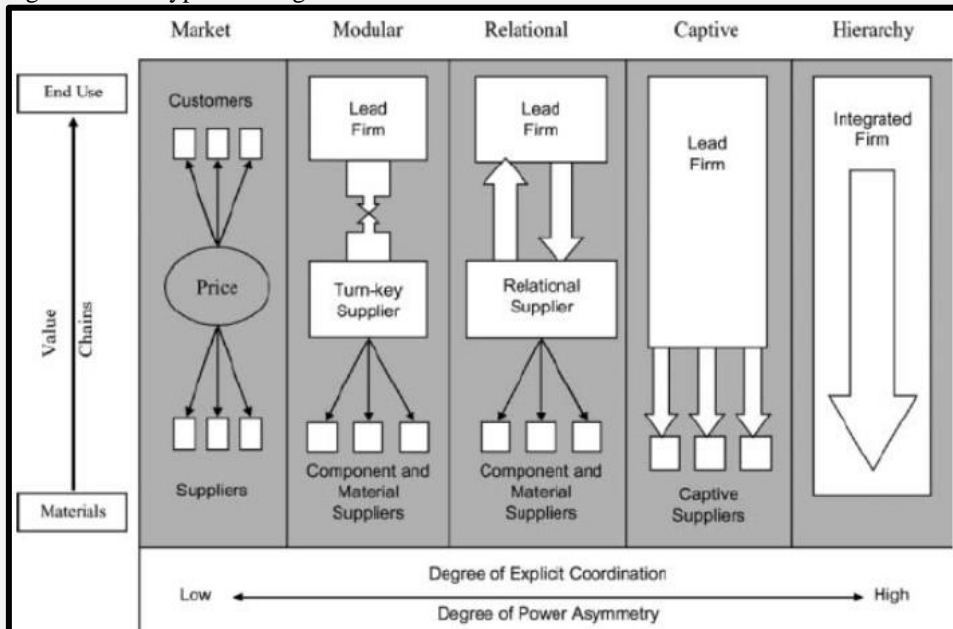
3. Relational: when product specifications cannot be codified, transactions are complex, and supplier capabilities are high, the Relational value chain arises, which occurs because tacit knowledge must be exchanged between highly competent buyers and suppliers. The mutual dependence that arises can be regulated through reputation, social and spatial proximity, family, ethnic and related ties. The exchange of complex tacit information is most often carried out by frequent face-to-face interactions and governed by high levels of explicit coordination, which makes the cost of switching to new partners high.

4. Captive: When both the ability to code instructions in detail and the complexity of product specifications are high, and suppliers' capacity is low, value chain governance will tend to be of the Captive type. Because the low competence of suppliers in the face of the complexity of product specifications in products requires a great deal of intervention and control on the part of the GVC coordinating company, encouraging the accumulation of transactional dependence between the suppliers and the coordinating company. Captive suppliers have often been confined to a narrow range of tasks, mainly simple assembly. They are dependent on the lead company for complementary activities such as design, logistics, component procurement, and modernization process technology. Suppliers that are part of captive-type chains face high switching costs.

5. Hierarchical: When product specifications cannot be codified, products are complex, and highly competent suppliers cannot be found, leading companies will be forced to develop and manufacture products in-house. This form of governance is generally motivated by the need to exchange tacit knowledge between value chain participants and efficiently manage the complex networks of inputs and outputs of resources, especially intellectual property. This chain is characterized by vertical integration, with control flowing from the parent company to the affiliated companies.

Figure 1 presents the five types of global value chains showing the variations of explicit coordination and asymmetry of power between the five types of the value chain.

Figure 1: Five types of the global value chain



Source: Gereffi, Humphrey, and Sturgeon (2005)

2.2 Manufacturing Internationalization

The integration processes of the world economy impacted the spatial distribution of factories of multinational companies and increased the scope of their activities. First, reducing tariff barriers reduced the importance of factories to overcome trade barriers. Second, the increasing sophistication of manufacturing and product development causes multinationals to place less emphasis on labor costs when choosing locations for their international factories. Third, the pressure to transfer ideas between new product development and production forces companies to develop close relationships between the two areas. Many corporations concentrate production and product development in the same geographic and organizational unit. This trend marks a distinction from traditional knowledge that the function of a plant is to produce what was designed by the company's headquarters (FERDOWS, 1997).

Ferdows (1997), in the article Making the most of foreign factories published in the Harvard Business Review in March 1997, identified six factory profiles presented by multinational companies: offshore, source, server, contributor, outpost, and lead. Table 1 presents the characteristics of each of the types of factories.

Table 1: Typology of international factory profiles

| Factory type | Activities | Production | Innovation | Marketing and Sales |
|--------------|---|--|-------------|---------------------|
| Offshore | Production of specific items at low cost | YES | NO | NO |
| Source | Production of specific items at low cost but purchasing raw materials and developing suppliers perform activities. It is usually the best factory in the global network. It is usually located with a low production cost, developed infrastructure, and access to qualified labor. | YES | FEW | NO |
| Server | Attend specific national or regional markets. Avoids tariff barriers, reduces taxes, logistics costs, or exchange rate fluctuations | YES, with limited authority to propose changes to products and processes | VERY LITTLE | NO |
| Contributor | It serves national markets, and its responsibilities include product innovation, process engineering, and supplier development. Compete with other factories in the development of technologies | YES | YES | NO |
| Outpost | Collects information about suppliers, market, competitors, technologies | YES | NO | YES |
| Lead | It develops new processes, products, and technologies for the entire company. Contact with end customers, laboratories, and other knowledge centers | YES, but it is not the primary competence | YES | YES |

Source: Elaborated by the actors from Ferdows (1997)

3 RESEARCH METHOD

Search for a logical, sequential chain for the research developed; this session presents the methodological aspects (research approach, procedure method, research sample, data collection technique, and data analysis technique) used to achieve the objectives initially proposed.

Considering that theories that make the crossing between approaches from the area of "International Manufacturing" and "International Management" are considered recent, such as the seminal works of Ferdows (1997), Shi and Gregory (1998), and, consequently, are in the consolidation phase, a qualitative approach was chosen. Qualitative research requires relative

theoretical guidance on the researcher's part (BRYMAN, 2007). It provides the possibility of understanding the context of the phenomenon studied. This approach allows understanding the process and not just the results.

Procedure methods are the framework and general guidance for proper scientific research (BRYMAN, 2007). Considering the nature of the research, which is to compare and identify differences in the management of the global chain of different origins, the most appropriate method is that of descriptive case studies (YIN, 2001).

Research to identify peculiarities and complementarities existing in the global value chain management. The sample was restricted to two companies in the aeronautical sector, Embraer and Boeing, intentionally selected. These two companies were chosen because they are leading companies in their operating segments. However, one (Embraer) is of Brazilian origin (emerging country). The other (Boeing) is of North American origin (developed country). Although companies are not direct competitors, they have quite different characteristics in terms of the profiles of their factories and the value chains they command.

Data analysis will be performed as suggested by the parameters proposed by Yin (2001) and Voss et al. (2002). Initially, an analysis of each case (intra-case analysis) was performed. Then, the individual cases were crossed analysis, thus promoting the categorization into patterns that make it possible to highlight similarities and differences.

4 PRESENTATIONS OF CASES

4.1 Embraer

Founded in 1969 as a mixed capital and state-controlled company, Embraer is today the third largest commercial aircraft manufacturing company globally, behind only the North American Boeing and the European Airbus, the leader in the commercial jet market. With up to 130 seats. The company also operates in the executive jets segment, occupying the fifth position among world manufacturers and the defense and security aircraft segment, the largest and leading Brazilian aerospace security and solutions company.

Headquartered in the city of São José dos Campos/S.P., Brazil, the company currently has several units spread across the nine countries where it has operations. In Brazil, its manufacturing units are in the cities of Gavião Peixoto/S.P. (factory), São José dos Campos (factory), Botucatu/S.P. (factory) and in Taubaté/S.P. (factory), Sorocaba/S.P. (services and repairs), Campinas/S.P. (logistics center), in Belo Horizonte (Engineering and Development Center).

Abroad, the company has factories in Harbin (China), another factory in Évora (Portugal), and Melbourne (United States). Figure 2, below, presents the geographic dispersion of Embraer's subsidiaries, and Table 2 presents the profile of each plant and one of its plants.

Figure 2: Embraer in the world.



Source: From Embraer (2013)

Table 2: Typologies of Embraer's factories

| Unit | Country | Characteristics | Typology |
|---------------------|---------------|--|----------|
| São José dos Campos | Brasil | Embraer's unit is responsible for designing, manufacturing, and providing after-sales aircraft support for the commercial, executive, and defense aviation markets. | Lead |
| Gavião Peixoto | Brasil | Production of the wings for the Embraer 190 and Embraer 195 aircraft. The final manufacture of the Phenom, Legacy models and the Super Tucano military aircraft, and the KC-390 military freighter. It is responsible for the production and technological modernization of military aircraft such as the EMB-314, AMX, and F-5 and the development and production of the KC-390 tactical freighter. | Source |
| Botucatu | Brasil | Manufactures and provides after-sales support for the Ipanema line of agricultural aircraft. It also produces components for the Embraer 170, Embraer 190, Phenom 100, and Phenom 300 lines and parts for the Super Tucano, KC-390, Legacy 450, Legacy 500 Legacy 650. | Offshore |
| Taubaté | Brasil | Embraer's Distribution and Logistics Center and industrial activity of cutting raw materials and in the administrative activity of planning, programming, execution, and supply of cut raw materials, including meeting the demands of subcontracts. | Offshore |
| Embraer-AVIC Harbin | China | A joint venture was created in 2012 between Embraer S.A. and the Aviation Industry Corporation of China (AVIC) to produce the Legacy 600/650 executive jets in China. | Server |
| Melbourne | United States | The first unit in the United States performs the final assembly of aircraft. It produces the Phenom 100 and Phenom 300 executive lines. In November 2012, work began at an Engineering and Technology Center at the Melbourne unit. | Outpost |
| Alverca - OGMA | Portugal | Maintenance. Repair and overhaul of aircraft, engines, and avionics. It also operates in the manufacture and assembly of components and aircraft modernization. | Server |
| Évora | Portugal | Centers of excellence opened in September 2012, dedicated to manufacturing machined metal structures and sets in composite materials. | Lead |

Source: Prepared by the authors from company data

At the end of the 1970s, the development of other products, in cooperation with Italian companies, allowed the company to reach high competence in technology. This change led to the closing of risk contracts with four leading suppliers, culminating in developing a new supply network configuration, developing the ERJ-145 regional jet, and initiating a fierce dispute with the new Canadian competitor Bombardier. This supply chain coordination model was consolidated and expanded to develop new commercial aircraft (models E-JETS and more recently E-JETS E2). The new defense and security aircraft KC-390 can be classified with a Global First Mover regarding its internationalization strategy, as proposed by Ramamurti and Singh (2009).

4.2 Boeing

Founded in 1916, Boeing has become the leading military and commercial aircraft producer. Throughout its history, the company has carried out a series of strategic mergers and acquisitions in the most diverse aerospace segments: North American Aviation, McDonnell Douglas, Rockwell International - company in the space and defense sector, Hughes Space & Communications, and Jeppesen - which made it possible with that the company becomes the most diversified in the sector in which it operates.

With corporate headquarters located today in Chicago, Illinois, the company is organized through two business units: "Commercial Aviation" (work focus) and "Defense, Space & Security." The commercial aviation business unit had annual revenue of US\$53 billion in 2013 and has approximately 80,000 employees. Boeing planes represent three-quarters of the world's commercial aircraft fleet in service today, with about 70% belonging to airlines outside the U.S. territory (BOEING, 2014).

The main products currently sold are the seven-family aircraft (737, 747, 757, 767, 777, and 787). Part of the production and assembly of these aircraft is carried out in three large factories located in Everett, Renton, and South Carolina. In developing the most recent aircraft launched, the 787, the company experienced a dramatic change in its management model. As this is a new aircraft project, the company sought to reduce operating costs by outsourcing part of the aircraft's production. While also seeking to make a series of innovations in the wings and fuselage material composition to reduce fuel consumption (a product responsible for most airlines' operating costs). This business model adopted to produce the 787, being highly dependent on the competence of the suppliers, was not successful, resulting in the delay of more than three years in the delivery of the first aircraft, cancellation of purchases, and more recently, failures. Operational.

5 DISCUSSIONS OF THE RESULT

Embraer emergence due to a policy of import substitution and subsequent privatization, and Boeing growth through acquisition and focus on the commercial aviation and defense sector. Due to the difference, Embraer earned \$6.2 billion in 2013, while Boeing earned \$86.6 billion over the same period. The two companies have different factory profiles and positioning in global value chains. Table 3 presents the profiles of plants around the world. It is essential to highlight that only manufacturing units were considered.

Table 3: Typologies of Boeing factories

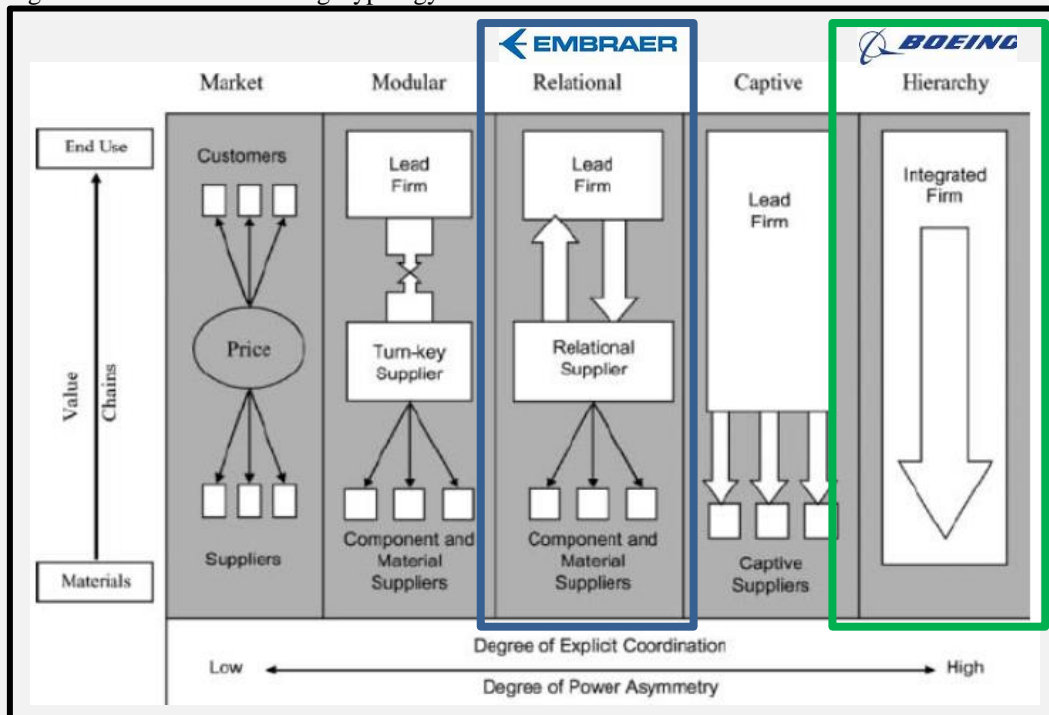
| Unidade | País | Características | Tipologia |
|----------------------|------|---|---|
| Everett - Washington | USA | Manufactures all 747 series to date, 767, 777, 7E7, 787. | Lead (para as linhas de produtos que atende). |
| Renton - Washington | USA | Manufactured the 707, 727, 737 and 757 series. Currently produces the Next-Generation 737. | Lead (para as linhas de produtos que atende). |
| South Carolina | USA | Manufactures, assembles and installs systems for the rear fuselage of the 787 Dreamliner and integrates fuselage sections. It also does the final assembly and delivery of this type of aircraft. | Lead (para as linhas de produtos que atende). |

Source: Prepared by the authors from company data

In terms of its global value chain, Embraer uses the so-called Relational chain from the moment it manages a complex supply chain as an essential competence. To manage project risks, the organization developed the practice of alliances with the establishment of joint ventures. In this way, Embraer coordinates its supply chain (or global value chain) through partnerships with its strategic suppliers (Ferreira, Salerno, Lourenção, 2001). Figure 3 shows the value chain used by Embraer – the so-called Relational GVC.

In turn, Boeing participates in and commands a Modular-type chain. The coding of specifications extends to complex products, and suppliers have the competence to develop complete modules, which reduces the need for monitoring by the leading chain company. Following a worldwide trend in manufacturing, Boeing joined the outsourcing of production activities, both locally and internationally, intending to reduce costs and accelerate the parallel development of several technologies necessary for the development of aircraft. Thus, about the 787 Dreamliner project, the company followed the Relational typology to reduce costs and deadlines. As highlighted by Hart-Smith, it is up to the project leader company to support the technological development and management of the supply chain (Hart-Smith, 2001).

Figure 3: Embraer and Boeing Typology in the Value Chain



Source: Prepared by the authors from Gereffi, Humphrey, and Sturgeon (2005)

However, the decision to incorporate many innovative technologies in the 787 projects raised the technical standards required of the suppliers in the North American company's value chain, which proved incapable of developing technology without the coordination and technical support of the leading company. In this way, the company assumed coordination and technological risks that proved to be harmful to the development of the aircraft. With delays and technical problems, the company had to support the supply chain by sending engineers and technicians to the supplier companies and greater control and coordination of the project. Boeing abandoned the Relational type of chain and adopted the GVC configuration called Hierarchy with this new global value chain configuration.

6 CONCLUSÃO

It is possible to affirm that the two companies differ substantially in two aspects related to their value chains, namely:

The. Regarding the profile of its plants, Embraer assigns much more roles to its manufacturing units than Boeing. While the Brazilian company has units to serve specific markets (Embraer-Harbin in the case of the Chinese market and OGMA in the case of the European market), Boeing assigns few roles to its plants, which have the same (but very complex) profile called lead

B. Regarding the profile of their global value chains, both companies dominate their supply chains. However, the Brazilian company develops much more Joint-Ventures and partnerships. In contrast, based on the problems with the 787 Dreamliner project, the North American company seeks to control its essential suppliers more intensively and closely.

Finally, it is worth mentioning that the present work has limitations related to access to primary data since it was not possible to conduct interviews with managers of the analyzed companies. It is suggested to continue the research for future studies, seeking to increase more solid empirical sources to strengthen the evidence raised in this exploratory study. Comparing companies from other sectors could bring new contributions to the theory.

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