

Organizational structures to manage global production networks – A contingency based multiple case study

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Abstract

The organizational structure of the global production network management varies across companies. Some have dedicated departments for global production management, others integrate it into existing line functions or in a staff function. The increasing trend of globalization underscores the importance of effective coordination of these networks. The aim of the paper is to explore the structural and contextual dimensions of the strategic management of global production networks and to derive recommendations for companies. Therefore, semi-structured interviews were conducted by interviewing managers who are responsible for the global production network to identify different organizational forms as well as relevant contingency factors.

Keywords: Global production networks, organization, network coordination

Introduction

The export has grown in recent decades, just as the globalization continues to increase. Accordingly, the globalization of corporate value creation is becoming increasingly prevalent among medium-sized and large corporations with global operations. This development leads to global production networks (GPNs). These networks are characterized as production sites, which are distributed worldwide and which are interconnected through the exchange of information, materials, and financial resources (Lanza et al., 2019). The motivations driving

this internationalization are varied, including factors such as the access to targeted markets, resources and cost-driven factors (Miltenburg, 2009).

In the recent years, the vulnerability of GPNs has been highlighted by crises such as the pandemic, war and political tensions. Such disruptive events are occurring more frequently and emphasizes the growing importance of risk mitigation, resilience, and capable management for the continuative success of the GPNs and corporations (Lanza et al., 2020). The rising environmental volatility, along with the ambiguity and diversity of factors make production network a profoundly complex management issue. Ferdows (2014) characterizes these challenges as hysteresis and detail complexity. Hysteresis refers to the temporal gap between the onset of a disruption and the subsequent adaptation of the network. Conversely, detail complexity characterizes the multitude of influencing factors and strategic motivations, and the interactions among them.

The management of GPNs includes numerous tasks such as product allocation, selection of manufacturing processes, the distribution of capacities, supply chain management, long-term production planning, performance controlling or investment decisions (Friedli et al., 2014; Olhager and Feldmann, 2022). The central task of modern GPN management is to optimize the whole network, which includes to define the plant roles and their degree of specialization (Friedli et al., 2014). The responsibility for these tasks is defined by the organisational structure. In practice, different organizational structures can be observed and vary depending on the company. GPN management can be located in a separate department or be part of a line function. In some companies, GPN management is seen as a central corporate function, whereas in others it is located in the business units. Depending on the company, decision-making power is divided differently between the head office and the individual production sites. Some organizations make GPN management decisions centrally, in other companies the individual sites are in charge for decision-making (Olhager and Feldmann, 2018). Furthermore, the mergers and acquisitions history and the organizational culture can influence the GPN management.

For these reasons and the importance of management, the aim of the research is to identify different forms of organizational structures and relate them to their specific contextual factors. Based on this, the following two research questions can be derived:

- RQ1: What structural aspects constitute a form of organization for the management of global production networks?
- RQ2: On which contextual factors does the form of organization for the management of global production networks depend?

Literature Review

There is an extensive literature on GPNs, although the papers dealing with management is limited. The topic of GPN management has been so far only considered in relation to the degree of centralization and coordination aspects, and has not yet been extensively researched. The corresponding literature can be divided into three streams (Figure 1):

The first stream deals with the *strategic coordination and the connection to the network configuration* of GPNs including coordination mechanism and infrastructural decisions and their impact on strategic network capability. Shi and Gregory (1998) focus on international manufacturing networks and provide a configuration map for those networks and its underlying strategies. Miltenburg (2009) takes up the network configuration map and developed a manufacturing strategy framework to identify the fitting strategy for each corporation with a manufacturing network. Scherrer and Deflorin (2017) expand this framework by linking network capabilities with site capabilities which contribute to the competitive advantage of the manufacturing network strategy. Sayem et al. (2018) ties in with competitive priorities and the manufacturing network configuration and uses the multiple case study approach to analyse

formal and informal coordination. Rudberg and West (2008), Ferdows et al. (2016), Feldmann et al. (2009) and Rudberg and Olhager (2003) contribute to the topic of the first stream as well.

The second stream concentrates on *decision-making* and its dimensions, which engage in the distribution of decision-making responsibility between headquarters and production sites. Centralised, integrated and decentralised are the three types of decision-making regarding the manufacturing strategy which were identified by Olhager and Feldmann (2018) in a quantitative survey. In centralised systems, decisions are mainly made at the network level and communicated to the individual plants. Decentralized systems work the opposite. Integrated systems involve both network and plant levels in decision-making (cf. for this section Olhager and Feldmann, 2018). Schuh et al. (2021) also deals with the degree of centralization in GPNs and provides a corresponding framework that considers the top-down and bottom-up perspectives. The top-down perspective outlines an ideal strategy based on function and network characteristics, while the bottom-up perspective examines direct factors affecting production networks, either enabling or hindering centralization (Schuh et al., 2021).

The third stream defines different *plant roles with associated autonomy*. Different degrees of autonomy can be observed, depending on the scope of the responsibility. Ferdows (1997) defined first the six strategic roles of foreign factories, which are the offshore factory, source factory, server factory, contributor factory, outpost factory and lead factory by executing multiple survey studies. Further literature from Mediavilla et al. (2015), Blomqvist and Turkulainen (2019) and Deflorin et al. (2012) work with this model. In addition other plant role models exist like the typology of Vereecke et al. (2006) which is derived from the flow of knowledge among plants and identified the types: isolated, receiver, hosting network player and active network player. Or the survey research of Cheng and Farooq (2018) who categorized the plant roles: star plant, old school plant, expert plant and replaceable plant. Another approach by Feldmann and Olhager (2013) identified via survey research three plant types with different site competencies, which are production, supply chain, and development. Plant type one includes the site competence production, therefore only production activities and relating process improvements are carried out at this plant. Plant type two is complemented by the site competence supply chain, which serves procurement and logistics. And plant type three additionally locates research and development tasks at the site and therefore includes all characterized site competencies (cf. for this section Feldmann and Olhager, 2013). Golini et al. (2016) expands this stream by embedding the manufacturing network into (a) the internal manufacturing network integration and (b) the external supply chain integration, and considers the impact of plant autonomy on performance.

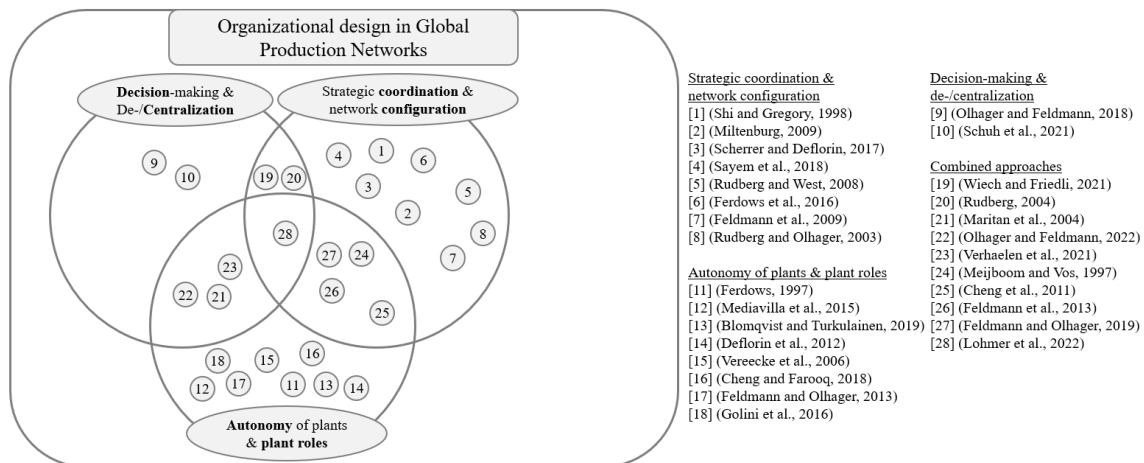


Figure 1– Overview literature streams

Some approaches can be assigned to several streams of literature, as they link different aspects with each other. Rudberg (2004) and Wiech and Friedli (2021) combine the streams of strategic network coordination with aspects of de-/centralized decision-making in their research. Maritan et al. (2004), Olhager and Feldmann (2022) and Verhaelen et al. (2021) contribute with their research to the field of de-/centralization and decision-making linked with plant roles and autonomy of plants. Cheng et al. (2011), Feldmann et al. (2013), Feldmann and Olhager (2019) and Meijboom and Vos (1997) are contributing to the intersection of plant roles and their autonomy with the stream of strategic network coordination and configuration. Whereby Lohmer et al. (2022) combines all streams.

In summary, it can be stated that the organisational design of GPN management is not covered in the literature streams yet. Stream one only considers the coordination and configuration of the production network, but not these two aspects in relation to the GPN management and the processes within the department. Stream two sees de-/centralisation as only one aspect of the organisation, but insights about the hierarchy within the GPN department are missing. Stream three expresses the organisational relationship between the locations and their tasks, however this ignores the overarching organisational structure of GPN management and the interaction with the corporate functions. Therefore, there is a need for further research and with our approach we want to close this research gap.

Theoretical background and research framework

To investigate the organizational structure for the GPN management the contingency theory is applied in this work. This perspective states that reaching organizational effectiveness requires congruence between specific attributes of an organization (Donaldson, 2001), such as its size (Child, 1975) or strategy (Chandler, 1962), and its external environment (Burns and Stalker, 1961). Following the contingency theory, we assume that there is not one optimal organizational structure, instead it is determined by a variety of factors, the so-called contingency factors. In the used framework the contextual dimensions represent the contingency factors.

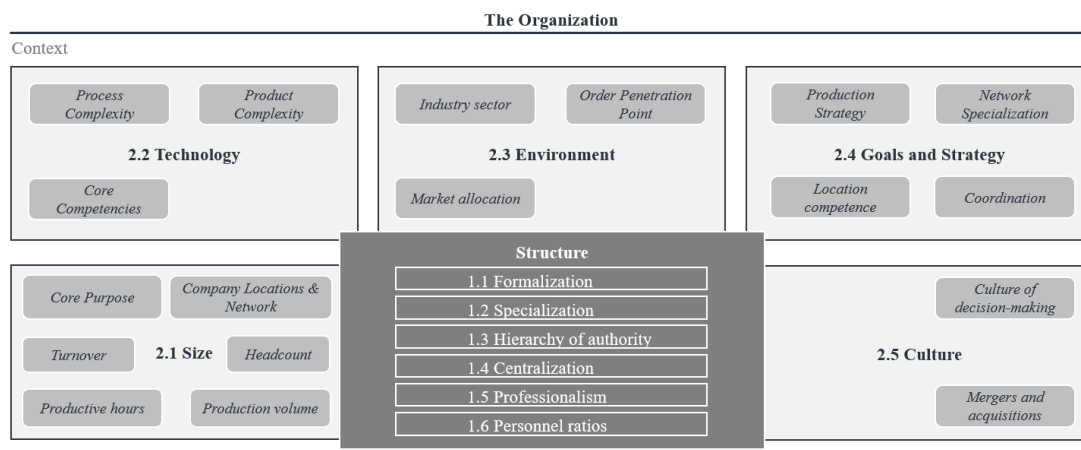


Figure 2 – Framework of organizational dimensions (based on Daft (2010))

The organization framework from Daft (2010) is used to operationalize the contingency theory. Accordingly, an organization consists of *structural* and *contextual* dimensions. The structural dimensions describe the degree of freedom in the design of the organization. The contextual dimensions surround the organization and can therefore be considered equivalent to the contingency factors. Analogous to the contingency theory, He also advocates a harmonization between structural and contextual factors and is therefore very well suited to

applying the contingency theory to GPNs in this work (cf. for this section Daft, 2010). Figure 2 depicts the resulting research framework which will be explained in detail in the following.

The *structural dimension* is used to describe the internal characteristics of an organisation and is subdivided into six aspects: formalization, specialization, hierarchy of authority, centralization, professionalism and personnel ratios (Daft, 2010), which are elaborated in Table 1.

Table 1 – Structural dimensions of an organization

Dimension	Definition
1.1 Formalisation	describes the scope of written documentation in the organisation, such as manuals, process descriptions and guidelines.
1.2 Specialisation	refers to the degree to which organisational tasks are subdivided into individual jobs.
1.3 Hierarchy of authority	describes how large the span of control for each manager is.
1.4 Centralisation	is related to the hierarchical level that is responsible for a decision.
1.5 Professionalism	describes the degree of formal qualification and training of the staff.
1.6 Personnel ratios	are based on the assignment of employees to different tasks and divisions.

Contextual dimensions describe the entire organisation, encompassing its culture, environment, goals and strategy, size, and technology (Daft, 2010). The individual aspects are explained in more detail below in Table 2.

Table 2 – Contextual dimensions of an organization

Dimension	Definition
2.1 Size	is usually measured by headcount or turnover and can also be measured by production volume and productive hours in the context of manufacturing.
2.2 Technology	describes the tools, processes and activities used to create business value. It can be measured in product and process complexity.
2.3 Environment	consists of all aspects outside of the organisation's boundaries, such as industries and markets.
2.4 Goals and strategy	specify the purpose of the organization and make the competitive difference to competitors.
2.5 Culture	includes the fundamental corporate values, concepts and standards that employees actively live by.

The framework according to Daft (2010) is detailed for the context of managing GPNs. For this purpose, relevant structural characteristics and contextual contingency factors are extracted from the operations management literature, which are explained below.

The organizational structure of a company, which refers to the subdimension 1.3 Hierarchy of authority, can be illustrated by an organizational chart. According to the literature, six different characteristics are identified. The functional structure exists of departments which are structured by task fields. The divisional structure includes departments which are subdivided into different business units or product etc. The geographic structure classifies departments according to regions, continents etc. The matrix structure combines two structures simultaneously. The horizontal structure is described by departments which are structured by processes and which have some additionally general divisions like human resource and finance. The hybrid structure exists when multiple structures are combined (cf. for this section Daft, 2010). Within an organization, the departments are located differently in the organizational structure, this aspect refers as well to the subdimension 1.3 Hierarchy of authority. A department can represent its own line function or be part of a line function, some departments

are staff functions and other departments are organised in project (Spitschka, 1993). The three types of decision-making to operate the manufacturing strategy by Olhager and Feldmann (2018) refer to the subdimension 1.4 Centralization.

The order penetration point, which refers to subdimension 2.3 Environment, is classified in four modes: Make-to-Stock (MtS), Assemble-to-Order (AtO), Make-to-Order (MtO), Engineer-to-Order (EtO). The mode MtS produces to store the products, AtO assembles when order is received, MtO starts with the production when has been received and EtO starts the engineering process with incoming orders (cf. for this section Hoekstra et al., 1992). The complexity of processes and products is spread by Ferdows et al. (2016) on a scale between the category 'simple/standardized' products resp. production processes and the category 'complex/proprietary' products resp. production processes. This categorization is used for the subdimension 2.2 Technology. Production, supply chain, and development are the site competencies which lead to the three plant types identified by Feldmann and Olhager (2013) relate to subdimension 2.4 Goals and strategy. The network specialization is characterized into four strategies by Schmenner (1982) and refers relate to subdimension 2.4 Goals and strategy. The General Purpose Plant Strategy involves maintaining plants capable of fulfilling diverse roles over different durations. In the Market Area Strategy, each division plant produces most product lines within a confined geographic region. The Product Plant Strategy shares divisional product responsibilities among plants. And in the Process Plant Strategy, different plants handle specific segments of the production process (cf. for this section Schmenner, 1982). Friedli et al. (2014) distinguishes between four production strategies at company level, which relate to subdimension 2.4 Goals and strategy. A company with the production strategy pricer focusses on an excellent price-performance ratio, whereby the customer king strategy is very much oriented towards customer needs. The classic producer focusses on the company's own capabilities and the innovator assumes technological leadership (cf. for this section Friedli et al., 2014).

Research Design

A multiple case study design according to Eisenhardt (1989) and Yin (2003) was chosen to explore the interaction of GPNs and its management and to get insights into the link between structural and contextual dimensions of an organization. This research method was selected due to its effectivity in exploring complex phenomena within real-world contexts. Additionally, it benefits from established theoretical frameworks guiding its design, data collection, and analysis process. Moreover it facilitates the analysis of diverse data sources through comprehensive data analysis and further relies on the data of multiple sources in a triangulated manner to foster a deeper understanding of the phenomena (Eisenhardt, 1989; Voss et al., 2002; Yin, 2017). The entire research process is going to be accurately planned and transparently documented to ensure replicability and to guarantee the requirements for robust qualitative empirical research (Eisenhardt, 1989; Yin, 2017).

The cases will be selected to represent specific settings, aiming to generalize the theory across a diverse field of global organizations (Eisenhardt, 1989). We are planning to interview representatives of ten European companies, which operate globally and have a GPN with at least three production plants. A high level of validity will be achieved, by interviewing only senior managers who are explicitly part of the GPN organization. The headquarter of the companies are located either in Germany or in Scandinavia. This country difference will be an interesting aspect for the research according to cultural aspects of cooperation and decision-making. Furthermore, the discrete production, the global footprint of the companies, and the multiple branches offering varying product features to capture contingency factors will be underlying criteria, on which the interviewees will be chosen. Detailed information on the planned case selection can be found in Figure 3.

Case	Industry	Country of headquarter	# plants	# employees	CEU	NEU	WEU	SEU	SEEU	NA	SA	CN	IN	SEA	RoW
A	Other vehicle construction	GER	5	< 5.000	■										
B	Manufacture of metal products	GER	12	5.001 – 10.000	■					■	■	■			
C	Construction industry	GER	3	5.001 – 10.000	■										■
D	Other vehicle construction	GER	4	> 10.000	■					■					
E	Manufacture of electrical equipment	GER	15	> 10.000	■			■	■			■			
F	Manufacture of machinery and equipment	GER	14	5.001 – 10.000	■	■		■		■		■	■		
G	Manufacture of machinery and equipment	GER	12	> 10.000	■		■			■		■	■		■
H	Manufacture of electronic products	GER	7	< 5.000	■					■		■			
I	Manufacture of machinery and equipment	SE	>25	> 10.000	■	■	■	■	■	■	■	■	■		■
J	Manufacture of machinery and equipment	SE	>25	5.001 – 10.000	■	■	■	■		■	■	■	■	■	■

GER = Germany, SE = Sweden, CEU=Central Europe, NEU=Northern Europe, WEU=Western Europe, SEU=Southern Europe, SEEU=South East Europe, NA=North America, SA=South America, CN=China, IN=India, SEA=South East Asia, RoW=Rest of World

Figure 3 - Sample of the interviewees

The data of each selected cases will be collected through online interviews, which will be held in German and English and which will last 45–60 minutes each. Participants are going to be contacted via email to arrange interviews, will actively provide consent for their involvement, will be assured confidentiality to encourage open and honest responses, and will be informed with a brief summary. For the interviews a semi-structured interview guideline and individual introduction slides for each company will be used. The guideline will include a specific set of questions about the contextual and structural dimensions of an organisation, as well as strengths and weaknesses, and changes. Semi-structured interviews enable the capture of emergent insights, as respondents have the opportunity to articulate their experiences and contribute unforeseen insights (Spradley, 1979). In addition, to triangulate the collected primary data and increase additional information (Eisenhardt, 1989), secondary material from websites and business reports is going to be used. The interviews will be recorded and the recording is going to be transcribed by using the software MAXQDA and subsequently the transcripts are going to be cross-checked by the research team manually.

To analyse the transcribed interviews a priori coding structure will be used, which will be derived from the literature review and the underlying organizational framework (Figure 2). This method provides a structured and systematic approach for case analysis, ensuring comprehensive examination of specific topics or concepts of interest (Saldaña, 2015). Moreover, we will ensure that our coding approach remained open to emergent trends and novel insights that may emerge during the interviews will be captured. With the support of the software MAXQDA all coding procedures will be conducted manually. Subsequently a within-case and a cross-case analysis will be conducted. The within-case analysis is looking on the organization of one specific company to understand the individual circumstances and relationships within the company. The cross-case analysis consists of two parts: (1) Comparison of different organizational forms and categorization. (2) The organization forms then will be compared in respect to relevant contingency factors to derive implications.

Preliminary findings and hypothesis for further analysis

Data collection has not yet been completed, but first implications can be derived from preliminary discussions and first interviews:

RQ1: The hierarchical structure, reporting channels, the distribution of competencies, the interfaces to departments as well as personnel ratios seem to influence the organizational

structure more than other structural aspects. Furthermore, five different locations of the GPN departments within an organization can be observed: an own GPN department, the GPN management as part of supply chain management, the GPN department as part of the industrial engineering, the GPN department as a staff position at management level and the GPN department as a temporary project organization.

RQ2: Small companies organize their GPN case-based in project organizations, whereas with increasing size companies tend to establish a separate department. This seems obvious, as the number of decisions and therefore the need for a separate department increases with size. With regard to the type of order processing, a contradicting result emerges. The two companies with MtS have own GPN departments. Compared to MtO, however, a later customer decoupling point would argue in favour of a lower need for coordination and therefore against a separate department. But one of the two is very large, which means that the size effect described above also applies here. The other company, however, is comparatively small and only has three plants. This suggests that there are other factors that determine the existence of a GPN department and that company policy personnel decisions can flank rational structures. Furthermore, the contextual dimensions of culture influence the GPN management, where the mergers and acquisitions history is a decisive aspect. Companies with a high level of acquisitions will initially have many different types of GPN management and will have to restructure them.

In addition to the preliminary results, further hypotheses will be investigated in the interviews: (1) It stands to reason that with a higher proportion of production volume abroad, a greater need for coordination is required, which would suggest a own designated GPN department. (2) The same conclusion can be drawn from the process orientation of the sites, as the distribution of production stages across several sites means that interfaces also have to be managed centrally. (3) The situation is different with a high level of decentralization. If the sites are characterized by a high degree of autarky, there is less need for central management arguing for a rather lean organization. (4) A further hypothesis can be derived from product complexity. It should be noted that with complex products and processes, as is the case in machinery industry, industrial engineering knowhow is required and therefore GPN management is located in the industrial engineering department rather than supply chain department.

Discussion and Conclusion

The organizational structure is constituted by different structural dimensions. Hierarchy and centralization seem to be most relevant to characterize organizational forms for GPN management. The contingency factors, such as size, complexity, network configuration, industry, production strategy, network specialization and site competencies, vary for each company and therefore each company has to find its fitting organizational structure for the GPN department. It seems that GPN organisations go through different stages of maturity, which are linked to the respective degree of internationalisation and size. At the beginning, GPN management is usually a project organisation, then it becomes part of a line function or staff unit and then later it becomes a separate department. However, this development is determined by many individual factors. We want to make an initial contribution to this discussion with our research.

This work is the first to deal explicitly with the organisational structures of the management of GPNs. The organisational forms identified can then be linked to existing results in respect to the degree of decentralisation, coordination mechanisms and plant roles. This work therefore makes a significant contribution to the academic discourse on global production. The topic is also of enormous practical relevance. All of the companies examined are undergoing or are about to undergo organisational transformation. This shows that the organisation must be constantly adapted to changing requirements. With the help of the results, companies are

enabled to find the right organisational form according to their specific contingency factors. The findings are limited according to the small sample of 10 companies, which just cover some industries, countries and sizes of GPNs. Furthermore, the generalisability of case study research is limited due to the empirical approach. Therefore, further research is necessary with a larger sample and additional methods.

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