OPEN INNOVATION WITHIN INDUSTRIAL NETWORKS

GER POST

Abstract

Companies, especially large and multinational ones, have to deal with challenges of globalisation, complex and risky technological developments, and continuously changing market needs. One way of dealing with these uncertainties and opportunities is to build collaborations with other firms and R&D organisations. Open innovation, strategic alliances and other forms of collaboratiopn are built on interfirm networks. These Industrial networks and interfirm relationships can be studied from different disciplinary angles and theoretical perspectives. This chapter describes these theoretical perspectives and the practical implications of industry networks for open innovation management

Prerequisite	Generic knowledge of the organizational theory, systems theory and innovation management.
Objectives of the lecture	This module aims at providing knowledge on industrial networks and offering practical examples of innovation-driven collaboration within (or between) these networks.
Workload	2-4h teaching; 8-16 h self-study.
Learning outcomes	**Knowledge** **LO #115:** To remember and to understand the basic concepts of OI and their relationships **LO #90:** To understand the dynamics between innovation and the contextual environment. **LO #119:** To recognize and assess the interdependencies in the system of innovation (ecosystem) across organizations. **Skills** **LO #99:** To understand and assess networks and collaboration networks. **Competences** **LO #64:** To apply, analyse, evaluate and design strategic decision making with regard to the implementation of relevant open innovations mechanisms in the organization.
Reading List	Håkansson,H., Ford, D., Gadde, L., Snehota, I., & Walusewski, A. (2009). Business in Networks, John Wiley.
European Qualifications Framework (EQF) Level	Lwvels 6, 7.

Lecture Content

Definitions

The term '(business) network' has been widely used in academic research and in business practice. According to Håkansson and Ford, a network – in its most abstract form – is "a structure where a number of nodes are related to each other by specific threads" (Håkansson & Ford, 2002, p. 133)

'Innovation Networks' are defined by Espelid et al. (2013, p. 112) as "business network structures within which actors are intensely interacting to develop and implement innovations through adaptation, cooperation and coordination".

Theoretical background

Basic Systems Theory

The (general) systems theory is trans- or interdisciplinary study of the abstract organisation of phenomena, independent of their substance, type, or spatial or temporal scale of existence. It investigates both the principles common to all complex entities, and the (usually mathematical) models which can be used to describe them (von Bertalanffy, 1968; Midgley, 2003).

A system can be said to consist of four things. The first is *objects* – the parts, elements, or variables within the system. These may be physical or abstract or both, depending on the nature of the system. Second, a system consists of *attributes* – the qualities or properties of the system and its objects. Third, a system has internal *relationships* between its objects. Fourth, systems exist in an environment. A system, then, is a set of things that affect one another within an *environment* and form a larger pattern that is different from any of the parts.

The fundamental systems-interactive paradigm of organisational analysis features the continual stages of input, throughput (processing), and output, which demonstrate the concept of openness/closedness. A closed system does not interact with its environment. It does not take in information, and it is therefore likely to atrophy, that is to vanish. *An open system* receives information, which it uses to interact dynamically with its environment. Openness increases its likelihood to survive and prosper.

Various system characteristics are: wholeness and interdependence (the whole is more than the sum of all parts), correlations, perceiving causes, the chain of influence, hierarchy, suprasystems and subsystems, self-regulation and control, being goal-oriented, interchange with the environment,

inputs/outputs, the need for balance/homeostasis, change and adaptability (morphogenesis), and equifinality: there are various ways to achieve goals. A central topic of the systems theory is self-regulating systems, i.e. systems self-correcting through feedback.

Industrial networks consisting of individual companies (actors) and relationships between these actors have been observed in a range of studies over the past 25 years (for summaries, see Iacobucci, 1996; Laage-Hellman, 1997; Ford et al., 1998; Naude & Turnbull, 1998; Sheth & Parvatiyar, 2000). The relationships are likely to become complex and dynamic over time. Their current form is the outcome of previous interactions between the actors embedded in the network.

Industrial Network Approach

Håkansson and Ford claim that individual companies can not been seen as 'isolated' actors but must be studied and managed as actors embedded in a wider (industrial) network with other actors, structures and relationships. They even label these networks as "quasi-organisations", built on similar dimensions that can been seen within individual organisations. "A business network has a specific and intense structure with economic, technical and social dimensions" (Håkansson & Ford, 2002, p. 135).

Firms are embedded in various ways in networks where both economic factors and social dimensions are crucial (Gadde et al., 2003). One special characteristic of a network is its indeterminateness. In the Industrial Network Approach, the usual distinction between a firm and its environment is not advocated (Snehota, 1990). The set of actor bonds is not given, since there is no overarching purpose governing the network. Rather, relationships are established for various purposes. The network does not have a natural centre or clear borders and it is dynamic over time (Snehota & Håkansson, 1995). In this view, networks are loosely connected systems of actors and relationships in which no firm can dominate (Wilkinson & Young, 2002).

Scholars studying innovation in industrial networks build in many cases on the early network approach developed by the International Marketing and Purchasing group. To industrial network scholars, the embedded nature of relationships leads to a 'networked view of reality' (Easton, 1992).

Gadde et al. (2003) argue that the traditional strategic management theory brings a clear competitive focus to relationships and builds on the concept of 'winning,' whereas the industrial network view provides a more balanced approach to cooperation and competition. More recent developments presented in the literature on strategic networks and relational strategies support the industrial network view.

The structure and dynamics of an industry network can be described and analysed by using a wide array of social and organisational network analysis tools. The figure below describes the

development of a wind turbine industry network over two periods., The UCINET toolkit for social network analysis has been used in producing the figure.

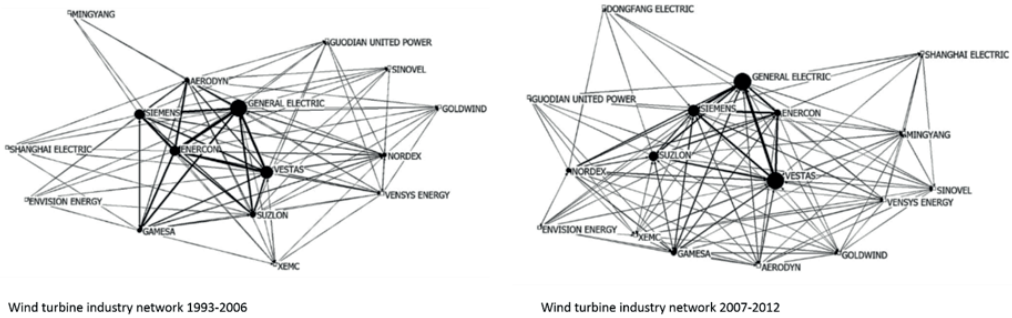

Figure 1. Development of a wind turbine industry network (adopted from Zhou, Li, Lema & Urban, 2015)

Resource-Based View on Industrial Networks

One basic assumption in the industrial network approach is the existence and significance of business relationships. These relationships with customers, suppliers, and other organisations represent strategic resources in different ways. A company's relationships are important resources in themselves. Especially when it comes to technical development, each individual firm is increasingly reliant on relationships with others. These relationships combine the physical and organisational resources of a company with those of its counterparts. Therefore, a significant part of a company's total resource base is located beyond its ownership (Gadde, Huemer & Håkansson, 2003).

An industrial network can be described and studied as a set of interconnected resources. In this perspective, the actors possess resources and perform activities in cooperation and competition with other firms. The activities and resources are not coordinated and combined spontaneously. They are purposefully directed by many individual actors who try to influence one another systematically (Gadde, Huemer & Håkansson, 2003).

A significant part of a company's total resource base is located beyond its ownership boundaries and is controlled bilaterally with other firms. In this view, the resources of a company are tied to resources in other firms. Every company is part of a larger collective entity involving relationships with counterparts. In the interaction between two business partners, the resources of the two units are affected—both in terms of how they are used and how they develop.

From the network resource perspective, the main concern for a company is to make the best use of the resource constellation in the network. In these efforts, it is important that resources

are not perceived as given. Resources have always 'hidden' and unexploited dimensions that can be explored and developed in interaction with business partners (Gadde, Huemer & Håkansson, 2003).

Industry Nets

Building on the academic debate on the benefits and limitations of the Industrial Network Approach, strategic and social research on networks and resource-based studies on networks, Möller & Rajala (2007) focus on intentionally formed networks that contain a finite set of at least three organisations, and call these networks strategic or business 'nets'. These nets come in many forms and with many purposes: supplier nets, distribution nets, technology development or R&D nets, competitive coalitions, technology coalitions, etc. Möller and Rajala presents a framework for studying these nets, the processes taking place (like innovation), and the management of these processes (see Table 1).

Innovation and change in industrial networks

Each company gains benefits and incurs costs from the network in which it is embedded and from the investments and actions of the other companies involved. Håkansson and Ford (2002, p. 135) claim that a company's "ability to act and the effects of its actions are constrained by the existing structure of the network. Change by companies and change within companies occur through changes to the structure of the network".

From this perspective, in order to establish innovation, companies need to build on interaction with other parties within the industrial network(s). Innovation in a industrial network is not the result of an individual company or a single technology, but comes from collaborative development, synthesis and application of various technologies, competencies and facilities across the network.

Practical implications

IMP scholars debate regularly whether firms are able to 'manage networks' or can only 'manage in networks' (Golfetto, Salle, Borghini & Rinallo, 2007, Möller & Halinen, 1999) introduces four levels of complexity in managing business networks and relationships: (1) industries as networks, (2) firms in a network, (3) relationship portfolios, and (4) exchange relationships.

Håkansson and Ford (2002) claim that companies often do their best to control the network surrounding them and to manage the relationships so that their own objectives are achieved. This ambition is one of the key mechanisms in network development. This causes the paradox that the more successful a company is in its control ambitions, the less innovative the network will become.

Table 1. Network management framework (Möller & Rajala, 2007)

Level of Management Issues	Key Themes	Managerial Challenges
Level 1 Industries as Networks Network Visioning & Orchestration	Networks, as configurations of actors and value activities are not transparent. Capability to understand networks, their structures, processes and evolution is crucial for network management. Capability to influence other core actors is essential.	How to develop valid views of relevant networks and their opportunities? How to analyze strategic nets and key actors for understanding network competition? How to orchestrate whole networks?
Level 2 Firms in Strategic Nets Net Management	Firms' network behavior is related to: - strategic nets they belong to - positions and roles they play in these nets - major business relationships Capability to identify, evaluate, construct and maintain positions and relationships is essential in strategic nets.	How to develop and manage strategic nets? How to mobilize and coordinate key actors? How to enter new nets (market entry, new product field, new technology net)? How to manage net positions?
Level 3 Net & Relationship Portfolios Portfolio Management	Firm is a nexus of resources and activities. Which activities to carry out internally and which through different types of nets is a core strategic issue. Capability to manage one's positions and roles in multiple nets is required.	How to develop and manage an optimal strategic portfolio? How to manage the actor relationships in particular nets - from organizational and snalytical perspectives?
Level 4 Exchange Relationships Relationship Management	Individual customer/supplier relationships form the bases of strategic nets. Capability of creating, managing and concluding strategic relationships is a core resource for a firm.	How to evaluate future value potential of a strategic relationship? How to manage relationships efficiently - from organizational and snalytical perspectives? How to manage major relational episodes efficiently?

If one actor directs the development processes totally, the network runs the risk of becoming a hierarchy with reduced potential for innovation.

More generally, Håkansson and Ford (2002) describe a network as a basis from which developments can take place but also as a resource constellation that creates inertia and limits innovation. Some scholars and practitioners emphasise the costs of changes and the importance of using the resources that are already available to the company in its existing relationships.

Network configurations can be analyzed from two perspectives (Cantù, Corsaro, Fiocca & Tunisini, 2013): that of the focal actor versus that of the collective, emergent network. In the focal actor perspective, the company deliberately tries to 'orchestrate' the network by developing relationships with selected partners so as to benefit from their resources (Möller & Rajala, 2007). Conversely, the emergent network vision emphasises the self-organising aspects of networks, claiming that networks cannot be managed entirely by a single company. In this perspective, the firm has never complete control over the journey of its innovation. It can nevertheless try to influence how its innovation resources are used and combined through interaction (Baraldi & Strömsten, 2009).

Innovation-driven interaction between parties occurs within a single industrial network – within supply and demand chains – or between multiple industrial networks. In many cases this collaboration is organised in (strategic) alliances.

Supply and demand chain collaboration

Original Equipment Manufacturers are increasingly seeking to involve their suppliers and service partners in product, process and service development in an attempt to reduce the development costs and time, and to increase product quality and value (e.g. Wynstra 1998). Håkansson and Eriksson (1993) present four key issues in "getting innovations out of supplier networks", related to combining and integrating different supplier relationships: prioritising, synchronising, timing, and mobilising. However, the existence of network interdepenencies may also obstruct innovation and the time to market. In order to bring innovative technology and novel products to the market, companies have to deal with technological, knowledge, social, logistic, and administrative interdependencies (Johnson & Ford, 2007).

Cross-industry innovation

Various problems in the society call for radical change and collaboration across industries (also called crossover innovation). Collaboration across industries extends the network resouce base of an individual company, as well as the collaboration itself. It helps to combine and integrate technologies from different industries and to exploit these combined resources and business skills via novel products and services in new or existing markets. However, cross-industry collaboration requires (basic) understanding of the technologies, structures and cultures of these other industries.

Table 2. The impact of different types of innovation on firms, relationships and the network (Luthardt & Mörchel, 2000)

	Firms	Relationships	Network
Incremental Innovation	Position of CS_A (Innovator) enhanced, position of CS_{CA} (competitor) deteriorated. Value for customer firms slightly enhanced.	Relationchips remain unchanged.	Network structure unchanged. Resources of network slightly enhanced.
Modular Innovation	Value of resources of $CS_{B/OLD}$ destroyed. New resources are integrated in the network $CS_{B/NEW.}$ Value for customer firms enhanced.	Relationships of Inegrators with $CS_{B/OLD}$ destroyed. Establishment of relationship with $CS_{B/NEW.}$ has to be established (low transaction costs).	Network structure slightly changed. Resources of network enhanced.
Architectural Innovation	Value of resources of established integrators threatened. New resources are integrated into the network ($Integrator_{NEW}$). Custom Value enhanced, but period of uncertainty.	Relationships of established integrators with component suppliers and customers have to be established (high transaction costs).	Network structure considerably changed. Resources partly sustained, partly destroyed.
Radical Innovation	All existing resources threatened/destroyed. Value for customers significantly enhanced, but period of strong uncertainty.	All relationships threatened/destroyed.	Network endangered in its entirety (resources and relationships).

Exploration and exploitation in alliances

A special type of industrial networks are alliance networks. Alliances and alliance networks are made of (strategic) collaboration agreements aiming at sharing and valorising technological experise and intellectual property. In many cases these networks also aim at (pre-competitive) collaboration on basic or applied research, technology development, product and service engineering, and the joint development of industry standards. Dittrich and Duysters (2007) describe four types of strategic

technology alliances: (1) joint research pacts, (2) joint development agreements – both non-equity based – (3) joint ventures, and (4) research cooperation. The latter two are equity-based types of collaboration.

Building on the work of March (1991), Dittrich (2008) describes two kinds of alliance-based networks: exploration networks and exploitation networks. These kinds of networks differ from each other in four ways. Exproration networks demonstrate a preference for flexible legal structures like non-equitiy-based alliances, whereas exploitation networks tend to use legal structures for long-term collaboration like equity-based alliances. Second, in exploration networks the partnerships are more dynamic and flexible due to the need for continuous seach for novel technologies and business opportunies, requiring access to a variety of competences and facilities. Exploitation networks, on the other hand, require more sustainable and close collaboration and will require more stable partnerships. In exploration networks companies can benefit from companies' competences and networks in other industries and technological domains, while exploitation networks are more often built on partnerships in similar technological areas.

Additional reading material for students

In order to describe, analyse and design open innovation in industrial networks, one must be able to describe and understand the topology of a network. In doing this scholars can use the theory and tools of social network analysis. See the links to SNA software below. Additional reading material on Industry Networks can be found on the portal of the IMP-group (http://impgroup.org).

Key take-aways

The main lessons learned from this chapter are:

- The development of open innovation collaboration builds on existing but continuously changing industry networks;
- These networks can be described and analysed from different theoretical perspectives and according to different methodologies and tools;
- Industry networks emerge and develop over time and cannot be fully controlled by a single company.

Pedagogical guidelines

The concept of the Industy Network and the various theories on industrial networks are difficult to understand for Bachelor-level business students and for technology students in general. Their

understanding of industry is primarily based on and driven by the perspective of the individual firm. Teaching the concept of the industrial network and how companies operate within these networks requires the use of (in depth) case study materials.

Master and PhD students should be able to deal with the suggested reading materials by themselves, but could use additional frontal teaching and case materials.

Evaluation questions

Individual work examples

What does the industry network of [EXAMPLE OR CORE COMPANY] look like? Who are the dominant actors? How can this network be descibed (topology)? How does innovation take place within this network? How do the actors collaborate on technology development and innovation?

Group work examples

Select an industry or company and collect data on the network structure and intercompany collaboration. Prepare a report that deals with the questions described above and how open innovation in this network could be improved.

Teaching tips

Links to slides and other teaching materials

- Part of the materials provided by Antero Kutvonen (LUT) on the OI-Net platform could be used;
- Links to various software tools for social and organisational network analysis: https://en.wikipedia.org/wiki/Social_network_analysis_software and http://www.gmw.rug.nl/~huisman/sna/software.html.

Supporting case materials

- Consumer electronics: The Fabric of Production, The Philips Industrial Network, by Mila Davids.
- Mobile communication: Nokia's Strategic Change by Means of Alliance Networks. A Case of Adopting the Open Innovation Paradigm by Dittrich.
- Aerospace: The evolution of an aerospace innovation network: a ten-year case study, by Ronald Beckett.

References

• Baraldi, E. & Strömsten, T. (2009). Controlling and combining resources in networks–from Uppsala to Stanford, and back again: The case of a biotech innovation, Industrial Marketing Management, 38, 541-552.

• Bartanffy, L. von (1968) General system theory – Foundations, development, applications, George Braziller, New York.

• Cantù, C., Corsaro, D., Fiocca, R. & Tunisini, A. (2013) IMP studies: A bridge between tradition and innovation, Industrial Marketing Management, 42, 1007–1016.

• Davids, M. (2004). The fabric of production: The Philips industrial network. History and technology, 20(3), 271-290.

• Dittrich, K. (2008). Nokia's strategic change by means of alliance networks. A case of adopting the open innovation paradigm. Open Innovation: The Networked R and D, Icfai's Professional Reference Book Series, Icfai University Press, Chennai, India. Managing Open Innovation in New Product Development Projects, 123.

• Dittrich, K., & Duysters, G. (2007). Networking as a means to strategy change: the case of open innovation in mobile telephony. Journal of product innovation management, 24(6), 510-521.

• Easton, G. (1992), Industrial Networks: A Review, in B. Axelsson & .G Easton (Eds), Industrial Networks: A New View of Reality, London: Routhledge.

• Espelid, T.S., Ramos, C., Corsaro, D & Henneberg, S.C. (2013). (Re)Organising for Interaction within Innovation Networks - An Exploratory Study in the Public Sector, IMP Journal, 7 (2), 112-128.

• Ford, D., Gadde, L.E., Håkansson, H., Lundgren, A., Snehota, I., Turnbull, P. & Wilson, D. (1998). Managing business relationships, Wiley, London.

• Gadde, L.E., Huemer, L. & Håkansson, H. (2003) Strategizing in industrial networks, Industrial Marketing Management, 32, 357– 364.

• Goglio-Primard, K., & Crespin-Mazet, F. (2015) Organizing Open Innovation in Networks – the role of boundary relations, International Management, 19.

• Golfetto, F., Salle, R., Borghini, S. & Rinallo, D. (2007) Opening the network: Bridging the IMP tradition and other research perspectives, Industrial Marketing Management, 36, 844–848.

• Håkansson, H. (1982). International marketing and purchasing of industrial goods: An interaction approach. IMP Group. Chichester: Wiley.

• Håkansson, H. & Eriksson, A.K. (1993) Getting Innovations out of Supplier Networks, Journal of Business-to-Business Marketing, 1 (3), 3-34.

• Håkansson, H. & Ford, D. (2002). How should companies interact in business networks?, Journal of Business Research, 55, 133– 139.

• Håkansson,H., Ford, D., Gadde, L., Snehota, I., & Walusewski, A. (2009). Business in Networks, John Wiley.

• Iacobucci, D. (1996). Networks in marketing, Sage, Thousand Oaks/London/New-Delhi.

• Johnsen, R, & Ford, D. (2007). Exploring the concept of asymmetry: A typology for analyzing customer-supplier relationships", Industrial Marketing Management, 37 (4), 471-483.

• Laage-Hellman, J. (1997). Business networks in Japan: Supplier-customer interaction in product development, Routledge, London.

• Luthardt, S., & Mörchel, J. (2000). The Impact of Different Types of Innovations on Industrial. In 16th IMP-conference.

• Midgley, G. (Ed.). (2003). Systems thinking. London: Sage.

• Möller, K. & Halinen, A. (1999) Business Relationships and Networks: Managerial Challenge of Network Era, Industrial Marketing Management 28, 413–427.

• Möller, K. & Rajala, A. (2007) Rise of strategic nets - New modes of value creation, Industrial Marketing Management, 36/7, 895–908.

- Naude, P. & Turnbull, P.W. (1998). Network dynamics in international marketing, Pergamon, Oxford.
- Sheth, J.N., Parvatiyar, A. (2000). Handbook of relationship marketing, Sage Publishing, Thousand Oaks.
- Snehota, I., (1990) Notes on a Theory of Business Enterprise, Doctoral Thesis, Uppsala University.
- Snehota, I. & Håkansson, H. (Eds.), (1995) Developing relationships in business networks. London: Routledge.
- Wilkinson, I. & Young, L. (2002) On cooperating: firms, relations and networks, Journal of Business Research, 55/2, 123–132.
- Wynstra, F. (1998) Purchasing involvement in product development. PhD dissertation, Eindhoven University of Technology.
- Zhou, Y., Li, X., Lema, R., & Urban, F. (2015). Comparing the knowledge bases of wind turbine firms in Asia and Europe: Patent trajectories, networks, and globalisation. Science and Public Policy, 1–16.