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The role of ICT-based information systems in knowledge transfer within multinational companies

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Abstract. This paper focuses on the internal network of multinational companies (MNC) and aims to investigate the role of information systems (IS) based on modern information and communication technologies (ICT) in transferring knowledge between different plants of the MNC, a subject still debated in the literature. To shed more light on this relationship, we propose that in the context of the MNC, the plant's role in the knowledge network has to be taken into consideration.

The analysis is based on a case study approach with interviews conducted at thirteen manufacturing plants. Data analysis shows that plants can have two basic roles in the knowledge network: knowledge senders or knowledge receivers. Knowledge sending plants see IS less supportive in transferring knowledge, while most knowledge receivers rely heavily on some form of IS. Furthermore, IS proved unhelpful if the quality of data entered in the system was low, or when strategic support to allocate resources to use IS was missing.

Keywords: Information systems, Knowledge transfer, Manufacturing network, Multinational companies.

1 Introduction

Manufacturing companies have changed their way of producing products. Traditionally, a manufacturing company had one plant and served the world out of this plant. Today, many companies produce their product portfolios in a network consisting of several plants located in different countries. These plants represent the building blocks of the internal network of multinational companies (MNCs). To coordinate these plants, the flow of knowledge has been recognised as of key importance [5, 8, 27].

Beside the knowledge sending and receiving units, and the knowledge itself, benefits of a knowledge transfer process are also influenced by the connection between the sending and receiving unit [16, 24], including the mechanisms and channels used to transmit the knowledge [3]. Gupta and Govindarajan [9] show that these transmission

mechanisms and channels positively influence the amount of knowledge shared, both at sending and receiving units. Almeida et al. [3] demonstrate that MNCs use a multitude of different transmission mechanisms to move knowledge across different intra-firm units. They also show that MNCs put a heavy emphasis on using information systems to facilitate knowledge transfer, including shared databases, common communication software, standardised design tools and file formats, company intranets, etc. Reviewing the literature on knowledge transfer within MNCs, Song [22] argues however that existing studies provide only limited information on how these transmission systems are used to transfer knowledge, and how their usage influences the benefits of the knowledge transfer. Thus, this paper aims to fill this gap by focusing on the role of a specific type of transmission systems, namely information systems (IS) based on modern information and communication technologies (ICT), in facilitating the knowledge transfer process within MNCs.

The role of IS in knowledge transfer is debated in the literature. While most of the studies find that IS supports knowledge transfer [e.g., 2, 11, 12, 23], some authors challenge this view [10, 20] arguing that IS can hardly contribute to organisational knowledge transfer [13, 19]. This paper aims to contribute to this debate by proposing to take into consideration an additional factor, namely the role of the plant in the intra-organisational knowledge sharing processes within the MNC. Thus, we aim to answer the following research question (RQ):

How supportive are information systems for transferring knowledge between different plants of a multinational company?

2 The role of plants within the knowledge flow in MNCs

Knowledge transfer processes within an MNC are generally carried out between a knowledge-sending and a knowledge-receiving plant [9, 16, 26]. In this process, the driver for knowledge transfer is mainly the knowledge-receiving plant, as it faces problems that it cannot solve alone. After the knowledge transfer, the perception of the knowledge-receiving plant defines the knowledge transfer success [17].

Vereecke et al. [27] identified four distinct roles of a plant. They analysed the engagement of the individual plant related to the frequency of knowledge sending and receiving, innovation sending and receiving and whether the plant hosted visitors or how frequent own employees were sent to other plants. Based on this, Vereecke et al. [27] derived four plant roles, namely (1) the isolated plant, (2) the receiver, (3) the hosting network player, and (4) the active network player.

Szulanski [25] suggests to take into account the following elements when analysing knowledge transfer: the two actors of the knowledge transfer process, i.e. the knowledge-source and the knowledge-recipient, and the channel of knowledge transfer. The knowledge-source in our case is the knowledge sending plant within an MNC that needs to have the willingness and capacity to share knowledge with other units from within the network. On the other hand, knowledge receivers need to have the ability to absorb, i.e. identify, assimilate and exploit the knowledge provided by the sender. The main attention related to the channel has been on the *relationship between knowledge-sending and knowledge-receiving plants*. Within the channel, transmission mechanisms

play an important role, as these mechanisms can support the knowledge transfer process [1, 3]. Literature discusses a wide range of mechanisms through which knowledge can be shared [7, 9, 22, 26], ICT/IS being among the most fundamental ones [3].

3 The role of ICT-based IS in knowledge transfer

Modern ICT-based IS play a crucial role in today's MNCs. According to O'Brien and Marakas [18, p. 4] "an information system (IS) can be any organized combination of people, hardware, software, communications networks, data resources, and policies and procedures that stores, retrieves, transforms, and disseminates information in an organization". IS in general can help the purpose to create, store, process, retrieve, transfer and apply data and information within organisations [2]. Here we focus mainly on the transfer component as we are interested in how ICT-based IS supports the knowledge transfer process between different plants of the same MNC.

Bigiardi et al. [4] argue that these systems based on information and communication technologies can be efficiently and effectively used to share intra-organisational knowledge. IS tools that make knowledge explicit, enable its transfer within multinational companies [14, 21]. Such tools include groupware, computer-supported cooperative work (electronic knowledge repositories, wikis), intranet, e-mail, portals and online communities [4, 6]. Iyengar et al. [11] show that the use of ICT systems significantly contributes to the effectiveness of the knowledge transfer at the receiver side as well. Jasimuddin et al. [12] bring several case examples where knowledge repository systems largely supported the knowledge transfer process between senders and receivers, but they also note that the correct introduction and classification of information in such systems is an important factor for receivers to find relevant knowledge. Sook-Ling et al. [23] offer further case study evidence for the usefulness of IT-based systems, such as knowledge repositories and e-mail systems, in sharing intra-organisational knowledge. Summarising the role of IS in knowledge transfer, Alavi and Leidner [2] argue that the positive contribution of these systems to the knowledge sharing process is based on three enabling factors: 1) IS has the potential to extend the reach of the internal network by connecting different isolated actors, 2) offers an increased variety of communication channels, and 3) it enables a faster access to knowledge sources.

Despite these enabling factors, several authors have criticised the general assumption that IS can significantly support the transfer of knowledge within an organisation. Alavi and Leidner [2] emphasise that if there is no overlap between the sender and receiver in their underlying knowledge base, then "the real impact of IT on knowledge exchange is questionable" (p. 112).

Roberts [20] also questions the role of IS in transferring knowledge, and argues that IS can not entirely replace the face-to-face interaction between sender and receiver, as "the transfer of know-how requires a process of show-how" (p. 439). Knowledge transfer requires socialisation, willingness to send and receive, and trust between the sender and receiver, which can be built via personal interactions. Hislop [10] raises similar critique, arguing that all knowledge has a non-codifiable element (that is not transferable via IS), and is deeply embedded in the activity, and social and cultural context of

the knowledge sender. In light of these arguments, it is not surprising that Mageswari et al. [13], for example, have not found any significant relationship between IS utilisation and intra-organisational knowledge sharing. In their literature review, Panahi et al. [19] also conclude that the role of IS in knowledge transfer is currently uncertain (with supporting and opposing arguments both co-existing in the literature), and call for further research in this field.

4 Methodology

To gain an understanding of knowledge transfer, and especially of how IS supports the knowledge flow in manufacturing networks, we examined thirteen plants and analysed 24 examples of knowledge transfer projects. We used middle-range theory development [15], by linking theory and empirical work. We derived dimensions from theory and refined them through case study research. Eisenhardt and Graebner [14] 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 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 needed level of detail.

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 during 2016. 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. After the data collection, the case data was first analysed within each respondent plant, followed by a cross-case analysis within and across countries.

5 Data analysis

To provide a detailed answer to our RQ, we first analysed the position of each individual plant within the knowledge network of MNCs. Based on interview data we tried to assess the extent to which each individual plant participates in (1) knowledge sending and (2) receiving, in (3) innovation sending and (4) receiving, and in (5) offering versus (6) receiving employee training (cf. [27]). Each of the six measures was rated with interviewees on a scale from None (0) to High (3), with Low (1) and Medium (2) as intermediary values, and a sum of these measures was computed at the end (Table 1).

Based on these ratings the overall position of each plant in the knowledge network has been assessed by adding up all sending/offering scores (i.e. knowledge sending, innovation sending, offering trainings) and subtracting the total score of receiving (i.e. knowledge receiving, innovation receiving, receiving trainings). Plants in the table are sorted based on their overall position. An overall score above zero indicates that the plant is more actively engaged in information and knowledge sending activities, and thus it can be categorised as a knowledge-sender (S2, S3, S1), while a negative score

indicates that the plant should be viewed as a primarily knowledge-receiving unit (A3, M3, R1, R3, A1, M1, A2, A4, R2).

Table 1. The position of interviewed plants in the knowledge network

Plant code	Sum of position	Plant code	Sum of position
S2	$2.5+3+3-1-1-1 = 5.5$	R1	$2+1+2-3-3-3 = -4$
S3	$2+3+3-2-1-1 = 4$	R3	$2+1+1-3-3-3 = -5$
S1	$2+1+3-1-1-1 = 3$	A1	$1+1+1-3-3-2 = -5$
M2	$3+3+1-3-3-2 = -1$	M1	$0+1+1-3-2-2 = -5$
A3	$2+2+1-2-2-2 = -1$	A2	$0+0+1-3-0-3 = -5$
M3	$2+1+1-2-3-3 = -4$	A4	$1+1+0-3-3-2 = -6$
<i>(continued in next column)</i>		R2	$1+0+1-3-3-3 = -7$

Sum of position = Total sending/offering score – total receiving score

Thus, to investigate the role of IS in knowledge transfer, we divide our analysis into two parts, the first related to net knowledge sending plants (Table 2), and the second to knowledge receiving plants (Table 3). Interviewees were asked to identify one or two recent knowledge transfer projects and to rate and discuss the role of modern ICT-based IS in supporting knowledge exchange.

Table 2. The role of IS in knowledge transfer at knowledge sending plants

Plant code	Knowledge transfer project	Role of IS	IS support
S1	Product transfer to US plant	<i>Helpful for storing information, but face-to-face meetings and employee exchange were more used.</i>	Partial
	Implementing a production line in a French plant	<i>All necessary knowledge was provided in a common database, but the knowledge intake was refused by French plant</i>	No
S2	Skilling up Polish plant	<i>The common online platform used was helpful, because the high quality of the data introduced.</i>	Yes
	Product transfer to Polish plant	<i>Although an IS was in place for knowledge transfer, it could not be used due to bad data quality.</i>	No
S3	Process introduction in a HU plant	<i>The transfer of crucial knowledge could only be carried out through personal interaction.</i>	No

Interview data indicated that although all knowledge sending plants had multiple, cutting edge IS in place, they were only rarely used. Bad quality of data introduced in the system was one of the reasons mentioned. For some of the projects, IS was simply not used because the complexity of the project required a more intensive face-to-face interaction. The only response supporting the contribution of IS to the knowledge exchange was offered for a project, which was of strategic importance for the company, and thus enough resources were deployed for the proper functioning of the system.

On the other hand, knowledge receiving units generally use IS to support the transfer of knowledge. Compared to knowledge sending plants, in general, they perceive that IS offer much more support for knowledge transfer. Several respondents argued that IS actually represents the first and foremost channel for acquiring knowledge, which is afterwards complemented with face-to-face knowledge sharing.

Both cases where IS was not reported as being supportive for knowledge transfer from the knowledge-receiving manager's perception had bad data issues: for one project (R2, new component manufacturing) the data was mostly missing due to the innovative nature of the product and the time pressure around manufacturing its components, while for the other project (M3, implementation of safety standards) the system had stored high quantities of useful information (hundreds of safety standards), but it was organised in a manner that "required a lot of time to process".

Table 3. The role of IS in knowledge transfer at knowledge receiving plants

Plant code	Knowledge transfer project	Role of IS	IS support
R1	Implementing lean techniques	<i>Online platforms were frequently used to ask experts for best practices</i>	Yes
	ERP implementation	<i>Face-to-face trainings had to be used, only some information was acquired through IS</i>	Partly
R2	New component manufacturing	<i>New product with fast growing sales: knowledge exchange was mainly human-to-human</i>	No
	Implementing an Industry 4.0 project	<i>The project involved a lot of standardised information which were provided through IS.</i>	Yes
R3	Implementing a TPM system	<i>IS was used to transfer project management information from other units with experience</i>	Yes
	Implementing work safety standards	<i>IS was only partly used to receive the new standards and then monitor KPIs</i>	Partly
A1	Inventory reduction	<i>Video conference used to share knowledge on recycling, leading to inventory reduction</i>	Yes
	New product manufacturing	<i>Steps of new product implementation, that was documented and shared through IS</i>	Yes
A2	Changing product „recipe“	<i>For quality HQ decided to change the recipe of a product, sharing a how-to manual through IS.</i>	Yes
	Standardisation of controlling	<i>IS tools helped the HQ to transfer a standardised communication guideline with authorities</i>	Yes
A3	Improving production standards	<i>Sharing documentation and manuals with other plants through IS</i>	Yes
	Improving safety standards	<i>Incremental improvements of safety standards through IS in a periodical manner</i>	Yes
A4	New product introduction	<i>IS helped to transfer new product knowledge from HQ, introduced in the local market</i>	Yes
	Product transfer from Austrian plant	<i>Lack of a common system made hard to exploit the whole facilities and efficiency of IS</i>	Partly
M1	New product manufacturing	<i>A centralised IS was used to transfer knowledge that was fully standardised.</i>	Yes
M2	New raw material introduction	<i>Measures from the intranet portal was used together with experts' support</i>	Yes
	New product manufacturing	<i>Intranet portal was combined with regular meetings on project development.</i>	Partly
M3	Production process improvement	<i>Quality and process related knowledge acquired from central database</i>	Yes
	Implementation of safety standards	<i>Too much time needed to process the overloaded knowledge content in the system.</i>	No

6 Discussion and Conclusion

This paper looked at the role of ICT-based IS in the intra-organisational knowledge transfer within the internal network of manufacturing MNCs. Our results show that, indeed, in most of the cases IS plays a central role in transferring knowledge between different units, which is in line with the mainstream assumptions in IS literature [3, 11]. However, in line with the case findings of Jasimuddin et al. [12], we also argue that the data quality and strategic commitment towards using IS for transferring knowledge is an important precondition. Besides offering further support for previous findings, our results bring important new insights as well. We argue that the role of the plant in the internal knowledge network (i.e. knowledge sender or receiver) has to be also taken into consideration. Our findings show that this distinction can offer at least a partial explanation for the debated role of IS in knowledge transfer [e.g., 19, 20].

Knowledge sending plants in our sample see IS less beneficial for transferring knowledge. We argue that knowledge senders have to transfer complex knowledge “packages”, which contains both codified and tacit knowledge elements. This explanation is in line with the practice-based approach of knowledge transfer put forward by Hislop [10]. Thus, for a successful knowledge sending project, transmission mechanisms that are able to transfer non-codifiable knowledge are absolutely essential, i.e. different forms of personal interactions are more important for sending knowledge.

Knowledge receiving plants, on the other hand, report that IS is helpful in most of the knowledge transfer projects. We argue that in a receiver position, the plant is motivated to find the relevant knowledge for a certain situation or problem. Regardless of the type of the knowledge searched for, the most convenient way to acquire it, is to transfer it through an IS [cf. 11]. If this transfer is not enough, IS-based knowledge transfer was complemented in several cases by face-to-face interactions or trainings. Thus, in contrast to knowledge senders, receiver plants see IS as a primary enabler of knowledge transfer that may or may not be complemented with personal interaction.

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