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Cross-Company Sharing of Resources: Cases, Success Factors and Valuation Metrics

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Abstract: Resource sharing in the industrial context, often referred to as industrial symbiosis, offers great ecological and economic potentials for the involved companies and for entire industrial regional ecosystems. Under the scientific conduct and project lead of Cologne University of Applied Sciences, an extensive resource-sharing-ecosystem is currently prepared and established within the industrial area of Cologne, Germany, using a digital platform as facilitator for match making and knowledge transfer between the involved companies. The work-in-progress paper presents preliminary research findings of this real-world laboratory, focusing on prerequisites and governance necessary to encourage trust and allow for cooperative open innovation. Secondly, the paper indicates, which particular categories of tangible as well as intangible resources are most suitable for cross-company sharing and how they can be identified within companies. Finally, the paper introduces a preliminary assessment model to capture and validate the economic and ecological beneficial effects of resource sharing.

Keywords: Sharing Economy, Industrial Symbiosis, Platform-based Ecosystems, Resource Sharing, Open Innovation, Collaborative Innovation

1 Problem

Digital sharing platforms for the private sector have become established in many areas of our social life and eventuate in better utilization of existing resources and knowledge exchange. Sharing a vehicle or temporarily renting an overnight accommodation is nowadays possible via platforms that match supply and demand. Sharing aimed at private consumers has also been extensively researched by academics regarding its constitutive characteristics and success patterns, potential benefits, and social acceptance. (Haqqani et a. 2022, Curtis 2021, Schor 2016, Botsmann 2015)

In the industrial sector, however, sharing is not yet established as an economic form. Companies are cautious about platform-based ecosystems (Grondys 2019, Antikainen et al. 2018, Eckartz et al. 2017). However, the transfer of the sharing concept to industry (i.e. referring to such tangible resources like machines, facility infrastructure, logistics, raw materials, and storage capacities) as well as intangible resources (i.e. knowledge, technology, market expertise, data, artificial intelligence, and innovation capacities) could potentially bring considerable economic and ecological benefits (Brandauer et al. 2023). All parties, i.e. those who give a resource into a bilateral/multilateral cross-company relationship/network, as well as those who take the respective resource, could effectively benefit from such form of cooperation.

Against this background, the paper gives insights into a research project which is currently starting in an economic region within the industrial area of North Rhine-Westfalia in Germany. The project aims at establishing a sharing economy network involving more than 50 companies, all connected via on online sharing platform.

The major goals of the project are the following: In the first place, reasonable use cases of cross-company resource sharing will be identified and established in order to showcase good practices and successful references for the entire network. Secondly, a major scientific goal of the project is to assess and validate the economic and ecological value-added that is implied with the sharing of both tangible as well as intangible resources. Finally, success criterions and suitable forms of governance are to be scientifically investigated, practically established and highlighted, in order to guarantee a long-term success of the particular network in North Rhine-Westfalia, as well as to make this sharing network a blueprint for other comparable industrial regions within Germany, and the entire European Union.

The project chooses the research design of a real-world laboratory in order to explore industrial sharing and related research questions regarding effective use cases, their ecological and economic impacts, as well as general success criterions and governance forms. The technical infrastructure for this real-world experiment will be a digital platform. For its practice-oriented development, the applied science research process according to Ulrich (1984) is used. This approach also ensures the real-world laboratory's suitability to the problem and topic (Beecroft et al. 2018, p. 84). During the 24-month real-world laboratory phase, a reflective and cyclical learning process is pursued, in line with the recommendations of Beecroft et al. (2018, p. 92) and Rose et al. (2018).

2 Theoretical Background

The research can be classified within the tradition of network and cooperation research. According to Hellmer et al. (1999, p. 75), networks consist of reciprocal, loosely coupled, but interdependent relationships between a larger number of relatively autonomous actors. Relative autonomy generally allows for the existence of power imbalances but excludes power monopolies. Loose coupling ensures the autonomy of the actors but prevents isolation from the outside, thus promoting resource exchange and interactive, reflective learning processes. Sydow (1992, p. 79) adds that business networks should be understood as an organizational form of economic activities that aim at the joint realization of competitive advantages and exhibit less competitive behavior.

In comparison, according to Etter (2003, p. 44), cooperations are characterized neither by loose coupling nor by reciprocity. They also exhibit greater external closure. This makes it a less complex mode of interaction, often developing as a dyadic relationship between only two actors. At the same time, numerous studies define cooperation as a central constitutive feature of business networks. Wurche (1994, pp. 127 ff.) confirms that cooperation can also be considered a subset of network relationships. In this context, Semlinger (2001, pp. 30 f.) shows that cooperation should be seen as the dominant coordination model in business networks, in which mutual alignment of behavior and expectations occurs through a not necessarily symmetrical interplay of autonomy and control (or power and dependence).

Another branch of science relevant to the research project is the platform economy. With digitalization and the establishment of online platforms, inter-company collaboration has changed. Shree et al. (2021) foresee numerous future applications for B2B platforms. Current applications fall into four main categories. Classic transaction platforms open up new sales channels for companies and enable more intensive customer relationship building (BMWi 2020, p. 4). Collaborative development platforms facilitate joint innovation and product development, often within open ecosystems in the sense of open innovation (Gawer and Cusumano 2014, p. 418; Lerch et al. 2019, p. 16). Internet of Things (IoT) platforms allow for the centralized collection, analysis, and use of decentralized data, for example, from machines or products (Lerch et al. 2019, p. 25). Networking platforms aim to facilitate the exchange of data and information, and sometimes also physical resources (Shree et al. 2021, p. 362).

3 Premises and Success Factors of Cross-Company Cooperation

According to Etter (2003, p. 44), the relationship elements of trust and continuance are of great importance for successful cooperation. A minimum degree of interdependence between the actors, for example in the form of resource dependence or complementarity, is also considered a basic prerequisite. This is confirmed by von Borell de Araujo and Franco (2017, p. 381 ff.) and they add that companies must consciously protect themselves from their own vulnerability to the opportunistic behaviour of others, e.g. through contractual safeguards. When it comes to digital B2B cooperation platforms, their acceptance and application intensity depend on numerous influencing factors. Özcan et al. (2022a) examine the success patterns of digital platforms and state that approximately 85% of all B2B platforms fail due to rapidly changing environmental factors and their own objectives. As a solution, they propose continuous performance management throughout the lifecycle of digital platforms (Özcan et al. 2022b). In addition to that Schüler and Petrik (2023) investigate the influence of network effects, i.e. the growth of platforms with regard to their connected partners, and provide evidence for their significant importance. These and other studies should be considered in the design of the organizational infrastructure, platform design, and network governance.

4 Use Case of Cross-Company Resource Sharing

For project structuring purposes, the range of potential use cases was divided into four clusters. Each of these areas offers a multitude of possible use cases, some of which are listed below:

<u>Data and AI:</u>

- Benchmark-oriented KPI sharing
- Structured data sharing
- Infrastructure for AI and data analysis
- Joint training of AI models
- Regional data spaces
- Regional open innovation platform

Production resources and infrastructure:
- Storage sharing
- Sharing of transport routes
- Cooperative machine utilization
- Mobile maintenance and service pool
- Regionally networked machine parks
- Shared Production

Raw materials and energy:
- Sharing of process waste heat
- External offtake of production waste
- Joint spare parts logistics
- Purchasing cooperation for critical raw materials
- Infrastructure for take-back systems
- Regional closed loops

Knowledge and training:
- Sharing of available training places
- Shared training format
- Common learning platform
- Shared pools of experts
- Regional training network with a coordinated learning path

5 Postulated Effects and Valuation Models

The range of potential applications for inter-company resource sharing is so diverse that the measurement of effects and impact analysis must be equally differentiated. Furthermore, in addition to the economic benefits, the ecological benefits (e.g. potential for CO2 emission reduction and mitigating global warming potential) as well as social implications of resource sharing must also be considered. Table 1 lists the potential economic and ecological effects of industrial resource sharing for both; those who provide (surplus) resources as well as for those who make (temporary) use of them.

	Wirkungyhypothesen					
	Ressourcenanbieter			Ressourcenempfänger		
Ressourcenart	**Wirtschaftliche Nutzeneffekte**	**Ökologische Nutzeneffekte**	**Soziale Nutzeneffekte**	**Wirtschaftliche Nutzeneffekte**	**Ökologische Nutzeneffekte**	**Soziale Nutzeneffekte**
Produktionsmaschinen und -anlagen	Steigerung der Maschinenauslastung, dadurch günstigere Verteilung der Fixkosten	Steigerung der Ressoucenproduktivität und damit Senkung der CO2-Emmission für die einzelnen damit produzierten Produkte	Motivationssteigerung innerhalb der eigenen Belegschaft durch Vermeidung längerfristig stillstehender Produktionsstraßen	Vermeidung von Investitionsausgaben (CAPEX)	Vermeidung von Neubeschaffungen und entsprechender Ressourcen- und Energieverbräuche	Motivationssteigerung innerhalb der eigenen Belegschaft durch Erweiterung der eigenen Fähigkeiten und Kapazitäten
Hallen und Flächen	Steigerung der Hallen- bzw. Flächenauslastung, dadurch günstigere Verteilung der Fixkosten	N/A (siehe Nutzeneffekt Ressourcenempfänger)	Motivationssteigerung innerhalb der eigenen Belegschaft durch Vermeidung längerfristig "brachliegender" Flächen und Gebäude	Vermeidung von Investitionsausgaben (CAPEX)	Vermeidung von Flächenversiegelungen und der Errichtung neuer Gebäude	N/A
Transportmittel und Logistiksysteme	Steigerung der Logistik-Auslastung, dadurch günstigere Verteilung der sprungfix anfallenden Kosten	Vermeidung von Leerfahrten im Zuge der Versorgungs- und/oder Distributionslogistik	N/A	Vermeidung von Investitionsausgaben (CAPEX) bzw. variabel anfallenden Kosten für Speditionsaufträge	Vermeidung von Neubeschaffungen und/oder eigener energieverbrauchender Speditionsaufträge	N/A
Mess- und Prüfstände	Steigerung der Geräteauslastung, dadurch günstigere Verteilung der Fixkosten	Steigerung der Ressoucenproduktivität und damit Senkung der CO2-Emmission für die einzelnen damit produzierten (geprüften) Produkte	Motivationssteigerung innerhalb der eigenen Belegschaft durch Kommerzialisierung der eigenen Kompetenzen	Vermeidung von Investitionsausgaben (CAPEX)	Vermeidung von Neubeschaffungen und entsprechender Ressourcen- und Energieverbräuche	Motivationssteigerung innerhalb der eigenen Belegschaft durch Erweiterung der eigenen Fähigkeiten und Kapazitäten
Maschinen und Anlagen für das Prototyping	Steigerung der Maschinenauslastung, dadurch günstigere Verteilung der Fixkosten	Steigerung der Ressoucenproduktivität und damit Senkung der CO2-Emmission für die einzelnen damit erstellten Prototypen	Motivationssteigerung innerhalb der eigenen Belegschaft durch Kommerzialisierung der eigenen Kompetenzen	Vermeidung von Investitionsausgaben (CAPEX)	Vermeidung von Neubeschaffungen und entsprechender Ressourcen- und Energieverbräuche	Motivationssteigerung innerhalb der eigenen Belegschaft durch Erweiterung der eigenen Fähigkeiten und Kapazitäten
Büroräume und Co-Working-Spaces	Steigerung der Gebäudeauslastung, dadurch günstigere Verteilung der Fixkosten	N/A (siehe Nutzeneffekt Ressourcenempfänger)	Unternehmens-übergreifender sozialer Austausch und gegenseitige Inspiration	Vermeidung von Investitionsausgaben (CAPEX)	Vermeidung von Gebäudeerrichtungen	Unternehmens-übergreifender sozialer Austausch und gegenseitige Inspiration
Instandhaltungs-leistungen	Steigerung der Auslastung und Erweiterung des Geschäftsmodells	N/A (siehe Nutzeneffekt Ressourcenempfänger)	Motivationssteigerung innerhalb der eigenen Belegschaft durch Kommerzialisierung der eigenen Kompetenzen	Vermeidung von Fxkosten (für eigene Instandhaltungsteams) bzw. variablen Kosten für externe Instandhaltungs-dienstleistungen	Steigerung der Lebensdauer von Maschinen und Anlagen	Motivationssteigerung innerhalb der eigenen Belegschaft durch Erweiterung der eigenen Fähigkeiten und Kapazitäten
Werkzeug- und Formenbau	Steigerung der Auslastung und Erweiterung des Geschäftsmodells	N/A	Motivationssteigerung innerhalb der eigenen Belegschaft durch Kommerzialisierung der eigenen Kompetenzen	Vermeidung von Fxkosten (für eigenen Werkzeug- und Formenbau) bzw. variablen Kosten für externe Werkzeugvergaben	N/A	Motivationssteigerung innerhalb der eigenen Belegschaft durch Erweiterung der eigenen Fähigkeiten und Kapazitäten
Fachkräfte in der Produktion	Vermeidung von Kurzarbeit und betriebsbedingten Kündigungen	N/A	Vermeidung des Arbeitsplatzverlustes einzelner Mitarbeitender, Anreicherung der eigenen Tätigkeit (Job Rotation & Enrichment)	Vermeidung von Personalmangel und dadurch bedingten Prodkutionsausfällen	N/A	Steigerung des Sicherheitsgefühls innerhalb der eigenen Belegschaft (Netzwerk-Zugehörigkeit)
Fachkräfte in der F&E und Konstruktion	Vermeidung von Kurzarbeit und betriebsbedingten Kündigungen	N/A	Vermeidung des Arbeitsplatzverlustes einzelner Mitarbeitender, Anreicherung der eigenen Tätigkeit (Job Rotation & Enrichment)	Vermeidung von Personalmangel und dadurch bedingten Auftragsablehnungen	N/A	Steigerung des Sicherheitsgefühls innerhalb der eigenen Belegschaft (Netzwerk-Zugehörigkeit)
Domain-Wissen	Kommerzialisierung der eigenen Wissensbasis, ggf. Einstieg in Entwicklungs-kooperationen	N/A	Motivationssteigerung innerhalb der eigenen Belegschaft durch Kommerzialisierung des eigenen Know-hows	Steigerung der Innovationsfähigkeit und technischen Problemlösungs-kompetenz	N/A	Motivationssteigerung innerhalb der eigenen Belegschaft durch Erweiterung der eigenen Wissensbasis
Produktionsbezogene Daten	Kommerzialisierung der eigenen Datenbasis und Erweiterung des Geschäftsmodells	N/A	N/A	Aufbau datengestützer Dienste (intern/extern) z.B. im Bereich Predictive Analytics (Maintenance & Quality)	ggf. Vermeidung des Aufbaus eigener Server-Architektur	N/A
Produktionsferne Daten	Kommerzialisierung der eigenen Datenbasis und Erweiterung des Geschäftsmodells	N/A	N/A	Aufbau datengestützer Dienste (intern/extern) z.B. im Bereich Customer Relationship Management	ggf. Vermeidung des Aufbaus eigener Server-Architektur	N/A

6 Summary and Outlook

The yet conducted, preliminary theory-based research serves as preparation for the research project that will operate as a real-world laboratory, investigating the potential practices, success factors, and impacts of inter-company resource sharing. Initial success criteria and key prerequisites for successful business collaborations and industrial symbioses have been identified. A wide range of potential use cases have also been identified, the feasibility of which will be tested within the selected project region. Finally, a set of postulated effects and corresponding valuation instruments has been identified and developed to measure the effects and draw conclusions about overall success.

Questions for Feedback

As the project is about to start mid of 2026, the research group would be interested in feedback to the following questions:

- Which cross-company sharing activities (bilaterally or within larger networks) are known so far?
- What is the intended benefit of existing sharing activities?
- Which evaluation models are used to proof the beneficial effects?
- Are there any findings regarding the necessary prerequisites and success factors for inter-company cooperation and, in particular, resource sharing?

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