



Spring 2019

## Go Global or Stay Local? Understanding How Fiscal Incentives Reshape Supply Networks

Ricardo Silveira Martins

Janaina Siegler

Armando Souza-Junior

Barbara Flynn

Guilherme Silveira Martins

Follow this and additional works at: [https://digitalcommons.butler.edu/cob\\_papers](https://digitalcommons.butler.edu/cob_papers)








Part of the Business Administration, Management, and Operations Commons

---






## Go Global or Stay Local? Understanding How Fiscal Incentives Reshape Supply Networks


Rede Global ou Local? Entendendo como Incentivos em Zonas de Livre Comércio Impactam a Configuração de Redes de Suprimentos



 Ricardo Silveira Martins<sup>1</sup>  
 Janaina Siegler<sup>2</sup>  
 Armando Souza-Junior<sup>3</sup>  
 Barbara Flynn<sup>4</sup>  
 Guilherme Silveira Martins<sup>5</sup>

Universidade Federal de Minas Gerais, Centro de Pós-Graduação e Pesquisa em Gestão, Belo Horizonte, MG, Brasil<sup>1</sup>  
Butler University, Lacy School of Business, Indianapolis, IN, USA<sup>2</sup>  
Universidade Federal do Amazonas, Escola de Estudos Sociais, Manaus, MA, Brasil<sup>3</sup>  
Indiana University, Kelley School of Business, Indianapolis, IN, United States<sup>4</sup>  
Insper Instituto de Ensino e Pesquisa, São Paulo, SP, Brasil<sup>5</sup>

Guest editors for this article: Emílio José Montero Arruda Filho   
Cristiana Fernandes De Muyllder   
Airton Cardoso Caçado   
Ruby Roy Dholakia   
Angela Paladino 

Editor-in-chief: Wesley Mendes-Da-Silva 

Received 23 November 2018

Last version received at 02 April 2019

Accepted 22 April 2019

# of invited reviewers until the decision

	1	2	3	4	5	6	7	8
1st round	⊗			⊗		⊗		
2nd round								

## Resumo

Este estudo investiga a forma como as empresas reconfiguram sua base de fornecedores e reformulam suas redes de produção para capturar o valor dos incentivos fiscais de Zonas Francas para capturar valor de incentivos. Seis redes de produção localizadas em Manaus, Brasil, são analisadas utilizando a estrutura da Rede Global de Produção e fatores relacionados ao tipo de fábrica e relacionamento com fornecedores. Foi conduzido um estudo de caso múltiplo e dados foram coletados por meio de entrevistas em profundidade no local. Os seis empresas selecionadas para os casos são líderes em três diferentes setores: transporte, mecânica e química. Os resultados indicam que, se aplicados efetivamente, os incentivos podem afetar a configuração da rede de produção a partir de uma perspectiva de imersão, fazendo com que a empresa mude seu papel estratégico. Com base na análise, propomos cinco proposições que desafiam as relações entre autonomia, criação de valor, tipos de plantas e níveis de inserção. As proposições são particularmente úteis para fornecedores e distribuidores, bem como agências públicas, incluindo provedores de infraestrutura e formuladores de políticas.

**Palavras-chave:** localização de instalações; desenho de redes de suprimentos; gestão de fornecedores; zonas de livre comércio.

## Abstract

This study investigates the way firms reconfigure their supply base and reshape their production network to capture value from Free Trade Zone incentives to capture value from incentives. Six production networks located in Manaus, Brazil are analyzed using the Global Production Network framework and factors related to plant type and supplier relationships. A multiple case study was conducted. Data was collected using in-depth semi-structured interviews administered in loco, and the selected the firms were leaders in three different industries: transportation, mechanical assembly and chemicals. The results indicate that, if effectively applied, incentives can impact production network configuration from an embeddedness perspective, causing a firm to change its strategic role. Based on the analysis, we propose five propositions that challenge the relationships among autonomy, value creation, plant types and levels of embeddedness. The propositions are particularly useful for suppliers and distributors, as well as public agencies, including infrastructure providers and policymakers.

**Keywords:** facility location; supply network design; supplier management; free trade zones; global production network.

**JEL Code:** Q31, E32, F6.

## Introduction

Governments establish public policies that alter normal market operations. With a goal of reinforcing the domestic economy or a specific region, a government may offer incentives to attract firms, for example, through a Free Trade Zone (FTZ). FTZs allow free trade with countries across the world from a designated physical site inside a country, where imported items will be processed or used in manufacturing operations under special customs rules (Murphy & Knemeyer, 2015). The goal is generation of economic development for a geographical region. General local conditions are improved by economic development through creating income and jobs, as well as through attracting new capital investment (Benton, Napier, & Ulku, 2016).

We aim to understand how companies' supply chain strategies are impacted by local conditions under FTZ incentives. In the case studied in this paper, we focused in understand how firms structure their networks to capture the benefits offered by Manaus FTZ. The focal companies' supply chain strategies and practice implementations can bear different impacts. For example, firms the implementation and use of cooperative and collaborative strategies between focal companies and their suppliers can incentivize and/or leverage the development of local clusters as well as bring global companies to stablish local sites directing influencing the level of local embeddedness if the company and its supply chain. On the other hand, if just simple isolated components happen without the need or encouragement of further collaboration, the relationship will remain on the level of exports and imports.

In the first situation, the firm would have a strong local presence, while in the second it would maintain its global performance. In the first case, due to the economic multiplier effects, it is understood that the benefits would be greater for the region that shelters the FTZ, while in the second case, they are minimized. The level of embeddedness in a network can be a key variable in this differentiation (Handerson, Dicken, Hess, Coe, & Yeung, 2002). These decisions have impact to the economic regional development as well as the influence on public policies.

This study poses the following research question: How can different supply chain value capture strategies, immerse in the local or act globally, when stimulated by the incentives of a public policy can effectively contribute to the development of regional and innovation poles? In looking at this issue, this study focuses on how companies reconfigure their suppliers base and reshape their production network to capture incentive value from a FTZ.

We analyzed six production networks located in Manaus, Brazil's FTZ. The analytical approach was based on the work of Miltenburg (2015), which combined the Global Production Network (GPN) framework (Handerson et al., 2002) with the works of Ferdows (1989, 1997) and Feldmann and Olhager (2013). This combination of analytical resources, originated from different theoretical contributions complement each other to contribute to a better understanding of the strategic challenges of supplier location and local buyer and supplier relationships and the impacts of these relationships on regional development.

The rest of this paper continues as follows. The first section presents the literature review and the main theoretical background. This is followed by the methods of data collection and analysis, while in the third section, the results are presented and their implications discussed. The final section presents the main conclusions of the study.

## Literature Review

Production paradigms have been changed by trade liberalization through supplying international markets via local manufacturing. The influence of operations management concepts on international manufacturing has evolved from a global sales, marketing and plant focus to international manufacturing networks, which are a coordinated aggregation (network) of intra-firm plants located in different places (Ferdows, 1989; Rudberg &

Olhager, 2003; Shi & Gregory, 1998). Decision on whether to develop a local network can be explained by focusing on the network, instead of the factory, as the unit of analysis (Shi & Gregory, 1998). International manufacturing networks can be a source of new strategic capabilities, rather than simply a location decision or source of coordination. Both manufacturing network and internal factory characteristics are influenced by market requirements and corporate strategies.

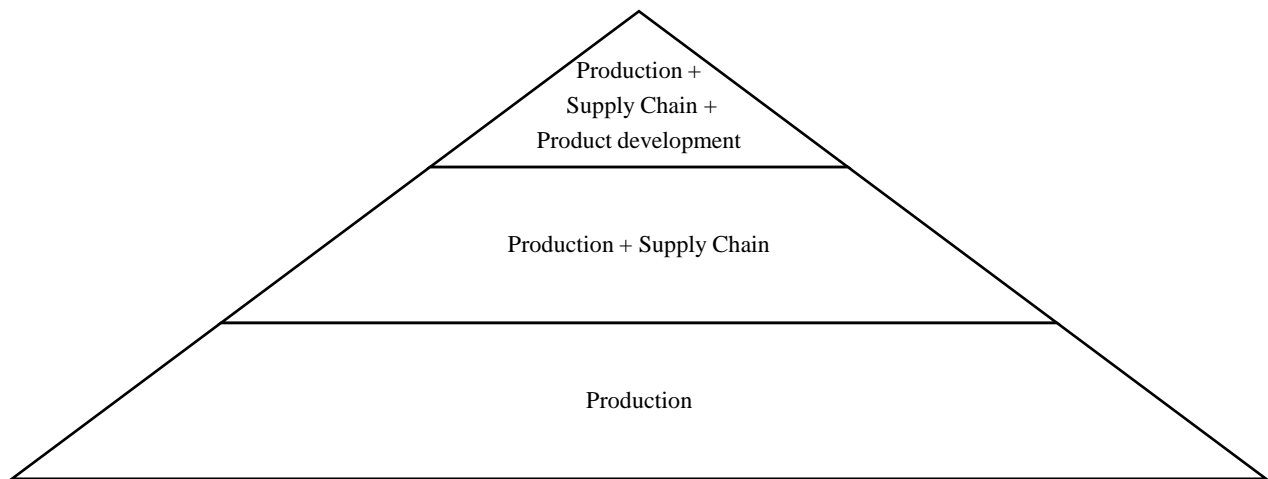
We build on the works of Ferdows (1989, 1997) and Feldmann and Olhager (2013) to characterize plant types and their strategic role, based on the level of site competence and strategic reason for location. This is helpful in understanding how firms design their network strategy and potentially evaluate how they will interact with local agents.

### **Strategic roles of foreign factories**

Ferdows (1989) identified plants by their competence and location advantages, identifying six types: Offshore, Source, Server, Contributor, Outpost, and Lead plants. Offshore factories focus primarily on manufacturing specific items at a low cost. The autonomy of managers in Offshore factories is minimal; they neither choose suppliers nor negotiate prices. Investments are also kept at the minimum level. Source factories also focus on low-cost production. However, their managers have more autonomy than Offshore factory managers do, involved with decisions related to supplier selection, process changes, and redesign decisions. While a Source factory focuses on low cost, it searches for locations to produce where the infrastructure is relatively developed and where a skilled workforce is available. Server factories focus on specific national or regional markets. They have relatively low autonomy in the production process and typically orient their search for plants to take advantage of geographical position, considering tariff barriers or logistics costs. Contributor factories also focus on specific national or regional markets. However, they have their own research and development departments, in addition to engineering and production capabilities, and they also participate in the choice of key suppliers. Outpost factories have strategic functions, such as collecting information to enable strategic decision making. This type of factory is typically located in an area where advanced suppliers, competitors, research laboratories, or customers are located. Finally, Lead factories capture local skills and technological resources, then disseminate their product and processes innovations to all of the plants in the firm.

The more oriented towards low cost a plant in a given location is, the more it will make use of local values that provide cost reduction. Plants with greater autonomy in their investments, technology development, and supplier selection have a perspective of innovation, constantly search for differentiating factors and are committed spreading them across the network. As a result, they tend to be more immersed within a site and focused on foreign markets, due to the expectation that they function in a leading position within the network (Ferdows, 1989, 1997; Feldmann & Olhager, 2013; Handerson et al., 2002)

Three characteristics help distinguish between plant types: strategic purpose, scope of activities, and level of capability. The strategic purpose of a plant can include proximity to markets, access to process and product technology, and access to factors necessary for low-cost production (Miltenburg, 2015). The scope of activities can range from narrow to the broad, based on the plant's involvement in production activities, sourcing, distribution, design and improvement, and Research and Development (R&D). The level of capability includes a plant's competence and capability development. Plant types with a narrow scope of activities and a low level of capability are predominant in simple production networks, such as Server, Outpost, and Offshore. Plant types such as Contributor, Lead, and Source are used in complex production networks because they typically have a broad scope of activities and a high level of capability. Plant competence is related to production, supply chain, and product development (Figure 1) (Feldmann & Olhager, 2013). This framework to understand the relationship between the complexity of a plant's strategy and its location decision and related goals.



**Figure 1.** Hierarchical Framework of Site Competencies Levels

Source: from Feldmann, A., & Olhager, J. (2013). Plant roles - Site competence bundles and their relationships with site location factors and performance. *International Journal of Operations & Production Management*, 33(6), 722-744. <http://doi.org/10.1108/IJOPM-03-2011-0077>

## Global production network framework (GPN)

The global production network framework (GPN) incorporates elements from economic geography to prioritize a product, in developing an understanding of how a firm defines its network strategy in terms of R&D, design, production, and marketing. Thus, the supply network is the unit of analysis (Cheng, Farooq, & Johansen, 2015). GPN helps in evaluating the impact of a firm on a region and the local economy (Handerson et al., 2002). Figure 2 depicts the elements of the GPN framework and their relationships.

b

**Figure 2.** Global Production Network (GPN) Framework

Source: Handerson, J., Dicken, P., Hess, M., Coe, N., & Yeung, H. W.-C. (2002). Global production networks and the analysis of economic development. *Review of International Political Economy*, 9(3), 436-464. <https://doi.org/10.1080/09692290210150842>

The GPN framework describes network in terms of three foundations and three forces. The three foundations on which the network rests are value, power, and embeddedness. Value includes both surplus value and economic rents. The focus is on how value is created, enhanced, and captured. It also considers whether value was created, enhanced, or captured using the firm's capabilities, if it was developed locally, or if it was developed through privileged access to resources.

Power can be a source of value enhancement and capture, depending on whether its source is corporate, institutional, or collective. It is corporate when the focal firm makes decisions and resource allocations. Power is institutional when national and local state agencies can exercise power to influence a firm's investment and other decisions of lead firms and other firms integrated into the network. Finally, it is collective when there are consistent actions by collective agents who seek to influence firms in particular locations, such as union labors or trade unions.

Embeddedness can be on a territorial or network level. At the territorial level, a firm is analyzed in its geographical space, evaluating its contribution to the development of these locations. At the network level, embeddedness concerns network structure, encompassing its social and spatial features. Thus, embeddedness is a key variable in global and regional economic growth analysis (Handerson et al., 2002). The impact of a network is different based on the potential location of a plant, in order to meet specific rules, regulations, stock market dynamics, interest rate and use of capital access, and institutional environment.

Three forces further shape network design, according to the GPN framework. First, the sector in which a firm operates is the group of firms with similar technologies, products, and market constraints that are likely to follow similar ways of being competitive. Second, external institutions impact the network, including the sector, government, and others. The third force deals with how power is exercised through governance and ownership structures. Combined, these all impact how a production network is shaped.

Thus, we focus on deepening understanding of how a firm defines its strategy and reshapes its production network to capture value from incentives. We use the concept of buyer-supplier relationships embeddedness to analyze inter-firm relationships that lead to the delivery, consumption, and maintenance of goods and services (Choi & Kim, 2008). We define Free Trade Zones (FTZ) (also known as Foreign Trade Zones, Duty-Free Zones, or Special Economic Zones) as the geographical boundary of the study. In the broadest definition, an FTZ is an exception to a country's tariff and or fiscal policies (Siroën & Yücer, 2014) that is described as an incentive for location in that country.

## Method

Aiming to further understand how firms reshape their production network to capture value from tax incentives, we conducted exploratory multiple case studies. Research developed for the field of operations strategy used qualitative methods, throughout interviews. The method was selected taking in consideration the complexity of the existing organizational settings in FTZ because it enables the researchers to better understand the units seen in their wider context (Collis & Hussey, 2009; Creswell, 2007; Stake, 2008; Yin, 2009).

The interviewees declared the decisions made, based on the parameters considered, as well as, in this case, the importance of incentives as drivers of actions and, eventually, intentionally misrepresenting the global strategies for local settings. In this way, the approach to occupants of key positions is fundamental.

## Case selection

This research was conducted in the Manaus FTZ also known as Manaus Industrial Pole (MIP). It was opened in the 1950's with the initial purpose to safeguard the sovereignty of Brazil in the Amazon region (Bomfim & Botelho, 2009) and based on tax incentives. Over the years, the PIM evolved to an industrial complex that host around 500 companies from different nationalities operating in 19 industries and sub-sectors of activity (Severiano & Tapajos, 2017; Superintendência da Zona Franca de Manaus [Suframa], 2016).

For purposes of this research, we selected the firms that were leaders in three different industries: transportation, mechanical assembly and chemicals. The selection of the industries was made considering the focal firms' financial, economic, and production importance to PIM and Manaus region. The transportation industry was represented by the two-wheeled vehicles production that together, represent more than 90% of the Brazilian production of motorcycles. The companies investigated in each other industry (mechanical assembly – wristwatches, and chemicals – beverage concentrates) are also among the top ten industries in the PIM. They also represent production network of firms of different nationalities which are American, Brazilian, Chinese, and Japanese (Severiano & Tapajos, 2017; Suframa, 2016). The diversity of the cases enabled the researchers to understand how a firm reshapes its production network based on the premise that a firm will have multiple opportunities to evolve and select the geographical location of the members of its supplier network.

## Data collection and respondents

Data was collected using in-depth semi-structured administered in loco between August and November, 2015. We followed field-based data collection methods described by Eisenhardt (1989), Pagell (2004), and others, with a goal of to “not only identify constructs but also develop an understanding of why identified constructs might

be important” (Pagell, 2004, p. 464). Suggestions from Krippendorff (2013), Miles, Huberman and Saldaña (2014) and Yin (2013) were also taken into consideration in building and analyzing the case studies.

Twelve interviews and six site visits were conducted. The respondents were authorized and indicated by the companies, were informed about the content of the issues that would be dealt with, agreed to participate and signed a Consent Form. The respondents held senior management positions and interview questions dealt with general characterization of the firm, including its history, motivation for location in the MIP, production structure, production capacity, key customers and decision-making structure.

Two researchers participated in the data collection for observations and note taking. The interviews the interviews lasted, on average, 1 hour and 20 minutes. They were recorded and transcribed for subsequent analysis.

Questions concerning the structure and shape of the supplier network were also asked, including topics such as who the local suppliers are and their importance, distribution of items and role in the aggregation of the value of local and international suppliers, and the availability, development, evaluation, and expertise of local suppliers. We also asked questions about supply chain integration including integration structure, information sharing, resources, risks, returns, and coordination mechanisms. Finally, we asked about relationships with local first-tier suppliers, agreements, collective strategies, joint trust deeds, possible opportunistic behaviors, and challenges in attracting strategic suppliers to the Manaus MIP as available in the recorded, then transcribed for subsequent analysis.

## Data analysis

The analysis was based on GPN and the work of Ferdows (1989, 1997) and Feldmann and Olhager (2013), based on the analysis used by Miltenburg (2015). Our interests were in the network reconfiguration process that allowed the focal firm to operate in Manaus and become the beneficiary of tax incentives. Even though the focus of our analysis was different from Miltenburg’s (2015), both frameworks were suitable for our purpose.

GPN terminology was used to characterize the foundation on which the production network rests, including value (creation, enhancement, and capture), power (corporate, institutional, or collective), embeddedness in the geographical space and contribution to the development of these locations. We also considered the relationship among the local and global partners in the network (network embeddedness).

The analysis also focused on plant type and network type, based on Feldmann and Olhager (2013). The plants were classified as Offshore, Source, Server, Contributor, Outpost, or Lead plants. Classification was based on the plant’s strategic purpose, proximity to markets, access to process and product technology, access to factors necessary for low-cost production, scope of activities, and level of capability.

Social network analysis was used to investigate whether being local or global affected the network configuration. This allowed for an in-depth investigation of the structural characteristics and inherent relationships within a network (Hollenbeck & Jamieson, 2015; Wichmann & Kaufmann, 2016). We used quadratic assignment procedures (QAP) (Dekker, Krackhardt, & Snijders, 2007) at Ucinet 6 for Windows (via double Dekker semi-partialling) to analyze whether a relationship between firms was correlated and if the correlations were affected by the firms’ nationality. Degree centrality, which reflects the number of adjacent ties a firm builds in a network (Freeman, Borgatti, & White, 1991) was used to discuss the firm’s position in the network. Firm ties were based on buyer-seller relationships; each focal firm indicates most important suppliers and these suppliers indicates most important buyers.

## Case Analysis

A multiple case study was conducted, and the firms selected to compose the cases were leaders in their industries.



## Transportation assembly: two-wheeled vehicles

The two-wheeled vehicles firms located in Industrial Pole of Manaus (PIM – acronym in Portuguese), together make the largest center of motorcycle production in the Latin America. This industry also is the most relevant in the PIM, consisting of about 70 companies. They include finished goods manufacturers and supplier for components and parts. The researched firms in this industry were called M1 and M2.

Firms M1 and M2 are our Motorcycle Cases with operations in Manaus, where almost the totality of motorcycles in Brazil is manufactured and assembled. For both, M1 and M2, their headquarters are in Japan. However, they can develop technology processes in their plants in Brazil. Brazilian facilities were mainly built to fulfill a local demand and appropriate of taxes and capital incentives offered by Brazilian government. In both cases, we have a global network focusing on a regional market, that in case of firm M1 **regional** means South America, more than Brazil (M2). The sample firms M1 and M2 are the two world leading firms in this industry and not differently, they are also the firms with the biggest shares in the Brazilian market with, respectively, 80.29% and 9.66%.

In 1971, firm M1 was originally an importer to fulfill an internal Brazilian demand. In 1976, it opened a motorcycles production plant in Manaus. Government taxes incentives played a major role in this decision. Its Manaus plant has now capacity to produce two million motorcycles a year. M1's process is very locally verticalized. As it was said, "We are not just a motorcycle plant assembler, we are several different firms within the same firm. We are responsible for several parts of the process, such as machining, casting, stamping, manufacturing of rings and sintering" (Interviewed#1). Local production is autonomous and local suppliers are relatively of high relevance, considering among them the internal suppliers. Firm M1 splits suppliers into groups and it understands itself also as a supplier, called as **Internal Supplier**. It refers to parts that are completely made inside the plant (i.e., cylinder head). It is compiled by several interconnected processes, such as press-shop, welding, painting, sintering, wheel manufacturing, exhaust pipe manufacturing, machining, plastic injection, seats manufacturing. Another type of supplier is composed of international ones. These are many strategic suppliers for high added value parts, such as electronic circuits. The last source is local suppliers. According to the respondents, 87% of the items are from 31 local suppliers located in Manaus. These suppliers refer to fenders, bumpers, CDI, fuel pump, clutch, transmission, axles, and tires. The number of local suppliers doubled over the last decade. Firm M1 wants to bring more strategic suppliers to Manaus, "Today, 87% of the items we buy, we buy from local suppliers". (Interviewed#1). Among the local suppliers, there are the Japanese suppliers who moved to Manaus to work with M1 and mainly supply for M1 and some of these suppliers supply to M2 as well. To reduce the need for space and inventory, it has used JIT. Several suppliers make the deliveries two hours before the departure of a ready motorcycle from an assembly line and ready to be shipped. Some suppliers deliver every hour. Two examples are Mazza and Mitsuba. "Every hour Mazza bring [to firm M1] two full-load trucks of parts" (Interviewed#2). Mitsuba is a Japanese group of about 47 companies in its group to fulfill automotive industry worldwide. One of the key components it supplies to M1 is the fuel pump.

Firm M2 also installed its production plant in Manaus during the 1970's. It has the capacity to assemble 450,000 motorcycles a year. Regarding its supplier network, it is important to note that it shares several suppliers with M1, especially the strategic ones who moved to Manaus, mostly from Japan, to supply for both M1 and M2. According to the respondents, about 60% of all materials in M2 come from global suppliers, and 40% comes from domestic suppliers. The great majority of all strategic components come from global suppliers. The local suppliers are exclusively for non-strategic items. Reasons are related to these suppliers' low performance on the majority of the competitive criteria. "We have a lot of challenges with local suppliers. The quality [of their product] is terrible; the delivery [time or schedule] is also terrible. Thus, for many times, we prefer to insource. We buy the needed equipment and produce those items ourselves, even if the cost is higher". Interviewed#2's says that even though there could be lots of advantages of buying from local suppliers, such as logistics costs and lower level of inventory needs, it is usually not possible due to quality constraints.

For M1, power is shared between the head office and the local plant. The local plant works with the head office to make decisions related to production and resource planning. Projects are developed in the local plant,

including strategic and pioneering projects, for example, flex-fuel motorcycle development. The plant is fully integrated with the development of innovations and new knowledge.

Plants providing innovations to the manufacturing network, are **hosting network players** and, at the same time, receivers of innovations from other units in the network (active network players) (Vereecke, Van Dierdonck, & De Meyer, 2006). However, this is not the case of M2, whose projects are centralized in its headquarters in Japan. There is a local Japanese suppliers' association that negotiates costs and prices, but there is not a strong labor union or collective power downstream in the network. The government has a significant amount of institutional power because of the fiscal incentives associated with the Manaus FTZ.

Territorial embeddedness is unbalanced in M1 and M2, reflecting local involvement with project development and the presence of local suppliers. There is a substantial difference in network embeddedness between them. M1 develops projects in Manaus and then shares them with the other plants. M1's processes are very locally verticalized, as it has been said before. Local production is autonomous and local suppliers are of relatively high importance, considered to be internal suppliers.

### **Mechanical assembly: wristwatches**

The mechanical industry in the Manaus MIP is represented by wristwatch manufacturers' brands and their supply networks. There are 31 firms that are part of this industry. W1 is Japanese-owned, installing its factory in Manaus in 1981. Besides its own brand, firm W1 also produces global brands. In total, it produces an average of 10,000 wristwatches daily. Firm W2 is Brazilian-owned. It installed its plant in Manaus in 1997 and produces an average of 50,000 watches monthly.

Power is very centralized in the wristwatch networks, with the head office assigning production tasks and making resource decisions. There are no local supplier associations, labor unions or collective power downstream. The government has a significant amount of institutional power because of the fiscal incentives.

Firm W2's headquarters, as well as design innovation and definition of models and trends, are located in São Paulo. Development of a project is subcontracted to a broker in China. Suppliers are selected and produce parts. Inputs that do not add value, such as manuals and packaging, are purchased locally in Manaus. The domestic market (other regions of Brazil) is the source for graphic materials and exhibitors.

Territorial embeddedness is weak, reflecting the lack of economic power of local suppliers, which are restricted to the amount of activities that fulfills the local content law. W2 is a global network with local decisions, while W1 is a global network focusing on a regional market. In both cases, there is little integration with local suppliers, other than shared information about production scheduling, delivery dates, and payments. There is also performance monitoring, and suppliers are replaced if they have poor performance.

### **Chemical industry: beverage and concentrates**

The chemical industry is represented by two industry-leading firms that produce concentrated preparations for non-alcoholic beverages. Both implement advanced technologies, have a strong brand worldwide and compete in the same markets with similar products. They were attracted to Manaus by tax incentives and use them to reduce their blend production costs. B1 is the manufacturer with beverage production operations in Manaus since 1990. B2 belongs to a global brand. It has been in Manaus since 2002.

Power is very centralized in both B1 and B2. The head office assigns production tasks and makes resource decisions. On site, there are no R&D local teams for new projects. B2 has a local team for R&D, focused on local raw materials. In terms of power, there are on-site supplier associations, labor unions and collective power downstream. The governments have a significant amount of institutional power because of the tax incentives and supervisory bodies.

In terms of territorial embeddedness, both plants play a role in regional distribution. However, their networks are quite different. B1 attracts some strategic suppliers that make a significant contribution to regional economic growth. One example is a world leader in caramel coloring and natural coloring sources for food and beverage applications, which is a typical nexus supplier (Yan, Choi, Kim, & Yang, 2015). This supplier has seven plants, located in North America (Louisville, KY and Port Washington, WI), Europe (Cork, Ireland and Manchester and Somerset, UK), South America (Manaus, Brazil), Asia (Shanghai, China) and Africa (Matsapha, Swaziland). On the other hand, B2 does not have sufficient production volume to do the same. Internationally, both B1 and B2 have strong ties with suppliers to support their global network. B2 sources packaging, pallets and steel drums from a local supplier (5%), with its remaining raw materials coming from more industrialized parts of Brazil (40%) or from Europe, Asia and the U.S. (50%). Local suppliers only play a minor role in adding value.

## Networks and Implications

Tax incentives impact business costs as well as network configuration and are an important reinforcement of competitive potential. However, they do not influence changes in the center of power; the most important decisions continue to be made outside of Brazil in the networks that were analyzed. The relationship with the local sites remained functional. In other words, the local sites are exploited to produce at low cost for the local/regional market, usually through a line of restricted products, with little embeddedness, in either scope or complexity of activities, since the local suppliers generally have a low capability level. Tax incentives, alone, are insufficient to improve the position the firms of the FTZ in their networks. Tax incentives only reorient the network configuration (i.e., the number of plants and their geographical location).

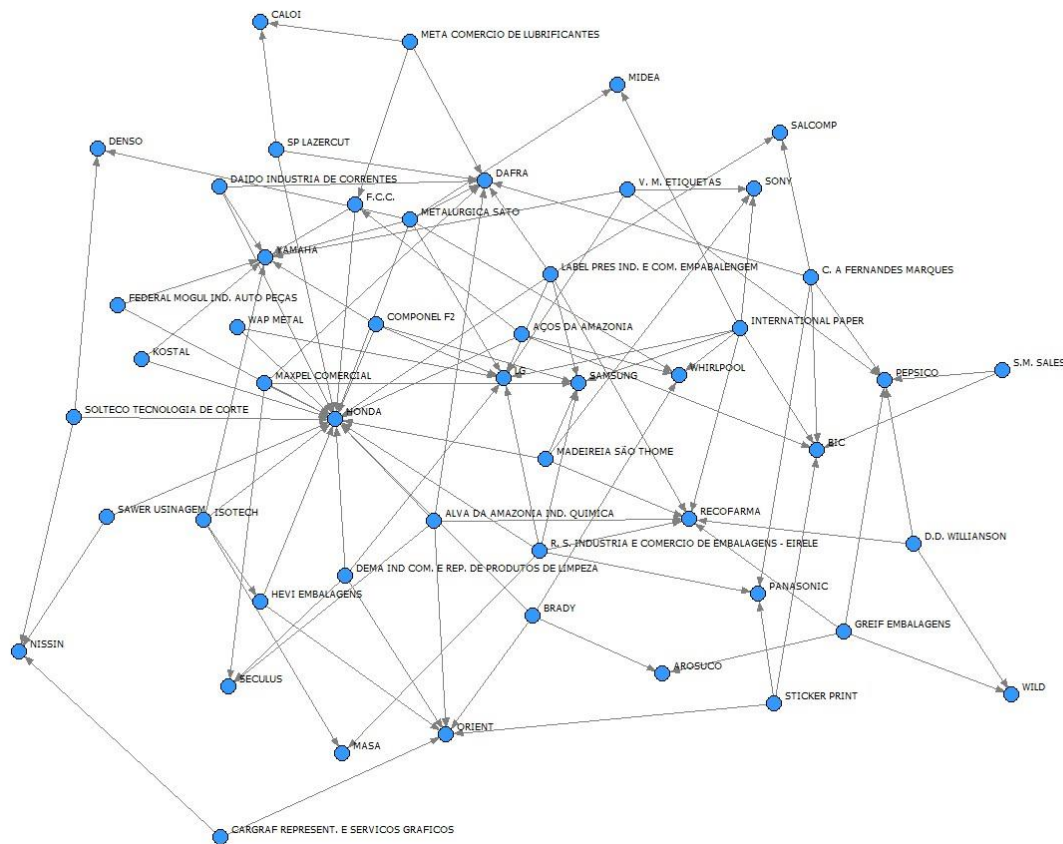
In many cases, the firms established in Manaus have other sources of value, such as brand, however, Manaus offers conditions for creating, enhancing, and capturing value primarily related to the financial and economic incentives launched by the Brazilian government for establishing production plants in Manaus. While the opportunity to reduce production costs, even with low scale production, causes changes in the network configuration, it does not substantially change coordination and local relationships. With the exception of M1, the plants located in Manaus have the simplest purpose, production-related competence (Feldmann & Olhager, 2013), resulting from their contribution to low network costs.

Network strategies allow, with some exceptions, capturing value originating with suppliers or others only when replicating advanced technological processes that generate lower unit costs of production and forms of relationships with suppliers from abroad. For example, M1 creates substantial value and incorporates it into its products through close collaboration with local suppliers through hourly deliveries.

While incentives can significantly improve competitive potential, plants that were attracted by incentives do not have increased importance in corporate strategies, since they do not influence the center of power. The most important decisions about products, processes, strategic suppliers and prices are still made outside Brazil. On the other hand, these firms do not face rigid power structures in local supplier associations, labor unions, or collective power upstream. Brazilian government policies play a major role in institutional power, because of the fiscal incentives.

Few network activities are developed on-site, both in terms of the scope of activities and the level of capability. Considering all of the suppliers sampled and their primary customers (Figure 3), we noted non-specialized suppliers and commodity offerings that include firms from another different network as their important customers, as Samsung, LG, and Sony. In analyzing their relationship correlations with firms in the Manaus networks, we found an overlap; different suppliers have ties with the same buyers (QAP analysis output: r-square 0.02; p-value<0.04648). However, this finding is different when we look at local vs. international suppliers (QAP analysis output, r-square 0.14; p-value<0.04548); local suppliers tend to share a relationship with the same buyers, while many foreign supplier relationships are exclusive to some buyers. This can be explained by the type of item supplied; local firms supply non-critical items, such as paper, protective packaging and crude aluminum, playing

a secondary role in the Manaus network. Multinational firms, on the other hand, participate but do not commit themselves with local suppliers.



**Figure 3.** Social Network of Buyers and Suppliers

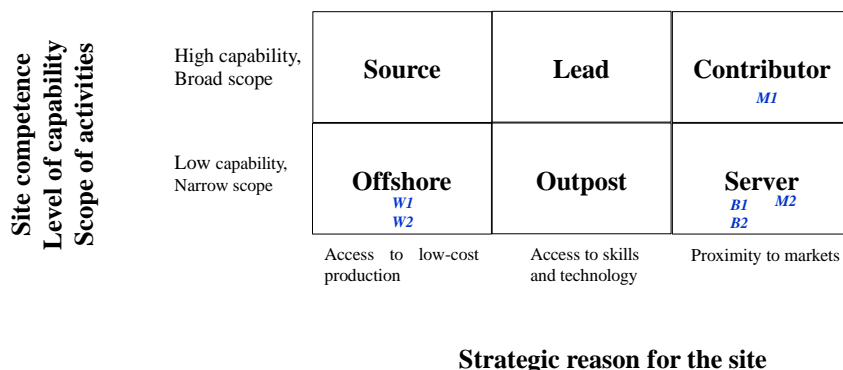
Source: Research results.

According to GPN, embeddedness can be territorial or network. Firms establish on-site activities to minimally comply with the legislation to guarantee their access and absorption of tax benefits, while maintaining strong ties with elements of their overseas networks. The firms studied do not have local strategic suppliers, except for B1 and M1. M1 has vertically integrated strategic processes, while B1 is integrated with some strategic suppliers that were attracted to Manaus. M1 is an example of network embeddedness, with centrality degree 25, higher than the levels reached by M2 (centrality = 10), B1 (7), W1 (6), B2 (5) and W2 (3). The firms studied were characterized by both their low territorial embeddedness and connections with other firms in their network, regardless of their home country ties.

As providers of low complexity items, performance monitoring provides a governance mechanism, and in the case of inadequate performance, replacement of local firms is extremely easy. This can be understood using the structure-strategy paradigm proposed by Bensaou (1999) to analyze the buyer-supplier relationship. Power is the reference for classifying relationship types relative to upstream and downstream firms in a supply network. The studied firms have dominance in their network, except for W2, which implies that they hold some power with suppliers and partners in their distribution channels, and they take advantage of this position. Firms that operate in favorable situations capture some benefits from the market, such as a low level of contestability, and from suppliers, such as the power of oligopsony and imbalance in bargaining power (Chang, Chiang, & Pai, 2012). Many small and medium-sized firms comprise the network, both upstream and downstream. Most offer similar products, jointly with a leading firm that is very selective with its strategic partners and with a preference for arm's length network. Only M1 has governance by vertical integration of its strategic processes, and B1 has greater integration with its local strategic suppliers. Integration in the supply network happens primarily through

operational collaboration (e.g., joint responsibility, shared planning), information exchange and cross-functional integration (Tsanos, Zografos, & Harrison, 2014), potentially improving products and processes (Lazzarini, Claro, & Mesquita, 2008), as well overall performance (Liao & Kuo, 2014).

Figure 4 presents the analytical framework for geographical positioning. The plants installed in Manaus have the simplest purpose, production-related competence (Feldmann & Olhager, 2013). Their goal is to capture tax incentives and fulfill their role in the network, through a breakthrough in position in the local market or through generating higher profitability for the network, for example. Most of the firms can be characterized as focused on local or regional market (Ferdows, 1989, 1997). Their primary role is to provide a lower cost of production, without local autonomy of processes, products, and suppliers, with a narrow scope of activities and a low level of capability, thus, they are Offshore (W1 and W2) and Server plants (B1, B2, and M2). M1 is an exception; as a Contributor, it also focuses on specific national and regional markets. It has its own R&D department, in addition to engineering areas and production capabilities, with a broad scope of activities and a high level of capability. Its strategy is installing plants in strong markets, with local resource management and autonomy (Shi & Gregory, 1998).



**Figure 4.** Strategic Matrix of the Role of Foreign Plants

Source: Research results.

For most Server and Contributor plants, the main strategic reason for installing plants in Manaus is proximity to Brazilian and South American markets. It is reasonable to assume that the FTZ incentives had no impact on the decision making of firms B1, B2, M1, and M2 to install their plants in Brazil. However, this does not apply to firms W1 and W2, since the low weight/volume relationship would not justify duplication of plants across the continent just to catch up with the market, as this could be achieved by other elements of their distribution channels. In either case, the production model implies low embeddedness and requires a low level of capability, considering the narrow scope of activities and complexity of items from local suppliers. Thus, incentives have had a short-range and far less impactful effect in the Manaus FTZ than was expected, and consequently, on its contribution to regional development. The industrial character of the FTZ, without considering local raw material or perishable products, limits the ability of the approximately 500 firms of different nationalities operating in 19 sub-sectors of activity (Suframa, 2016) to influence territoriality. There are many firms from many sectors of economic activity that operate in the Manaus FTZ, however, without an agglomeration to provide scale and cause them to be attractive to global suppliers. A counterpoint to this policy would be waiting for the FTZ to mature so that the skills there could be used as the foundation for designing local and national public policies to support the formation of new nodes in global networks or what Hein (2000) described as ‘new islands of an archipelago economy.’

**Theoretical implications**

This study contributes to the literature in different ways. Because it investigated independent but complementary analytical structures (firms and their suppliers), it encouraged the use of different theoretical frameworks to deepen the discussion related to value creation, location decision, and the role of production plants

to its supplier network and power relationship among international supply networks. This study indicates that although many times the geographic location of low production cost facilities may guide the network configuration, it is insufficient to improve the position the firms of the FTZ in their networks. From a theoretical perspective, these implications may elicit other research questions regarding the capture of sources of value other than cost. As a possible example, one could investigate how supply networks reconfigure and how power relations might change within networks in cases where the captured value is not cost.

### **Managerial implications**

From a managerial perspective, this study suggests that global network management should align its expectations. If the expectation is to capture value based on low cost production facilities, the location decision of those should be guided by the location of relevant consumer markets. In this case, in addition to cost, the market can be used positively to capture differentiated values that, together with the economies of scale, can be beneficially reverted to the unit and change its role in the network. These possibilities are directly related to plant autonomy and its strategic local buyer and suppliers relationships.

From a public policy perspective, fiscal incentives as a form of institutional power, shape the supply network through increasing opportunities for value capture. In other words, incentives mediate new embeddedness and strategic roles in production networks, for example by positioning plants to absorb increased production capacity to capture lower cost, effectively impacting the network configuration. For those firms whose primary value is low cost, incentives represent a huge boost. For other firms, whose value of the product is differentiated in a way other than cost, incentives can represent a new source of competitive development. As other potential local sources of value are not accessible, such as logistics, labor or technology, the plants in an FTZ are able to maintain a strong external network. This gives them the flexibility to withdraw, if necessary, or change their strategy or configuration if the strategic suppliers do not decide to move together.

However, the Brazilian government incentives, which had as the goal to attract firms to Manaus and thus develop the region, should have had other complementary public actions to supplant local weaknesses. Considering the geographical location of Manaus and the weak Brazilian infrastructure, it is important to consider the central role that logistics plays in movement among nodes in the network, in both a functional and physical sense. There is no doubt that logistics considerations vastly increase the complexity and geographical extensiveness of production networks (Coe, Dicken, & Hess, 2008). Moreover, logistics conditions form a powerful local multiplier, since there is a logistics service supply chain and logistics firms are a means of networking firms, service systems, and physical flows (Cui & Hertz, 2011).

Since the implementation of Manaus FTZ in 1957, the region's weaknesses have not changed, and the region has not established itself as one of the so-called 'new islands of an archipelago economy' (Hein, 2000). It has lacked the public action needed to strengthen the model. It seems that the opportunity to access incentives and the ease of offering them have inhibited public action that could enhance value creation and capture, making the Manaus FTZ more effective and competitive. The plants that we studied complain that, although the labor cost may be low in Manaus, it is not specialized and the turnover for simple operations activities is very high. Transportation is also another challenge, since Manaus is like an island in the middle of the Amazon Rain Forest. It is challenging and costly to get anything from and to there, requiring intermodal transport that includes waterways, highways, and air freight transportation.

It may seem to be easier to grant a tax incentive than to renew and expand a more elaborate policy that could also mitigate the deficiencies in logistics and labor training. Meanwhile, the model of regional development in the Brazilian Amazon region that is supported by granting fiscal incentives continues to attract isolated firms that do not bring the expected aggregate value to the location, once strategic suppliers do not follow them. What if the local conditions were better than today? We believe that the network could be pulled to Manaus, guiding larger local immersion and more strategic suppliers, which could be enhanced tremendously if there was a search for productive specialization, providing greater density or 'islands of an archipelago economy.'

## Final Remarks and Contributions

Our primary purpose was to investigate how different firms' supply chain strategies in response to the possibilities of value capture yield by a public policy can effectively contribute to the development of innovation and regional clusters, corroborating the expectations of public development policies. Accordingly, the impact on regional development is inherent and territorial embeddedness is deeper, and the leader may attract strategic partners or promote vertical integration. After developing the analysis in the previous sections, the following propositions can be made.

**Proposition 1:** Autonomy and value creation are the main factors in determining embeddedness differentials. This is because a firm with greater autonomy creates more value for itself and its venture partners, establishing deeper roots on its local site, as well as attracting more suppliers.

**Proposition 2:** Contributor, Outpost, and Leader plant types have relatively more autonomy and are more production-oriented in value differentiation, which allows them to capture more tax benefits that tend to make them more local.

In this way, these firms reshape their networks to be more immersed and local-acting on site. They expect that the benefits captured can provide lower costs that reinforce their own values. Thus, network reshaping occurs in favor of creating higher value on the local foundation on which it is established.

**Proposition 3:** Offshore, Source, and Server plant types have relatively less autonomy and are oriented towards low-cost production. In this way, they capture tax benefits that tend to help them become global.

Operating in this way, these firms use a larger scale to maximize their gains, reconfiguring the network, while accessing plants in other parts of the world and enhancing the flow of trade with external actors, receiving supplies and sending large quantities of finished products worldwide.

**Proposition 4:** The limits of the frontier that determines whether a supply network will become more global or remain more local can be defined by the scale of production and other logistical features, such as the relationship between weight vs. freight vs. cost.

In order to capture the tax benefits, Server plant types put together a local network of suppliers, as we found in the case of the firm B1. On the other hand, a Contributor plant type can put together a network with greater global immersion, as in the case of firm M2 in this study.

**Proposition 5:** FTZs should focus on Contributor, Outpost, and Leader plant types, which have the greatest potential to effectively contribute to local and regional development strategy, as was the premise of this public intervention.

We believe that the frameworks used in this research allowed us to evaluate how firms react strategically in relationship to their networks when opportunities, such as tax incentives, arise. In the cases studied in this research, opportunities were created by public policy to attract production plants to a particular location. Our purpose was to evaluate what happens to the network shape when there are no local firms ready to participate in an international network. The propositions above are particularly useful for businesses (suppliers, distributors) and public agencies (infrastructure providers and policymakers).

There are opportunities for complementary research to understand how smaller firms that are already in place can benefit from the arrival of large firms and how they can qualify to become local suppliers.

## References

- Bensaou, M. (1999). Portfolios of buyer-supplier relationships. *Sloan Management Review*, 40(4), 35–44.
- Benton, C. N., Napier, M., & Ülkü, M. A. (2016). On supply chain integration to free trade zones: The case of the United States of America. *Global Business Review*, 17(4), 1-11. <http://doi.org/10.1177/0972150916645675>
- Bomfim, R., & Botelho, L. (2009). *Zona Franca de Manaus: condicionantes do futuro*. Manaus: Editora Valer.
- Chang, C.-W., Chiang, D. M., & Pai, F.-Y. (2012). Cooperative strategy in supply chain networks. *Industrial Marketing Management*, 41(7), 1114–1124. <https://doi.org/10.1016/j.indmarman.2012.04.011>
- Choi, T. Y., & Kim, Y. (2008). Structural embeddedness supplier management: A network perspective. *Journal of Supply Chain Management*, 44(4), 5–13. <https://doi.org/10.1111/j.1745-493X.2008.00069.x>
- Cheng, Y., Farooq, S., & Johansen, J. (2015). International manufacturing network: Past, present, and future. *International Journal of Operations & Production Management*, 35(3), 392–429. <https://doi.org/10.1108/IJOPM-03-2013-0146>
- Coe, N. M., Dicken, P., & Hess, M. (2008). Global production networks: Realizing the potential. *Journal of Economic Geography*, 8(3), 271–295. <https://doi.org/10.1093/jeg/lbn002>
- Collis, J., & Hussey, R. (2009). *Business research: A practical guide for undergraduate and postgraduate students* (3rd ed.). Basingstoke: Palgrave Macmillan.
- Creswell, J. W. (2007). *Research design: Qualitative & quantitative, and mixed methods approaches* (2nd ed.). Thousand Oaks: Sage.
- Cui, L., & Hertz, S. (2011). Networks, and capabilities as characteristics of logistics firms. *Industrial Marketing Management*, 40(6), 1004–1011. <https://doi.org/10.1016/j.indmarman.2011.06.039>
- Dekker, D., Krackhardt, D., & Snijders, T. A. B. (2007). Sensitivity of MRQAP test to collinearity and autocorrelation conditions. *Psychometrika*, 72(4), 563–581. <https://doi.org/10.1007/s11336-007-9016-1>
- Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of Management Review*, 14(4), 532–550. <https://doi.org/10.2307/258557>
- Feldmann, A., & Olhager, J. (2013). Plant roles - Site competence bundles and their relationships with site location factors and performance. *International Journal of Operations & Production Management*, 33(6), 722-744. <http://doi.org/10.1108/IJOPM-03-2011-0077>
- Ferdows, K. (1989). Mapping international factory networks. In K. Ferdows (Ed.), *Managing international manufacturing* (pp. 3-21). New York, NY: Elsevier.
- Ferdows, K. (1997, March-April). Making the most of foreign factories. *Harvard Business Review*, 73-88.
- Freeman, L. C., Borgatti, S. P., & White, D. R. (1991). Centrality in valued graphs: A measure of betweenness based on network flow. *Social Networks*, 13(2), 141-154. [https://doi.org/10.1016/0378-8733\(91\)90017-N](https://doi.org/10.1016/0378-8733(91)90017-N)
- Hein, W. (2000). Die ökonomie des archipels und das versunkene land. *E+Z*, 41(11), 304–307.
- Handerson, J., Dicken, P., Hess, M., Coe, N., & Yeung, H. W.-C. (2002). Global production networks and the analysis of economic development. *Review of International Political Economy*, 9(3), 436–464. <https://doi.org/10.1080/09692290210150842>



- Hollenbeck, J. R., & Jamieson, B. B. (2015). Human capital, social capital, and social network analysis: Implications for strategic human resource management. *Academy of Management Perspectives*, 29(3), 370-385. <https://doi.org/10.5465/amp.2014.0140>
- Krippendorff, K. H. (2013). *Content analysis: An introduction to its methodology*. Thousand Oaks, CA: Sage Publications.
- Lazzarini, S., Claro, D., & Mesquita, L. F. (2008). Buyer-supplier, and supplier-supplier alliances: Do they reinforce or undermine one another? *Journal of Management Studies*, 45(3), 457-675. <https://doi.org/10.1111/j.1467-6486.2007.00748.x>
- Liao, S. H., & Kuo, F. (2014). The study of relationships between the collaboration for supply chain, supply chain capabilities, and firm performance: A case of the Taiwan's TFT-LCD industry. *International Journal of Production Economics*, 156, 295-304. <https://doi.org/10.1016/j.ijpe.2014.06.020>
- Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). *Qualitative data analysis: A methods sourcebook* (3rd ed.). London: Sage.
- Miltenburg, J. (2015). Changing a multidomestic production network to a global function network: North America Heinz Ketchup from 1960 to 2015. *International Journal of Production Economics*, 168, 267-278. <https://doi.org/10.1016/j.ijpe.2015.07.003>
- Murphy, P. R., Jr., & Knemeyer, A. M. (2015). *Contemporary logistics* (11th ed.). Upper Saddle River, NJ: Pearson Education.
- Pagell, M. (2004). Understanding the factors that enable and inhibit the integration of operations, purchasing and logistics. *Journal of Operations Management*, 22(5), 459-487. <https://doi.org/10.1016/j.jom.2004.05.008>
- Rudberg, M., & Olhager, J. (2003). Manufacturing networks and supply chains: An operations strategy perspective. *Omega: The International Journal of Management Science*, 31(1), 29-39. [https://doi.org/10.1016/S0305-0483\(02\)00063-4](https://doi.org/10.1016/S0305-0483(02)00063-4)
- Shi, Y., & Gregory, M. (1998). International manufacturing networks to develop global competitive capabilities. *Journal of Operations Management*, 16(2/3), 195-214. [https://doi.org/10.1016/S0272-6963\(97\)00038-7](https://doi.org/10.1016/S0272-6963(97)00038-7)
- Siroën, J. M., & Yücer, A. (2014). Trade performance of free trade zones (Document de Travail N° DT/2014-09). *Université Paris-Dauphine*, Paris, France.
- Severiano, A., & Tapajós, L. (2017, fevereiro, 28). Enfrentando crise, Polo Industrial de Manaus faz 50 anos e busca caminhos. *GI Amazonas*. Recuperado de <http://g1.globo.com/am/amazonas/noticia/2017/02/enfrentando-crise-polo-industrial-de-manaus-faz-50-anos-e-busca-caminhos.html>
- Stake, R. E. (2008). Qualitative case studies. In N. K. Denzin & Y. S. Lincoln (Eds.), *Strategies of qualitative inquiry* (3rd ed., pp. 119-150). London: Sage Publications.
- Superintendência da Zona Franca de Manaus. (2016). *Indicadores de desempenho do Polo Industrial de Manaus 2008-2013*. Recuperado de [http://www.suframa.gov.br/download/indicadores/RelIndDesDEZEMBRO\\_2013-31\\_01\\_2014-10\\_08\\_39.pdf](http://www.suframa.gov.br/download/indicadores/RelIndDesDEZEMBRO_2013-31_01_2014-10_08_39.pdf)
- Tsanos, C. S., Zografos, K. G., & Harrison, A. (2014). Developing a conceptual model for examining the supply chain relationships between behavioural antecedents of collaboration, integration, and performance. *The International Journal of Logistics Management*, 25(3), 418-462. <https://doi.org/10.1108/IJLM-02-2012-0005>

- Vereecke, A., Van Dierdonck, R., & De Meyer, A. (2006). A typology of plants in global manufacturing networks. *Management Science*, 52(11), 1737–1750. <https://doi.org/10.1287/mnsc.1060.0582>
- Wichmann, B. K., & Kaufmann, L. (2016). Social network analysis in supply chain management research. *International Journal of Physical Distribution & Logistics Management*, 46(8), 740-762. <https://doi.org/10.1108/IJPDLM-05-2015-0122>
- Yan, T., Choi, T. Y., Kim, Y., & Yang, Y. (2015). A theory of the nexus supplier: A critical supplier from a network perspective. *Journal of Supply Chain Management*, 51(1), 52-66. <https://doi.org/10.1111/jscm.12070>
- Yin, R. K. (2013). *Case study research: Design and methods*. Thousand Oaks, CA, USA: Sage.

### Authors

Ricardo Silveira Martins

Av. Antônio Carlos, 6627, 31270-901, Belo Horizonte, MG, Brasil


E-mail address: [rmartins@face.ufmg.br](mailto:rmartins@face.ufmg.br); [ricardomartins.ufmg@gmail.com](mailto:ricardomartins.ufmg@gmail.com)

 <https://orcid.org/0000-0001-9717-3896>

### Janaina Siegler

625 Butler Way, Indianapolis, IN, 46208, USA


E-mail address: [jsiegler@butler.edu](mailto:jsiegler@butler.edu)

 <https://orcid.org/0000-0002-1743-760X>

### Armando Souza-Junior

Av. Gen. Rodrigo Octávio Jordão Ramos, 3000, Coroado I, Campus Universitário Senador Arthur Virgílio Filho, Setor Norte, 69077-000, Manaus, AM, Brasil


E-mail address: [armando-jr07@bol.com.br](mailto:armando-jr07@bol.com.br)

 <https://orcid.org/0000-0003-2950-1434>

### Barbara Flynn

801 W Michigan St, Indianapolis, IN, 46202, USA


E-mail address: [bbflynn@iu.edu](mailto:bbflynn@iu.edu)

 <https://orcid.org/0000-0001-6577-5315>

### Guilherme Silveira Martins

Rua Quatá, 300, 04546-042, São Paulo, SP, Brasil

E-mail address: [guilhermesm2@insper.edu.br](mailto:guilhermesm2@insper.edu.br)

 <https://orcid.org/0000-0002-8503-4431>

### Contributions

1st author: led the projects that originated this article. He worked on the conception of the research question, was responsible for the team meetings, for the conception of the survey, for shaping the data collection process, analyzing the results, the theoretical framework, and the development of the conclusions.

2nd author: worked together with Ricardo on the conception of the research question, in shaping the data collection process, refining the theoretical framework, analyzing the results, and the and the development of the conclusions. She also reviewed the English version of the paper.

3rd author: together with the first two co-authors, worked on the conception of the research question. He was also the leader and coordinator of the data collection process, directly participating in all the phases of it, including the result analysis, and the development of the conclusions.

4th author: As a Richard M. and Myra Louise Buskirk Professor of Manufacturing Management at the Indiana University Kelley School of Business, Professor Flynn is an expert on supply chain integration, global manufacturing and operations strategy. She was the supervisor of Professor Martins during his sabbatical studies. She worked on the conception of the research question together with the other co-authors, guided the theoretical contributions, and her work on developing and shaping the data collection process was decisive for the success of this research.

5th author: collaborated analyzing the results and the development of the conclusions.

**Funding**

The authors report that the work received support from Capes BEX 5902/15-0 and CNPq 445574/2014-3 and 07480/2017-8.

**Conflict of Interest**

The authors have stated that there is no conflict of interest.

**Plagiarism Check**

The RAC maintains the practice of submitting all documents approved for publication to the plagiarism check, using specific tools, e.g.: iThenticate.