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Manufacturing Network Integration and Culture: An Institution-Based View

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Abstract

Purpose: In pursuit of increased competitiveness, global manufacturers often seek tighter integration among the plants in their production networks. However, this is a challenging task because plants are dispersed across multiple institutional environments. Although the literature provides abundant evidence of how *formal* institutional environments affect the integration among plants, little is known about the role of the *informal* institutional environment—such as culture. In this study, we investigate the relationship between different dimensions of culture and manufacturing network integration.

Methodology: We combine survey data from the most recent International Manufacturing Strategy Survey with secondary data that capture cultural dimensions. We then analyze the responses from 581 assembly plants in 21 countries obtained from the survey using a multilevel regression model.

Findings: Our results show that plants located in masculine and long-term-oriented national cultures are associated with lower levels of integration with other plants. The results for the other four Hofstede dimensions of national culture were not statistically significant. At the level of organizational culture, we found that a collaborative plant environment positively relates to higher levels of network

integration. We did not find statistically significant evidence for the relationship between cultural or geographical distance and network integration.

Practical implications: This research provides managers with practical insights into the types and combinations of cultural environments that affect the integration of plants in a global network. This knowledge is useful for informing effective integration strategies and tactics.

Originality: We provide new, empirical evidence of the relation between the informal institutional environments of a plant and its integration in a manufacturing network. Drawing on an institution-based view, we contribute to the literature on manufacturing networks by discussing and testing empirically the role of national and organizational culture in network integration.

Keywords: Global manufacturing networks, Network coordination, National culture, Organizational culture, Cultural distance, Multilevel regression.

Article classification: Research paper.

1. Introduction

Coordination among plants in a production network is believed to be a potent source of competitive advantage for multinational firms (Bartlett and Ghoshal, 1998). However, the extent of network integration is often more limited than that envisioned by headquarter managers (Gupta and Govindarajan, 2000). Network integration does not occur by itself. It is shaped by factors contingent on the environment of each plant. In practice, plants are integrated at different levels with sister plants (Vereecke et al., 2006). We study network integration; the level of integration among plants in an intra-organizational network.

In the OM literature, network integration has usually been treated as a *formal* control mechanism used by headquarters to achieve specific goals. However, pursuing full integration of all plants is not a worthy objective. Often, plants are discouraged from integrating with other plants because it can lead to excessive dependency or loss of plant autonomy (Golini et al., 2016). International business literature shows that the actions of network nodes are determined by their contextual embeddedness (Hoenen and

Kostova, 2014; Kostova et al., 2019; Kostova et al., 2008). OM literature, in contrast, has rarely considered the impact of *informal* institutions on network integration.

In this study, we investigate the impact of informal institutional environments in three different ways. First, we study the influence of the informal institutional environment at the national level—operationalized as national culture—on a plant's level of integration with sister plants. Second, we investigate whether the cultural distance between the plant's and its headquarters' national culture affects the plant's tendency to integrate with sister plants. Finally, we study whether the informal institutional environment at the organizational level—operationalized as a collaborative organizational culture—affects a plant's likelihood of integrating with sister plants. As an additional test, we check whether network integration is affected by geographical distance.

This study makes four distinctive contributions to the literature. First, the study complements prior works on network integration by drawing on an institution-based view instead of the more common resource-based view. The institution-based view emphasizes that companies are heavily influenced by their institutional environments (Peng et al., 2008). Second, a deeper understanding of what drives integration between plants is developed, which contributes to the recent research on the types of integration and their relation to performance (e.g., Cheng et al., 2016; Golini et al., 2016). This is achieved by taking a plant-level perspective rather than the network perspective. Third, the research on network integration has mainly drawn on mathematical modeling or qualitative case studies (Cheng et al., 2016; Cheng et al., 2015). The modeling research usually aims to optimize the capacity or product volume allocations among plants, whereas the qualitative case studies tend to describe integration practices anecdotally. Hence, OM literature lacks empirical designs that draw on econometric methods to study network integration (a recent exception is Cheng et al., 2016). Our study reduces this omission in the literature. Finally, while most previous studies examine the role of national culture only, this study accounts for the multilayered nature of culture by also considering the organizational level.

2. Theoretical background

Manufacturing network integration means linking together geographically dispersed plants to accomplish a collective set of manufacturing activities (Martinez and Jarillo, 1991). This involves the

integration of both material flows and information flows between plants (Cheng et al., 2016). Our theoretical development lies at the plant level; therefore, we study the integration of a plant with its sister plants by drawing on the institution-based view (e.g., Hoenen and Kostova, 2014; Kostova et al., 2019; Kostova et al., 2008).

We introduce a socio-cultural and institutional perspective to account for plants' embeddedness in the host country as well as its organizational bond with the headquarters in the firm's home country (Hoenen and Kostova, 2014; Meyer et al., 2010). Both these environments have built-in institutional rules that provide a basis for social order. An institution-based view (Peng et al., 2008) suggests that the institutional environment "determine[s] the socially acceptable patterns of organizational structures and actions" (Kostova et al., 2008: 997). In this study, we focus on *informal institutions*, which constitute the cultural–cognitive elements of the [institutional] environment: "Cultural because they are socially constructed symbolic representations; […] cognitive in that they provide templates for framing individual perceptions and decisions" (Scott, 2010: 7).

The following are our conceptual foundations. First, in line with prior studies, we use *national culture* to represent the informal institutional environments of the host and home countries because it refers to the "assumptions and conceptions of the 'way the world is'" (Scott, 2010: 7), which distinguish one group of people from another (Hofstede and Hofstede, 2005). This implies that different informal institutional environments determine managerial perceptions (Bendoly et al., 2006) and, therefore, plants' preferences to perform certain activities—for instance, network integration—and pursue certain sets of outcomes (Newman and Nollen, 1996). Thus, we investigate how the embeddedness of a plant in the host country—with its distinctive national culture—influences its levels of network integration.

Second, plants are part of another institutional environment: the company itself (Kostova et al., 2008). The "way things are done around here" differs from one company to another (Waisfisz and Minkov, 2015). We highlight the importance of exploring the effects of this organizational embeddedness by incorporating organizational culture into our research model. Organizational culture can be defined as "the way in which people in an organization relate to each other, to their work, and to the outside world" (Waisfisz and Minkov, 2015: 15). Congruent with our theoretical standpoint, our

model does not consider the integration between plants as an automatic response to corporate policies but considers it to be dependent on the socio-cultural environment of the plants.

Finally, because the headquarters and the plants belong to different institutional environments at the national level—the host and home countries—we also study the role of cultural distance and, additionally, that of geographical distance. In line with our institution-based view, we argue that plants are linked to the headquarters' institutional environment because they are an "extension of organizing principles across borders" (Kogut, 1993: 137). The home country acts as the institutional environment of the headquarters and indirectly influences the entities (i.e., the plants) under its administration. In that sense, the headquarters can be seen as the "origin" of the firm, which embodies the unique historical developments and values that have been defined by the home country's culture (Meyer et al., 2010). As noted by Kogut (1993), the institutional environment in which the firm has matured sets the organizational structures, policies, and practices.

3. Hypotheses development

3.1 National culture and network integration

Culture is "the collective programming of the mind that distinguishes the members of one group or category of people from others" (Hofstede et al., 2010: 6). At the national level, national culture is manifested in visible (practices and their associated symbols, heroes, and rituals) and invisible forms (values). According to Hofstede et al. (2010), the latter are remarkably stable and define the dimensions that differentiate one national culture from another. Hofstede's framework is the most widely used in the international business literature (Kirkman et al., 2006). We chose this framework because of its focus on values (rather than norms or practices), which explicitly differentiates national culture from organizational culture, and the diversity of the respondents in the original survey in terms of managerial responsibilities and occupation (for an in-depth discussion, see Hofstede (2006)). Hofstede's six dimensions of national culture are:

- *Power distance* refers to "the extent to which the less powerful members of organizations and institutions accept and expect that power is distributed unequally" (Hofstede, 2018).

- *Uncertainty avoidance* refers to "anxiety and distrust in the face of the unknown, and conversely, [to] a wish to have fixed habits and rituals, and to know the truth" (*ibid*).
- *Individualism* means that "individual choices and decisions are expected," whereas collectivism states that "one 'knows one's place' in life, which is determined socially" (*ibid*).
- *Masculinity* refers to the extent of being assertive, tough, and focused on material success, which is socially endorsed, whereas femininity refers to the extent of being modest, tender, and concerned with the quality of life (*ibid*).
- *Long-term orientation* refers to cultures wherein members value preparation for the future, adaptiveness, humility, and pragmatism, as well as education, perseverance, and thrift. In short-term-oriented cultures, members embrace respect for tradition, maintenance of norms, and personal stability (Hofstede et al., 2010).
- *Indulgence* is "a tendency to allow relatively free gratification of basic and natural human desires related to enjoying life and having fun" (Hofstede et al., 2010: 281).

Scholars have studied how cultural dimensions affect the implementation of practices and moderate the relationship between implementation and performance outcomes (e.g., Newman and Nollen, 1996; Pagell et al., 2005; Wiengarten et al., 2011; Wong et al., 2017). These practices can be placed on a continuum where technical practices (i.e., encoded into technologies) and social practices (i.e., encoded into people's actions) represent opposite ends. The role of national culture expectedly varies depending on the practice's position along this continuum. For example, the implementation of automation is not affected by the same cultural dimensions as that of Total Quality Management. Network integration, the practice investigated herein, is arguably closer to a social practice than a technical one.

A few recent fine-grained analyses have demonstrated the link between national culture and social practices such as the use of enterprise resource planning systems (Bendoly et al., 2006), project team management (Chipulu et al., 2014), quality management (Flynn and Saladin, 2006; Wiengarten et al., 2011; Wiengarten et al., 2015), and lean (Kull et al., 2014). We posit that national culture influence network integration since employees' predisposition to engage in coordination activities depends on the

"unwritten rules" that characterize their social environment (Hofstede et al., 2010). These rules can be represented by the national culture dimensions of their host country.

3.1.1 Power distance

In countries with high power distance, employees expect to be told what to do and let top managers define and deploy the strategy. All members consider that a top-down, hierarchical approach serves as a pragmatic and fair organization method. Because network integration is generally a responsibility given by the top management to the plants, plants privilege network integration where power distance is large because they believe that superiors "know better." Headquarters' involvement can act as an inhibiting influence causing units to be less eager to collaborate with their peers (Yamin et al., 2011). However, units in countries with high power distance values do not question its validity out of respect for hierarchy (Danese et al., 2017).

Furthermore, Chipulu et al. (2014: 376) found that managers in high power distance cultures emphasize "traditional, task-focused managerial professionalism" (see also Pakdil and Leonard, 2016). Network integration is expected to improve performance so task-focused plants will seek this improvement. Although some studies show that high power distance inhibits employees' participation and engenders their reticence to balanced structures (Newman and Nollen, 1996), we assume that respect for hierarchy will prevail.

> *Hypothesis 1a.* The higher the power distance in a plant's national culture, the higher is the plant's integration with its sister plants.

3.1.2 Uncertainty avoidance

Countries with high uncertainty avoidance prefer clarity, structure, and strict procedures and rules. In such countries, plant managers prioritize strong control and standardization (Bortolotti et al., 2015; Pakdil and Leonard, 2016), systematic planning (Hope and Mühlemann, 2001), and disruption avoidance (Kull et al., 2014). They also tend to make decisions based on proof rather than intuition (Flynn and Saladin, 2006). Regarding network integration for plants located in countries with high uncertainty avoidance, DeSanctis et al. (2018) advise establishing strong formal links with suppliers to

avoid problems and complacency. Similarly, network integration likely depends on the plant's intention to control the flow of goods by sharing information, to prevent unexpected situations by sharing procedures and forecasts, and to ensure timely communication using information technologies. Assumedly, plants in countries with high uncertainty avoidance interpret integration as stability.

> *Hypothesis 1b.* The higher the uncertainty avoidance in a plant's national culture, the higher is the plant's integration with its sister plants.

3.1.3 Individualism

In individualist societies, social ties are loose because individuals look after themselves. In the workplace, the employer-employee relationship is rather transactional (Hofstede and Hofstede, 2005). The superficiality of employee loyalty fits well with practices related to low task dependency and individual-level rewards (Gray and Massimino, 2014) rather than social practices. Plants in individualistic societies favor activities within their boundaries and avoid cooperation within the network if it does not serve their interests.

Furthermore, individuals in individualistic cultures tend to rely on their own judgment to make decisions and make less use of external sources (Flynn and Saladin, 2006). This means that the information and knowledge accessible through integration with other plants is not considered fundamentally important (Bendoly et al., 2006). Moreover, because collaboration at the network level is rarely evaluated with formal indicators, managers in individualistic societies see fewer personal incentives to engage in network integration.

In contrast, in collectivist cultures, individuals protect each other without questioning loyalty. Practices with a strong social component fit well with collectivist cultures because they require teamwork and a long-term philosophy (Pakdil and Leonard, 2016; Wiengarten et al., 2011; Wiengarten et al., 2015). Furthermore, individuals identify themselves as members of a group: the "in-group" so the members of a plant may see those of sister plants as equals: their family. Consequently, collectivist values seem preferable for network integration because they can foster cooperation and goal congruence across a "family of plants."

Hypothesis 1c. The higher the individualism in a plant's national culture, the lower is the plant's integration with its sister plants.

3.1.4 Masculinity

In masculine cultures, competition and ambition are valued over interpersonal relations. Accordingly, plants in masculine cultures prefer merit-based practices, management by objectives, and process control (Chipulu et al., 2014; Newman and Nollen, 1996; Pakdil and Leonard, 2016). In masculine cultures, performance goals drive behavior. Managers perceive technical practices (such as automation or set-up time reduction) as more effective drivers of performance than social practices (Pakdil and Leonard, 2016). In contrast, in feminine cultures, members pursue performance and social goals, which translates into "a willingness to give more than they receive in outcomes" (Flynn and Saladin, 2006: 591). Therefore, we argue that the quest for performance that is typical of a masculine culture may hinder network integration.

The assertiveness factor further supports the negative effect of masculine cultures on network integration. While masculine-oriented plants tend to resolve conflicts "by a 'good fight'" (Flynn and Saladin, 2006: 587), feminine-oriented ones use compromise and negotiation. In that regard, masculine-oriented plants question the validity of external sources of information (Danese et al., 2017). Masculine cultures prefer competition, whereas feminine cultures prefer cooperation (Kull et al., 2014).

Hypothesis 1d. The higher the masculinity in a plant's national culture, the lower is the plant's integration with its sister plants.

3.1.5 Long-term orientation

A plant located in a country characterized by long-term orientation culture sees the network as a vast reserve of ideas and integration as an opportunity to learn from other plants. Its affinity for thriftiness motivates it to integrate with other plants to access long-term economy-of-scale benefits. Prior research, for example, shows that long-term-oriented cultures support the effectiveness of lean, which requires long-term commitment and perseverance (Newman and Nollen, 1996; Pakdil and Leonard, 2016).

Furthermore, in long-term-oriented cultures, individuals seek success through investment in lifelong personal networks (such as *guanxi* in China), which illustrates their appreciation of social connections (Hofstede et al., 2010). Voelpel et al. (2005) found that Chinese plants (long-term-oriented national culture) contribute more than U.S. plants (short-term-oriented) to knowledge flows in a production network. They argue that members of long-term-oriented national cultures prioritize gaining peer respect and building on reputation. This is a subtle yet important nuance in which network integration "is a social ritual more concerned with good manners than with performance" (Hofstede et al., 2010: 219). Furthermore, other characteristics of long-term-oriented cultures, such as the reciprocation of favors, respect for tradition, and personal steadiness, infer that internal integration may be encouraged. Although Kull et al. (2014) argue that sometimes integration is used to gain short-term advantages, such as resolving urgent problems, relatively more evidence supports that integration benefits from having long-term orientation.

Hypothesis 1e. The higher the long-term orientation in a plant's national culture, the higher is the plant's integration with its sister plants.

3.1.6 Indulgence

At first sight, it is intuitive to argue that individuals in indulgent cultures will participate in network integration because of their natural extrovert traits and the importance they place on having friends. Hofstede et al. (2010) mentioned that members of indulgent countries tend to send more e-mails and have more contact with foreigners via the Internet than members of restraint countries. However, socialization does not always mean integration. Although social relationships do relate to network coordination, network integration requires that participants attach importance to their duties beyond having fun. In that sense, employees in indulgent cultures may be prone to focus on friendship and leisure, thus running the risk of losing focus and objectivity of duties.

In restraint societies, instead, the gratification of human needs is regulated and suppressed by strict social norms, causing individuals to perceive life as difficult yet customary and duty as the normal state of being. Practices have to suit this way of seeing work life. For instance, studies have call for an adjustment of human resource practices in countries with strong restraints, such as Bangladesh and

Pakistan (López-Duarte et al., 2016). We expect that restraint values will encourage plants to reduce network conflicts by coordinating their manufacturing activities with sister plants. Because the national culture dictates that duty is the norm, network integration will have fertile grounds.

Hypothesis 1f. The higher the indulgence in a plant's national culture, the lower is the plant's integration with its sister plants.

3.2 Organizational culture and network integration

Organizational culture emerges from the organization's history, members, events, and evolving context. Building on Hofstede's work on national cultures, Waisfisz and Minkov (2015) noted that values are key to comparing national cultures, but within a country, *practices* on the shop floor differentiate organizations. Based on this understanding, we draw on the Competing Values Framework to study the organizational culture of plants.

The Competing Values Framework is an extensively used taxonomy in the literature (Gambi et al., 2015; Hartnell et al., 2011). It is congruent with our definition of culture, where practices (behaviors or artifacts) represent a manifestation of values (Schein, 2010; Schneider et al., 2013). This framework prescribes four types of organizational cultures: clan, adhocracy, market, and hierarchy. Among these, we study *clan* cultures, which can be characterized as a combination of internal focus, integration, and unity of processes plus flexibility and discretion. We chose the clan culture because, according to previous studies, it is key to facilitating integration practices (e.g., Bortolotti et al., 2015; Bortolotti et al., 2019; Wiengarten et al., 2015). We call it a *collaborative* organizational culture.

A collaborative organizational culture embraces teamwork, participation, employee involvement, and open communication (Hartnell et al., 2011). Besides collaboration, values of attachment, affiliation, trust, and support form a collaborative culture. Its strong emphasis on employee satisfaction and commitment is compatible with the values of social practices in operational settings—such as network integration. For example, involving the employees and caring about their training helps disseminate practices (Boscari et al., 2016; Erthal and Marques, 2018; Netland, 2016), improves employee relationships (Bortolotti et al., 2019), and assists task planning (Gambi et al., 2015; Prajogo

and McDermott, 2005). We, therefore, hypothesize that a collaborative culture at the organizational level transcends to the network level.

Hypothesis 2. The stronger the collaborative organizational culture at a plant, the higher is the plant's integration with its sister plants.

3.3 Distance and network integration

The separation between the institutional environment of a plant and that of its headquarters is known as *distance*. Distance introduces friction and complexity to the management of cross-border operations (Hutzschenreuter et al., 2016). Along with informal institutions, we focus on cultural distance. We also test the role of geographical distance. These two are the most common distance measures in the international business literature (Beugelsdijk et al., 2018; Hutzschenreuter et al., 2016). *Cultural distance* refers to the differences or incongruence between two national culture systems (Tihanyi et al., 2005). It affects location choices, establishment modes, the benefits of practice transfers, and subsidiary performance (Beugelsdijk et al., 2017). *Geographical distance* is "the distance between two points on the surface of the earth, as given by latitudinal and longitudinal coordinates" (Beugelsdijk et al., 2018: 1116).

3.3.1 Cultural distance and network integration

Plants find it easier to understand and adopt practices designed in culturally similar countries (e.g., Kostova and Zaheer, 1999; Naor et al., 2010). Gray et al. (2011) found that plants' failures to comply with quality practices were partly driven by cultural distance. Grøgaard and Colman (2016) found that cultural differences largely affect subsidiaries' interpretation and implementation of corporate values. In line with these results, we advance that cultural distance may influence network integration using two arguments: a control perspective and a cognitive perspective.

The *control perspective* suggests that a large cultural distance prompts corporate managers to exert tight control over plants. Plants, however, may sense that constant monitoring and frequent performance assessments constrain their freedom to perform. In this context, cultural distance makes plants face the challenge of ensuring their legitimacy in the host country (Kostova and Zaheer, 1999)

while performing according to the headquarters' standards. This legitimacy-related pressure may ultimately motivate some plants to deviate from these standards by, for example, prioritizing issues within the factory walls instead of the production network. A serious consequence of headquarters' permissive attitude toward these deviations is the plants' sense of unfairness, which may create friction between sister plants (Mykhaylenko et al., 2017).

From a *cognitive perspective*, differences between cultures may interfere with agreements between the managers of the host and home countries. Plant managers would have difficulties in following the procedures that contradict their *national cultural* values and the local institutions' demands, causing misunderstandings and conflicts. Also, the large cultural distance may lead the plant to misinterpret its intended strategic role. This can result in plants adopting a self-centered logic by following what they think they should do to evolve in the intra-firm network, which does not always respond to the headquarters' goal of encouraging inter-unit integration (Birkinshaw and Lingblad, 2005).

Hypothesis 3. The larger the cultural distance between the host and home countries, the lower is the plant's integration with its sister plants.

3.3.2 Geographical distance and network integration

Although some authors include the differences in cultures as an inherent part of geographical distance (cf. Wiengarten and Ambrose, 2017), we consider that cultural and geographical distances are distinguished by their effects on organizational behaviors.

A fundamental argument for the impact of geographical distance is physical separation. Distance limits the frequency and intensity of interaction between the members in the home and host countries. In the long term, it can hinder the development of a strong partnership, damage knowledge exchanges, and undermine trust (Ambos and Ambos, 2009; Hansen and Løvås, 2004). Further, the lack of contact, shared identity, and informal cooperation increase the perception of being part of a different group: an "out-group" (Hansen et al., 2005). As a result, plants may prefer to behave like the other organizations in their local environment—that is, the host country—because it is more legitimate and

less risky. This suggests that a large geographical distance between the plant and its headquarters discourages the plant's integration with sister plants.

Hypothesis 4. The larger the geographical distance between the host and home countries, the lower the plant's integration with its sister plants.

4. Methodology

4.1 Sample and data collection

To analyze our research model, we combine both primary and secondary data sources. We obtain our primary data from the sixth edition of the International Manufacturing Strategy Survey (IMSS), which was conducted by a global network of scholars by administering a common questionnaire in their respective countries. The questionnaire is organized into three main sections. The first section relates to the strategy and performance of the business unit the plant belongs to. The second section focuses on the manufacturing strategy and performance of the plant. The third section captures the different manufacturing and supply chain practices used in the plant. The initial IMSS dataset comprised 931 plants in 22 different countries. We were personally involved in collecting data from two of these countries.

Our analysis uses a subsample from the IMSS database that includes only countries with (1) available Hofstede scores and (2) complete data for the variables studied. Our final sample comprises 581 assembly plants in 21 host countries. These plants belong to firms located in 29 different home countries, thus representing 111 distinct pairs of headquarters–plant combinations (see Table 1). We extract data on the following variables of our model: location of the headquarters and plant, size, supply chain input and output, collaborative organizational culture, and network integration. The Appendix provides the specific details of items used from the IMSS questionnaire as well as the IMSS section from which these variables were retrieved.

Table 1. Sample description

Host Country	N	Host Country	N
Belgium	25	Malaysia	13
Brazil	24	Netherlands	29
Canada	18	Norway	22
China	60	Portugal	27
Denmark	26	Romania	18
Finland	15	Slovenia	10
Hungary	33	Spain	19
India	45	Sweden	28
Italy	34	Switzerland	25
Japan	58	Taiwan	22
		USA	30
Total			581

SIC Code	N	%
25	165	28
26	81	14
27	102	18
28	134	23
29	69	12
30	30	5
Total	581	100

Home Country	N	Home Country	N
Austria	5	Italy	29
Belgium	13	Japan	70
Brazil	13	Luxembourg	2
Canada	11	Malaysia	5
China	49	Netherlands	17
Denmark	22	Norway	20
EUA	1	Portugal	12
Finland	12	Romania	10
France	11	Slovenia	8
Germany	44	Spain	14
Hungary	10	Sweden	29
		Iceland	1
India	43	Taiwan	22
Ireland	1	UK	10
		USA	71
Total			581

Number of employees	N	%
Less than 50	10	2
Between 50 and 249	183	31
Between 250 and 499	99	17
More than 500	289	50
Total	581	100

We obtain secondary data from Geert Hofstede's recognized database on national culture (Hofstede et al., 2010). The database provides the score for Hofstede's six dimensions for different countries. Each dimension is expressed on a scale from 0 to 100. Table 2 presents the scores for each dimension for the countries in our sample. Finally, we collect the data needed for estimating geographical distances from Google Maps. For this, we use the geographical coordinates for the respective capital cities in the countries included.

Table 2. Hofstede dimensions scores

Countries	Power distance	Uncertainty avoidance	Individualism	Masculinity	Long-term orientation	Indulgence
Austria	11	70	55	79	60	63
Belgium	65	94	75	54	82	57
Brazil	69	76	38	49	44	59
Canada	39	48	80	52	36	68
China	80	30	20	66	87	24
Denmark	18	23	74	16	35	70
Finland	33	59	63	26	38	57
France	68	86	71	43	63	48
Germany	35	65	67	66	83	40
Hungary	46	82	80	88	58	31
Iceland	30	50	60	10	28	67
India	77	40	48	56	51	26
Ireland	28	35	70	68	24	65
Italy	50	75	76	70	61	30
Japan	54	92	46	95	88	42
Luxembourg	40	70	60	50	64	56
Malaysia	100	36	26	50	41	57
Netherlands	38	53	80	14	67	68
Norway	31	50	69	8	35	55
Portugal	63	99	27	31	28	33
Romania	90	90	30	42	52	20
Slovenia	71	88	27	19	49	48
Spain	57	86	51	42	48	44
Sweden	31	29	71	5	53	78
Switzerland	34	58	68	70	74	66
Taiwan	58	69	17	45	93	49
UK	35	35	89	66	51	69
USA	40	46	91	62	26	68

4.2 Measures

The dependent variable, *network integration*, is measured by the extent to which a plant is using practices of integration in the production network. In particular, IMSS asks questions about the extent of information sharing, joint decision-making, the use of technology, and the development of a network performance management system. These items are adapted from Rudberg and Olhager (2003).

Instead of using the original Competing Values Framework scale, we use a proxy for measuring the *collaborative organizational culture*. We use the business unit's programs oriented toward implementing a culture that promotes delegation and knowledge of employees, open communication

between managers and employees, autonomous teams, and employees' flexibility. The items are similar to and adapted from the items used in prior literature to measure "clan" or "group" culture (e.g., Gambi et al., 2015; Prajogo and McDermott, 2011).

We operationalize the *distance* variables as follows. We compute *cultural distance* using the Kogut and Singh index, a Euclidian distance measure that transforms Hofstede's cultural value dimensions into a single cultural score (Kogut and Singh, 1988). Despite recent critics, this remains the most used index in the international business literature (López-Duarte et al., 2016). *Geographical distance* is the distance between the headquarters' and plant's location based on latitude and longitude coordinates. Table 3 provides the computed distances for each pair of countries studied.

We included two control variables: plant size and the material flow between the plant and sister plants (inputs and outputs).

To assess the validity of network integration and collaborative organizational constructs, we performed exploratory factor analysis (EFA) and checked for convergent and discriminant validities as well as reliability. The results show that all item scores are greater than or equal to 0.7 and that the average variance extracted (AVE) values are greater than 0.5. These results show that convergent validity is met both at the item and construct levels. In addition, given that the square root value of the AVE is greater than the correlation between constructs, discriminant validity is met. Finally, all Cronbach's alpha values are greater than 0.7, indicating good reliability. Tables 4 and 5 summarize the measurement assessments.

Table 3. Geographical distance between each pair of countries

Country 1	Country 2	Distance
Belgium	Austria	900,74 km
Belgium	Germany	521,38 km
Belgium	Luxembourg	230,49 km
Belgium	UK	247,41 km
Belgium	USA	6633,21 km
Brazil	France	8579,2 km
Brazil	Germany	8859,76 km
Brazil	Japan	17808,41 km
Brazil	Spain	7778,48 km
Brazil	UK	8636,9 km
Brazil	USA	7430,21 km
Canada	Germany	6129,87 km
Canada	Ireland	4809,39 km
Canada	UK	5408,3 km
Canada	USA	1007,98 km
China	Denmark	8140,02 km
China	France	9131,32 km
China	Germany	8799,91 km
China	Italy	8900,84 km
China	Japan	2293,26 km
China	Taiwan	711,57 km
China	USA	12102,28 km
Denmark	Austria	839,3 km
Denmark	Germany	917,74 km
Denmark	Malaysia	9663,6 km
Denmark	Sweden	522,36 km
Finland	Germany	1725,76 km
Finland	Netherlands	1378,01 km
Finland	Switzerland	1859,07 km
Hungary	Austria	273,09 km
Hungary	Denmark	1012,32 km
Hungary	Germany	760,17 km
Hungary	Japan	9034,16 km
Hungary	Netherlands	1037,65 km
Hungary	UK	1414,36 km
Hungary	USA	7781,29 km
India	France	6594,18 km
India	Japan	5820,34 km
Italy	France	695,5 km
Italy	Germany	281,81 km
Italy	Netherlands	849,75 km
Italy	Sweden	1665,06 km
Italy	Switzerland	253,45 km
Italy	USA	7323,83 km
Malaysia	Germany	9956,98 km
Malaysia	Japan	5311,96 km
Malaysia	Switzerland	10076,1 km
Malaysia	UK	10532,21 km
Malaysia	USA	15270,25 km
Netherlands	France	529,16 km
Netherlands	Germany	568,09 km
Netherlands	Iceland	2075,95 km
Netherlands	Japan	9168,95 km
Netherlands	Sweden	1010,44 km
Netherlands	UK	497,69 km
Netherlands	USA	6744,09 km
Norway	UK	1193,27 km
Norway	USA	6595,18 km
Poland	Brazil	9855,44 km
Poland	EUA	4172,77 km
Poland	France	1371,47 km
Poland	Germany	998,02 km
Poland	Japan	8567,19 km
Poland	Portugal	2758,93 km
Poland	Spain	2121,61 km
Poland	USA	7581,73 km
Romania	Austria	914,84 km
Romania	France	1882,34 km
Romania	Germany	1373,93 km
Romania	Italy	1302,11 km
Slovenia	Austria	270,04 km
Slovenia	USA	7593,79 km
Spain	Canada	5478,69 km
Spain	France	803,07 km
Spain	Germany	1139,82 km
Spain	Italy	1129,58 km
Spain	Japan	10492,44 km
Spain	Luxembourg	1061,05 km
Spain	Netherlands	1331,23 km
Spain	Sweden	2339,77 km
Sweden	Germany	1421,4 km
Sweden	Japan	8158,91 km
Sweden	Norway	416,32 km
Sweden	UK	1458,69 km
Sweden	USA	6986,43 km
Switzerland	Germany	1011,57 km

Table 4. Exploratory factor analysis

Item	Mean	Std. Dev.	Loadings	% explained variance (unid.)	Cronbach's α	AVE
Network Integration						
NI1	3.253	1.015	0.846			
NI2	3.139	1.081	0.804	69%	0.848	0.648
NI3	3.352	1.065	0.787			
NI4	3.172	1.167	0.781			
Collaborative Organizational Culture						
COC1	3.271	0.962	0.752			
COC2	3.632	0.955	0.773			
COC3	3.371	1.018	0.709	58%	0.814	0.735
COC4	3.075	1.113	0.729			
COC5	3.436	0.960	0.714			

Table 3. Discriminant validity

	(1)	(2)
Network integration (1)	0.80[a]	
Collaborative organizational culture (2)	0.49[b]	0.86

[a] AVE Square root
[b] Correlations

5. Analysis and results

To test our hypotheses, we ran a series of multilevel regression models; we used the *xtmixed* command from Stata, which runs multilevel mixed-effects linear regression. Our data are clustered (i.e., plants are nested in the host countries), and different levels of analysis exist (i.e., country, firm, and plant levels) in our dependent and independent variables. Therefore, multilevel regression analysis qualifies as the appropriate data analysis technique (see Table 6).

The first model (empty model) allows the computation of the intraclass correlation coefficient (ICC) at the country level, which shows a value of 18%. This means that 18% of the variance of the dependent variable is explained by the differences between countries, emphasizing the relevance of including country variables in our model. Similar ICC results are found in previous multilevel regression studies (e.g., Wong et al. 2017). Model 0 includes the control variables of the study. The results indicate that size correlates with network integration ($\beta = 0.073$, $p < 0.005$).

Model 1, illustrated in Figure 1, shows the direct effects of our independent variables on network integration. The results show that national culture relates negatively and significantly to a plant's network integration through the dimensions of masculinity ($\beta = -0.125$, $p < 0.005$) and long-term orientation ($\beta = -0.115$, $p < 0.005$). These results support Hypothesis 1d and show no statistical significance for Hypotheses 1a, 1b, 1c, and 1f. The results also provide support for a statistically significant association between long-term orientation in a plant's national culture and the plant's integration with sister plants but in the opposite direction of that hypothesized in Hypothesis 1e.

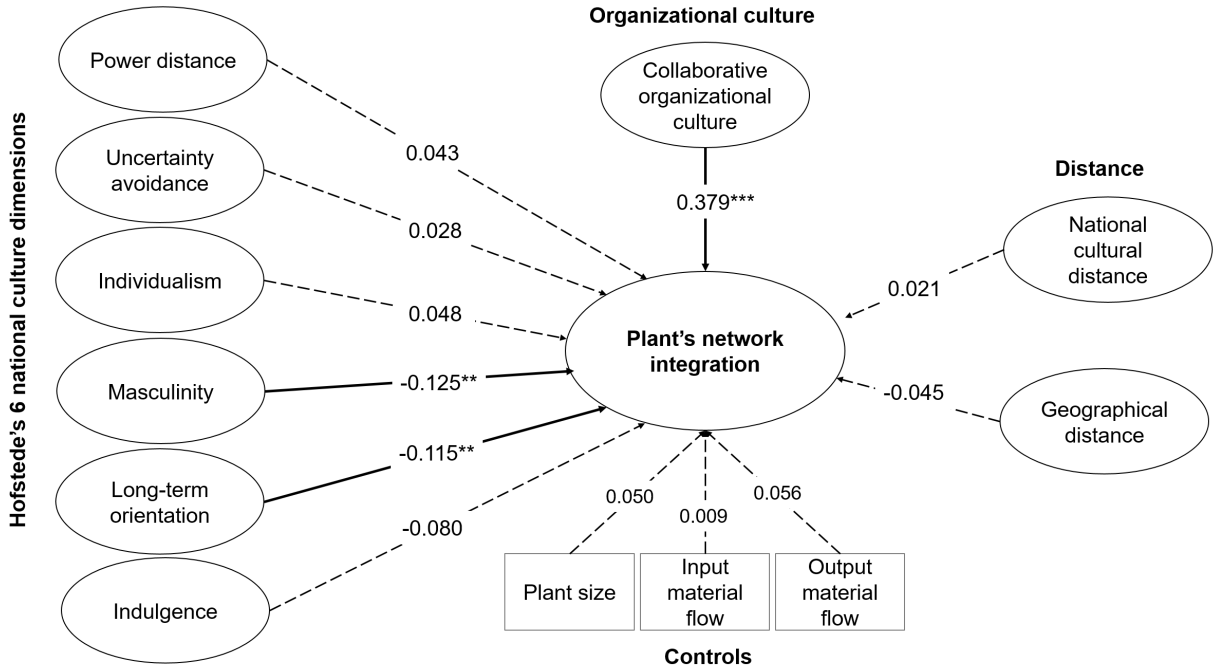

Figure 1. Direct associations between independent variables, control variables, and the dependent variable (Model 1)

In addition, the results suggest that while both cultural distance ($\beta = 0.021$, $p = 0.673$) and geographical distance ($\beta = -0.045$, $p = 0.395$) do not seem to influence a plant's network integration, a collaborative organizational culture plays a positive and significant role ($\beta = 0.379$, $p < 0.001$). These results support Hypothesis 2, but no statistical significance is reported for Hypotheses 3 and 4.

To assess the model fit, we compare the Akaike information criteria (AIC) and Bayesian information criteria (BIC) indicators. The lower the values of both indicators, the better the model fit. As shown in Table 6, the lowest values are reached in Model 1 (the direct effects model).

Table 6. Multilevel regression results

Parameters	*Dependent variable: Network integration*		
	Empty Model	Model 0	Model 1
Grand intercept			
cons	3.201***	3.206***	3.231***
Control variables			
Plant Size		0.073**	0.050
Input Material Flow		0.028	0.009
Output Material Flow		0.049	0.056
Hypotheses			
Power Distance			0.043
Masculinity			-0.125**
Individualism			0.048
Uncertainty Avoidance			0.028
Long-term orientation			-0.115**
Indulgence			-0.080
National Culture Distance			0.021
Geographical Distance			-0.045
Collaborative Organizational Culture			0.379***
Model fit indicators			
AIC		1265.531	1170.262
BIC		1290.819	1233.481

****p < 0.001; ** p < 0.005; *p < 0.10*

6. Discussion

6.1 Effects of national culture on network integration

Our results show that masculinity and long-term orientation affect network integration. Regarding the effects of *masculinity*, our study supports prior works indicating that feminine-oriented cultures provide a better environment for network integration than masculine-oriented ones. This is also the case for other soft practices such as lean (Kull et al., 2014) and quality practices (Flynn and Saladin, 2006). In

masculine national cultures, people are driven by competition; this reduces the incentives to integrate with sister plants.

Regarding the effects of *long-term orientation*, we found that it has a negative relationship with network integration. One explanation for this result is that plants in long-term oriented countries may not interpret integration as support for adaptation but as generating high dependency on sister plants. Integration is thus less preferred. In contrast, in short-term-oriented countries, plants may engage in integration because they see it as "the norm" for planning and controlling operations.

The literature on production transfers in outsourcing dyads can provide some explanation. Aaboen and Fredriksson (2016), for example, found that after a transfer, units need a certain degree of independence, thereby entering a "dormant" state in the relationship. Thus, even if plants are willing to establish a long-term collaboration, as their long-term orientation culture would suggest, they will manage the network integration activities differently depending on the development of the relationship until that moment. In that sense, perhaps the level of inter-plant dependency affects the relationship between long-term orientation and network integration.

Another possible explanation is that a strong emphasis on thriftiness supports integration only to a minimal extent. Individuals in long-term-oriented countries tend to be careful about spending resources, which can restrain the use of resources for network integration. A last explanation relates to the component of personal stability—a core value in short-term-oriented cultures. In this view, plants consider that coordination with other plants provides access to immediate problem-solving and short-term gains (Kull et al., 2014). Therefore, short-term-oriented cultures may be more willing to integrate with other plants.

Contrary to our hypotheses, the remaining cultural dimensions (power distance, uncertainty avoidance, individualism, and indulgence) did not show a statistically significant relationship with network integration, meaning that we cannot confirm whether these cultural dimensions matter. This may be attributable to several factors. First is the existence of other organizational characteristics—not included in our model—that work against or cancel out the effects we hypothesized. Moreover, the survey design may have endogeneity issues (Ketokivi and McIntosh, 2017). For example, taking into

consideration the levels of centralization and governance types at the network level could potentially explain the situations in which power distance matters.

Second, the theoretical lens we chose may not be capable of capturing the complex socio-cultural phenomenon studied. A more in-depth study that put other theories to test could provide a more nuanced set of hypotheses. For example, considering uncertainty avoidance, it is likely that the agency theory or contract management literature could offer richer explanations of the relationship between this cultural dimension and network integration. Finally, there is the possibility that the national culture dimensions simply do not influence the level of network integration or that they matter only to a marginal extent. For example, because of the performance focus in firms, indulgence has been shown to be irrelevant in organizations (Orzes et al., 2017).

6.2 Post-hoc analyses: interaction effects between national culture dimensions

Building upon the work of Flynn and Saladin (2006) and Hofstede et al. (2010), we study interaction effects to explore further the role of the national culture dimensions that showed no significant effects on network integration (i.e., power distance, uncertainty avoidance, individualism, and indulgence). Table 7 shows the results of these analyses. Three interaction terms are significant: power distance and individualism ($\beta = -0.371$, $p < 0.005$), individualism and uncertainty avoidance ($\beta = 0.271$, $p < 0.005$), and indulgence and uncertainty avoidance ($\beta = 0.261$, $p < 0.005$).

The interaction between power distance and individualism appears at low network integration levels. The combination of high power distance and high individualism is known as vertical individualism (Singelis et al. 1995); societies with vertical individualism are characterized by autonomous individuals that expect inequalities. In that sense, network integration is low because individual plants competing in a network aim to be the unique and the best (Triandis, 2001) without the help and interaction of other sister plants. On the other extreme (horizontal collectivism), when both power distance and individualism are low, the success of the individual is closely related to and dependent on other members in the group (Singelis et al., 1995). Network integration is thus seen as a way to achieve success.

Table 7. Multilevel regression results for post-hoc analyses

Parameters	*Dependent variable: Network Integration*		
	Empty Model	Model 0	Model 1
Grand intercept			
cons	3.201***	3.206***	3.253***
Control variables			
Plant Size		0.073**	0.062
Input Material Flow		0.028	0.009
Output Material Flow		0.049	0.039
Hypotheses			
Power Distance (PD)			-0.013
Masculinity (MAS)			-0.154**
Individualism (IND)			0.150
Uncertainty Avoidance (UA)			0.055
Long-term orientation (LT)			-0.214**
Indulgence (INDUL)			-0.147
National Culture Distance			0.042
Geographical Distance			-0.061
Collaborative Organizational Culture			0.363***
PD x INDUL			0.033
PD x UA			0.069
PD x IND			-0.371**
IND x UA			0.271**
IND x INDUL			-0.098
INDUL x UA			0.261**
Model fit indicators			
AIC		1265.531	1167.987
BIC		1290.819	1256.494

****p<0.001; ** p<0.005; *p<0.10*

Moreover, the combination of high individualism and uncertainty avoidance leads to higher integration between plants. Perhaps in these contexts, where plants seek for clarity and structure (high uncertainty avoidance), network integration is higher because it is a way to achieve individual stability for the plant's own benefit (high individualism). "(I)n strongly uncertainty-avoiding, individualistic countries, rules will tend to be explicit and written into laws" (Hofstede et al., 2010: 218). We then expect that these countries foster network integration as a means to support the corporate procedures and rules. Hofstede et al. (2010) also point out that in cultures with high uncertainty avoidance—where

"what is different is dangerous"—and high individualism (e.g., Belgium, Germany, Switzerland, Finland, and Canada francophone), people dislike the members of "other" groups to a certain extent (e.g., linguistic groups). Still, the strong inclusivity characterizing individualist countries enforces the respect of everybody's rights. In this context, we expect plants to consider network integration as an adequate practice.

Finally, the combination of high indulgence and uncertainty avoidance leads to higher network integration. Individuals in high indulgence societies are natural extroverts and value leisure over responsibilities. Thus, we hypothesized that in high indulgent societies, network integration would not be achieved because the objectives of these individuals may cause them to lose the focus of the integration effort. However, when combined with an environment in which these individuals value stability and structure, sister plants can be seen as an element that guarantees stability while allowing the development of bonds and social capital.

6.3 Collaborative organizational culture and network integration

Our results show that a collaborative organizational culture positively relates to network integration. This aligns with prior works assessing the relationship between organizational culture and manufacturing practices (Erthal and Marques, 2018; Wiengarten et al., 2015) and is congruent with our theoretical arguments. The results imply that collaborative behaviors (e.g., employee involvement, training and education, open communication about vision and goals, and multi-skilling) support coordination and integration practices among plants in a global network. While this finding may not be surprising, it shows that organizational culture traits transcend to the network level and should, therefore, be taken into account when studying or promoting network integration.

6.4 Distance and network integration

Contrary to the expectations, we cannot confirm whether cultural or geographical distances play a role in integration between plants. Studies on production transfers in outsourcing and offshoring literature hint toward some possible reasons behind the nonsignificant results. First, it is plausible that the history of the relationship between the headquarters and the plant—which is not collected in IMSS data—

compensates for the effects of the distance between the host and home countries. Social bonds derived from the use of expatriates, temporary task forces, and permanent teams have been proved to diminish distance effects (Ambos and Ambos, 2009; Parente et al., 2011; Stahl and Caligiuri, 2005). Second, the incongruence of the set of values between a plant's and its headquarters' institutional environments (i.e., cultural distance) may give rise to a "defensive" standpoint of plants (Meyer et al., 2010: 245). In these cases, plants will compete to defend their position in the intra-firm network by acting in accordance with the values of their national culture. Third, from a behavioral viewpoint, it is highly probable that the global mindset of the plant's members neutralizes the negative role of distance (Levy et al., 2007). If the plants' members have a certain level of international experience, they may better understand—or be more open to—other cultures (Uhlenbruck, 2004). Finally, an additional explanation for the nonsignificant results can perhaps be found in the supply chain risk literature. Plants may find that network integration reduces their supply chain risks, thereby overruling any possible differences between the national values in which the plant is located (host country) and in which it is indirectly embedded (home country). In that sense, distance encourages managers to care and learn about cultural idiosyncrasies so as to hedge against production and supply chain risks (Hutzschenreuter et al., 2016).

7. Conclusion

We have investigated the role of culture in the integration of plants in a manufacturing network. In response to the research call of Boscari et al. (2018), we built on the institutional theory to explain how the embeddedness of dispersed plants in their institutional environments affects the plants' behavior. We found that two specific dimensions of national culture in the host country—masculinity and long-term orientation—negatively relate to network integration. Several other variables at the national culture level were not statistically significant, suggesting that not all the individual dimensions of culture influence network integration. Our post-hoc analyses, however, show that there exist multiplicative effects between the dimensions—namely, between power distance and individualism, individualism and uncertainty avoidance, and indulgence and uncertainty avoidance. At the organizational culture level, we found that a collaborative culture supports network integration.

7.1 Key contributions to the literature

We show that informal institution-related factors (in the form of national and organizational cultures) affect a plant's level of integration with sister plants. Our results confirm the need for future studies to consider cultural variables when studying network integration. Instead of using the resource-based view (as employed by most of the existing research), we explicitly account for the complex context in which plants are embedded. Hence, we contribute to the research on production networks by providing a better understanding of its international nature (Demeter, 2017). Notably, we emphasize the informal institutional contexts that provide the values individuals espouse in their working environment. Hoenen and Kostova (2014) argue that "national culture values influence agency relations as they shape the way actors use information, evaluate situations, make decisions, and explain their actions." We provide additional evidence in support of this; however, we also draw attention to a multifaceted approach that considers the different institutional environments in which plants are embedded (Kostova et al., 2019; Kostova et al., 2008). Overall, this study highlights the importance of a plant's institutional embeddedness.

7.2 Limitations and future research

Our study identifies various promising paths for future research. The nonsignificant results provide ample opportunities for further studies in this area. First, we see opportunities in further research on plant-to-plant relationships. The IMSS data did not allow us to consider the specific nature and strength of relationships between the plant and sister plants. Future research could investigate whether a plant's dependence, trust, and social bonds within its network moderate certain national culture dimensions.

Second, regarding the headquarters–plant relationship, the nonsignificant results of the effects of distance and some national culture dimensions suggest the presence of complex social relationships that are affected by multiple and overlapping institutional environments. Future research could incorporate other formal institutional environments at the country level—such as regulations and laws (Kostova et al., 2019)—and at the organizational level—such as governance mechanisms (Lubatkin et al., 2007).

Third, our post-hoc analyses shed some light on the interaction effects of national culture at the host-country level. Future research could be conducted on the profiles of countries or configurational approaches that consider the combined effect of national culture values. Moreover, in our study, organizational culture appears to be the most important element in fostering network integration. Future works could consider Hofstede's three dimensions of culture (symbols, heroes, and rituals) rather than rely on the visible part, the behaviors, as well as the paradoxical views of organizational culture (Bortolotti et al., 2019)

Although the IMSS database provides a unique cross-industry and international dataset, it has issues related to the sampling frame and method biases, which affect the interpretation of the results. A clear limitation is that the data are cross-sectional and, therefore, do not capture the dynamism in global production networks. Econometric studies such as the one presented here help understand the bigger picture; however, they fall short in explaining the underlying dynamics. Future studies should overcome these methodological limitations. We especially call for longitudinal observational studies and case studies. There is still a lot of room for theorizing in this field, and the literature still does not know which parameters matter and how to measure them accurately.

7.3 Contribution to practice

This research provides practitioners with insights on the role of cultural dimensions during network integration. As an example, the efforts of a plant to improve its connection with other plants may be hindered by the ingrained values of its national culture if the plant is located in a masculine or long-term-oriented country. Being aware of this inverse relationship is the first step in finding a remedy. These results should be interpreted with caution because the way network integration is endorsed by the headquarters is key. If network integration is a strategy, we advise top managers to particularly promote network integration in high masculine and long-term-oriented cultures—e.g., Japan, China, and Germany—as, first, a means to achieve excellence and status (compatible with the masculinity values) and, second, a pragmatic solution to ensure the future of the plant in the network (compatible with long-term-orientation values). In practice, headquarters should recognize the contexts in which more resources are needed to engage specific plants in integration practices.

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Appendix: List of variable and items

Network integration *(IMSS Section C. Manufacturing Network)* Indicate the current level of implementation of action programs related to (1 None – 5 High):	
NI1	Improve information sharing for the coordination of the flow of goods between your plant and other plants of the network (e.g., through exchange information on inventories, deliveries, production plans, etc.)
NI2	Improve joint decision-making to define production plans and allocate production in collaboration with other plants in the network (e.g., through shared procedures, shared forecasts)
NI3	Improve the use of technology to support communication with other plants of the network (e.g., ERP integration, shared databases, social networks)
NI4	Developing a comprehensive network performance management system (e.g., based on cost, quality, speed, flexibility, innovation, service level)
Collaborative organizational culture *(IMSS Section A. Organization of the plant)* Indicate the current level of implementation of action programs related to (1 None – 5 High):	
COC1	Delegation and knowledge of your workers (e.g., empowerment, training, encouraging solutions to work-related problems, pay for competence or incentives for improvement results)
COC2	Open communication between workers and managers (information sharing, encouraging bottom-up open communication, two-way communication flows)
COC3	Lean organization (e.g., few hierarchical levels and broad span of control)
COC4	Autonomous teams (e.g., team responsible for planning, execution, and control, workers sharing experience, knowledge, and skills, formalization of team composition and responsibilities, workgroup incentives)
COC5	Workers flexibility (e.g., multi-tasking, multi-skilling, job rotation)
Plant size *(IMSS Section A. Organization of the plant)* What is the size of the business unit your plant belongs to?	
Input material flow *(IMSS Section C. Manufacturing Network)*	
IMF	Please provide an estimate of the distribution of value of inputs (materials, components, sub-assemblies products) from other plants/units in the network
Output material flow *(IMSS Section C. Manufacturing Network)*	
OMF	Please provide an estimate of the distribution of value of outputs (materials, components, sub-assemblies products) to other plants/units in the network