

Interfirm Collaboration in Global Production Networks – Maturity Model for Managing Interfirm Relationships

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Abstract

Today, data-sharing along global supply chains and outsourcing to international vendors are ubiquitous trends in global production. Both trends are a form of so-called interfirm collaboration. Previously, research focused on specified tools to gain advantages from interfirm collaboration. However, possible risks and structural obstacles hamper partners to engage in collaborative relationships. In this paper, a framework is presented to monitor the maturity of a firm's interfirm relationships. Thus, key factors and distinct dimensions are proposed that determine success in interfirm collaboration. The concluding framework visualizes interfirm relationships and creates transparency between collaborating stakeholders.

Keywords: Interfirm Collaboration, Interfirm Relationships, Global Production Networks

Introduction

The advent of globalization and digitalization during the last few decades continuously changes economies worldwide. Many corporations face challenges of the so-called VUCA-world (volatility, uncertainty, complexity and ambiguity) displayed in increasing margin pressure, market volatility or the emergence of disruptive technologies (Lanza et al., 2019; Verhaelen et al., 2021b). Grown markets and industry sectors such as retail,

automotive, plant construction and engineering companies are confronted with these challenges, whilst their business might be stuck in overcome structures (Lanza and Moser, 2012; Bhinge et al., 2015; Lanza et al., 2019).

Globalization has transformed these corporations into internationally operating and competing enterprises. One way of overcoming challenges in new markets is the collaboration with local competitors, suppliers or customers (Lanza et al., 2019). New alliances are to be formed both in foreign and home markets that lead to product innovation, improved service and new business opportunities. Hence, global firms find themselves embedded in a network of international suppliers, customers, competitors and partners (Lanza et al., 2019; Hochdörffer et al., 2021).

In previous years, research on these so-called global production networks (GPNs) has neglected their embeddedness with external companies and instead focused on internal network structures and knowledge transfer (Cheng et al., 2014). However, the emergence of smart sensors and cloud technologies enables to share, access and process data along the shopfloor and between companies. Consequently, corporations are enabled by new, digital technologies to mutually engage in cross-corporate activities, a form of so-called interfirm collaboration (Shi and Gregory, 2005).

However, implementing collaboration poses threats and many companies fail at implementation (Kampstra et al., 2006). While various aspects of interfirm collaboration have been theorized in literature, a cohesive conceptualization and practical guidelines for operations management are still missing. This makes it difficult for companies to leverage the full collaborative potential. The present work provides companies with guidelines and tools supporting the successful implementation of collaborative practices. By doing so, light is shed on interfirm collaborations, enabling an operations management perspective.

In the following section, related literature is discussed. Therefore, the term interfirm collaboration is clarified and existing approaches to the management of interfirm collaborations are reviewed. Subsequently, the underlying methodology of this research is presented. As a first result, eight key factors to successful collaboration are developed. Based on these factors, five distinct dimensions on interfirm collaboration are derived. These dimensions result in a management framework enabling to leverage the full potential of interfirm collaboration by building up collaborative skills. The concluding section stresses the need for future research and their practical application.

Theoretical Background

First and foremost, it remains to define the terms “interfirm” network and “interfirm” relationship. Per definition, production networks and particularly GPNs are set up by multiple internationally dispersed plants connected by material, informational and financial flows (Lanza et al., 2019; Verhaelen et al., 2021a). Rudberg and Olhager (2003) introduce the category of interfirm networks to emphasise that these networks are spanned between several, separately owned corporations and multiple plants. Hence, the term interfirm network will hereunder be used to describe the interlinkage between external and internal sites of a GPN.

The term collaboration commonly refers to a “coordinated, synchronous activity that is the result of a continued attempt to construct and maintain a shared conception of a problem” (Roschelle and Teasley, 1995, p.70). Scholars in various fields of research particularly highlight joint problem solving (e.g. Roschelle and Teasley, 1995), shared resources (e.g. Cao and Zhang, 2011) and mutual goals (e.g. Cuevas et al., 2015) as key elements of collaborations.

Hence, collaboration is defined “as the mutual engagement of participants in a coordinated effort to solve the problem together” (Roschelle and Teasley, 1995, p.70).

This definition emphasizes the difference between cooperation and collaboration. Whereas, cooperation divides a problem set between participants into smaller sub-problems that are merged once individually solved. In contrast, collaboration focuses on mutually solving a problem set (Roschelle and Teasley, 1995). The term cooperation marks a bottom line for collaborative interfirm relationships. Any further mutual engagement within an originally cooperative relationship is seen as a collaborative activity. Additionally, an upper limit of interfirm collaboration is given by the shared ownership of each other’s resources which would finally result in a joint venture or other forms of shared ownership (see Figure 1) (Barratt, 2004; Lambert et al., 1996).



Figure 1 – Levels of Interfirm Relationships (based on Lambert et al., 1996; Barratt, 2004)

To sum up, interfirm collaboration describes a form of hybrid governance between transactional exchange and shared ownership focusing on relational control and less contractual control (Cao and Zhang, 2011). In particular, profit and cost centres as well as the legal entity are not shared within an interfirm collaboration. Therefore, shared ownership marks the limit of interfirm collaboration to internal collaboration (Lambert et al., 1996).

Related Work

The motivation towards engaging in an interfirm collaboration stems from overcoming challenges posed by global competition and disruptive technologies. In related work, the so-called collaborative advantage is seen as a shared competitive advantage (Jap, 2001). Thus, such an interfirm advantage is the driving force behind interfirm collaboration and solely exists through a multilateral firm relationship between two or more partners (Cao and Zhang, 2013).

Cao and Zhang (2011) divide the collaborative advantage into five components: Process efficiency, flexibility, business synergies, quality and innovation. By conducting empirical studies, Cao and Zhang (2013) show that benefits from interfirm collaboration contribute to a significant increase in firm performance.

However, possible risks and structural obstacles hamper partners to intensify their relationships to adopt the full benefits from interfirm collaboration. In order to minimize risks and overcome obstacles, management must be provided with concepts and guidelines supporting the optimal design of interfirm collaborations.

Previous work by Min et al. (2005) develops a conceptual model for supply chain collaboration summarizing the characteristics needed to achieve collaborative benefits. The framework guides managers through the process of interfirm collaboration by highlighting key factors critical to collaborative relationships.

Moreover, Fawcett et al. (2008) develop a process model for supply chain collaboration. In doing so, they shed light on the process from a change management perspective. Therefore, Fawcett et al. (2008) recommend a transformation process and promote a deeper understanding of the value network in top management. Second, the recommended transformation process builds upon a culture of collaboration, reduction of resisting forces and the establishment of a continuous improvement process.

Simatupang and Sridharan (2005) propose a framework linking different features of interfirm collaboration, hence creating a holistic model providing practitioners with a better understanding on the interaction of corporate elements in collaborations.

To sum up, previous work provides guidance to the implementation of interfirm collaboration and the realization of collaborative advantages. However, the specific levers and factors required to realize the collaborative advantage and to overcome structural obstacles remain undefined.

Methodology

The goal of this work is to enable practitioners to realize successful interfirm collaborations. In order to achieve this goal, a framework is presented to monitor the current and desired state of interfirm relationships in a kind of maturity model. To develop this framework, we followed a Design Science Research approach (e.g. Hevner et al., 2004) more specifically the approach of Becker et al. (2009) for developing maturity models. The given work presents the results of the fourth and central phase, the iterative maturity model development.

First, general determinants of successful collaborations have been analysed. Based on these determinants, five dimensions on interfirm collaboration with their specific characteristics have been derived and consolidated into a maturity model for managing interfirm collaboration. The results have been gathered by a systematic literature review followed by interactive workshops with industrial experts on interfirm collaboration within a current research project to iteratively improve the framework.

Succeeding in Interfirm Collaboration

Previous work in the field of interfirm collaboration highlights specific methods and tools to realize collaborative benefits such as vendor managed inventory or collaborative data exchange (compare to Lehoux et al., 2014; Stamer et al., 2020; Treber et al., 2021). However, we propose that the coordination of stakeholders, mutual activities and shared resources are critical factors to succeed in interfirm relationships (compare to Håkansson, 1990).

Kampstra et al. (2006) find that market resistors, lack of trust, neglecting collaborative processes, implementation failures or organizational deficits are major risks to prosperous partnerships. These factors finally produce opportunism and limit the full potential of the collaborative advantage, thus leading to collaboration failure. In particular, collaborative culture and long-term design of partnerships are overlooked factors. Hence, interfirm collaboration should be seen as an ongoing relationship rather than an on-off solution to guarantee flexibility, adaptivity and responsiveness (Barratt, 2004; Lehoux et al., 2014). Despite all these intangible factors that influence the realized gains from collaboration, there are eight key factors to consider when building partnerships (see Figure 2):

- Establish an extensive and integrated collaborative culture. The objective here is that a culture of trust, mutuality and openness between organizations (Barratt 2004) enables problem-solving and innovativeness. Even in cases of opportunism, a strong culture helps to realign individual interests in hindsight. Therefore, a cultural fit between collaborating partners is a crucial factor (Kampstra et al., 2006).
- Enable flexible, transparent and synchronized communication along all participating firms, including the definition of communication systems and processes. IT failures and non-transparency lead to miscommunication hindering collaboration (Kampstra et al., 2006).
- Notwithstanding common knowledge, collaborations are better built on corporate strengths and not on weaknesses. In other words: do not collaborate to cover internal

weaknesses. It is generally harder to succeed if corporate (internal) collaboration fails and underlying processes are immature and unstable (Barratt, 2004; Kampstra et al., 2006).

- Establish internal collaboration first, then couple internal and external (equals interfirm) collaboration. Otherwise, an interfirm network might end up with several isolated communication channels (silo-thinking) instead of a collaborative whole (Barratt, 2004; Silbernagel et al., 2019).
- As already stated, long-term commitment in a collaboration avoids opportunism which is a major fear for collaborating partners (Barratt, 2004). Wherever sufficient commitment cannot be met, an incentive structure that promotes long-term thinking should be implemented.
- Concentrate on a few key partners and select them carefully (Barratt, 2004) by assessing corporate culture, collaborative potential, process and product skills. A detailed partner selection process must ensure goal alignment, shared interests and complementarity both from an operational and a cultural perspective. As partner selection, partner development and implementation are capital intensive processes, companies better focus on a handful of key partners preferably in the most promising segments (Barratt, 2004).
- Develop segment-specific (supply chain-, process-, product-specific) collaborations. By doing so, the segment-specific maximum of collaborative advantage can be reached (Barratt, 2004). Additionally, a step-by-step approach makes it easier to capitalize experiences from the first segments in a subsequent roll-out phase.
- Most important: establish goal congruence and inter-organizational trust to mediate power asymmetries. By doing so, opportunism, information asymmetry and interest conflicts are avoided (Cuevas et al., 2015). Potential partners lacking in power symmetry or trust are advised to align their business objectives in order to build bilateral trust (Cuevas 2015). To put it straight, trust and goal congruence are the base of prosperous interfirm collaboration.

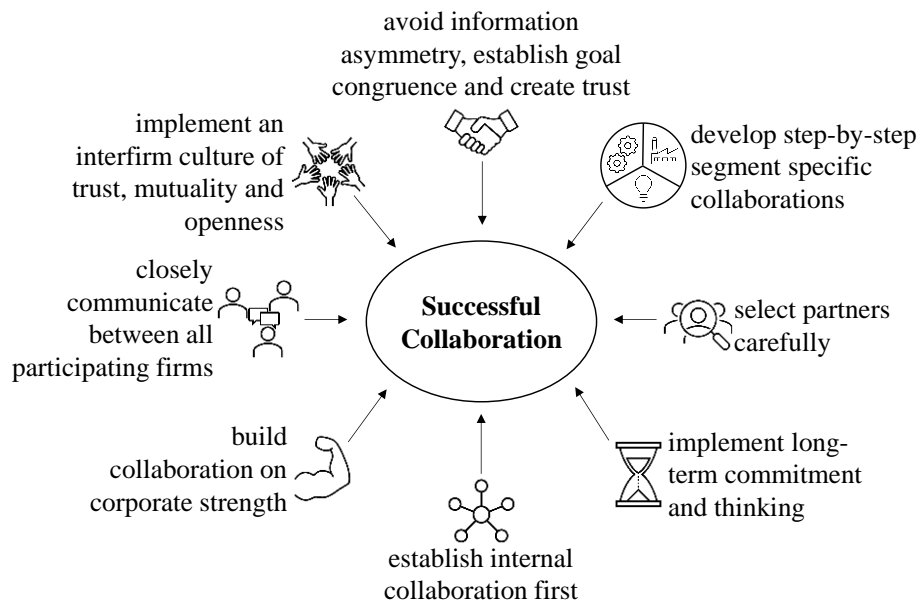


Figure 2 – Determinants of Successful Collaboration

Dimensions of Interfirm Collaborations

Collaboration happens on various corporate and interfirm levels that finally determine firm performance. By considering various viewpoints, the key levers and enablers to prosperous interfirm collaboration can be uncovered, allowing to individually adopt the correct management measures.

We propose that interfirm collaboration can be observed from five distinct dimensions. Each dimension can be determined along a set of well-defined characteristics. Both, the dimensions and the characteristics are derived from previous listed success factors. Thus the five dimensions, are a result of recombining, extending and rethinking the literature reviewed in interactive workshops with industrial experts on interfirm collaboration.

The five proposed dimensions on interfirm collaboration are the following:

- As the driving force behind collaborations, the so-called *collaborative advantage* defines the first dimension. Besides realized advantages, the mutual allocation of risks, costs and benefits sets the strategic frame of interfirm collaboration.
- The second dimension is determined by the participating *stakeholders*. In particular, the various participants in collaborations are characterized by their individual interests and goals (compare to Håkansson (1990)). Through a shared strategy and common targets, stakeholders are enabled to mediate power asymmetries to mutually engage in shared activities.
- Third, the core of each collaboration is given by the stakeholders' *relationship*. This dimension tries to answer how stakeholders interact in a collaboration. As there is no collaboration without mutual problem solving, a collaborative relationship emerges around shared activities, bilateral trust and cultural elements.
- As already mentioned, deviating *interests* and goals are a serious threat to successful interfirm collaboration. Since information and power asymmetries induce a potential partner risk, this square emphasizes the importance of interest alignment and mediating *incentive* mechanisms in interfirm relationships. Hence, optimally collaborative behavior between partners can be established.
- Fifth, as previously mentioned complimentary access to resources is the source of the collaborative advantage (Cao and Zhang, 2011). Therefore, a specific skillset both on a personal and an organizational level is needed to access complimentary resources and utilize the full potential in a partnership (compare to Dyer and Singh (1998) and Barratt (2004)). Insofar, *resources and skills* in an interfirm partnership build the partnerships base.

As all five dimensions and their characteristics closely interact with each other, some characteristics are partly redundant to ensure the dimensions' internal integrity. One might add that the view on collaborative *activities* could be added as a sixth dimension (Barratt, 2004) . However, collaborative activities must be defined use-case specific and are to be described through the relationship dimension.

Framework for the Management of Interfirm Collaborations

The presented framework picturizes the aforementioned dimensions in five separated squares (see Figure 3). Further, each dimension is represented by a corresponding set of characteristics, which can be clustered into subcategories (see Figure 4).

Those categories can be evaluated by a scoring system scaling from zero (“characteristic non-existent”) to three (“characteristic to a high degree fulfilled”). As one might have realized, the most collaborative relationship would always score with a “3”. Whereas, a purely transactional relationship would most likely always score with a “0”.

Only structural characteristics such as information symmetry might be rated with a score higher than zero for merely transactional relationships.

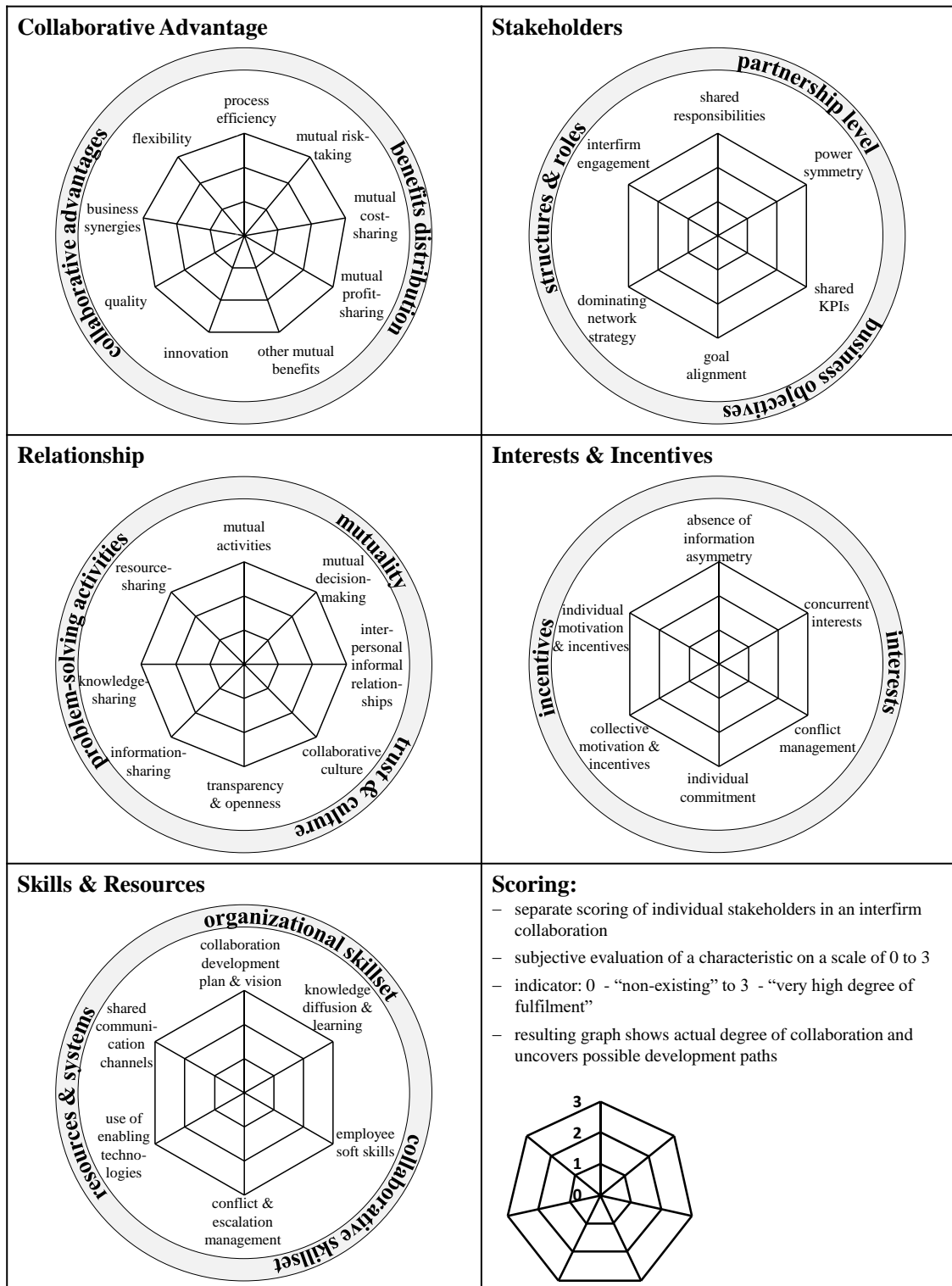


Figure 3 – Framework “Interfirm Collaboration”

This framework might be applied in central network management or strategic purchasing to analyse the firm’s collaboration maturity and manage the firm’s relationships. Foremost, the framework is applicable for firms with central network responsibilities. An explanation on how to apply the framework is given below (Figure 4).

The framework users are asked to fill out this framework for both the current state (red line) and the desired state (green line, “collaborative vision”). Deviations in the graphs show potential development paths. Furthermore, necessary measures needed to achieve the desired state can be derived.

Additionally, this framework visualizes firm relationships and creates transparency between the viewpoints of several stakeholders. It can be a starting point for stakeholder discussions and negotiations. Future development paths are revealed through the visualization the framework provides and design options can be discussed.

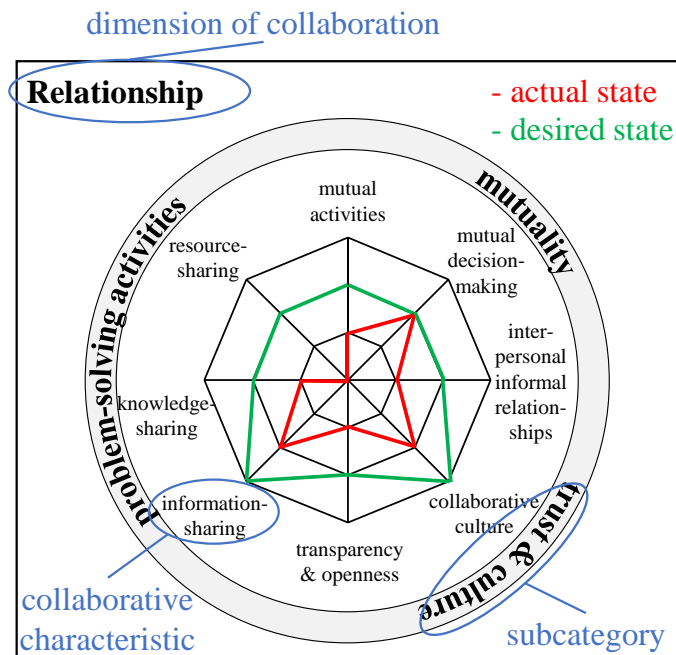


Figure 4 – Explanation of the framework and its application

In order to develop a broader perspective, an additional PESTEL-analysis might be conducted so that environmental influences on collaborations can be considered. Another use of this framework might be as an application in the sense of a cost-benefits analysis. By assigning weights to each characteristic an overall collaborative score can be calculated. However, it is mentioned that an ultimately collaboratively interfirm relationship is not always ideal. Some relationships might as well be optimal on a purely transactional level (Ferdows, 2014). Hence, this framework allows setting the optimal collaboration strategy and the deduction of the measures needed.

Conclusion and Outlook

In this work, a framework is presented to monitor the maturity of a firm’s interfirm relationships. Therefore, enabling practitioners to realize successful interfirm collaborations. The approach of Becker et al. (2009) for developing maturity models has been followed to develop this framework. Building upon a broad literature review and interactive workshops, levers to successful collaboration are revealed and relevant interfirm dimensions are presented. The concluding framework visualizes interfirm relationships and creates transparency between collaborating stakeholders.

In future research, the framework should be further evaluated in a broad empirical study. It might further be embedded in a larger network management framework. Thus, the derived collaboration success factors and the presented framework can be extended to a multi-partner case. Building upon that, future work could question roles and competencies within collaborating GPNs.

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References

- Barratt, M. (2004) 'Understanding the meaning of collaboration in the supply chain', *Supply Chain Management: An International Journal*, Vol. 9, No. 1, pp.30–42.
- Becker, J., Knackstedt, R. and Pöppelbuß, J. (2009) 'Developing Maturity Models for IT Management', *Business & Information Systems Engineering*, Vol. 1, No. 3, pp.213–222.
- Bhinge, R., Moser, R., Moser, E., Lanza, G. and Dornfeld, D. (2015) 'Sustainability Optimization for Global Supply Chain Decision-making', *Procedia CIRP*, Vol. 26, pp.323–328.
- Cao, M. and Zhang, Q. (2013) *Supply Chain Collaboration. Roles of Interorganizational Systems, Trust, and Collaborative Culture*, Springer, London.
- Cao, M. and Zhang, Q. (2011) 'Supply chain collaboration: Impact on collaborative advantage and firm performance', *Journal of Operations Management*, Vol. 29, No. 3, pp.163–180.
- Cheng, Y., Farooq, S. and Johansen, J. (2014) 'Global Operations: A Review and Outlook', in Johansen, J. et al. (Eds.), *International Operations Networks*, Springer London, London, s.l., pp.161–179.
- Cuevas, J.M., Julkunen, S. and Gabrielsson, M. (2015) 'Power symmetry and the development of trust in interdependent relationships: The mediating role of goal congruence', *Industrial Marketing Management*, Vol. 48, pp.149–159.
- Dyer, J.H. and Singh, H. (1998) 'The Relational View: Cooperative Strategy and Sources of Interorganizational Competitive Advantage', *The Academy of Management Review*, Vol. 23, No. 4, p.660.
- Fawcett, S.E., Magnan, G.M. and McCarter, M.W. (2008) 'A Three-Stage Implementation Model for Supply Chain Collaboration', *Journal of Business Logistics*, Vol. 29, No. 1, pp.93–112.
- Ferdows, K. (2014) 'Relating the Firm's Global Production Network to Its Strategy', in Johansen, J. et al. (Eds.), *International Operations Networks*, Springer London, London, s.l., pp.1–11.
- Håkansson, H. (1990) 'Technological collaboration in industrial networks', *European Management Journal*, Vol. 8, No. 3, pp.371–379.
- Hevner, March, Park and Ram (2004) 'Design Science in Information Systems Research', *MIS Quarterly*, Vol. 28, No. 1, p.75.
- Hochdörffer, J., Klenk, F., Fusen, T., Häfner, B. and Lanza, G. (2021) 'Approach for integrated product variant allocation and configuration adaption of global production networks featuring post-optimality analysis', *International Journal of Production Research*, pp.1–25.
- Jap, S.D. (2001) 'Perspectives on joint competitive advantages in buyer–supplier relationships', *International Journal of Research in Marketing*, Vol. 18, 1-2, pp.19–35.
- Kampstra, R.P., Ashayeri, J. and Gattorna, J.L. (2006) 'Realities of supply chain collaboration', *The International Journal of Logistics Management*, Vol. 17, No. 3, pp.312–330.
- Lambert, D.M., Emmelhainz, M.A. and Gardner, J.T. (1996) 'So You Think You Want a Partner?', *Marketing Management*, Vol. 5, No. 2, pp.24–41.
- Lanza, G., Ferdows, K., Kara, S., Mourtzis, D., Schuh, G., Váncza, J., Wang, L. and Wiendahl, H.-P. (2019) 'Global production networks: Design and operation', *CIRP Annals*, Vol. 68, No. 2, pp.823–841.
- Lanza, G. and Moser, R. (2012) 'Strategic Planning of Global Changeable Production Networks', *Procedia CIRP*, Vol. 3, pp.257–262.
- Lehoux, N., D'Amours, S. and Langevin, A. (2014) 'Inter-firm collaborations and supply chain coordination: review of key elements and case study', *Production Planning & Control*, Vol. 25, No. 10, pp.858–872.
- Min, S., Roath, A.S., Daugherty, P.J., Genchev, S.E., Chen, H., Arndt, A.D. and Glenn Richey, R. (2005) 'Supply chain collaboration: what's happening?', *The International Journal of Logistics Management*, Vol. 16, No. 2, pp.237–256.
- Roschelle, J. and Teasley, S.D. (1995) 'The Construction of Shared Knowledge in Collaborative Problem Solving', in O'Malley, C. (Ed.), *Computer Supported Collaborative Learning*, Springer Berlin Heidelberg, Berlin, Heidelberg, pp.69–97.

- Rudberg, M. and Olhager, J. (2003) 'Manufacturing networks and supply chains: an operations strategy perspective', *Omega*, Vol. 31, No. 1, pp.29–39.
- Shi, Y. and Gregory, M. (2005) 'Emergence of global manufacturing virtual networks and establishment of new manufacturing infrastructure for faster innovation and firm growth', *Production Planning & Control*, Vol. 16, No. 6, pp.621–631.
- Silbernagel, R., Wagner, R., Haefner, B. and Lanza, G. (2019) 'Qualitätsregelstrategien in Wertschöpfungsnetzwerken', *wt Werkstatttechnik*, Vol. 109, 11-12, pp.802–806.
- Simatupang, T.M. and Sridharan, R. (2005) 'An integrative framework for supply chain collaboration', *The International Journal of Logistics Management*, Vol. 16, No. 2, pp.257–274.
- Stamer, F., Steinke, M., Silbernagel, R., Häfner, B. and Lanza, G. (2020) 'Using Smart Services as a Key Enabler for Collaboration in Global Production Networks', *Procedia CIRP*, Vol. 93, pp.730–735.
- Treber, S., Benfer, M., Häfner, B., Wang, L. and Lanza, G. (2021) 'Robust optimization of information flows in global production networks using multi-method simulation and surrogate modelling', *CIRP Journal of Manufacturing Science and Technology*, Vol. 32, pp.491–506.
- Verhaelen, B., Haefner, B. and Lanza, G. (2021a) 'Methodology for the strategy-oriented distribution of decision autonomy in global production networks', *Procedia CIRP*, Vol. 96, pp.15–20.
- Verhaelen, B., Mayer, F., Peukert, S. and Lanza, G. (2021b) 'A comprehensive KPI network for the performance measurement and management in global production networks', *Production Engineering*.