

Product-service combination in manufacturing firms: The case of Embraer

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Abstract

This paper contributes to the discussion about the role of service in manufacturing firms. Market's complexity is forcing traditional product-manufacturing companies to change their position in the goods-services continuum by continuously extending the service business of their offers. Such authors as Lovelock and Gummesson (2004), Vargo and Lusch (2004, 2008) and Grönross (2007) have given contributions to understanding the meaning of services in business environments, highlighting the challenge of moving from a goods based logic to a service-centred logic. Nevertheless, according to Spring and Araújo (2009) the quest for foundational differences between products and services is misguided. What counts as a product or as a service is related to the nature of producer-user interactions and the institutional structure of production and networks rather than to the attribute of products or services. In order to clarify this idea with empirical evidence, this paper presents a case study research about Embraer, a Brazilian company that is the third major aircraft manufacturer in the world. The aim is to analyse product-services combinations in a manufacturing company, extending the application of services in manufacturing firms. The data were collected through secondary material, as articles and technical publications and interviews with managers. The analysis shows an illustration of a global service-manufacturing firm, which results in a web of multiple business-to-business relationships. The case of Embraer can be seen as empirical evidence of product-service combination, extending the role of business-to-business service networks for value creation in manufacturing firms.

Keywords

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1. Introduction

Since Lovelock and Gummesson (2004) contested the validity and continued usefulness of the IHIP (intangibility, heterogeneity, inseparability and perishability) as a core paradigm to differentiate services from goods (Fisk et al, 1993), several studies have been trying to understand the impact of this conceptual change. Authors, such as Reinartz and Ulaga (2008), Grönroos (2007), Campbell-Kelly and Garcia-Swartz (2007), Teboul (2006), Oliva and Kallenberg (2003), and Chesbrough and Rosenbloom (2002), claimed that the market's complexity is forcing traditional product-manufacturing companies to change their position in the goods-services continuum by continuously extending the service business to their offers. Gebauer (2008) emphasized this perspective by highlighting the challenge to move from a goods based logic to a service-centred logic and some studies have been developed to understand how the concepts of services are related within the business marketing field (Gebauer, 2008; Cova and Salle, 2008; Sheth and Sharma, 2008 and Van der Valk, 2008).

In order to contribute with this discussion, this paper presents a case study research about services in manufacturing firms: Embraer, one of the major aircraft manufacturers companies of the world. The aim is to analyse product-services combinations in a manufacturing company, extending the role of business-to-business service networks for value creation in manufacturing firms. First, the paper presents a theoretical review about the concepts of products and service in delivering benefits to customers. The concept of value

and the process of value creation are discussed, highlighting the role of services in business-to-business markets. Then, the IMP group network approach is presented in order to show ideas about business-to-business service networks. Next, the case of Embraer is described to illustrate these conceptual ideas in order to extend the application of service concept for manufacturing firms.

2. The product-service distinction revisited

Service used to be conceptualized and defined as being a special type of product. The existence of a continuum is admitted, allowing intangible-tangible extremes as a basis to differentiate pure goods from pure services. The most common perception is that there are packets of products that collect goods and services (Berry and Parasuraman, 1992), distinguishing services by their four characteristics: intangibility, heterogeneity, inseparability and perishability (Fisk et al, 1993). The characterization of the services through these properties predominated in the literature of services marketing, turning to a paradigm to classify the offers in the market. Nevertheless, Lovelock and Gummesson (2004) and Vargo and Lusch (2004) presented critics to this distinction of the “IHIP”. For these authors, not all services are characterized by these criteria and it is not possible to claim that these characteristics explain all distinctions between goods and services.

According to Grönroos (2006), the evolution of the service-centred logic was influenced by traditional authors from the Nordic School (Grönroos and Gummesson, 1985) and, more recently, by Vargo and Lusch (2004, 2008), who discussed what they called Service-Dominant Logic (S-DL). According to the S-DL, services must be understood as the application of specialized capacities (knowledges and skills) exchanged through business relationships (Vargo and Lusch, 2004 and 2008). For Grönroos (2006), services can be described as value-creating support to activities and processes. This way, according to Oliva and Kallenberg (2003) all firms have to do is adopt an unique service orientation. These approaches are similar in conceptualizing services as processes for value creation by resources' interactions among the parts in relationships. According to Gebauer (2008), Oliva and Kallenberg (2003), Teboul (2006), and Grönroos (2006), traditional product-manufacturing companies have to change their position in the goods–services continuum by continuously extending the service business in their offers. For this to happen, firms “may decide that providing services is beyond the scope of their competencies (...)” and therefore “not only are new capabilities, metrics and incentives needed, but also the emphasis of the business model changes from transactions to relationship-based” (Oliva and Kallenberg, 2003, p.161). This way, the product becomes part of the offering and the firm must develop services to support and improve continuously its use and effectiveness.

Nevertheless, according to Spring and Araújo (2009) the quest for foundational differences between products and services is misguided. What counts as a product or as a service is related to the nature of producer-user interactions and the institutional structure of production rather than to the attribute of products or services. The product-service founded on the four (IHIP) idiosyncratic features of services as well as process versus outcome consumption doesn't bear much scrutiny. This idea was clarified by Hill (1977, 1999) and Gadrey (2000) researches' about an institutional perspective on service definition. According to Hill (1977), a necessary condition for some item to be a good or a service is that it must be capable of being the subject of a transaction between two or more different economic units. To identify the characteristics of goods or services, the focus should be on the interaction between producers and users. According to Hill (1977, p.318), services can be understood “as a change in the condition of a unit or a person, or of a good belonging to some economic unit, with the prior agreement of the former person or economic unit”. Hill (1999) claims that a

service is produced by one economic unit for another, but is not exchanged between them. Products can be disentangled from relationships and capable of independent circulation makes them the ideal case for market exchange, but the output of services are not separate entities that exist independently of the relationship between producers and users. According to Spring and Araújo (2009, p.4), “in summary, the distinction between products and services often depends more on economic factors that determine boundaries and areas of responsibility in a producer-user interaction than on technical factors concerning production process”. By this way, Delaunay and Gadrey (1987) and Gadrey (2000) developed Hill’s (1977, 1999) definition by positioning that service activity is an operation intended to bring about a change in the status in a reality C that is owned by consumer B effected by service provider A at the request of B and in a many independently of medium C. This idea is illustrated by Spring and Araújo (2009), according to figure 1:

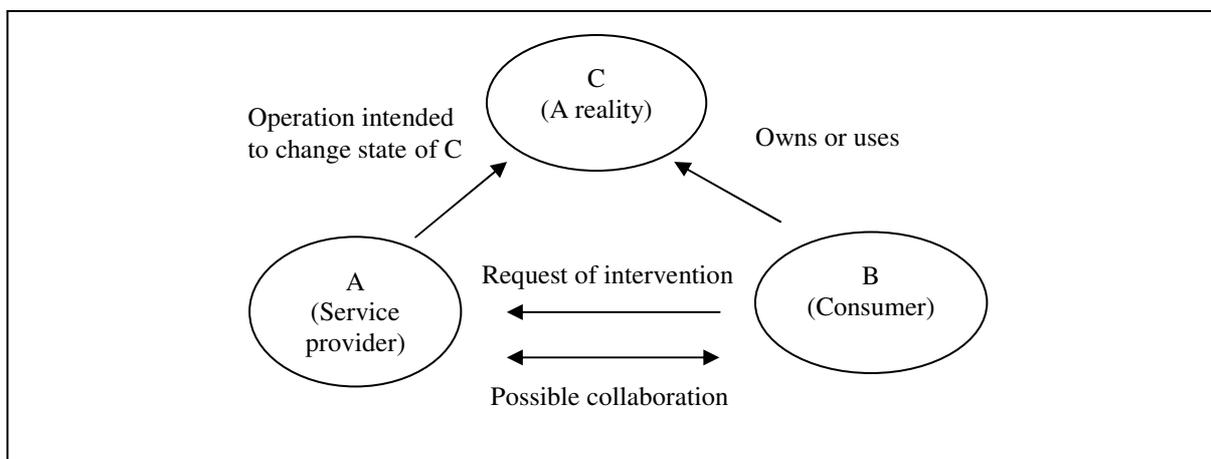


Figure 1: The service triangle
Source: Spring and Araújo (2009, p.449)

However, Spring and Araújo (2009) argue the institutional perspective notion that services cannot circulate as independent entities in a property rights and discuss about what makes services tradeable at all. Spring and Araújo (2009) suggest that products and services constitute different types of intermediaries and both require ‘stabilization’ and ‘objectification’ (Callon et al, 2002) to be transacted. The objectification of an entity doesn’t require that its properties are inscribed into tangibles, solid material even though many services rely on a significant array of tangibles resources. The tradeability of a service simply requires that its properties are objectified, stabilised and delimited, i.e, making services tradable requires the regulation of access to maintained socio-technical capacities which may involve a variety of modes of interaction between service providers and users. According to Callon et al (2002), the production, circulation and use of products should not be separated form a range of services normally associated with those activities. By this way, Araújo and Spring (2006) claims that Ford et al (2003) idea about focusing on mixed offering of product-service combination is a helpful start to overcome the service-product dualism. The business challenge for most firms is how to generate a variety of revenue streams from both product and service transactions, as the recent literature on expanding the role of manufacturing suggest (Araújo and Spring, 2006).

According to Bryson et al (2004, p.55), “manufacturing still matters, but manufacturing and services have become increasingly complementary and mutually support activities”. Howells (2000, p.15) identified two different methods by which manufactured products are not offered to consumers in their own right but, rather, as a part of a package that includes

service components: a) manufactured products provided with closely aligned services, and b) the manufactured product supplied to consumers as a vehicle for accessing services, i.e, in cases where the product is not the end point of the transaction, but only the beginning of the relationship between consumer and producer. According to Howells (2000), these types of service/product relationship represent forms of what is termed 'service encapsulation' in which services are wrapped around or embedded in products and in which services can produce innovations in other sectors of the economy. By this way, for Bryson et al (2004), there are four different forms to manufacturing companies transforming themselves into either partial service companies or complete service companies: I) manufacturing-service companies; II) service-manufacturing companies; III) from manufacturing to service companies and IV) virtual production companies. A manufacturing-service company (I) is a firm that has begun to sell services that are linked to physical products. This is the first stage towards becoming a full service company. A service-manufacturing company (II) still produces products but the balance of their activities is shifting towards services. Through the process of servicing, product manufacturing companies can learn and develop new products or redesign. On the other hand, companies moving from manufacturing to service companies (III) used to produce or sell goods, but are no longer engaged in these activities. The company begins to sell knowledge-products but rapidly realise that the sale of such products is more profitable than either producing or selling goods. Finally, a virtual production company (IV) is no longer directly engaged in the physical production of products. It has closed or sold its manufacturing plants or may never has been involved in the production process. Products are designed and marketed, but the production process is undertaken by service manufacturing companies, that may not produce a product in their own right, but instead manufacture and even design products for other companies. For Spring and Araújo (2009) the process about moving from manufacturing to service companies highlights the role of the literature on Business Models (Morris et al, 2005; Schweizer, 2005; Magretta, 2002) as a way to the understanding of how firms can fit strategic, operational and economical decisions in order to offer products and services.

The ideas of Hill (1977, 1999), Delaunay and Gadrey (1987), Gadrey (2000) and Spring and Araújo (2009) spread out the IHIP idea (Fisk et al, 1993) highlighting that services only can be understood by relationship between actors. For authors such as Ramirez (1999), Grönroos (2006) and Vargo and Lusch (2004, 2008), service is a process that enables the value co-creation in business relationships. According to Lusch et al (2010), the literature of supply chain management and marketing have been moving from models and purposes narrowly focused on goods to more general models and purposes associated with partnerships, value networks, service provision, and value creation. The next section presents a theoretical review about these concepts highlighting the role of services in business-to-business networks.

3. Services in business networks: a process of value co-creation

The IMP Interactive and Network approaches show that firms are connected by relationships and are embedded in business networks (Easton, 1992; Axelsson and Easton, 1992; Easton and Araújo, 1992; Ford, 1997). The term network refers to the exchange connection between multiple firms that are interacting with each other (Ford et al, 2006). Relationships can be seen as assets that vary in terms of content, strength and duration. It implicates costs of time and money, risks, uncertainties, and dependences (Ford et al, 2006; Ritter and Ford, 2004). This way, the management of these relationships is not a linear process that leads to an ideal partnership between clients and suppliers. Both parts will try to manage the relation their own way, according to their own priorities. So, it is important to

understand that the firms cannot manage the net, but can only “manage in the net” (Ford et al, 2006).

Anderson et al (1994) and Ritter and Ford (2004) emphasized that business nets are determined by the connection of relationships. For Håkansson and Snehota (1993), a relationship can be understood as an interaction mutually orientated between two reciprocally engaged parts. According to Ford (1997), business relationships can be described as complex combinations of exchanges and adaptation. The content of the exchanges can be studied according to four types: exchanges of products/services, informations, financial and social elements, which lead to a long term relationship characterized by interdependence, reciprocal adaptations and co-ordination of certain activities (Ford, 1997). Therefore, the processes of adaptation take place when one or both parts realize the potential of profit resulting from the relationship, and adapt functions, proceedings, tasks, attitudes, values, and objectives in order to obtain a better performance. Möller and Wilson (1995) agree with this idea and claim that an interaction between supplier-buyer can be described also as a process of co-ordination. For Anderson et al (1994), a business net is built by dyadic business relationships and these are reflexes of the business net in which they are embedded. Relationships between firms may have functions divided into two different dimensions: primary and secondary. The primary functions of business relationships concern the effects, positives or negatives, for both parts that interact in a dyadic relationship. The secondary functions, named “net functions”, capture the indirect, positive or negative, effects of the relationships (Anderson et al, 1994). In an attempt to clarify this idea, Anderson et al (1994) discuss some concepts like “net horizons”, “net context” and “net’s identity”. We can understand “net horizons” as a certain firm's perception on how far does the net in which it is embedded stretches out. The “net horizons” depend on the firm's experience and on the net's structural characteristics. This means that the horizons of the net of a certain firm change according to the business relationships it develops. According to Håkansson and Snehota (1993), the part of the net's horizon considered relevant to the firm is called “net context”, and it is structured in three dimensions: actors, activities and resources (Håkansson and Snehota, 1993). It is in the context of the net that the firm develops what is called “net's identity”, i.e. how a firm sees itself in the net and how it is seen by other members of the same net. The net's identity can indicate the appeal level of the firm as a partner for business relationships and exchanges of resources. According to Henneberg and Mouza (2006), managers can try to picture their companies' networks. They can describe a framework of interrelated dimensions consisting of network context, network horizon and network environment which is called as Network Picture (Ford et al, 2002). For Henneberg and Mouza (2006), a network picture is based on players subjective, idiosyncratic sense-making with regard to the main constituting characteristics of the network in which their company operating. “These perceived network pictures form the backbone of managers' understanding of relationships, interactions and interdependencies, and therefore constitute an important component of their individual decision-making” (Henneberg and Mouza, 2006, p. 409). For these authors, when a manager tries to picture its business network, a set of dimension need to be analyzed: I) boundaries (what's the deep and the width of the net); II) centre/periphery (what's the main firm and the periphery of the net); III) actors/activities/resources (involving individuals, groups or whole companies); IV) focus (on actors or relationships); V) directionality (of interactions); VI) time/task (short or long term); VII) power (of relationships); and VIII) environment (influence of external aspects). Not all these elements need to be present in a network, but these dimensions can be a way for picturing a business network (Henneberg and Mouza, 2006).

Stabell and Fjeldstad (1998) also claim that when the critical value of a firm comes from established business relationships in a net that is called value in network. Value is a

well-known and venerable concept in business markets (Anderson, 2004). But, there isn't a consensus about its meaning. Sometimes it is expressed only in economical terms (Galé, 1994; Smith, 2002), other times it is represented as a set of economical and non-economical aspects, such as market-perceived quality, total savings or satisfaction received (Nagle and Holden, 2002). According to Anderson (2004), each of these constituent components takes our understanding of the concept in a different direction. But it is only through an integrative perception of the term, i.e., by the conjunction of economical and non-economical aspects, that the process of value can be understood (Anderson, 2004). According to Johanson and Wedin (2005), the process of value creation has been studied from the value chain perspective (Porter, 1985), constellations of value (Normann and Ramirez, 1993), systems of value (Porter, 1996) and network perspective (Stabell and Fjeldstad, 1998; Johanson and Wedin, 2005; Amit and Zott, 2001). But, according to Stabell and Fjeldstad (1998), the process of value creation can be seen in three different perspectives: "value chain", "value shops" and "value in networks". To these authors value creation on a "value chain" perspective (Porter, 1985) occurs when a firm considered standardized offers and costs as the elements defining the value; "value shop" when a firm creates value through activities solving specific client problems; and, finally, "value in network" when the critical value of a firm comes from established business relationships in a net. To these authors, in this last case, value is created by activities in a network of business relationships, mediated by technologies. Thus, to them, both costs and business relationships are the driving factors of value creation. This perspective highlights the customers' participation in the value creation process, in which service may have a fundamental role. For authors such as Ramirez (1999), Grönroos (2006) and Vargo and Lusch (2004, 2008) service is a framework (Ramirez, 1999) or a process (Grönroos, 2006; Vargo and Lusch, 2004 and 2008) that enables the value creation in business relationships. For Ramirez (1999), value creation process is not unidirectional, but co-invented and combined through interactions among several economical actors. It's necessary to move from the industrial view of value to a co-productive perception of the term, see Table 1:

Table 1: From an Industrial to a Co-Productive View of Value

INDUSTRIAL VIEW	CO-PRODUCTIVE VIEW
Value creation is sequential, unidirectional, transitive, best described in value chains	Value creation is synchronic, interactive, best described in value constellation
All managed values can be measured in monetary terms	Some managed values cannot be measured monetarily
Value is added	Value is co-invented, combined and reconciled
Value is a function of utility and rarity	Exchanges the source of utility and rarity
Values are "objective" (exchange) and "subjective" (utility)	Values are contingent and actual (established interactively)
Customers destroy value	Customers co-create value
Value is only achieved once, at transaction, and only for the supplier (event)	Value is co-produced with the customers over time – for both co-producers (relationship)
Services are a "seperate" activity	Services is a framework for all activities considered as co-production
Customers are not a production factor	Costumers are managed as a production factor (assets)
The economic actors are analysed as holding one primary role at a time	The economic actors are analysed as holding several different roles simultaneously
The firms and the activity are the units of analysis	Interactions (offerings) are the units of analysis

Source: adapted from Ramirez (1999, p.61)

According to Ramirez (1999), value is interactively co-produced by relationships with customers, as co-creators. Value is contingent and actual, i.e. is co-invented, combined and reconciled by dynamics relationships. By this way, Ramirez (1999) highlights the role of services, as a framework with which to think of value creation. This change for the concept of service agrees with service-centred logic (Vargo and Lusch, 2004 and 2008; Groomros, 2006). This way, Jacob and Ulaga (2008) state that business markets are increasingly taking over the character of service markets. But the concept of value must be understood as a process of co-creation and all firms, including manufactures, must be service providers in order to create value (Reinartz e Ulaga, 2008; Cova e Salle, 2008; Campbell-Kelly and Garcia-Swartz, 2007; Teboul, 2006; Oliva and Kallenberg, 2003, and Chesbrough and Rosenbloom, 2002). Transforming a manufacturing firm into a service provider means having to adopt a business model based on relationships and develop profitable services offers (Oliva and Kallenberg, 2003).

4. Research method

This is a qualitative and exploratory research (Vergara, 2005) developed by a case study approach (Yin, 2003). Case study research (Yin, 2003; Byrne and Ragin, 2009; Ragin, 1992) investigates contemporary phenomenon within its real life context and in which multiple sources of evidence are used. Dubois and Araújo (2007) examined the application of qualitative research and particularly the use of case studies in purchasing and supply management, and discussed single and multiple case designs. These authors considered the problems of case study research using a number of examples, formulate some rules for conducting good case research, and show several studies that relied on single in-depth studies. Dubois and Gadde (2002) and Hakansson and Erikson (1993) highlight the interest and relevance of the single case research for theory development. Some authors have argued that a single case study is justified or even preferable over some conditions (Easton, 2003; Siggelkow, 2007). According to Easton (2003) a single case study can show the impact of a large number of powerful and active contingent relations working through the particular ways in which they operate, which will be not as rewarding as using several cases. This author claims that the relationship with existing theory is important, but when little exists, then one case can be enough to begin and develop the process of theory creation. Easton (2003) demonstrated and justified through critical realism that one case study is enough to structure the way of arguing the results of research.

This paper presents and discusses a single case research that contributes to the discussion about the role of service in manufacturing firms. The aim is to analyse product-services combinations in a manufacturing company, extending the role of business-to-business service networks for value creation in manufacturing firms. The selected case is Embraer, a Brazilian company that is the third major aircraft manufacturer in the world. The data were collected by a desk research (Vergara, 2005) and interviews with managers of Embraer headquarter located in São José dos Campos, São Paulo, Brazil. Secondary material, as articles and technical publications functioned as a significant source of information, against which the comments and opinions of the interviewees were reflected.

In the next section, we present the uniqueness of the case study selected: a firm whose business essence is to supply diverse clients with designing, manufacturing, selling and supporting aircraft for the global airline business, which results in a web of multiple business-to-business relationships, involving the Embraer service network. The analysis shows a good illustration of a global service-manufacturing firm, with subtle relationships that make up the web.

5. The Embraer Case

The Embraer Company is one of the largest aircraft manufacturers in the world. Embraer is a company with 40 years of experience in designing, manufacturing, selling and supporting aircraft for the global airline, defense and business aviation markets. It produced already around 5.000 aeroplanes, and operates in 88 countries, in five continents. Based in São José dos Campos, Brazil, Embraer was founded in 1969 as a government initiative and then privatized on December, 1994 (Portazio and Bitencour, 2008). Since then, Embraer develops its activities in order to compete in a global market, offering specific aircrafts three segments: commercial, defense and executive aviation. For each segment, Embraer produces specific aircrafts, see Table 2. Embraer is also offering services to support those businesses.

MARKET SEGMENTS	AIRCRAFTS
Commercial aviation	EMB 120; ERJ 135; ERJ 140; ERJ 145; ERJ 145XR; EMBRAER 170; EMBRAER 175; EMBRAER 190; EMBRAER 195.
Defense systems	SUPER TUCANO; EMBRAER 145 AEW&C; EMBRAER MULTI INTEL; EMBRAER 145 MP; LEGACY 600.
Executive aviation	LINEAGE 1000; LEGACY 650; LEGACY 600; LEGACY 500; LEGACY 450; PHENON 300; PHENON 100.

Table 2: Embraer aircrafts per market segments
Source: authors

To commercial aviation, Embraer offers a quite established family of regional aeroplanes: the pressurized twin-turboprop EMB 120, for 30 passengers, passing over the jets ERJ 135, 140, 145 and 145XR, with capacities from 37 until 108 passengers. To complement this line of commercial products, Embraer launched the family Embraer 170, 175, 190 e 195, seating 70 to 122 passengers. On the other side, Embraer's defense aircraft try to meet the budgetary requirements of defense programs worldwide. According to Embraer (2010c) more than 20 air forces around the world use Embraer's defense aircraft family and rely on Embraer Defense Systems for surveillance, combat, and training missions. To Executive Aviation, Embraer announced its entrance in the market in 2000. To reach this market, Embraer's executive family of airplanes are developed focusing high aircraft availability, simple maintenance and continued investments in customer support and services.

In order to attend these markets, Embraer has headquarters in São José dos Campos, Brazil, and offices, subsidiaries and customer service based in China, France, Portugal, Singapore and the United States. Aircraft and aircraft parts production are made in Brazil units, including sales, logistics and repair management of aircraft parts and technical and operational support. Foreign units, as in USA, Portugal, France, China and Singapore works in warehousing, sales, logistics and repair management of aircraft parts and technical and operational support. According to Embraer (2010b), the process of manufacturing an Embraer airplane can be divided into five stages: Suppliers, Manufacturing parts, Fuselage assembly, Final assembly and Delivery. Each one of them involves different activities in order to develop the airplane, step-by-step, according to Fig. 2:

MANUFACTURING STAGES OF AN EMBRAER AIRPLANE				
SUPPLIERS	MANUFACTURING PARTS	FUSELAGE ASSEMBLY	FINAL ASSEMBLY	DELIVERY
Step 1: Raw Material	Step 2: Stretch-forming the fuselage skin Step 3: Shaping and adjusting	Step 4: Surface treatment and corrosion-resistant coating Step 5: Structural assembly of a major component Step 6: Sealant Step 7: Fuselage mating Step 8: Installation of wiring, tubing and ducts	Step 9: Fuselage painting Step 10: Major component assembly Step 11: Final outfitting Step 12: Ground tests Step 13: Production flight	Step 14: Documentation and delivery

Fig. 2: Manufacturing stages of an Embraer airplane
Source: adapted from Embraer (2010b)

These are general stages followed to produce an Embraer aircraft, to commercial, defense aviation and executive use. The revenue of the firm comes from operations to these three market segments and from customer support, including after-sales support for parts, services, and technical assistance. According to Embraer (2010b), in 2009, Commercial aviation segment represented the major firm’s revenue per segment (66,7%), followed by Executive aviation (14,3%), Customer Support (10,4%) and Defense system (6.9%). In terms of revenue, these numbers highlights that services, offered by Customer Support activities, represent plus then manufacturing activities revenue coming from Defense systems. But, the main point here is that Embraer is a company that works in designing, manufacturing, selling and supporting aircraft for the global market. For this, the company developed a web of multiple business-to-business relationships, involving the Embraer Aviation Service business unit. The next section describes this area in order to show the combination of products and services by a manufacturing firm, also providing empirical evidences about extending the service concept in this context.

5.1 Embraer: a service-manufacturing firm

In order to support its customers and provide after-sales services, Embraer developed Aviation Services business unit, which encompasses aircraft maintenance, spare parts, training and aeronautical systems. Besides the Embraer-owned companies specialized in this type of activity, Embraer Aircraft Maintenance Services (EAMS) and OGMA – Indústria Aeronáutica de Portugal, located in the USA and Portugal, respectively, Embraer has its own workshops and parts warehouses in the USA, France, China, Singapore and Brazil. Aviation Service unit is divided into different activities: Field Suport, Technical Suport, Maintenance Engineering, Operational Support, Maintenance Services, Material Support, Technical Publications and Training, according Fig.3.

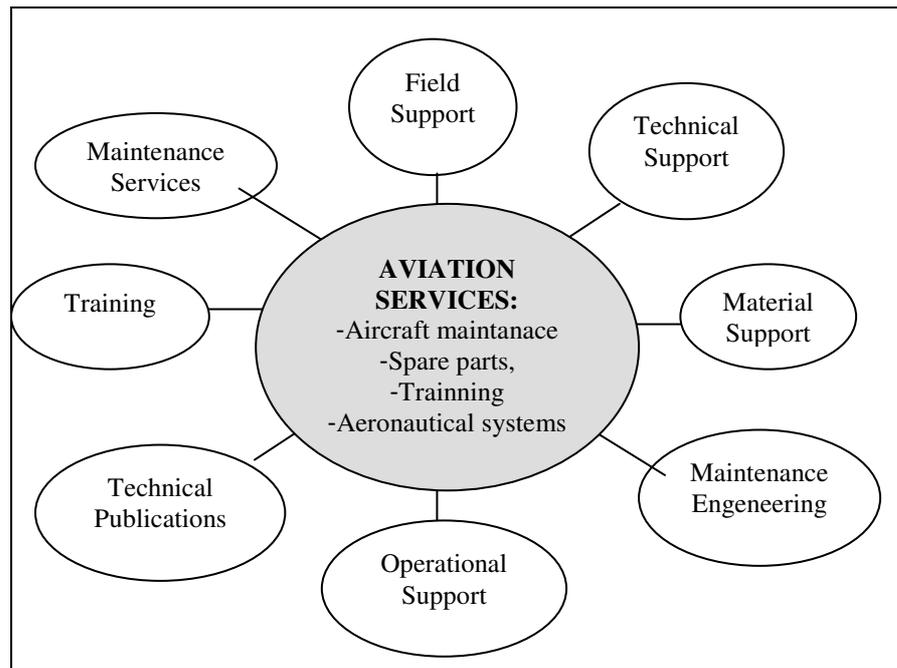


Fig. 3: Aviation services offered by Embraer
Source: authors

Acquiring an Embraer aircraft, customer has **Field Support** by a Customer Account Manager, responsible for taking care of all aspects of their operations, including maintenance, flight operations and spare parts. Working together with the customer account manager, there is a Spare Parts Representative, who is responsible for providing customers with a comprehensive initial provisioning list (IPL) of spare parts and ground support equipment and to make sure that all special tooling needs are addressed. Once a customer relationship is established, the Spare Parts Representative will work within the customer organization to ensure that all needed parts and tooling are available for all scheduled and non-scheduled maintenance services. Parts representatives at customer sites will assist in planning and ordering spare parts adequately and in a timely fashion. Customers can also count on the services of a dedicated Technical Representative or may call one of Regional Technical Representatives or Field Engineers that are available to assist Embraer customers and who generally serve as the first point of contact for routine technical inquiries.

For **Technical Support**, Embraer has, for each aircraft program, a dedicated team of technical support engineers who are able to identify issues and coordinate the implementation of solutions. A Structural Repair Support Group is available to help customers in the design and/or approval of repair schemes. A team formed by structural engineers and DERs (Designated Engineering Representatives) assures quick responses thus preventing AOG (Aircraft On the Ground) situations caused by unresolved technical issues or cutting down on AOG periods. Technical Support headquarters are in São José dos Campos, SP, Brazil. In addition, there are Regional Customer Support Facilities in Fort Lauderdale (USA) and Le Bourget, France. Embraer's vendors and partners play an important role in customer support effort. An Embraer team of vendor liaison engineers is routinely working to assure that partners are supporting Embraer customers effectively. Embraer **Material Support** Division provides assistance on spares support and logistics as well as a range of special support programs to help operators reduce costs. Embraer Material Support can assess tools, equipment and facilities available at Customer sites and recommend additional items or modifications. In addition to the sale of new parts and materials, Embraer provides options to

reduce Customers' investments in stocks through the following Customized Programs: spare parts pool (fleet hour agreement program); consignment stock; exchange program; insurance items rental program (high price and low-utilization items); consumables consignment and repair management. For spares support, service is provided through Sales and Distribution Centers in São José dos Campos, SP, Brazil, Fort Lauderdale (USA) and Villepinte, France or through Embraer's Distribution Centers in Weybridge, UK.

In the same vein, for **Maintenance Engineering**, the maintenance planning engineering group develops and supports scheduled maintenance programs for all Embraer aircraft. Maintenance plans are continuously updated, and the emphasis is on maximizing aircraft availability and reducing maintenance costs without compromising safety. Technical assistance is provided to customers to help them understand the maintenance requirements of their aircraft and to solve their maintenance scheduling problems. Enhanced maintenance programs are compiled for customers who have specific requirements. Individual updates to maintenance programs are provided to customers who have repairs or modifications to be that need to be implemented on their aircraft. Maintenance engineering activities also include detailed monitoring of the entire fleet and individual customers fleets on a daily basis by Embraer. A team is dedicated to fleet reporting analysis and corrective actions, aircraft dispatch reliability and control of unscheduled component removal rates. Updates are issued on a monthly basis to identify reliability trends and initiate the appropriate corrective actions. Data exchange with customers and suppliers is ongoing and ensures a reliable and consistent fleet performance database, which shortens the problem identification cycle. All information received is recorded in Embraer's databases and is used to identify the frequency as well as the basic factors affecting reliability. Reliability data is made available to customers in order to help them meet the requirements of their Reliability Programs.

Embraer provides all of its customers with the engineering information required for an efficient and safe operation of their fleet according to their national flight operation regulations. By **Operational Support** activities, Embraer makes available to its customers all flight operations documentation required and also flight operations software developed by skilled and experienced operations personnel at Embraer's Operations Engineering Division, as: runway analysis, flight planning and driftdown analysis. Fleet performance is monitored by regular visits to operators, conducted by Embraer Operations Support Division. A group of experienced instructor pilots is available to discuss all aspects of Embraer aircraft operations with the customer flight department. Initial flight training, route training and flight documentation preparation are some of the services that can be provided. Embraer Fleet Support team takes part in the regular operator visit program conducted by Embraer Operations Support Division, with the purpose of developing better communications with the operators' flight departments. By this way, Embraer **Technical Publications** are developed to meet the customer's needs, and to guarantee the access to the correct information for a safe and economic aircraft maintenance. Technical publications are based on international standards and are developed and updated by a team of specialized aeronautical engineers and technicians, who participate in all phases of the project, from development to production. Embraer uses advanced authoring and editing systems as well as CAD/CAM to produce high-quality technical publications in hard copy and on digital media. Technical publications are available on CD-ROM and online, in Fly Embraer portal. Embraer also offer associated services, such as customized publications, specialized management software, customized task cards and inclusion of maintenance information for items certified by the customer. The combination of Embraer's technical expertise in design and construction of regional transport aircraft with Flight Safety International (FSI) expertise in building on-the-job training and maintaining training facilities and programs assures delivery of **Training** programs to Embraer customers. Maintenance and operational training programs combine computer based

classroom instruction (academic) and "hands-on" training. The academic and practical phases are integrated to maximize the transfer of knowledge by practicing the procedures learned in the classroom. The practical phase involves training in simulators combined with computer-aided training and factory field trips. (Embraer strongly recommends that initial maintenance classes be held at Embraer's facilities in Brazil to allow students to have access to the aircraft).

To assist customers in achieving this objective, Embraer established its own services in Brazil (the Embraer Service Center) and made a number of strategic partnerships to ensure the highest **Maintenance Services** standards for the Embraer fleet worldwide. There are units, also through outsourced suppliers, distributed in five areas: North America, Europe, Africa-Middle East, South America and Asia-Pacific, see Table 3.

SERVICES CENTERS	LOCATION	SERVICES OFFERED
NORTH AMERICA		
Hawker Pacific Aerospace	Sun Valley, California	Components, E.M.B 145 gear, hydraulics
Swift Aviation Services, Inc.	Phoenix, Arizona	Embraer 135, Airframe line and base maintenance
Evergreen Aircenter, Inc.	Marana, Arizona	E.R.J 135/145, Airframe line and base maintenance
Triumph Accessory Services	Wellington, Kansas	Embraer 120, Embraer 135/145 components, mechanical and electro-mechanical
Bizjet International Sales and Support Inc.	Tulsa, Oklahoma	E.R.J 135/145, Airframe line and base maintenance
Midcoast Aviation Inc.	Cahokia, Illinois	E.R.J 135/145, Airframe line and base maintenance Components, landing gear
Embraer Aircraft Maintenance Services	Nashville, Tennessee	E.R.J 135/145, Legacy, Phenon and E-Jets All airframe maintenance; structures, composites and interiors; components repairs (mechanical, electro-mechanical and hydraulic); landing gear and aircraft painting
Piedmont Aviation Component Services	Kernersville, North Carolina	Embraer 120, Embraer 135 components, hydraulic and landing gear
Airservices of Cleveland	Cleveland, Ohio	E.R.J 135/145, Airframe line and base maintenance
Midway Aircraft Instruments Corp.	Little Ferry, New Jersey	Components: electrical, electronic and mechanical
Future Aviation Incorporation	Ft. Myers, Florida	Components: mechanical and electro-mechanical
Aero Precision Repair and Overhaul	Deerfield Beach, Florida	Components, ERJ 145 landing gear hydraulics
AAR Landing Gear Services	Miami, Florida	Components, E.M.B 120 landing gear hydraulics
EUROPE		
OGMA- Indústria Aeronautica de Portugal	Alverca, Portugal	E.R.J 135/145; E.M.B 170/175 Airframe line and base maintenance, Structures and composites, Rolls Royce AE3007 engine full capable, Authorized maintenance center
FlyBe	Exeter, United Kingdom	Sales engineering
LOT Poland	Warsaw, Poland	E.R.J 135/145, Airframe line and base maintenance Structural repairs
AFRICA AND MIDDLE EAST		
Egyptair	Cairo, Egypt	Sales engineering
Naturelink	Pretoria, South Africa	Sales engineering
SOUTH AMERICA		
ABC Taxi Aereo S/A	Minas Gerais, Brazil	E.M.B 110, E.M.B 121 Airframe line and base maintenance
Embraer Service Center	São Paulo, Brazil	Embraer 170;ERJ 135, 140, 145; E.M.B 110, E.M.B 120, Embraer 121, Airframe line and base and heavy maintenance
ELEB- Embraer Liebherr Equip. do Brasil S.	São Paulo, Brazil	Landing gears, valves, actuators, servo controls, maintenance, repairs and overhaul to all Embraer aircrafts.
ASIA-PACIFIC		
Hawker Pacific Asia Pte Ltd.	Singapore	ERJ 145 Line and base maintenance
Hawker Pacific Asia Pte Ltd.	Sidney, Australia	ERJ 145 Line and base maintenance

Table 3: Global distribution of Embraer's services centers

Source: authors

Services are delivered according to each type of airplane and, in general, Embraer Service Center performs a wide range of aircraft-related tasks from basic service checks to major

modifications. Aircraft maintenance, material support and logistics, flight operations information and training services can be accessed by a portal called FlyEmbraer. It delivers digital tools and data to support aircraft fleet maintenance and engineering activities. In addition to physical structures to provide services, the portal Fly Embraer allow an on-line and continuous support in order to provide value-added to customers (Embraer, 2010a). Interacting with customers by Aviation Service activities, Embraer develops a global business network. The next section discusses about the role of services to manufacturing companies, highlighting the application of a business-to-business service network for value creation.

6. Extending the role of services to manufacturing companies: the issue of business-to-business services networks

The case of Embraer highlights interesting issues about product-service arrangements. Embraer describes itself as a company that works in designing, manufacturing, selling and supporting aircraft for the global airline. By this way, the combination of products and services at Embraer can be understood according to Bryson et al (2004), for which manufacturing and services have: I) become increasingly complementary and II) mutually support activities. Firstly, Embraer offers services (as designing, selling and supporting activities) and products (manufactured aircrafts) in a complementary way, in order to attend aviation markets. For the other side, Embraer also offers services by support activities (Aviation Services), in order to support its customers and provide after-sales service. This service and business unit encompass aircraft maintenance, spare parts, training and aeronautical systems, as was showed before (see Figs. 2 and 3), which increase the value of use of the Embraer products, i.e. the aircrafts. Thus, the Embraer combination of products and services highlight how service is related with manufacturing firms. Embraer Aviation Services are developed to provide continuous value-added to customers, and are an evidence of Lusch et al (2010) ideas about service as processes for value creation by resources' interactions among parts in relationships. For the other side, Embraer Aviation Services also illustrates the ideas of Hill (1977, 1999), Delaunay and Gadrey (1987), Gadrey (2000) or Spring and Araújo (2009) about the institutional perspective on service definition. For Delaunay and Gadrey (1987) and Gadrey (2000) service activity is an operation intended to bring about a change in the status in a reality C that is owned by a customer B effected by a service provider A at the request of B and in a many independently of medium C. Fig. 4 shows the Embraer service triangle, i.e. the Embraer activities according to this analysis:

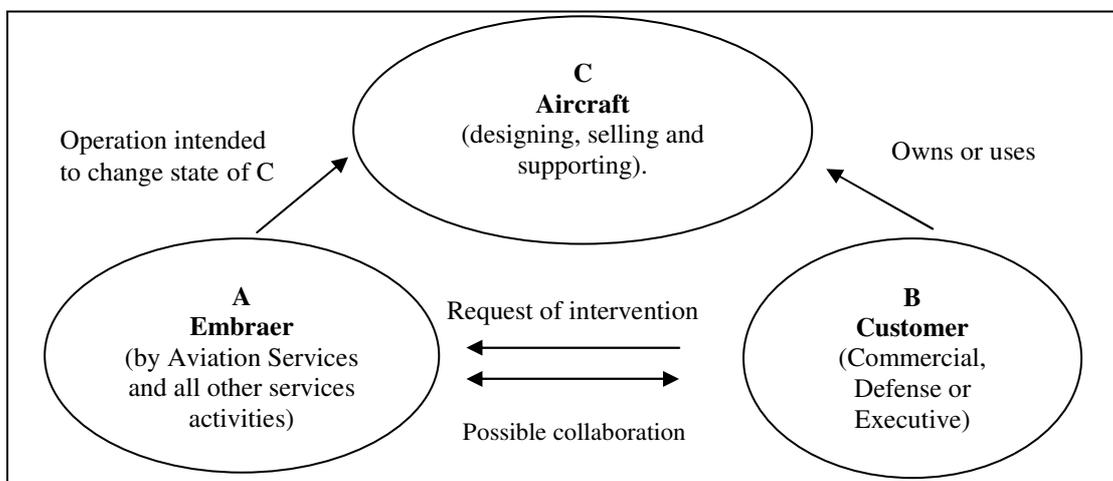


Fig. 4: The Embraer service triangle
Source: authors

As a service provider, Embraer (A) offers services (Aviation Services and all other services activities) intended to bring about a change in the status in a reality C (about designing, selling and supporting), which is owned by Customer B (for commercial, defense or executive use). Services activities are developed by request of intervention and/or possible collaborations. Acquiring an Embraer aircraft, customer has much different kind of support and after-sales services that can be also developed in collaboration within it, by a dedicated team in order to provide value addition. According to Spring and Araújo (2009), making services tradable requires the regulation of access to maintained socio-technical capacities which may involve a variety of modes of interaction between service providers and users, as we can see in Embraer Aviation Services business unit.

According the idea about “service encapsulation” (Howells, 2000), Embraer can be seen as a company providing manufactured products with closely aligned services. By this way, according Bryson et al (2004) concept for four different forms to manufacturing companies transforming themselves into either partial service companies or complete service companies, we can understand Embraer as a service-manufacturing company: Embraer produce products but the balance of theirs activities is shifting towards services. Through the process of servicing, product manufacturing companies can learn and develop new products or redesign, what can be seen among Embraer, customers and suppliers relationships. According to Oliva and Kallenberg (2003), moving from a traditional product-manufacturing company to extending the service business imply not only in new capabilities, metrics and incentives, but also in the emphasis of the business model changes from transactions to relationship-based, as we can see in Embraer. By this way, Embraer service triangle can be an example about how service provision is directly associated with partnerships, in order to get a business-to-business network for value creation (Lusch et al, 2010).

By this way, the role of services to manufacturing firms can be extended to a network application. The Embraer service triangle can also highlights the issue about business-to-business service networks. According to IMP Interactive and Network approaches, the term network refers to the exchange connection between multiple firms that are interacting with each other (Easton, 1992; Axelsson and Easton, 1992; Easton and Araújo, 1992; Ford, 1997). By this way, for the service provision, there is a network that is “generated”, which includes clients and partners (as service centers), but also suppliers, and the “suppliers of the suppliers” etc. The Embraer Aviation business unit can illustrate that there is business-to-business service network constituting the net horizon, the net context and the net identity of the firm (Håkansson and Snehota, 1993). The main point is that when traditional product-manufacturing companies, like Embraer, try to change their position in the goods-services continuum by continuously extending the service business to their offers, they probably “develop” a B2B service network that will also influence (or constitute) the B2B network that exists around the product. As a service provider, a manufacturing firm can probably have to attend this B2B service network.

6. Final considerations

This paper presents an exploratory research that was developed in order to provide a better understanding about product-services combinations in manufacturing firms. The theoretical review presented in this paper has revisited the product-service distinction and highlighted the role of service in manufacturing. Moving from a manufacturing firm into a service provider is still a challenge for managers, but is a way to obtain competitiveness. The case of Embraer can be seen as an empirical evidence of product-service combination in a manufacturing context. We show that as a manufacturer, Embraer offers other activities to develop and to support its products. Thus, developing service activities, Embraer turned itself

into a service-manufacturing firm, which works to and/or within its customer and suppliers allowing the creating of value. The application of specialized capacities (knowledges and skills) is done by Aviation Services business unit, or any other type of services, exchanged through business relationships. Embraer is a case study that contributes to the discussion about how a manufacturing firm can generate a variety of revenue streams from both product and service transactions, and it can be a useful example for manufacturing managers trying to extend service business to their offers. The analysis done showed how designing, manufacturing, selling and supporting aircraft for the global airline business results in a business-to-business service network, which is a good illustration of a global service-manufacturing firm with subtle relationships that make up the web.

The role of manufacturer-service interface to service business-to-business networks is in an early stage of research. Maybe the Henneberg and Mouza (2006) idea about how to picture a business network can be a start point in order to describe this network that involves services offers. The challenge to managers in manufacturing firms is to try to focus on mixed offering of product-service combination (Ford et al,2003), understanding their network pictures (Henneberg and Mouza, 2006) as a framework of interrelated dimensions including all product/services relationships. From this paper, some questions arise for further investigation: how to picture a business network describing product/service combination in manufacturing companies? Embraer is a case of a service-manufacturing company that offers services to reach its aims besides manufacturing. But, service business-to-business networks for manufacturing companies need to be understood for different product-service combinations that are related to the nature of producer-user interactions and the institutional structure of production and networks (Spring and Araújo, 2009). Does each one of the four different forms (Bryson et al, 2004) to manufacturing companies transforming themselves into either partial service companies or complete service companies involve different dimensions to picture the network? Trying to picture the business-to-business service network can be an empirical way to show how to transform a manufacturing firm in a service provider.

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