A plant's development stage in knowledge transfer in manufacturing networks

Maike Scherrer (maike.scherrer@unisg.ch)
University of St. Gallen
Institute for Technology Management
Switzerland

Patricia Deflorin
University of Applied Sciences HTW Chur
Swiss Institute for Entrepreneurial Management
Switzerland

Levente Szász
Babeș-Bolyai University
Faculty of Economics and Business Administration
Department of Economics and Business Administration in Hungarian Language
Romania

Béla Rácz
Babeș-Bolyai University
Faculty of Economics and Business Administration
Department of Economics and Business Administration in Hungarian Language
Romania

Abstract

The paper at hand analyses if plants follow a development path in knowledge transfer from a knowledge receiver role to a knowledge sender role. In this, the plant's age and the content of knowledge that is transferred are analysed. The study includes thirteen case studies in four different European countries (i.e., Switzerland, Romania, Albania, and Macedonia) and shows that the content of the transferred knowledge changes in relation to the plant's development stage and its role that the plant takes at the end of the undergone development stage. The lower the development stage, the more basic knowledge related to innovation and product/process improvement is transferred. As the development stage gets higher, more specific task related knowledge is transferred. Furthermore, results indicate that the plant's age cannot fully be linked to the development stage of the plant under investigation.

Keywords: Lateral knowledge flow, manufacturing networks

Introduction

Knowledge sharing enables a firm to develop itself further and to become a learning organisation (Shi and Gregory, 1998). Since many firms do not consist of one manufacturing plant alone but as dispersed networks of worldwide represented plants, knowledge sharing and its challenges have gained even more attention over the last couple of years (Dunning, 2006). Literature recognises the internal knowledge transfer as a valuable source of competitive advantage in a manufacturing network (Argote and Ingram, 2000).

Nevertheless, studies analysing the achieved benefits by internal knowledge transfer demonstrate positive (Ding et al., 2013), negative (Ambos et al., 2006) and curvilinear effects (Erden et al., 2014).

Literature provides results that a plant's age is an important contingency for the knowledge flow in manufacturing networks. It is discussed that older subsidiaries decrease in their willingness to learn and adopt to changes. More precisely, the older a subsidiary is, the less it accepts provided knowledge (Song et al., 2011). On the other hand, younger units seem to possess the ability and motivation to learn from provided knowledge (Song, 2014).

Moreover, plants differ in the role they play in their manufacturing network (Ferdows, 1997) and they undergo a development from a lower to a higher role (Blomqvist and Turkulainen, 2011). Plant roles are also differentiated by the amount of knowledge send to and received from the network (Vereecke et al., 2006, Szász et al., 2017).

Studies showing a change in a plant's role over time miss to discuss influencing factors that make the plants change their roles. The study at hand aims at closing this gap in literature by proposing that each plant undergoes development phases from a net knowledge receiver role, to an intermediate role where a plant both receives and sends knowledge, to a net knowledge sender role. We furthermore propose that a plant strives at the end to become isolated in terms of knowledge transfer to be able to concentrate on its specialisation. At the first sight, this goes against the conclusion of Vereecke et al. (2006) who argue that, as the amount of knowledge that flows through the plant increases, the plant gets deeper embedded in its network. But since plants that underwent a development from a net receiver to a net sender role are already deeply embedded in their network, our assumption is not a contradiction with the conclusion of Vereecke et al. (2006).

This paper aims at exploring if the age of the plant corresponds with its development stage in knowledge transfer and whether the content of knowledge that is sent and received differs based on the plant's development stage and the resulting role in knowledge transfer. We propose that the content of knowledge sent can be related to the development stage of a plant in terms of knowledge transfer. We add to literature as we jointly analyse the plant's role in knowledge transfer and the content of the knowledge transferred.

Thus, we aim at answering the following research questions:

RQ 1: "How does the knowledge content change depending on the plant's development stage in knowledge transfer?"

RQ 2: "How does the age of the plant influence its development stage in knowledge transfer?"

Literature review

Plant roles

Literature discusses different plant roles. Ferdows (1997) framed the discussion by introducing strategic roles a plant can take. In his paper, Ferdows discusses six strategic plant roles and corresponding skills. To change between different plant roles, the plants need to develop additional skills. At the end, Ferdows concludes that each plant strives to become a lead plant, which is the plant with the highest set of capabilities. Feldmann and

Olhager (2013) take the work of Ferdows (1997) and derive that plants undergo a development from only having production-related competencies to having production-related and supply-chain-related competencies to those having production-related, supply-chain-related and development-related competencies. Vereecke et al. (2006) also rely on Ferdows (1997) but only concentrate on the knowledge transfer activities within manufacturing networks. They derive four different groups of plants based on the flow of knowledge, innovation and people between plants. The more flows go through a respective plant, the deeper it is embedded in the manufacturing network and the more stable is the role of the plant in the network. Thomas et al. (2015) emphasise the importance of learning from each other and analyse how much knowledge actually is transferred and how much knowledge should be transferred within a manufacturing network in order to achieve the network goals.

Other authors (e.g., Ferraris et al., 2017, Tippmann et al., 2017, Crespo et al., 2014) analyse how plants can become better in innovation or production by taking in additional knowledge. But these authors concentrate on a single site perspective and do not discuss how the plant changes its role within the manufacturing network.

To summarise, literature has recognised that the transfer of knowledge between plants is important. Nevertheless, these studies generally discuss only a status quo and not how the plants are developing over time.

Knowledge flow in manufacturing networks

Knowledge flow within the manufacturing network describes the transferring process between the knowledge-sending and knowledge-receiving plant (Tseng, 2015, Gupta and 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). The knowledge-receiving plant, on the other hand, needs to have absorptive capacities to be able to internalise the provided knowledge (Tsai and Ghoshal, 1998, Foss and 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 and Clark, 1985).

Literature has shown that plant age is an important variable influencing the willingness to participate in knowledge transfer in manufacturing networks. Older plants have a decreased willingness to learn and adapt to changes (Cyert and March, 1963). The older a plant is, the less it accepts the provided knowledge (Song et al., 2011, Song and Shin, 2008). On the other hand, younger plants seem to possess the ability and motivation to learn from the provided knowledge (Frost et al., 2002, Song, 2014).

Absorptive capacity depends on the pre-existing stock of knowledge. If the knowledge-receiving plant does not have pre-existing knowledge in relation to the provided knowledge, then the receiving plant will be unable to base the newly provided knowledge on existing knowledge (Phelps et al., 2012, Gupta and Govindarajan, 2000, Salomon and Martin, 2008). The receiving plant also needs to be able to discard old practices to sustain new ones (Argote, 1999, Rogers, 1983).

Knowledge transfer success does not only depend on the knowledge sending and receiving plant, but also on certain preconditions. These preconditions include institutional-level or social ties (Bell and Zaheer, 2007, Foss and Pedersen, 2002, Tsai, 2002), cultural background (Inkpen and Tsang, 2005, Bhagat et al., 2002, Szász et al., 2016), mother tongue/functional language (Szulanski, 2003), geographic proximity (Darr and Kurtzberg, 2000, Bell and Zaheer, 2007), strategic similarities (Gupta and Govindarajan, 2000, Eisenhardt and Calunic, 2000, Scherrer and Deflorin, 2017), or product/product family similarities (Haas and Hansen, 2007, Ambos and Ambos, 2009, Tran et al., 2010, Scherrer and Deflorin, 2017).

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

Methodology

To gain an understanding of lateral knowledge transfer, we examined thirteen plants and analysed 24 examples of knowledge transfer projects. 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 and Graebner, 2007, Voss et al., 2002) provided us with deep 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 required level of detail.

Case plants were selected based on the joint fulfilment of the following criteria: (a) they belong to a MNC with at least four manufacturing plants, (b) their MNC is a leading company in its field, with the 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. An equal number of cases (three to four) was targeted in each of the four countries involved: Switzerland, Romania, Albania, and Macedonia. Field data were collected from December 2015 until March 2017. The main method of data collection was a semi-structured interview, uniformly applied in each country. Researchers have participated in multiple interviews in different countries to enable a uniform understanding of data collection.

In order to analyse our research questions, we first asked the interviewees to evaluate in general how much (1) knowledge and (2) innovation they sent and received and (3) how much training they offered 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 are based on the work of Vereecke et al. (2006). The first dimensions covers knowledge transferred, which needs to be distinguished from data based (information) exchange and refers to more explicit data concerning day-to-day activities related to products, processes, technology, management or services. In addition, we aim at capturing innovation, which is related to 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.

Second, we asked the participants to provide information about beneficial and less beneficial knowledge transfer projects and to explain what content explicitly has been transferred between plants. With this, we aimed at getting a better understanding of the specific content transferred with reference to knowledge or innovation. We furthermore were interested why the interviewees considered a knowledge transfer project as beneficial or not.

All interviews were taped and afterwards transcribed. The interview's contents were summarised into a manuscript containing the details of each knowledge transfer discussed. Afterwards, the research team conducted a cross-case comparison (i.e. comparing different knowledge transfer projects and different plant roles).

Data analysis

Table 1 summarises the question of how much the different plant managers participated in knowledge transfer activities in general.

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

As Table 1 depicts, we summarised the 13 plants in four groups. Group 1 (Net senders) consists of those plants that send much, but only receive some knowledge. The groups 2 and 3 are intermediate groups. In this, the plants in group 2 (Balanced actors) send and receive knowledge to an equal extent. Plants in group 3 (Active receivers) also send and receive knowledge, but they receive more than they send. Plants in group 4 (Net receivers) mainly receive knowledge. If they send knowledge, it only happens to a small extent.

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 in the receiving group. The intermediate group is not fully consistent related to amount of knowledge transferred and the age. Plant R1 belongs to the intermediate 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 related participation in knowledge transfer activities.

Table 2 summarises the content of specific projects the interviewees described in relation to the beneficial and a less beneficial knowledge/innovation transfer projects.

After analysing the data in greater detail, we concluded to split knowledge in task related knowledge and improvement. Task related knowledge is detailed knowledge about how a task needs to be conducted so that the respective job can be done either more efficient or more effective. Improvement relates to knowledge that is needed to improve products or process set-ups or IT tools and programs that have not been implemented properly.

Table 2 – Summary of transferred content based on selected project of interviewees

		Task knowledge			Improvement			Innovation	
Plant		Product	Process	Technology	Product	Process	IT	Product	Process
Net senders	S2	x	x						
	S3		x						
	S1		x	x					
Balanced actors	M2				x	x			
	A3					x			
Active recievers	M3					x			
	R1					x	x		
	R3					x			
Net receivers	A1							x	
	M1							x	
	A2							x	
	A4							x	
	R2								x

N = 26; some double counts in similar categories

Since Table 2 summarises the 26 given beneficial and less beneficial knowledge transfer projects, Table 2 cannot directly be linked to Table 1, which contains the general overview of knowledge transfer activities of each plant analysed.

As Table 2 shows, the net senders send more task knowledge. This is used to explain others how things work and how jobs can be conducted. An example coming from S1 contains the transfer of task knowledge of what to change in machine settings so that the product can be produced in a better quality. The two intermediate groups, the balanced actors and the active receivers, send and receive knowledge needed for improvement. An example in this group comes from plant R1. They already had implemented lean processes in production. A sister plant supported R1 in improving the processes so that the lean goals finally could be achieved. Net receivers receive mainly knowledge about product innovations. A2 gave the example that they received from a sister plant a new recipe for concrete production. In this, the sister plant adapted the existing recipe for A2 and transferred it to A2, to which the product was completely new.

Overall, we conclude that there is a difference in the content of knowledge that is transferred along the different stages the plants belong to. While net receivers receive innovations, the intermediate group receives and sends improvement contents. The net senders concentrate on sending task-related knowledge to support other plants in very detailed questions.

Discussion and conclusion

The subsequent paragraphs briefly summarise the findings.

First and in relation to RQ1, we conclude that the plants undergo a development from a net knowledge receiver role to the role of a net knowledge sender. Related to this, the knowledge that is shared within the network changes based on the development state the plant is in. The plants in the fourth group, the net receivers, receive product and process innovation knowledge. We conclude that plants that are in the knowledge receiving group are in the state of establishing their plants related to the product portfolio of the respective network. The plants in the two intermediate groups, which send and receive knowledge either with a higher share in sending or receiving knowledge, transfer knowledge related to product or process improvement. For these two groups, we conclude that the plants already have knowledge about the products and processes used in the network but have the goal to improve efficiency or effectiveness. The last group, the net senders, are engaged in the exchange of task knowledge. This contains knowledge that is sent to explain other plants how to conduct the required job. To sum up, the content of knowledge changes along the development stage. The knowledge that is transferred by the different groups leads us to the overall conclusion that the higher the plant's development stage in knowledge transfer, the more detailed the transferred knowledge is. While innovation and improvement related knowledge is broad, the knowledge transferred related to taskknowledge is very specific and dedicated to very detailed tasks in seeking for perfection of the knowledge receiving plant.

Literature discusses prerequisites for a knowledge transfer to be beneficial. Next to social/functional ties, cultural background, mother tongue/functional language or geographic proximity, strategic similarities and product/product family similarities are discussed (Scherrer and Deflorin, 2017). Based on our results, we propose for a further research project to consider the prerequisites in more detail. We assume that ties, and lingual/geographical proximity can be important for plants that are newly implemented in the network. As the time spent by plants within the network increases, the strategic and product/product family similarities gain importance, and as a consequence, the knowledge changes from general innovation and improvement knowledge towards very specific task-related knowledge. It would be an interesting avenue to follow to analyse whether the prerequisites also undergo a similar development path as the content of knowledge exchanged. In this, we propose that the older a plant is (i.e. the longer it has been part of the respective network), the more pre-existing stock of similar knowledge and more product/process similarities exist, which leads to a higher amount of task knowledge to be exchanged. The younger the plant is, the less similarities and pre-existing stock of knowledge exists and as less social ties are established. Subsequently, the younger the plant in the network is, the more general innovation and improvement knowledge is transferred to establish the new plant in the network and to increase the level of product/process similarities.

Second, and related to RQ2, we only found partial support for the relationship between plant age and development stage in knowledge transfer. The net senders are basically the oldest plants in the sample, while the net receivers are the youngest plants in the sample. The intermediate groups (balanced actors and active receivers) are mixed in plant age. The oldest plant (M3) is older than the youngest net sender (S1), while the youngest plant in the intermediate group (R1) is only slightly older than the youngest net receiver (M1 and R2). The data allows to imply that the plant age corresponds with a change in the amount of knowledge sent and received, but it cannot be linked to the knowledge transfer stage directly. With this, we cannot fully support or contradict the findings of Song et al. (2011) and Song (2014), stating that the older a subsidiary is, the less likely it accepts provided knowledge and, conversely, the younger a subsidiary is, the more it is motivated to learn from others. One explanation why we do not get a fully comprehensible result is the fact that we asked plant age and not how long a plant was part of the network it belongs to right now. M3 is 50 years old and part of the active receiver group. Since we do not know how long M3 belongs to its actual network, we cannot fully explain whether the plant age influences the plant's role in the development from net receiver to net sender. We rather conclude that it is not the pure plant age that influences the motivation in participating in knowledge transfer activities, but a combination of plant age and the time since the analysed plant became a member of its current manufacturing network.

Overall, we contribute to operations management literature by linking the plant's development stage of knowledge transfer and the knowledge content that is transferred. Managers should pay attention to this fact when linking knowledge sending and receiving plants for the knowledge transfer.

The study is limited in its generalisability because we only conducted case studies. Nevertheless, the variance between the cases in terms of country offers a good basis to formulate propositions for further research attempts.

Acknowledgement

We would like to thank the Swiss National Science Foundation (SCOPES Joint Research Project IZ73Z0_152505) for the financial support provided for the research project discussed in this paper.

References

Ambos, T. C. & Ambos, B. 2009. The impact of distance on knowledge transfer effectiveness in multinational corporations. *Journal of International Management,* 15**,** 1-14.

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**,** 294-312.

Argote, L. 1999. *Organizational leanring: Creating, retaining and transferring knowledge,* Norwell, MA, Kluwer.

Argote, L. & Ingram, P. 2000. Knowledge Transfer: A Basis for Competitive Advantage in Firms. *Organizational Behavior & Human Decision Processes,* 82**,** 150-169.

Bell, G. G. & Zaheer, A. 2007. Geography, Networks, and Knowledge Flow. *Organization Science,* 18**,** 955-972.

Bhagat, R. S., Kedia, B. L., Harveston, P. D. & Triandis, H. C. 2002. Cultural variations in the cross-border transfer of organizational knowledge: An integrative framework. *Academy of Management Review,* 27**,** 204-221.

Blomqvist, M. & Turkulainen, V. 2011. Managing global manufacturing networks - uncovered plant roles of global manufacutring companies. *European Operations Management Association (EUROMA).* Cambridge, UK.

Crespo, C. F., Griffith, D. A. & Lages, L. F. 2014. The performance effects of vertical and horizontal subsidiary knowledge outflows in multinational corporations. *International Business Review,* 23**,** 993-1007.

Cyert, R. M. & March, J. G. 1963. *A Behavioral Theory of the Firm,* Englewood Cliffs, NJ, Prentice-Hall.

Darr, E. D. & Kurtzberg, T. R. 2000. An Investigation of Partner Similarity Dimensions on Knowledge Transfer. *Organizational Behavior and Human Decision Processes,* 82**,** 28-44.

Ding, X.-H., Liu, H. & Song, Y. 2013. Are internal knowledge transfer strategies double-edged swords? *Journal of Knowledge Management,* 17**,** 69-86.

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

Eisenhardt, K. M. 1989. Building Theories from Case Study Research. *Academy of Management Review,* 14**,** 532-550.

Eisenhardt, K. M. & Calunic, D. C. 2000. Coevolving: At last, a way to make synergies work. *Harvard Business Review,* 78**,** 91-101.

Eisenhardt, K. M. & Graebner, M. E. 2007. Theory Building from Cases: Opportunities and Challenges. *Academy of Management Journal,* 50**,** 25-32.

Erden, Z., Klang, D., Sydler, R. & Von Krogh, G. 2014. Knowledge-flows and firm performance. *Journal of Business Research,* 67**,** 2777-2785.

Feldmann, A. & Olhager, J. 2013. Plant roles: Site competence bundles and their relationships with site location factors and performance. *International Journal of Operations & Production Management,* 33**,** 722-744.

Ferdows, K. 1997. Making the Most of Foreign Factories. *Harvard Business Review,* 75**,** 73-88.

Ferraris, A., Santoro, G. & Dezi, L. 2017. How MNC's subsidiaries may improve their innovative performance? The role of external sources and knowledge management capabilities. *Journal of Knowledge Management,* 21**,** 540-552.

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**,** 49.

Frost, T. S., Birkinshaw, J. M. & Ensign, P. C. 2002. Centers of Excellence in multinational corporations. *Strategic Management Journal,* 23**,** 997.

Gupta, A. K. & Govindarajan, V. 2000. Knowledge flows within multinational corporations. *Strategic Management Journal,* 21**,** 473-496.

Haas, M. R. & Hansen, M. T. 2007. Different knowledge, different benefits: toward a productivity perspective on knowledge sharing in organizations. *Strategic Management Journal,* 28**,** 1133-1153.

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.

Inkpen, A. C. & Tsang, E. W. K. 2005. Social capital, networks, and knowledge transfer. *Academy of Management Review,* 30**,** 146-165.

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**,** 8155-8160.

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**,** 101-119.

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**,** 567-593.

Phelps, C., Heidl, R. & Wadhwa, A. 2012. Knowledge, Networks, and Knowledge Networks A Review and Research Agenda. *Journal of Management,* 38**,** 1115-1166.

Rogers, E. 1983. *The diffusion of innovation,* New York, Free Press.

Rosenzweig, E. D. & Easton, G. S. 2010. Tradeoffs in manufacturing? A meta-analysis and critique of the literature. *Production and Operations Management,* 19**,** 127-141.

Salomon, R. & Martin, X. 2008. Learning, knowledge transfer, and technology implementation performance: A study of time-to-build in the global semiconductor industry. *Management Science,* 54**,** 1266-1280.

Scherrer, M. & Deflorin, P. 2017. Prerequisite for lateral knoweldge flow in manufacturing networks. *Journal of Manufacturing Technology Management,* 28**,** 394-419.

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**,** 3755-3775.

Shi, Y. & Gregory, M. 1998. International manufacturing networks - to develop global competitive capabilities. *Journal of Operations Management,* 16**,** 195-214.

Song, J. 2014. Subsidiary absorptive capacity and knoweldge transfer within multinational corporatinos. *Journal of International Business Studies,* 45**,** 73-84.

Song, J., Asakawa, K. & Chu, Y. 2011. What determines knowledge sourcing from host locations of overseas R&D operations?: A study of global R&D activities of Japanese multinationals. *Research Policy,* 40**,** 380-390.

Song, J. & Shin, J. 2008. The paradox of technological capabilities: a study of knowledge sourcing from host countries of overseas R&D operations. *Journal of International Business Studies,* 39**,** 291-303.

Szász, L., Rácz, B., Scherrer, M. & Deflorin, P. 2017. Strengthening plant position in multinational companies by transitioning towards knowledge sending roles. *In:* EUROMA (ed.) *24rd Euroma Conference.* Edinburgh, Scottland: European Operations Management Association.

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**,** 757-780.
Szulanski, G. 1996. Exploring internal stickiness: Impediments to the transfer of best practice within the firm. *Strategic Management Journal,* 17**,** 27-43.
Szulanski, G. 2003. *Sticky knowledge: Barriers to knowing in the firm,* London, England, Sage Publications.
Thomas, S., Scherrer-Rathje, M., Fischl, M. & Friedli, T. 2015. Linking network targets and site capabilities: A conceptual framework to determine site contributions to strategic manufacturing network targets. *International Journal of Operations & Production Management,* 35**,** 1710-1734.
Tippmann, E., Sharkey Scott, P. & Parker, A. 2017. Boundary capabilities in MNCs: Knowledge transformation for creative solution development. *Journal of Management Studies,* 54**,** 455-482.
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**,** 493-511.
Tsai, W. 2002. Social Structure of "Coopetition" Within a Multiunit Organization: Coordination, Competition, and Intraorganizational Knowledge Sharing. *Organization Science,* 13**,** 179-190.
Tsai, W. & Ghoshal, S. 1998. Social capital and value creation: the role of intrafirm networks. *Academy of Management Journal,* 41**,** 464-476.
Tseng, C.-H. 2015. Determinants of MNC's Knowledge Inflows to Subsidiaries: A Perspective on Internalization Advantages. *Management International Review,* 55**,** 119-150.
Vereecke, A., Van Dierdonck, P. & De Meyer, A. 2006. A Typology of Plants in Global Manufacturing Networks. *Management Science,* 52**,** 1737-1750.
Voss, C., Tsikriktsis, N. & Frohlich, M. 2002. Case research in operations management. *International Journal of Operations & Production Management,* 22**,** 195-219.
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**,** 168-182.