MAIKE SCHERRER – PATRICIA DEFLORIN
– LEVENTE SZÁSZ – BÉLA-GERGELY RÁCZ
– ILDIKÓ-RÉKA CARDOŞ – ISTVÁN FÁBIÁN

PREREQUISITES FOR A BENEFICIAL KNOWLEDGE TRANSFER BETWEEN MANUFACTURING PLANTS

A TERMELŐÜZEMEK KÖZÖTTI SIKERES TUDÁSTRANSZFER ELŐFELTÉTELEI

The paper aims at exploring the prerequisites for a beneficial knowledge transfer between manufacturing plants of multinational companies (MNCs), by taking the characteristics of the knowledge sending and knowledge receiving plant into consideration. This research seeks to understand how efforts undertaken by manufacturing plants, and how collaborative tools and coordination mechanisms influence a successful knowledge transfer. The study includes thirteen case studies conducted in manufacturing plants from four different European countries (i.e., Switzerland, Romania, Albania, and Macedonia). Given the exploratory nature of this study, the authors used a qualitative research approach. The main method of data collection involved multiple semi-structured interviews at manufacturing plants, uniformly applied in each country in order to observe general patterns across different cases. Their results show that the personal interaction between knowledge sending and receiving plants is more important for a successful knowledge transfer than information systems or prior related knowledge.

Keywords: **knowledge transfer, manufacturing network, knowledge sending, knowledge receiving, multinational companies**

A jelen tanulmány célja megvizsgálni a sikeres és hatékony tudástranszfer előfeltételeit a multinacionális termelővállalatok különböző telephelyei között, figyelembe véve a tudásküldő és tudásfogadó telephelyek tulajdonságait. A szerzők kutatásukban azt vizsgálják, hogy a telephelyek által megtett erőfeszítések, az általuk alkalmazott kollaborációs eszközök és koordinációs mechanizmusok miként járulnak hozzá a sikeres tudástranszferhez. A tanulmány tizenhárom esettanulmányt tartalmaz, amelyeket négy európai országban készítettek (Svájc, Románia, Albánia és Macedónia). Tekintettel a kutatás feltáró jellegére kvalitatív kutatási módszert alkalmaztak a szerzők. Az adatgyűjtés fő módja a félig-strukturált interjúk módszertanára épült, amelyeket az említett négy országban egységesen hajtottak végre annak érdekében, hogy párhuzamot tudjanak vonni a különböző esetek között. Eredményeik azt mutatják, hogy a személyes interakció a tudásküldő és tudásfogadó telephelyek között sokkal fontosabb egy sikeres tudástranszfer tekintetében, mint az alkalmazott információs rendszerek vagy az előzetes tárgyi tudás.

Kulcsszavak: **tudástranszfer, termelési hálózatok, tudásküldés, tudásfogadás, multinacionális vállalatok**

Funding/Finanszírozás:
The authors would like to thank the Swiss National Science Foundation (SCOPES Joint Research Project IZ73Z0_152505) and UEFISCDI Romania (Executive Agency for Higher Education, Research, Development and Innovation Funding, PN-III-P1-1.1-TE-2016-0502 project) for the financial support provided for the research project discussed in this paper.

Authors/Szerzők:
Maike Scherrer, professor, Zurich University of Applied Sciences, (maike.scherrer@zhaw.ch)
Patricia Deflorin, professor, University of Applied Sciences of the Grisons, (Patricia.Deflorin@fhgr.ch)
Levente Szász, professor, Babeş-Bolyai University, (levente.szasz@econ.ubbcluj.ro)
Béla-Gergely Rácz, assistant professor, Babeş-Bolyai University, (bela.racz@econ.ubbcluj.ro)
Ildikó-Réka Cardoş, assistant professor, Babeş-Bolyai University, (ildiko.cardos@econ.ubbcluj.ro)
István Fábián, PhD student, Babeş-Bolyai University, (istvan.fabian@econ.ubbcluj.ro)

This article was received: 23. 09. 2020, revised: 21. 10. 2020, accepted: 22. 10. 2020.
A cikk beérkezett: 2020. 09. 23-án, javítva: 2020. 10. 21-én, elfogadva: 2020. 10. 22-én.

Knowledge sharing enables a firm to develop itself further and to become a learning organisation (Shi & Gregory, 1998). Since many firms do not consist of one manufacturing plant only but are actually dispersed networks of plants scattered around the globe, knowledge sharing and its challenges have gained even more attention over the last couple of years (Dunning, 2006).

In this process, critique arose that studies analysing knowledge flow in manufacturing networks stay at the aggregated network level (Foss et al., 2010). Some authors argue that it is not possible to fully understand the flow of knowledge based on organisational-level analysis alone (Argote & Ingram, 2000; Foss et al., 2010; Gupta et al., 2007). They claim that the plant level, and especially the underlying processes and relationships, need to be analysed as well. It is assumed that they mediate the variables at network level (Abell et al., 2008; Foss et al., 2010).

The objective to analyse both the network and the plant level is also supported by the mixed results concerning knowledge transfer benefits. Studies analysing the achieved benefits by internal knowledge transfer demonstrate positive (Ding et al., 2013), negative (Ambos et al., 2006), mixed (Szász et al., 2016) and curvilinear effects (Erden et al., 2014). To explain these differences, some authors suggest that the benefit of knowledge transfer depends on context similarities, adaptation cost, the cost of knowledge transfer, or the competences of the knowledge receiver. In addition, mechanisms, prerequisites, and motivation to engage in knowledge transfer also need to be considered (Tran et al., 2010).

Given the lack of research in this field, our research is primarily exploratory in its nature, and aims at exploring the prerequisites for a beneficial knowledge transfer between manufacturing plants within MNCs at network and plant levels. On the plant level we aim to analyse knowledge transfer activities by taking the characteristics of the knowledge sending and the knowledge receiving plant simultaneously into consideration (RQ1). On the network level, we take into consideration the coordination mechanisms that influence knowledge transfer activities between plants belonging to the same network (RQ2). Thus, in order to gain deeper understanding in when knowledge transfer is beneficial within a manufacturing network, the study at hand follows to answer two research questions:

RQ1: "What are prerequisites of a beneficial knowledge transfer at the sending and receiving plant?"

a) *"How do efforts undertaken by the knowledge sending and receiving plant influence knowledge transfer success?"*
b) *"How do collaborative tools influence a successful knowledge transfer?"*
c) *"How do similarities between the knowledge sending and receiving plant influence knowledge transfer benefits?"*

RQ2: "How do coordination mechanisms influence a successful knowledge transfer?"

We argue that the research questions are relevant from both theoretical and practical perspectives: it aims to contribute to filling a theoretical gap by enhancing our understanding of the conditions of beneficial knowledge transfer within MNCs, and from a practical perspective it aims to offer useful guidance for plant managers to facilitate successful knowledge transfer projects. The paper therefore builds on an exploratory research, and is structured as follows. We start with the literature review, followed by the description of the case research methodology used. In the last two parts we present our results and findings followed by the conclusions and discussions in the light of our research questions.

Literature review

Knowledge transfer, knowledge sharing and knowledge flow

As our paper is built around the concepts of knowledge transfer, knowledge flow and knowledge sharing, it is important to clarify their meaning. According to Baksa and Báder (2020) knowledge sharing is the efficiency-oriented behaviour of employees, that implies two individuals sharing their experience and knowledge of their fields of expertise (Hankonen & Ravaja, 2017). Through knowledge sharing, individuals can share valuable skills and craftsmanship, resulting new knowledge, which can benefit the learning capacity of the whole plant (Ergün & Avcı, 2018).

On the other hand, knowledge transfer and knowledge flow are rather defined as a process of communication (Minbaeva, 2007) on a manufacturing network level (Tsai, 2002). Knowledge sharing between plants can lead to performance benefits to the knowledge-receiving plant, resulting a better overall performance of the manufacturing network (Szász et al., 2019). Poor knowledge transfer can lead to uncertainty in the manufacturing network, but also be a major waste of corporate resources (Pauleen & Holden, 2010).

Knowledge flow is mentioned as one of the two types of the information flow by Vereecke and De Meyer (2006). The administrative information flow consists of information on inventory, production plans, forecasts, purchasing requirements etc. Knowledge flow is mainly tacit, which is rarely written and relies more on the experience of the individuals involved in the process. According to other researchers, knowledge flow is one of the main reasons multinational companies can exist and are able to dissolve cultural (Pauleen & Holden, 2010) and national boundaries (Dunning, 1993).

Knowledge flows in manufacturing networks

Literature recognises the internal knowledge transfer as a valuable source of competitive advantage in a manufacturing network (Argote & Ingram, 2000). Researchers claim the importance to analyse knowledge flow within manufacturing networks on both the network and plant level (e.g., Foss et al., 2010; Gupta et al., 2007). Subsequently, the literature research is organised along this line.

Knowledge flow within the manufacturing network describes the transferring process between the knowledge-sending and knowledge-receiving plant (Tseng, 2015; Gupta & Govindarajan, 2000; Minbaeva, 2007). Three different flows of knowledge exist: (1) forward, from headquarters to a plant, (2) reverse, from a plant to headquarters, and (3) lateral, between peer plants (Ambos et al., 2006).

Since we are interested in the knowledge transfer between peer plants, we concentrate in this paper on the lateral knowledge flow. In lateral knowledge flows the knowledge-sending plant needs to be willing to transfer knowledge and needs to have transferring capabilities in order for the knowledge transfer to be successful (Wang et al., 2004; Szulanski, 1996; Mahnke et al., 2005; Szász et al., 2019). The knowledge-receiving plant, on the other hand, needs to have absorptive capacities to be able to internalise the provided knowledge (Tsai & Ghoshal, 1998; Foss & Pedersen, 2002). The knowledge-receiving plant furthermore needs motivation to accept and use the provided knowledge, otherwise, the recipient may reject the implementation or feign acceptance of the provided knowledge (Hayes & Clark, 1985). According to Demeter and Losonci (2016) there are several reasons why such a knowledge transfer can become less effective, such as:

- lack of motivation at both plants, especially at the knowledge-receiving, but also at the knowledge-sending plant,
- low level of similarity between the technological and/or geographical attributes of the sending and receiving plants (Rosenkopf & Almeida, 2003),
- competitive relationship between peer plants (Dyer & Nobeoka, 2000),
- causal obscurity, when we do not know how the transferred knowledge affected the performance of the knowledge-receiving plant,
- low absorptive capacity of the knowledge-receiving plant, due to lack of experience and previous knowledge (Cohen & Levinthal, 1990).

Manufacturing network coordination, and especially mechanisms to coordinate the flow of knowledge within one network have been recognised as essential to combine the dispersed knowledge in the network (Ferdows, 2006; Rudberg & West, 2008; Vereecke et al., 2006). Even though many coordination mechanisms have been discussed in literature, the answer is still lacking which of these mechanisms serve as prerequisites to coordinate the knowledge flow within a network. The main coordination mechanisms are: the degree of standardisation (Maritan et al., 2004; Rudberg & West, 2008; Scherrer-Rathje & Deflorin, 2017), centralisation (Feldmann & Olhager, 2011; Netland & Aspelund, 2014; Scherrer-Rathje & Deflorin, 2017) and autonomy, split into strategic and operational decision making autonomy (Golini et al., 2016; Kawai & Strange, 2014). Standardisation is the degree of similarity of products, processes, or systems throughout the network (Maritan et al., 2004). Centralisation and autonomy are linked, as decentralisation of decision making is the main indicator of a site's autonomy (Maritan et al., 2004).

Based on the presented literature, for the paper at hand, we take the dimensions of standardisation, centralisation and autonomy into consideration when analysing prerequisites of a beneficial knowledge transfer at network level (RQ2).

Knowledge flow on plant level

Knowledge flow within the manufacturing network describes the transfer process between the knowledge-sending and knowledge-receiving plant (Gupta & Govindarajan, 2000; Minbaeva, 2007; Tseng, 2015). To analyse the knowledge transfer on plant level, we follow the suggestion of Szulanski (2000) and take the basic elements of knowledge transfer into consideration: the source, the recipient and the channel.

(1) The source of knowledge, in our case the knowledge-sending plant, needs to be willing and needs to have transferring capabilities in order for the knowledge transfer to be successful (Mahnke et al., 2005; Szulanski, 1996; Wang et al., 2004; Szász et al., 2019).

(2) The recipient, in our case the knowledge-receiving plant, needs to have absorptive capacities to be able to internalise the provided knowledge (Foss & Pedersen, 2002; Tsai & Ghoshal, 1998). Absorptive capacity depends on the pre-existing stock of knowledge. Literature discusses causal ambiguity to be an essential prerequisite to internalise provided knowledge (Gupta & Govindarajan, 2000; Phelps et al., 2012; Szulanski, 2000).

(3) The channel links the knowledge sending and receiving plant with each other. These channels can be formal or informal. Formal channels are those that are coordinated centrally, whereas informal channels are self-established friendships or other social ties within the manufacturing network (Adenfelt & Lagerström, 2008; Bell & Zaheer, 2007; Foss et al., 2010; Song, 2014). Thus, most of these informal channels are based on the personal interactions between employees of the knowledge sending and receiving plants.

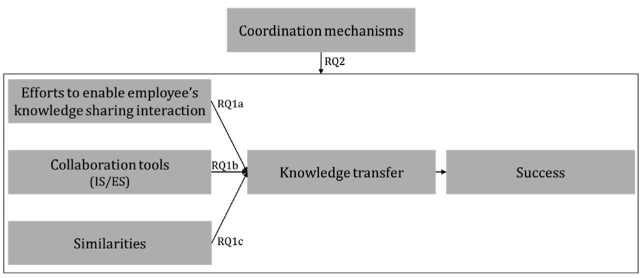
Next to the personal interactions, formal channels also exist in the sense of information and communication systems. These systems can be used to share knowledge among members of the manufacturing network (Bigliardi et al., 2010). In this sense, they also build on the interaction between employees working at sending and receiving plants.

Finally, literature discusses that knowledge transfer can be enabled through similarities. These can be strategic or knowledge similarities (Darr & Kurtzberg, 2000; Scherrer & Deflorin, 2017). Both can help to overcome the possible lack of the pre-existing stock of knowledge of the knowledge receiving plant in the sense that also, for example, similar strategic orientation can enable the knowledge receiving plant to understand the provided knowledge. Strategy can be operationalised through competitive priorities such as cost, quality, flexibility, delivery or innovation (Schoenherr & Narasimhan, 2012; Szász & Demeter, 2014).

To measure the result of the knowledge transfer, we consider two categories. The first consists of knowledge outputs such as an increase in product, process, or technology knowledge (Argote & Ingram, 2000; Darr & Kurtzberg, 2000; Kang et al., 2010). The second consists of operational performance measures, such as cost, quality, flexibility, delivery or innovation (Hayes & Wheelwright, 1984; Rosenzweig & Easton, 2010; Schoenherr & Narasimhan, 2012; Szász & Demeter, 2014).

Figure 1.

Conceptual Framework



Source: own editing

To sum up, Figure 1 shows the conceptual framework of the research paper at hand. While the source and the recipient need to have the described preconditions like the willingness to share knowledge and absorptive capacity to take the knowledge in, the channel can have different characteristics. Since we propose that these characteristics influence the knowledge transfer activities, we group the elements of the channels into (1) effort that a company puts into the interaction between knowledge sending and receiving plants, (2) the provided collaboration tools (information systems, enterprise systems), as well as (3) the similarities between the plants. The (4) coordination mechanisms (i.e. standardisation, centralisation and autonomy) frame the interplay between the plants within the manufacturing network.

Methodology

Being a primarily exploratory research, we have chosen the multiple case study method (Yin, 1988), which gives the possibility to both discover diverse knowledge roles of the multiple plants involved and their different underlying capabilities, but also to observe general knowledge transfer similarities across different cases.

The unit of analysis is the manufacturing plant within the multinational company. To gain an understanding of lateral knowledge transfer we examined 13 manufacturing plants located in Switzerland, Romania, Macedonia and Albania. We used middle-range theory development (Merton, 1968), by linking theory and empirical work. We derived dimensions from theory and refined them through case study research. Eisenhardt and Graebner (2007) recommend the case study approach for research interests such as ours, since the topic is not well documented and relatively unknown. The qualitative research approach (Eisenhardt, 1989; Eisenhardt & Graebner, 2007; Voss et al., 2002) provided us with deeper insights into the selected case plants and allowed us to generate new insights. The plant level was selected as the unit of analysis to gain information in the needed level of detail. Moreover, based

Table 1.

Plant's' knowledge transfer activities

		Group 1 Net senders			Group 2 Balanced actors		Group 3 Active receivers			Group 4 Net receivers				
	Plant	S2	S3	S1	M2	A3	M3	R1	R3	A1	M1	A2	A4	R2
	Age [years]	152	74	25	18	6	50	4	8	12	3	9	8	3
Knowledge	Send	+++	++	++	+++	++	++	++	++	+			+	+
	Receive	+	++	+	+++	++	++	+++	+++	+++	+++	+++	+++	+++
Innovation	Send	+++	+++	+	+++	++	+	+	+	+	+		+	
	Receive	+	+	+	+++	++	+++	+++	+++	+++	++		+++	+++
Training	Trainer	+++	+++	+++	+	+	+	++	+	+	+	+		+
	Trainee	+	+	+	++	++	+++	+++	+++	++	++	+++	++	+++

Legend: + = low amount; ++ = medium amount; +++ = high amount

Source: own editing

on Voss et al. (2002) who consider that case studies should contain between 3 and 30 cases, and Eisenhardt (1989) who reduce this interval to 4-10 cases, an approximately equal number of cases (three to four) was targeted in each of the four participating countries, i.e. Switzerland, Romania, Albania, and Macedonia, resulting in a total number of 13 case studies. More specifically, we conducted case study analysis at 3 manufacturing plants from Switzerland (S1, S2, S3), 3 from Romania (R1, R2, R3), 4 from Albania (A1, A2, A3, A4) and 3 from Macedonia (M1, M2, M3). These plants operate in various industries like automotive, electronics, food, constructions, rail, steel, cement, and industrial equipment offering a good variety in terms of country and industry to ensure a higher validity of cross-case analysis.

Case plants were selected based on the joint fulfilment of the following criteria (Szász et al., 2019): (a) they belong to a multinational company (MNC) with at least four

Table 2.

Cross-case analysis of case data related to successful projects

	Company	S1	S2	S3	R1	R2	R3	A1	A2	A3	A4	M1	M2	M3
Efforts to enable employee's knowledge sharing interaction														
Formal	Job Rotation		x	x	x		x			x	x			x
	Cross-functional interfaces				x		x		x					
	Center of Competence					x								
	Help desk				x									
	Global meetings (Centrally coordinated)								x				x	
	Centrally coordinated visits of other plants	x	x		x		x	x		x	x	x		x
	Centrally coordinated trainings		x								x	x		
	Standardised documentation	x				x		x					x	
Informal	Ad-hoc support between plants (Social ties)		x	x			x		x	x				
Collaboration tools	Information Sharing / Web	x	x	x	x	x	x		x	x	x	x	x	x
	Collaboration platform	x	x		x	x			x			x	x	
	Document Management System				x	x	x		x	x	x	x	x	
	Intranet / News	x	x		x	x	x	x	x		x		x	
	Decision support System		x		x	x	x		x				x	x
	Data warehousing, data mining, & OLAP		x		x	x	x		x	x	x	x	x	x
	Conferencing tools (eg., video conferencing)	x	x	x	x	x	x	x	x	x	x	x	x	x
	Communication tools (e.g., email, wikis, file sharing, etc.	x	x	x	x	x	x	x	x	x	x	x	x	
	Artificial intelligence tools/Expert Systems		x			x							x	
	Simulation tools		x	x	x	x	x						x	
Similarities														
Knowledge	Product		x	x		x	x	x	x	x	x	x	x	x
	Process	x	x	x	x	x	x	x	x	x	x	x	x	x
	Technology	x	x	x	x	x	x	x	x	x	x		x	x
	Management				x				x		x		x	x
	Service							x	x	x	x		x	x
Prior related knowledge	Product		x					x			x			
	Process		x		x								x	
	Technology			x										
	Management													
	Service													
Coordination mechanisms														
Standardisation	High		x		x	x	x	x	x	x	x	x		x
	Medium	x		x									x	
	Low													
Centralisation	High	x				x	x	x	x	x	x	x		
	Medium		x		x								x	x
	Low			x										
Strategic decision autonomy	Headquarters	x	x	x	x	x	x	x	x	x	x	x	x	x
	Plant													
Operational decision autonomy	Headquarters						x	x			x			
	Plant	x	x	x	x	x			x	x		x	x	x
Success														
Knoweldge output	Product related knowledge increase													
	Technology related knowledge increase	x				x								
	Process related increase		x	x	x		x		x		x	x		x
Competitive Priorities increase	Cost		x				x							x
	Quality			x	x		x	x	x			x		
	Delivery speed	x				x	x							
	Flexibility	x	x			x	x							
	Innovation					x								
	Service (pre-sales)													
		Knowldge sending plants			Knowledge receiving plants									

Source: own editing

manufacturing plants, (b) their MNC is a leading company in its field, with the headquarters (HQ) in a developed country, and operations in at least three countries, (c) the plant to be interviewed is not an isolated player (Vereecke et al., 2006), i.e. it is actively engaged in knowledge sending and/or receiving to/from other units from within the MNC. Companies with no clear knowledge roles for the analysed plant or companies that were not transparent enough regarding their knowledge transfer activities and underlying were excluded from this study.

Within the qualitative research approach, we used semi-structured interview as the main method of data collection, with an interview protocol uniformly applied in each country. Each manufacturing plant was interviewed at least once, but in some cases follow-up interviews were conducted to clarify specific knowledge transfer aspects. Interviews were targeted at the highest managerial level who oversee the knowledge transfer projects, but also actively participate in facilitating knowledge transfer activities. Researchers have participated in multiple interviews in mixed teams from different countries to enable a uniform understanding of the data collected. Field data were collected from December 2015 until March 2017.

In order to analyse our research questions, we first asked the interviewees general questions about the plants (environmental conditions, strategies and involvement in knowledge transfer activities, embeddedness in network). Second, they were asked to evaluate their embeddedness in the knowledge transfer activities within their networks, more exactly to evaluate in general how much (1) *information* and (2) *innovation* they send and receive and (3) how much *training* they offer to employees from other plants and how much training they received from other plant staff in comparison to other plants in the network. These dimensions were adapted from the work of Vereecke et al. (2006). The first dimension covers the amount of information transferred, which needs to be distinguished from pure data based exchange and refers to more explicit data concerning day-to-day activities related to products, processes, technology, management or services (i.e. meaningful information related to manufacturing). In addition, the second dimension aims at capturing innovation, which is related to a more tacit type of knowledge. Transferring innovation from one plant to another means that there are no routines established and most often, its implementation is based on a combination of knowledge and information. Third, trainings were also assessed as a frequent form of complex knowledge transfer within the manufacturing network of MNCs.

Next, in order to derive differences between beneficial and less beneficial knowledge transfer, we asked interviewees to identify a successful and a less successful knowledge transfer project and to explain what content explicitly has been transferred between plants. Altogether we examined 25 examples of knowledge transfer projects, as one of the 13 plants refused to identify an unsuccessful project. By having multiple knowledge transfer projects, we aimed at getting a better understanding of the specific content transferred within these processes. We were also interested in the factors that made the interviewees consider a knowledge transfer project beneficial or not which were mainly related to the process (e.g. time and resources needed to transfer knowledge) or the outcome (e.g. new process technology introduction) of knowledge transfer processes.

We then discussed the different prerequisites for knowledge transfer based on factors derived from literature. In addition, to gain in-depth insights, we encouraged the interviewees to discuss additional relevant factors. It has to be noted that each knowledge transfer project was investigated from a unilateral perspective, but we aimed to include both sender and receiver plants in our sample to gain a better understanding of both roles within manufacturing networks.

All interviews lasted between two and three hours, were taped and afterwards transcribed. The contents of all interviews were summarised into a manuscript containing the details of each knowledge transfer discussed. Afterwards, the research team conducted a cross-case analysis to compare and to gain a proper understanding of knowledge transfer processes at each manufacturing plant. Besides the interview data, company documentations, archive data, manuals, we used industry publications and personal observations in order to formulate conclusions (Szász et al., 2019).

Data analysis and findings

Following the analysis of interview data, complemented by archival data and personal observation, we categorized the 13 plants in four groups in terms of their involvement in knowledge sending and knowledge receiving activities (Table 1):

- Group 1 (Net senders) consists of those plants that send a lot of knowledge to other plants, but receive only minimal knowledge from others.
- Group 2 (Balanced actors) and Group 3 (Active receivers) are intermediate groups. The plants in group 2 send and receive knowledge approximately to an equal extent. Plants in group 3 are also involved in both sending and receiving knowledge, but they receive somewhat more and send somewhat less than plants belonging to Group 2.
- Group 4 (Net receivers) consists of those plants that are mainly knowledge receivers, and engage only rarely in knowledge sending activities, and if they do so, they send only low amount of knowledge.

Table 1 further shows that the older plants in the sample are those who act as knowledge senders. The younger the plants are, the more they are leaning towards the net receiving group (Group 4). The intermediate groups are not fully consistent related to amount of knowledge transferred and the age. Plant R1 belongs to the active receivers group despite being one of the youngest plants in the sample. Plant M3 is also part of the intermediate group, but with 50 years in age, it is older than the youngest plant in the net sender group (S1). Consequently, we can only partly support the existing results from literature discussing plant age and the participation in knowledge transfer activities as correlating factors.

During the interviews, the interviewees were asked to identify successful and less successful knowledge transfer projects in order to derive differences between beneficial and less beneficial knowledge transfer. Table 2 shows the cross-case results of case data related to successful projects. All units investigated, no matter if they are knowledge sending or knowledge receiving plants, engage in formal (job rotation, centrally coordinated visits of other plants, trainings, standardised documentation) and informal (ad-hoc support between plants) efforts to facilitate knowledge exchange. Furthermore, all plants have various types of collaboration tools in place (such as information sharing tools, web, intranet, video conferencing, email, file sharing, and even more complex systems which can facilitate knowledge transfer activities). When it comes to similarities, all knowledge exchanging plants have similar process knowledge and most of them also have similar product, process and/or technology knowledge. The level of standardisation and centralisation is overwhelmingly high, with the majority of strategic and operational decisions making activities at headquarters. Overall, if the knowledge transfer projects were successful, the plants reported either a knowledge output in a process or a technology related knowledge increase.

In order to differentiate between beneficial and less beneficial knowledge transfer, we asked the interviewees to identify successful and less successful knowledge transfer projects and to explain what content explicitly has been transferred between plants. From this resulted 25 examples of knowledge transfer projects, one of the plants refusing to comment on unsuccessful projects. Table 3 and Table 4 highlight some examples of prerequisites leading

Table 3.

Examples of successful knowledge transfer projects

Company	Role	Project description	Supporting factors
S1	Knowledge sender	Duplication of production line at sister plant. Knowledge sending plant provided technological and process knowledge and supported employees at sister plant in implementing and ramping-up production.	*Effort* - Monthly video conferences coordinated by central - Every six month visit of employees from knowledge sending plant at knowledge receiving plant - High effort in establishing personal ties between employees of knowledge sending and receiving plant *Collaboration tools* - All necessary documentation stored in information sharing software *Similarities* - Establishment of similar production line as at sending plant - No prior related knowledge in place *Coordination mechanism* - High level of standardisation in documentation *Success* - Technological knowledge output
R3	Knowledge receiver	Implementing of TPM system. Other plant provided knowledge of how to implement TPM and how to follow the rules. TPM was implemented and running after 1,5 years at interviewed plant. To compare: average implementation time within company is 3 years.	*Effort* - Centrally coordinated visits of other plants that had TPM already implemented - One employee from knowledge sending plant served as a consultant for receiver plant - Consultant made frequent visits at knowledge receiving plant *Collaboration tools* - All necessary documentation stored in information sharing software *Similarities* - Similar processes at knowledge sending and receiving plant - No prior related knowledge in place *Coordination mechanisms* - High level of standardisation - High level of centralisation; Autonomy at HQ *Success* - Process knowledge output
M3	Knowledge receiver	New process knowledge transferred from sister plant to M3. In it, the sister plant enabled M3 in how to implement and use a process extensions to the existing production process.	*Effort* - Ad-hoc visits to other plants to see how they conducted process step of interest for selection purpose - One employee from knowledge sending plant served as a consultant for receiver plant - Job rotation with knowledge sending plant was key - Network of peers contacted for ad-hoc questions (social ties) *Collaboration tools* - Information in database - Video conferencing tools used to interact with knowledge sending plant *Similarities* - Similar technology knowledge at sending and receiving plant - No prior related knowledge *Coordination mechanisms* - High level of standardisation - Medium level of centralisation with strategic autonomy at HQ and operational autonomy at plant *Success* - Process related knowledge output

Source: own editing

Table 4.

Examples of unsuccessful knowledge transfer projects

Company	Role	Project description	Hindering factors
S2	Knowledge sender	Product transfer from S2 to low cost plant.	*Effort* - HQ forced employees of S2 to provide their process knowledge - Employees of S2 were not motivated to give their knowledge to other plant - Process was rushed, not enough management attention *Collaboration tools* - All necessary documentation stored in information sharing software, but bad data quality *Similarities* - Similar product, process and technology knowledge - Prior related knowledge related to product, process and technology *Coordination mechanisms* - High level of standardisation - Medium level of centralisation with strategic autonomy at HQ and operational autonomy at plant *Success* - No success
A3	Knowledge receiver	Providing information about accidents so that the same accident does not happen in one of the other plants as well. However, not all accidents could be avoided.	*Effort* - Formal documentation of accident and how it came to it - no personal experience exchange *Collaboration tools* - Database for report *Similarities* - Similar product, process and technology knowledge - No prior related knowledge *Coordination mechanisms* - High level of standardisation - High level of centralisation with strategic autonomy at HQ and operational autonomy at plant *Success* - No success
M2	Knowledge receiver	Reproduction of a product that was produced at an other plant only based on company documentation of that specific product. At the end, the final product did not perform well under different humidity conditions.	*Effort* - No personal contact, experience exchange would have hindered project failure *Collaboration tools* - Product documentation in company database *Similarities* - Same product, process and technology knowledge - Prior process related knowledge *Coordination mechanism* - Medium level of standardisation - Medium level of centralisation with strategic autonomy at HQ and operational autonomy at plant *Success* - No success

Source: own editing

to a knowledge transfer success (Table 3) and some, where the knowledge transfer was unsuccessful (Table 4).

The comparison between Table 3, showing examples of successful projects, and Table 4, showing examples of unsuccessful projects, displays that the successful projects were characterised by a high level of effort in personal contact (monthly video conferences, frequent employee visits from knowledge sending plants at knowledge receiving plants, personal ties between the knowledge sending and knowledges receiving plants, job rotations between sending and receiving plants, consultancy activities, frequent visits of key knowledge sending personnel at the knowledge receiving plants, ad-hoc visits to other plants). As the manager of S3 commented: "*Knowledge transfer is a people's business*" or as the plant manager of M3 summed up: "*Systems are not enough. Network is the key factor …. The network of people*."

Even though in all successful projects, information about the emphasised projects were in the company databases, they were only useful if the data quality was appropriate. And even then, the information alone was not useful if there were no employees from the knowledge sending plant explaining the content of the documents and data repositories to their peers at the knowledge receiving plants.

Prior-related knowledge showed to be of no necessity for a successful knowledge transfer. In all three examples provided in Table 3, no prior-related knowledge was in place. In comparison to this, two out of three examples of the unsuccessful projects had prior-related knowledge based on the emphasised project in place.

With regard to the coordination mechanisms, the companies showed similar characteristics, no matter if the project was successful or not. All companies have a medium to high level of standardisation and a medium to high level of centralisation with strategic decision autonomy always at headquarters and operational autonomy partly at headquarters and partly at the plant level.

Discussion and conclusion

The subsequent paragraphs briefly summarise our findings in light of the research questions of this paper.

First, related to RQ1.a, our study revealed that both knowledge sending and knowledge receiving plants engage in formal and informal efforts to facilitate knowledge exchange. The knowledge transfer is more successful in case of similar process knowledge or similar product/technology knowledge base. Moreover, all companies have a medium to high level of standardisation and a medium to high level of centralisation with strategic decision autonomy always at headquarters and operational autonomy partly at headquarters and partly at the plant level. We align with Scherrer and Deflorin (2017), who consider that these aspects (strategic similarities and product/product family/technology similarities) are prerequisites for a knowledge transfer to be beneficial.

Second, related to RQ1.b, despite the often-discussed fact that the information systems are necessary for a successful knowledge transfer, our data mirror a different perspective. Only if a personal interaction between the knowledge sending and receiving plant is established, the knowledge transfer has been considered as beneficial. In line with this, several authors have criticised the general assumption that information systems can support the knowledge transfer within organisations. Authors claim that if there is no overlap between the knowledge sender and receiver in their underlying knowledge base, knowledge transfer based on information systems alone does not work (Alavi & Leidner, 2001). As stated above, our data do not reveal the importance of prior knowledge stock. Instead, our conclusion is more in line with the statement of Roberts (2000), saying that information systems will never be able to entirely replace face-to-face interactions (RQ1.a) between knowledge sender and receiver.

Third, in relation to RQ1.c, we conclude based on our data that the pre-existing stock of knowledge, claimed to be necessary to have the ability to absorb provided knowledge, does not hold true in all of our cases. With this, our data do not support the necessity of causal ambiguity for a beneficial knowledge transfer (Gupta & Govindarajan, 2000; Szulanski, 2000). Instead, the personal contact seems to be able to overcome non-existing prior knowledge stocks, which is an important implication for newly established plants with less knowledge or plants located in countries with lower levels of pre-existing knowledge base.

Fourth, related to RQ2, we conclude that at least a medium level of standardisation needs to be in place to enable the possibility of knowledge transfer, but the coordination mechanisms alone seem not to be responsible for a successful knowledge transfer.

To sum up, managers seeking beneficial knowledge transfers within manufacturing networks should take the importance of personal interactions during the knowledge exchange process into account. It is worth to invest in personal exchange activities, such as mutual plant visits, joint projects, informal meetings, joint training programs and team-buildings, to bind social ties even prior to knowledge exchange activities, as these social ties support a higher frequency of interactions and a higher willingness to participate in knowledge exchange activities, and ultimately can secure the success of transferring knowledge between peer plants belonging to the internal network of the same MNC.

Overall, our study contributes to operations and knowledge management literature by exploring the role of some plant-level and network-level factors in successful knowledge transfers, but it is also limited in its generalizability given that case study research was conducted. Nevertheless, the variance between the cases in terms of country, industry and age offers a good basis to formulate propositions for further research attempts. Further research on a larger scale should verify our results and quantify the importance of personal factors compared to structural factors in successful knowledge transfers. Future research should also involve additional factors, such as disseminative capability, absorptive capability dimensions, to investigate whether there is an interaction between these factors and the ones involved in our study that can further improve successful knowledge transfers. Another highly relevant future research issue is related to the COVID-19 pandemic as it influences the way employees work at companies and poses an important limit to personal interactions which was deemed as the most influential prerequisite of successful knowledge transfer. How changing work habits will influence knowledge transfer projects remains, thus, an issue for further investigation.

References

Abell, P. M., Felin, T. & Foss, N. J. (2008). Building micro-foundations for the routines, capabilities, and performance links. *Managerial and Decision Economics, 29*(6)**,** 489-502. https://doi.org/10.1002/mde1413

Adenfelt, M. & Lagerström, K. (2008). The development and sharing of knowledge by centres of excellence and transnational teams: A conceptual framework. *Management International Review (MIR), 48*(3)**,** 319-338. https://doi.org/10.1007/s11575-008-0018-8

Alavi, M. & Leidner, D. E. (2001). Review: Knowledge management and knowledge management systems: Conceptual foundations and research issues. *MIS Quarterly, 25*(1)**,** 107-136. https://doi.org/10.2307/3250961

Ambos, T. C., Ambos, B. & Schlegelmilch, B. B. (2006). Learning from foreign subsidiaries: An empirical investigation of headquarters' benefits from reverse knowledge transfers. *International Business Review, 15*(3), 294-312. https://doi.org/10.1016/j.ibusrev.2006.01,002

Argote, L. & Ingram, P. (2000). Knowledge transfer: A basis for competitive advantage in firms. *Organizational Behavior & Human Decision Processes, 82*(1)**,** 150-169. https://doi.org/10.1006/obhd.2000.2893

Baksa, M. & Báder, N.(2020). A tudáskérés és tudásmegosztás feltételei – egy szervezeti tudáshálózat elemzése. *Vezetéstudomány*, *51*(1), 32-45. https://doi.org/10.14267/VEZTUD.2020.01.03

Bell, G. G. & Zaheer, A. (2007). Geography, networks, and knowledge flow. *Organization Science,* 18(6)**,** 955-972. https://doi.org/10.1006/obhd.2000.2893

Bigliardi, B., Ivo Dormio, A. & Galati, F. (2010). ICTs and knowledge management: An Italian case study of a construction company. *Measuring Business Excellence, 14*(3)**,** 16-29. https://doi.org/10.1108/13683041011074182

Cohen, W. M., Levinthal, D. A. (1990). Absorptive capacity: a new perspective on learning and innovation. *Administrative Science Quarterly*, *35*(1), 128-152. https://doi.org/10.2307/2393553

Darr, E. D. & Kurtzberg, T. R. (2000). An investigation of partner similarity dimensions on knowledge transfer. *Organizational Behavior and Human Decision Processes, 82*(1), 28-44. https://doi.org/10.1006/obhd.2000.2885

Demeter, Krisztina & Losonci, Dávid (2016). A lean tudás átadásának gyakorlatai multinacionális hálózatokban. *Vezetéstudomány*, *47*(12), 61-71. https://doi.org/10.14267/VEZTUD.2016.12.06

Ding, X.-H., Liu, H. & Song, Y. (2013). Are internal knowledge transfer strategies double-edged swords? *Journal of Knowledge Management, 17*(1), 69-86. https://doi.org/10.1108/13673271311300769

Dunning, J. (2006). *American investment in British manufacturing industry.* London, New York: Routledge.

Dunning, J. H. (1993). *Multinational Enterprises and the Global Economy*. Reading, MA.: Addison-Wesley.

Dyer, J. H. & Nobeoka, K. (2000). Creating and managing a high-performance knowledge-sharing network: the Toyota case. *Strategic Management Journal*, 21, 345-367. https://doi.org/10.1002/(SICI)1097-0266(200003)21:3<345::AID-SMJ96>3.0.CO;2-N

Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of Management Review, 14*(4)**,** 532-550. https://doi.org/10.5465/amr.1989.4308385

Eisenhardt, K. M. & Graebner, M. E. (2007). Theory building from cases: Opportunities and challenges. *Academy of Management Journal,* 50(1), 25-32. https://doi.org/10.5465/amj.2007.24160888

Erden, Z., Klang, D., Sydler, R. & Von Krogh, G. (2014). Knowledge-flows and firm performance. *Journal of Business Research,* 67(1), 2777-2785. https://doi.org/10.1016/j.jbusres.2012.09.001

Ergün, E., & Avcı, Ü. (2018). Knowledge Sharing Self-Efficacy, Motivation and Sense of Community as Predictors of Knowledge Receiving and Giving Behaviors. *Journal of Educational Technology & Society*, *21*(3), 60–73. Retrieved from https://www.jstor.org/stable/26458507

Feldmann, A. & Olhager, J. (2011). Distribution of manufacturing strategy decision-making in manufacturing networks. *18th International Annual EurOMA Conference.* Cambridge, England.

Ferdows, K. (2006). Transfer of changing production know-how. *Production & Operations Management, 15*(1), 1-9. https://doi.org/10.1111/j.1937-5956.2006.tb00031.x

Foss, N. J., Husted, K. & Michailova, S. (2010). Governing knowledge sharing in organizations: Levels of analysis, governance mechanisms, and research directions. *Journal of Management Studies, 47*(3)**,** 455-482. https://doi.org/10.1111/j.1467-6486.2009.00870.x

Foss, N. J. & Pedersen, T. (2002). Transferring knowledge in MNCs: The role of sources of subsidiary knowledge and organizational context. *Journal of International Management, 8*(1)**,** 49-67. https://doi.org/10.1016/s1075-4253(01)00054-0

Golini, R., Deflorin, P. & Scherrer-Rathje, M. (2016). Exploiting the potential of manufacturing network embeddedness: An OM perspective. *International Journal of Operations & Production Management, 36*(12)**,** 1741-1768. https://doi.org/10.1108/ijopm-11-2014-0559

Gupta, A. K. & Govindarajan, V. (2000). Knowledge flows within multinational corporations. *Strategic Management Journal, 21*(4)**,** 473-496. https://doi.org/10.1002/(SICI)1097-0266(200003)21:3<345::AID-SMJ96>3.0.CO;2-N

Gupta, A. K., Tesluk, P. E. & Taylor, M. S. (2007). Innovation at and across multiple levels of analysis. *Organization Science, 18*(6), 885-897. https://doi.org/10.1287/orsc.1070.0337

Hayes, R. H. & Clark, K. B. (1985). *Exploring the sources of productivity differences at the factory level.* New York: Wiley.

Hayes, R. H. & Wheelwright, S. C. (1984). *Restoring Our Competitive Edge: Competing Through Manufacturing.* New York: John Wiley and Sons.

Kang, J., Rhee, M. & Kang, K. H. (2010). Revisiting knowledge transfer: Effects of knowledge characteristics on organizational effort for knowledge transfer. *Expert Systems with Applications, 37*(12), 8155-8160. https://doi.org/10.1016/j.eswa.2010.05.072

Kawai, N. & Strange, R. (2014). Subsidiary autonomy and performance in Japanese multinationals in Europe. *International Business Review, 23*(3), 504-515. https://doi.org/10.1016/j.ibusrev.2013.08.012

Mahnke, V., Pedersen, T. & Venzin, M. (2005). The impact of knowledge management on mnc subsidiary performance: The role of absorptive capacity. *Management International Review, 45*(2), 101-119.

Maritan, C. A., Brush, T. H. & Karnani, A. G. (2004). Plant roles and decision autonomy in multiplant networks. *Journal of Operations Management, 22*(5), 489-503. https://doi.org/10.1016/j.jom.2004.05.007

Merton, R. K. (1968). *Social theory and social structure.* New York: The Free Press.

Minbaeva, D. B. (2007). Knowledge transfer in multinational corporations. *Management International Review, 47*(4), 567-593. https://doi.org/10.1007/s11575-007-0030-4.

Netland, T. H. & Aspelund, A. (2014). Multi-plant improvement programmes: A literature review and research agenda. *International Journal of Operations & Production Management, 34*(3), 390-418. https://doi.org/10.1108/ijopm-02-2012-0087

Pauleen, D. J., Rooney, D., & Holden, N. J. (2010). Practical wisdom and the development of cross-cultural knowledge management: a global leadership perspective. *European Journal of International Management, 4*(4), 382-395. https://doi.org/10.1504/ejim.2010.033608

Phelps, C., Heidl, R. & Wadhwa, A. (2012). Knowledge, networks, and knowledge networks a review and research agenda. *Journal of Management, 38*(4), 1115-1166. https://doi.org/10.1177/0149206311432640

Roberts, J. (2000). From know-how to show-how? Questioning the role of information and communication technologies in knowledge transfer. *Technology Analysis & Strategic Management, 12*(4), 429-443. https://doi.org/10.1080/713698499

Rudberg, M. & West, B. M. (2008). Global operations strategy: Coordinating manufacturing networks. *Omega, 36*(1), 91-106. https://doi.org/10.1016/j.omega.2005.10.008

Rosenkopf, L., & Almeida, P. (2003). Overcoming local search through alliances and mobility. *Management Science*, *49*(6), 751-766. https://doi.org/10.1287/ mnsc.49.6.751.16026

Rosenzweig, E. D. & Easton, G. S. (2010). Tradeoffs in manufacturing? A meta-analysis and critique of the literature. *Production and Operations Management, 19*(2), 127-141. https://doi.org/10.1111/j.1937-5956.2009.01072.x

Scherrer-Rathje, M. & Deflorin, P. (2017). Linking QFD and the manufacturing network strategy: Integrating the site and network perspectives. *International Journal of Operations & Production Management, 37*(2), 226-255. https://doi.org/10.1108/IJOPM-07-2014-0350

Scherrer, M. & Deflorin, P. (2017). Prerequisite for lateral knowledge flow in manufacturing networks. *Journal of Manufacturing Technology Management, 28*(3), 394-419. https://doi.org/10.1108/JMTM-10-2015-0090

Schoenherr, T. & Narasimhan, R. (2012). The fit between capabilities and priorities and its impact on performance improvement: Revisiting and extending the theory of production competence. *International Journal of Production Research,* 50(14), 3755-3775. https://doi.org/10.1080/00207543.2011.588266

Shi, Y. & Gregory, M. (1998). International manufacturing networks - to develop global competitive capabilities. *Journal of Operations Management,* 16(2), 195-214. https://doi.org/10.1016/S0272-6963(97)00038-7

Song, J. (2014). Subsidiary absorptive capacity and knoweldge transfer within multinational corporatinos. *Journal of International Business Studies,* 45, 73-84. https://doi.org/10.1057/jibs.2013.55

Stenius, M., Haukkala, A., Hankonen, N., & Ravaja, N. (2017). What Motivates Experts to Share? A Prospective Test of the Model of Knowledge-Sharing Motivation. *Human Resource Management*, *56*(6), 871–885. https://doi.org/10.1002/hrm.21804

Szász, L., & Demeter, K. (2014). How do companies lose orders? A multi-country study of internal inconsistency in operations strategies. *Operations Management Research*, *7*(3-4), 99-116. https://doi.org/10.1007/s12063-014-0091-z

Szász, L., Scherrer-Rathje, M. & Deflorin, P. (2016). Benefits of internal manufacturing network integration: The moderating effect of country context. *International Journal of Operations & Production Management,* 36(7), 757-780. https://doi.org/10.1108/IJOPM-05-2015-0265

Szász, L., Rácz, B.G., Scherrer, M. & Deflorin, P. (2019). Disseminative capabilities and manufacturing plant roles in the knowledge network of MNCs. *International Journal of Production Economics*, *208*(Febr), 294-304. https://doi.org/10.1016/j.ijpe.2018.12.004

Szulanski, G. (1996). Exploring internal stickiness: Impediments to the transfer of best practice within the firm. *Strategic Management Journal, 17*(S2), 27-43. https://doi.org/10.1002/smj.4250171105

Szulanski, G. (2000). The process of knowledge transfer: A diachronic analysis of stickiness. *Organizational Behavior and Human Decision Processes, 82*(1), 9-27. https://doi.org/10.1006/obhd.2000.2884

Tran, Y., Mahnke, V. & Ambos, B. (2010). The effect of quantity, quality and timing of headquarters-initiated knowledge flows on subsidiary performance. *Management International Review, 50*(4), 493-511. https://doi.org/10.1007/s11575-010-0046-z

Tsai, W. & Ghoshal, S. (1998). Social capital and value creation: The role of intrafirm networks. *Academy of Management Journal, 41*(4), 464-476. https://doi.org/10.2307/257085

Tsai, W. (2002). Social Structure of "Coopetition" Within a Multiunit Organization: Coordination, Competition, and Intraorganizational Knowledge Sharing. *Organization Science, 13*(2), 179–190. https://doi.org/10.1287/orsc.13.2.179.536

Tseng, C.-H. (2015). Determinants of MNC's knowledge inflows to subsidiaries: A perspective on internalization advantages. *Management International Review, 55*(1)**,** 119-150. https://doi.org/10.1007/s11575-014-0230-7

Vereecke, A., Van Dierdonck, P. & De Meyer, A. (2006). A typology of plants in global manufacturing networks. *Management Science,* 52(11), 1737-1750. http://dx.doi.org/10.1287/mnsc.1060.0582

Voss, C., Tsikriktsis, N. & Frohlich, M. (2002). Case research in operations management. *International Journal of Operations & Production Management, 22*(2), 195-219. https://doi.org/10.1108/01443570210414329

Wang, P., Tong, T. W. & Koh, C. P. (2004). An integrated model of knowledge transfer from MNC parent to China subsidiary. *Journal of World Business, 39*(2)**,** 168-182. https://doi.org/10.1016/j.jwb.2003.08.009

Yin, R.K. (1988). *Case Study Research and Design Methods*. Newbury Park: Sage.