

# Inter-firm Cooperation: Basis of a Course in Industrial Engineering

*Jabier Retegi (jretegi@mondragon.edu)  
Mondragon University, Faculty of Engineering, Spain*

*Juan Ignacio Igartua (jigartua@mondragon.edu)  
Mondragon University, Faculty of Engineering, Spain*

## Abstract

Inter-firm cooperation, with its different goals and in its different forms as a source of productivity and competitiveness, has been a subject of active research during the last few decades. Based on a review of the literature, the authors analyse the goals that can be pursued through inter-firm cooperation and then, they examine industrial engineering curricula in five faculties of five different countries to verify if this source of competitiveness is sufficiently addressed in education. The results indicate that, in general, this topic is not directly addressed in studies in all its extents, and, in some cases, it is merely treated as a sub-product of internal productivity tools and concepts or a supply chain approach. The paper concludes that the inclusion of inter-firm synergies with a broad vision could improve industrial engineering curricula, and a basic course structure is proposed.

**Keywords:** Industrial engineering, Competitiveness, Inter-firm, Productivity, Synergies

---

## Introduction

Retegi and Igartua (2021) suggest that broadening the optimisation scope from company to value chain and industrial ecosystems is one of the potential future paths for industrial engineering development for the future decades. In this sense, the European Commission (2020b) will support its new industrial strategy by a new focus on industrial ecosystems that encompass all players operating in a value chain. Moreover, considering the impact of digitisation, business process management will increasingly involve more integration across a complex network of partners (Caputo et al, 2018). Although it is still limited, research interest in cooperation increased from 1994 to 2014 (Dorn et al, 2016).

In this paper, the authors analyse some of the alternatives to obtain competitive advantage through cooperation between firms and verify if this source of competitiveness is sufficiently addressed in industrial engineering studies. To achieve this, the curricula of five different faculties in five different countries are analysed.

## Methodology

For this research, a literature review was conducted. The articles were located using the Web of Science database. The research was carried out during February 2022 with the following search string: (“competitive\*” OR “productivit\*”) AND (“inter-compan\*” OR “intercompan\*” OR “inter-firm\*” OR “interfirm\*” OR “industrial ecosystem\*”) in the title, abstract, and keyword fields with the publication year between 2016 and 2022. As a result, the authors identified 432 articles. The titles and abstracts of the selected articles were read, and those relevant to inter-firm cooperation for productivity and/or competitiveness were retained. During the examination of the articles, the main references linked to the topic of this article were analysed and classified. The purpose of the literature review was to identify the variety of inter-firm relationships leading to an increase in performance. The relevant articles were classified depending on the goal of the cooperation between firms and ranked depending on their citations. Due to length limitation of this paper, only one paper per inter-firm cooperation goal is indicated.

An analysis of industrial engineering curricula has been conducted for several European faculties in five different countries to identify subjects that can be related to the competences of identifying and/or developing inter-firm synergies. The cases were selected from among the schools or faculties offering industrial engineering degree studies for which details about the courses were publicly available.

## Review of the literature

The phenomenon of inter-firm cooperation can be seen from different perspectives regarding the motivations, outcomes, form, or factors that affect its success. An extensive literature review and proposal for a framework of inter-firm collaborative business strategies is presented in Bhattacharyya (2020). Considering the outcomes of cooperation, Bengtsson and Raza-Ullah (2016) present an extensive literature review on the four main dimensions of the performance increase in cooperation: innovation performance, knowledge sharing, creation, acquisition, and economic, financial, market, and competitive performance. The network of the cooperation structure created to implement the inter-firm synergies can take different forms, as indicated in Nassimbeni (1998).

From the perspective of the goals, the inter-firm cooperation literature has addressed diverse perspectives linked with competitiveness and productivity (Franco and Haase, 2015), as is indicated in Table 1.

Type of synergies	Goals of synergies
Improvement of supplier’s quality	A driver company contributes to the quantitative and qualitative development of a supplier by a structured program of improvement (Mitrega et al, 2017).
Sharing of common services	Sharing common services as a way to reduce costs and improve quality: administration, information technologies, etc (Della Peruta et al, 2018).
Increase in procurement performance	Firms share a common procurement service to obtain better goods and/or services, quality, prices, and payment terms through a professionalised common structure and scale economies (Saha et al, 2011).
R&D and innovation efficiency	Firms in a region sharing the use of the same core technology promote the creation of an R&D alliance (Martínez-Noya et Narula, 2018; Huggins and Thompson, 2017).

Training and skills promotion	Firms in a region having similar skills needs promote the creation of a vocational education training unit (Della Peruta et al, 2018).
Industrial symbiotic relationship	Firms with geographic proximity are engaged in a collective approach to competitive advantage involving physical exchange of materials, energy, water, and by-products (Chertow, 2007; Bacon et al, 2020).
Financial services	Firms share financial resources through cash pooling or credit mechanisms (Everaert et al, 2008)
SMEs networking for internationalisation	Firms establish common services to facilitate internationalisation processes in selected countries (Montoro-Sánchez et al, 2018).
Knowledge management to support decision-making	Firms share resources to provide information for an effective decision making (Wulf and Butel, 2017).

*Table 1: Goals for synergetic inter-firm relationships*

In Institute of Industrial Engineers IIE (2006), the industrial engineer's roles in industry are presented. The references to inter-firm relationships to obtain productivity improvements are limited to supply chain management (audit suppliers and solve issues) and to the coordination of third-party quality audits. No references to the strategic relevance of inter-firm relationships are found.

In this research, as can be seen in Table 2, the curricula of five industrial engineering related degrees (bachelor's and/or master's degrees) offered in different European countries (France, Austria, Sweden, Switzerland, and Spain) have been analysed.

Country	Bachelor's/Master's	Courses
France	Bachelor's	3 ECTS. Oriented towards supply chain and purchase management and logistics.
Austria	Master's	2+2 ECTS. Manufacturing and supply chain network; implementing innovation strategy through M&A.
Switzerland	Master's	4+4 ECTS. Strategic partnership, supply chain network, and value chain management in practice in two different master's degrees.
Sweden	Master's	No specific courses found.
Spain	Bachelor's	Part of 6 ECTS. Linked to a mainly internally oriented logistics course.

*Table 2. Analysis of some European curricula*

It is found that, in general, this topic is not directly addressed in the studies, and in some cases, it is treated as a sub-product of supply chain management or logistics. Some specific courses addressing value chain management, implementation of innovation strategy through M&A, or strategic partnership are part of master's degree programs in the optional list of courses of programs analysed from Austria and Switzerland. It can be concluded that the scope of inter-firm productivity is mainly addressed from the supply chain/logistics optimisation perspective.

Considering the goals that can be achieved through inter-firm synergies exploitation and the residual presence of this topic in industrial engineering curricula, content is proposed that could include the contents in the Table 3.

<b>Inter-firm sources of productivity and competitiveness</b>	
Studies	Industrial engineering-related bachelor's or master's degrees (3 creds.)
Skills	To be aware of the importance of inter-firm cooperation to improve competitiveness and to face the future challenges of the firm. To be able to detect and conceptualise opportunities for improvement of productivity and/or competitiveness fostering inter-firm relationships
Contents	Procurement improvement through aggregation of purchasing capacity; supplier development processes; industrial symbiotic ecosystems; sharing of common services and resources (financial, knowledge exchange, etc.); collaborative research & development & innovation models; SMEs networking for internationalisation; regional promotion of training and research centres and activities; regional clusters/sectorial clusters; addressing the macro transitions through inter-firm cooperation
Methodology	Basic theory (motivations, forms of cooperation, expected synergies, strategic and inter-dependence issues) and case studies

*Table 3: Basic information about a new subject on inter-firm productivity sources*

This subject could be implemented in undergraduate or master's degree programs but should be compulsory.

## Conclusions

The relevance of inter-firm cooperation for productivity and competitiveness with several approaches is well reflected in the literature. The skills needed to propose and implement efficient cooperation projects include strategic, competitive, and economic skills but also require integrating product, process, and technology aspects that can condition or foster the interest in such projects. That makes this field a natural area for industrial engineers' skills development and a challenge to contribute to firms' competitiveness.

After having analysed the research related to inter-firm cooperation as a source of competitiveness and the curricula of studies in industrial engineering and management, the following conclusions can be extracted:

- From the review of the literature, we can conclude that the topic of inter-firm cooperation as a source of productivity and competitiveness is much broader than the supply chain approach.
- In most of the programs, we did not identify specific subjects oriented towards identifying and exploiting the possibilities of inter-firm synergies in all its extents. In some cases, this can be addressed as a derivation of internal optimisation and/or an improvement of commercial relationships. Some institutions offer some courses from the optional list.
- Obtaining better productivity and competitiveness requires a new perspective of management that goes beyond internal sources of improvement and external competitive or vendor-buyer relationships.

- To be effective, the European trends (European Commission, 2019; European Commission, 2020a) that will affect industry (digitisation, energy transition, circular economy, climate neutrality, and strengthening of value chains) require coordinated action between firms belonging to the same value chain or firms constituting new value chains.
- The perspective of reaching inter-firm synergies requires a cooperative state of mind of managers that cannot be treated as a sub-product of the application of internal productivity increasing tools, nor as a transaction cost optimisation perspective.
- Industrial engineers should integrate the scope outside of the firm as a field to be managed to increase productivity and competitiveness through inter-firm synergies.
- The list of contents is too extensive for a 3-credit course. The basic content of a course and its items presented in this paper can constitute an initial approach that should be selected and developed depending on the priorities of the industrial sector of the region/country and the challenges to be addressed.

This paper has some limitations due to the small sample of industrial engineering studies that have been analysed and the availability of details of the teaching programs.

## References

- Bacon, E., Williams, M.D. and Davies, G. (2020), "Coopetition in innovation ecosystems: a comparative analysis of knowledge transfer configurations", *Journal of Business Research*, Vol. 115 No. 7, pp. 307-316.
- Bhattacharyya, S.S., (2020) Development of an integrated framework regarding inter-firm collaborative business strategies. *Journal of Science and Technology Policy Management*. Vol. 12 No. 1, 2021. pp. 62-85. DOI 10.1108/JSTPM-02-2020-0019
- Bengtsson M., Raza-Ullah T. 2016, A systematic review of research on coopetition: Toward a multilevel understanding, *Industrial Marketing Management*, Volume 57, 2016, Pages 23-39, ISSN 0019-8501.
- Caputo, A., Fiorentino, R., & Garzella, S. (2019). From the boundaries of management to the management of boundaries: Business processes, capabilities and negotiations. *Business Process Management Journal*, 25(3), 391–413. doi:10.1108/BPMJ-11-2017-0334
- Chertow, M. R. (2007). "Uncovering" industrial symbiosis. *Journal of Industrial Ecology*, 11(1), 11–30.
- Della Peruta, M. R., Del Giudice, M., Lombardi, R., et al. (2018). Open innovation, product development, and inter-company relationships within regional knowledge clusters. *Journal of the Knowledge Economy*, 9, 680–693.
- Dorn, S., Schweiger, B., & Albers, S. (2016). Levels, phases and themes of coopetition: A systematic literature review and research agenda. *European Management Journal*, 34 (5), 484–500. <https://doi.org/10.1016/j.emj.2016.02.009>
- European Commission (2019) Communication from the Commission to the European Parliament, The European Council, The Council, The European Economic and Social Committee and the Committee of the Regions. The European Green Deal. Brussels, 11.12.2019. COM (2019) 640 final

- European Commission (2020a) Communication from the Commission to the European Parliament, The European Council, The Council, The European Economic and Social Committee and the Committee of the Regions. Europe's moment: Repair and Prepare for the Next Generation. Brussels, 27.5.2020. COM (2020) 456 final
- European Commission (2020b) Communication from the Commission to the European Parliament, the European Council, The European Economic and Social Committee of the Regions. A New Industrial Strategy for Europe. Brussels, 10.3.2020. COM (2020) 102 final
- Everaert, P., Sarens, G. & Rommel, J. Using Transaction Cost Economics to explain outsourcing of accounting. *Small Bus Econ* 35, 93–112 (2010). <https://doi.org/10.1007/s11187-008-9149-3>
- Franco, M., Haase, H. (2015) Interfirm alliances: A taxonomy for SMEs. *Long range planning* 48, 168-181.
- Huggins, R., Thompson, P. (2017) Entrepreneurial networks and open innovation: the role of strategic and embedded ties, *Industry and Innovation*, 24:4, 403-435, DOI: 10.1080/13662716.2016.1255598
- IIE Institute of Industrial Engineers (2006) Industrial Engineering Roles. Downloaded the 2021/02/20 from [https://www.iise.org/uploadedFiles/IIE/About\\_IIE/What\\_IIEs\\_Do\\_IIE-IAB\\_v2.pdf](https://www.iise.org/uploadedFiles/IIE/About_IIE/What_IIEs_Do_IIE-IAB_v2.pdf)
- Martinez-Noya, A., & Narula, R. 2018. What more can we learn from R&D alliances? A review and research agenda. *BRQ Business Research Quarterly*, 21(3): 195–212.
- Mitrega, M., Forkmann, S., Zaefarian, G. and Henneberg, C.S. (2017), "Networking capability in supplier relationships and its impact on product innovation and firm performance", *International Journal of Operations & Production Management*, Vol. 37No. 5, pp. 577-606.
- Montoro-Sanchez, A., Diez-Vial, I., & Belso-Martinez, J. A. (2018). The evolution of the domestic network configuration as a driver of international relationships in SMEs. *International Business Review*, 27(4), 727–736.
- Nassimbeni, G. 1998. Network structures and co-ordination mechanisms. *International Journal of Operations and Production Management* 18(6): 538-554.
- Retegi, J., Igartua, J.I. Trends and Proposals for European Industrial Engineering, Proceedings of the 14th EPIEM Conference 2021. DOI 10.3217/978-3-85125-827-1,
- Saha, R.L., Seidmann, A., Tilson, V. (2011) Unexpected Motivations behind Joining Group Purchasing Organization (GPO). Proceedings of the 44th Hawaii International Conference on System Sciences.
- Wulf, A., & Butel, L. (2017). Knowledge sharing and collaborative relationships in business ecosystems and networks. *Industrial Management & Data Systems*, 117(3), 1407–1425. <https://doi.org/10.1108/IMDS-09-2016-0408>