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A contingency view on knowledge transfer: empirical evidence from the software industry

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Abstract
Reports on failures of knowledge transfer (KT) seriously accumulate. A reason for failure, claimed by contingency theory and strongly supported in other disciplines, is the lack of fit between context and configuration. Assessing the reported failures, we found substantial evidence for this view. Unfortunately, literature on KT explored context and configuration isolated, but largely ignored the fits between both and their relationships to success. Thus, we developed a contingency framework on KT including the above contingency concepts and underlying factors evident in the KT literature. Based on that, we addressed the unexplored relationships between fits and success by case study research in the software industry. In-depth interviews yielded audio-recorded statements for theory building leading to nine propositions. We encourage case study research to reach conceptual closure as well as hypotheses-testing research to achieve empirical validation.
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Introduction: why do knowledge transfer projects fail?

Knowledge is viewed as the 'most strategically significant resource of the firm' (Grant, 1996a) and major source of competitive advantage (Spender, 1994; Szulanski, 1996; Lee & Choi, 2003). Thus, knowledge transfer (KT) is fundamentally important because it makes knowledge usable and exploitable in and outside the company (Davy, 2006; Lin, 2006). With the rise of multinational corporations, coordination and control has become one major field for KT inside the company. Outside, the imperative of providing and protecting knowledge in strategic alliances hints at its importance. The relevance can also be shown by corporate spending on transfer projects such as business skills training, which is predicted to reach $18 billion in the U.S. and $13 billion in Europe by the end of 2006 (HEC, 2003). Despite its importance, companies and researchers alike are increasingly reporting failing KT projects (e.g. DeTienne & Jackson, 2001; Earl, 2001; Gold *et al.*, 2001; Kalling, 2003; Rerup, 2004; Lucas, 2006). Szulanski & Cappetta (2003) go so far to claim that 'efforts to transfer knowledge have had a distinctly modest record of success.' An explanation for failure in general can be the lack of fit between context (i.e. factors the unit under observation cannot influence) and configuration (i.e. factors the unit under observation has to decide upon) as claimed by contingency theory. This has been empirically proven in different scientific fields such as organizational studies and strategic management (e.g. Lawrence & Lorsch, 1967; Zajac *et al.*, 2000). In the KT

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projects reported failed, we found evidence to assume that lacking fits are reasons for failures. Slaughter & Kirsch (2006) observed KT problems in product development of software companies. The investigation revealed that companies frequently employed routine configurations with similar degrees of interactivity. Contexts, however, differed significantly in the location of senders and receivers (same unit and different units) indicating lack of fit. We found further evidence in a study on KT failures in virtual industries (Hasty *et al.*, 2006). Here, homogenous transfer configurations for networked knowledge provision were used in contexts, where receivers possessed heterogeneous experiences or pre-knowledge on the topic. Furthermore, Kanu (2005) showed that KT in higher education from Western to South-Eastern universities collapsed frequently. The description indicated that the employed configurations, or scientific programs, were just copied from Western applications. As cultural context in the south-east in terms of learning attitude or discursive practices differs significantly from the West, resulting lack of fit can be assumed. However, research on KT only explored context and configuration separately, but the fits between both and the subsequent relationships between fits and success were not given significant attention. Therefore, the paper addresses two research objectives. A contingency framework on KT will be developed from theory to build a solid foundation for the first empirical research. Based on that, propositions on the relationships between KT fits and KT success will be formulated. At this, we followed the common practice of exploring new scientific fields by case study research qualitatively and focused on the software industry, where the 'process of interest is transparently observable' (Eisenhardt, 1989). Thus, we prepare the ground for future case study research to reach conceptual closure and hypotheses-testing research to empirically validate the contingency framework and contribute to answer the question – why do KT projects fail and how can enduring success be achieved?

Theoretical background on contingency theory and KT

Describing a new paradigm in organizational research, Pennings (1975) stated more than 30 years ago that 'organizational effectiveness is a function of the goodness of fit or consistency between environmental and structural variables' and highlighted the departure from the 'traditional practice of endorsing or prescribing an ideal, universal type of organization.' Today, countless studies later, the generally formulated assumption of contingency theory, success depends on fits between context and configuration, has been empirically validated in various research settings (Galbraith, 1973; Drazin & van de Ven, 1985; Lewin *et al.*, 2004). For example, researchers tested the fits between environment and organizational structure (Burns & Stalker, 1961; Lawrence & Lorsch, 1967), environment and strategy (Venkatraman & Prescott, 1990; Zajac *et al.*, 2000), or organizational size and specialization (Khandwalla, 1977). In the different settings, the unit under observation was either determined to be the business function, business unit, or the whole corporation (Lewin *et al.*, 2004). Under the concept of *context*, contingency theory subsumes factors the unit under observation cannot influence, but has to take into consideration for decision-processes. As stated by Pennings (1975), these 'factors are beyond the control of the organization' and 'characterized by uncertainty' (e.g. environment). Contrary, the concept of *configuration* entails factors the unit under observation can influence and has to decide upon (e.g. strategy) – notably under the restrictions of contextual factors (Galbraith, 1973). The fundamental concept of *fits* represents specific combinations of these contextual and configurational factors that influence success (Meilich, 2006). As stated by Schoonhoven (1981), 'any way of organizing is not equally effective under all conditions.' *Success* itself is considered to be a desired outcome of decision-processes by the unit under observation (Lewin *et al.*, 2004). Thus, contingency theory does not propose 'simple unconditional associations' between factors but 'complex conditional associations' (Drazin & van de Ven, 1985). These 'multipolar propositions' are empirically tested as 'interactions' between pairs of context–configuration factors and success (Schoonhoven, 1981).

In the last decades, knowledge attracted enormous attention leading to the emergence of the knowledge-based view of the firm. Its representatives consider knowledge as the dominant dynamic capability driving all other competencies and capabilities. Accordingly, it has been hypothesized that 'performance differences between firms are a result of their different knowledge bases and differing capabilities in developing and deploying knowledge' (Bierly & Chakrabarti, 1996). In the scientific debate, there is a broad agreement on the fundamental role of KT or knowledge sharing for developing and deploying a firm's knowledge base. Several definitions of KT have been employed in the literature so far. Very commonly a generic sender–receiver knowledge-exchange definition has been installed (Lin *et al.*, 2005). For example, KT is 'the process through which one unit is affected by the experience of another' (Argote & Ingram, 2000). Szulanski (1996) especially hints at the importance of the receiver identity for KT. Both receivers and senders have been approached on different conceptual levels (e.g. firm, unit, individual). Other researchers expanded this definition by explicitly incorporating the channel (e.g. electronic networks, print documentation) as carrier of knowledge (Schulz, 2001) and demanding subsequent knowledge usage by the receiver as a constituting element of KT (Darr & Kurtzberg, 2000; Inkpen & Tsang, 2005; Ko *et al.*, 2005). We follow these expanded views by defining KT as transfer of *knowledge* from a *sender* over a *channel* to a *receiver* so that it is learned and used.

A contingency framework on KT as theoretical foundation for empirical research

We will now address our first research objective by developing a contingency framework on KT. Our process of framework development started with the derivation and definition of fundamental concepts and relationships from contingency theory. As described in the previous chapter, context, configuration, fits, and success represent the major concepts, as well as fits and success constitute the relationships under observation. Afterwards, we applied contingency theory on KT by identifying KT-specific factors for each of the above concepts in the literature on KT. We qualitatively scanned scientific publications concerned with KT from the fields of knowledge management, strategic management, international business and information systems for factors matching the contingency concept definitions. For clarity reasons, we finally structured the identified factors within the context and configuration concept by the above-described KT objects' sender, receiver, channel, and knowledge. The developed contingency framework is shown in Figure 1 and will be discussed in detail.

KT context

Sender- and receiver-related contextual factors

The *geographical dispersion of senders and receivers* addresses the spatial distance KT has to overcome. In today's business environment dispersion ranges from global to local (Sapsed *et al*., 2005). Benaroch (1996) shows in an investigation of KT in the mass customization of knowledge-intensive products and services that location of senders and receivers has to be carefully taken into transfer planning consideration. Especially, transfer mechanisms from headquarters to subsidiaries (Gupta & Govindarajan, 1991) and formalization of the underlying processes (Malik, 2001) should be adjusted to the spatial positions of KT participants. Zander & Kogut (1995) observe that increasing spatial distance between sender and receiver limits teachability of knowledge and hence increases time of transfer. Moreover, firms need to develop a clear notion on how many potential targets have to be involved in transfer initiatives. This factor is frequently referred to as *number of receivers* in the literature (Spender, 1994). Investigating learning technologies, Bates (2001) shows its significant influence on media selection decisions. One paper mentioned *time pressure for conducting transfer* perceived by receivers as another contextual factor (Salas *et al*., 2002). Managers should develop a deep understanding on how fast KT has to occur because it makes a fundamental difference if the group of receivers runs on adrenaline or is laid-back. Also related to temporal conditions of transfer, the *flexibility needs of receivers* were discussed in the literature. This factor touches the issue of demanded changes for scheduled transfer times by the receiver. One study reports that structural mechanisms of transfer between headquarters and international joint ventures vary with the flexibility needs of receivers (Lyles & Salk, 1996). In their works, Szulanski (1996), Grant (1996b), and

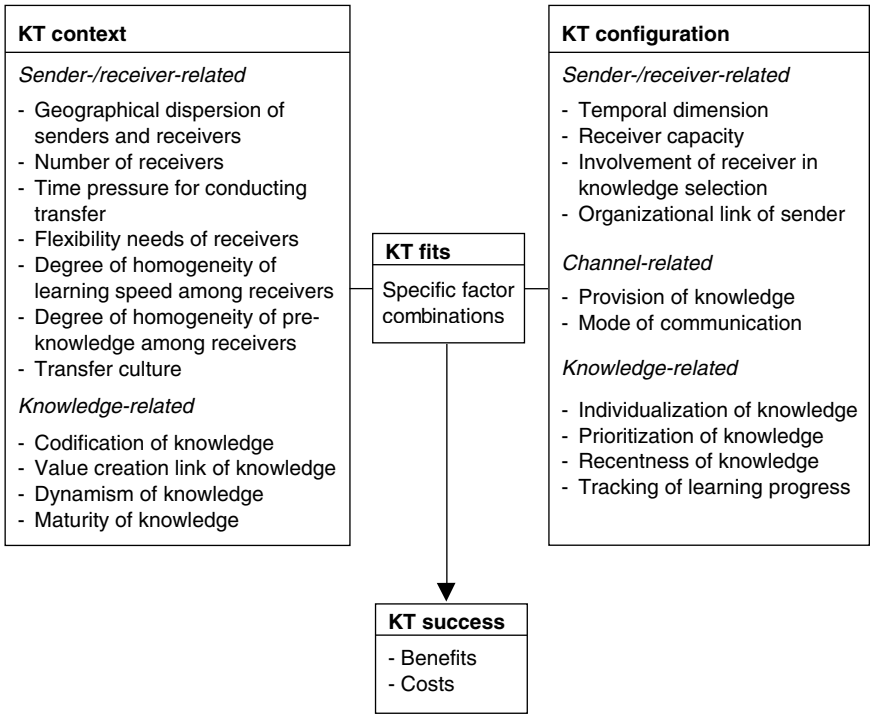

Figure 1 Contingency framework on KT.

Mowery *et al*. (1996) introduce the *degree of homogeneity of learning speed among receivers* or 'absorptive capacity' into the discussion on KT context. It reflects 'the ability to assimilate and replicate new knowledge' (Chen, 2004) or stated in another way 'the ability for a recipient to listen, respond to messages quickly, and to be attentive' (Ko *et al*., 2005). There is broad consensus in the literature on its vital role as KT impediment (Chen, 2004). In a related discussion, light was shed on the *degree of homogeneity of pre-knowledge among receivers* (Lyles & Salk, 1996; Bontis *et al*., 2002). The factor gives an indication on how differences in the 'depth' of current knowledge bases or cognitive maps among receivers shape KT context (Szulanski *et al*., 2004). Armbrecht *et al*. (2001) discuss *transfer culture* (referred to in a broader sense as organizational culture) by studying drivers, metrics, and enablers of KT in R&D. In general, transfer culture hints at company values, which either support or impede KT (Jarvenpaa & Staples, 2001), and thus creates the context for social interaction (Karlsen & Gottschalk, 2004). It represents one of the most vigorously discussed contextual factors in recent times (Abou-Zeid, 2005; Peltokorpi, 2006) and incorporates the concepts of trust (Inkpen, 1996; Szulanski *et al*., 2004; Ko *et al*., 2005) and social ties (Inkpen & Tsang, 2005; Wang *et al*., 2006).

Knowledge-related contextual factors

The widely applied distinction between tacit and explicit knowledge can be traced back to the factor *codification of knowledge*. Tacit knowledge is personal, context-specific and therefore hard to formalize while explicit knowledge refers to knowledge that is transmittable in formal, systematic language (Nonaka & Takeuchi, 1995). Swap *et al*. (2001) highlight the importance to analyze the codifiability of knowledge before deciding on traditional KT configurations such as mentoring and storytelling. This contextual relevance has also been acknowledged by Zander & Kogut (1995) remarking that tacit knowledge limits speed of transfer and Molina *et al*. (2004) arguing that explicit knowledge certified by the ISO 9000 standard positively impacts transferability. Chen (2004) pleads that the degree of explicitness of knowledge should be especially taken into consideration when deciding on the alliance form for transfer (equity based *vs* contract based). Another knowledge-related factor was brought into discussion by Davenport *et al*. (1998) in an analysis of successful knowledge management initiatives. The so-called *value creation link of knowledge* addresses the location of knowledge usage in a firm's value chain. Firms are advised to carefully assess if they will transfer knowledge from primary processes (e.g. production) or secondary processes (e.g. purchasing) in the planning phase of each KT project (Castro & Neira, 2005). Investigating transfer failures, Fahey & Prusak (1998) shed light on the factor *dynamism of knowledge*. According to their observations, firms frequently miss to thoroughly answer the question how fast changes in the knowledge base are likely to occur before starting the transfer. The last contextual factor we were able to identify in the literature is the *maturity of knowledge*. It refers to the status of knowledge in its life-cycle. Studying the context of a construction firm's global KT system, Kudyba (2005) emphasized that it makes a fundamental difference for later configuration decisions if knowledge to be transferred is fresh or consolidated by experience.

KT configuration

Sender- and receiver-related configurational factors

What does literature tell us about the concrete KT configuration decisions influenced by the previously established context? A frequently mentioned configurational factor is the *temporal dimension* of transfer. Firms have to decide coherently how to synchronize receivers and senders in time. Enders & Hutzschenreuter (2003) show that in internet-based management education, knowledge can be delivered synchronously in live lectures or asynchronously by remote access to recorded sessions. A similar distinction is made by a study on strategic trends in electronic learning (e-learning) (Leary, 2001). Kudyba (2005) stresses the importance of online chat networks and informal networks of correspondence involving communities of practice for synchronous configurations. With the so-called *receiver capacity*, we identified another configurational factor in the literature. KT project teams need to determine how many receivers can be served by the configuration at most. Classroom trainings impose a clear receiver restriction whereas online trainings are highly scaleable (Bates, 2001). In a study on knowledge re-usage and repositories, Markus (2001) elaborated on the factor *involvement of receiver in knowledge selection*. Firms face the decision if and to what extent an assessment of receiver needs should be done during the selection of knowledge for transfer. Observing contingency effects in training, Newstrom & Lengnick-Hall (1991) recommend the usage of manageable questionnaires for this purpose. Finally, our literature analysis uncovered the factor *organizational link of sender* in a firm's value chain. KT configurations may either locate the responsible person/unit for KT in a primary process (e.g. production) or in a secondary one (e.g. purchasing) (Hutzschenreuter, 2002).

Channel-related configurational factors

With regard to the channel design of transfer, firms face the fundamental question of how knowledge should be provided. Changchit (2003) narrows the alternatives of *knowledge provision* to network based or traditional and touches the concepts of infrastructure, access, and connectivity. Other studies focus on fine-grained distinctions within each of these alternatives (Davenport *et al*., 1998; Agarwal *et al*., 2004; Karlsen & Gottschalk, 2004). For example, Buckley *et al*. (2005) show different levels of social knowledge provision by expatriate managers in China. The role of storytelling as traditional form of knowledge provision was discussed by Connell *et al*.

(2004). In our further analysis, we identified a second channel-related factor in the literature. *Mode of communication*, also known as transfer control or interaction, refers to the degree of interactivity between sender and receiver during the KT process (Hutzschenreuter, 2002). Inkpen (1996) sheds light on the importance of different modes of communication for KT in strategic alliances. Tsai & Tsai (2005) contrasts direct instruction and interaction as extremes on a decision spectrum of interactivity.

Knowledge-related configurational factors

Several decisions have to be made when configuring knowledge for transfer. Leary (2001) shows that firms can employ different degrees of *individualization of knowledge*. Other studies touched this factor under the terms of personalization or customization. The challenges in mass-customizing knowledge-intensive products and services were described by Benaroch (1996). Moreover, there is significant evidence that *prioritization of knowledg*e constitutes a configurational factor. Firms have the possibility to classify knowledge by importance (Davenport *et al*., 1998; Glazer, 1998). These priority areas are sometimes described as 'must know' or 'nice to know.' Kudyba (2005) observed that knowledge team members prioritized available knowledge resources by the demand for these resources. Configurations additionally need to address the factor *recentness of knowledge*. KT project teams may define the pace of change in the knowledge base before starting the transfer (Armbrecht *et al*., 2001). Pantazis (2002) shows that high recentness of knowledge can be one major advantage of e-learning configurations. The last knowledge-related factor we have identified in the literature is the *tracking of learning progress*. It indicates whether a firm provides the receiver with mechanisms to document learning advancement (e.g. self-test, certification) (Pantazis, 2002; Salas *et al*., 2002).

KT fits

In words of contingency theory applied to the transfer of knowledge, KT fits are *specific combinations of contextual and configurational factors* that influence KT success. Past research on KT has tended either to exclude success from the scope of studies or to investigate the influence of context and configuration on success isolated. Thus, we only uncovered a very limited number of KT fits in the literature. Chen (2004) postulates that KT configurations linking the sender over equity-based alliances are more successful than those with a loose contract-based alliance link, if the codification of knowledge is low. In many cases, especially knowledge characterized with a low degree of codification is firm-specific and success-critical. Alliances, in which both partners hold equity contributions, limit barriers to transfer this kind of knowledge as they constitute long-term relationships. Another KT fit incorporating again the contextual factor codification of knowledge was formulated by Levin & Cross (2004). KT configurations with a high interactivity mode of communication are more successful than those with low degrees of interactivity after the codification of knowledge has passed a certain threshold of tacitness. Tacit knowledge entails insights, intuitions, and beliefs that are tightly intertwined with the experience of the sender. Such knowledge is subjective and difficult to articulate. Interactive modes of communication allow the receiver to ask questions and thus enhance mutual understanding. Levin & Cross (2004) measured fits as 'interactions' by multiplying the factor-underlying measures.

KT success

The fundamental reference point of our contingency framework is KT success. As said before, to our knowledge only a very limited number of studies have addressed KT success so far. What we can learn from past research is the distinction between a benefit and cost factor of KT success. The *benefits* were conceptualized as degrees to which the firm acquired the targeted knowledge and to which the acquired knowledge contributes to the firm's technology development, new product development, human resource quality, and production efficiency (Chen, 2004; Molina *et al*., 2004; Inkpen & Tsang, 2005; Ford & Staples, 2006). The *costs* were approached over expenses for planning, conducting, and post-processing of KT (Bates, 2001; Jones, 2001) and reflect 'project efficiency in terms of time and budget' (Levin & Cross, 2004). Based on this conceptual understanding, a KT configuration is regarded as successful if the monetarily valued benefits of KT exceed the costs associated with it (Szulanski *et al*., 2004).

In summary, our contingency framework on KT includes the contingency theoretical concepts context, configuration, fits, and success. For each concept, we identified KT-specific factors from KT literature. Rich insights emerged on KT context, 11 factors ranging from geographical dispersion of senders and receivers to maturity of knowledge and KT configuration, 10 factors running from temporal dimension of transfer to tracking of learning progress. Little evidence was found on KT fits, as specific combinations of contextual and configurational factors, and KT success. To our knowledge, only two fits in the substantial space of possible fits have been explored. With regard to KT success, only the distinction of a cost and benefit factor became evident. Therefore, we will now follow the common practice of exploring new topic areas, here the relationships between KT fits and KT success, by case study research in the software industry on the foundation of our contingency framework.

Exploration of relationships between KT fits and KT success by case study research in the software industry

As described previously, the relationships between KT fits and KT success represent a novel scientific field. Although we know from literature what contextual and configurational factors have to be taken into consideration (see our framework for these *a priori* specifications), we almost not

know what specific factor combinations constitute KT fits that influence KT success. According to Eisenhardt (1989), case study research is 'especially appropriate in new topic areas' and strongly supports 'theory building.' Thus, we decided to employ case study research following the widely applied process presented by Eisenhardt (1989) without – most importantly – predefining any possible relationships between KT fits and KT success. As results of the case study process, our propositions address the second research objective.

Sample

As noted by Eisenhardt (1989) and supported by Yin (1984), 'given the limited number of cases which can usually be studied, it makes sense to choose cases such as extreme situations and polar types in which the process of interest is transparently observable.' Software companies produce knowledge-intensive services (Harrigan & Dalmia, 1991) with short life-cycles (Argyris, 1991; Pakirh, 2001) and thus KT to internal (e.g. sales, R&D staff) and external (e.g. consultants, customers) receivers (Moenaert & Deschoolmeester, 1992) is fundamentally important (Mohrmann & Von Glinow, 1990; Pakirh, 2001; Rogers, 2001). Based on that, firms conduct a universe of KT projects each year and are quite open-minded for research initiatives. Thus, we chose the German software industry as a cornerstone for empirical research on the subject. As usual in case study research, the sample was selected theoretically. We started with a list provided by Creditreform, one of the most important business information services in Germany, including listed and non-listed German software companies (German industry code: KA722) in 2003 ($n = 427$). From this group, we included companies covering a broad spectrum of software companies in terms of size, internationalization, and diversification to isolate 'theoretical useful cases' (Eisenhardt, 1989). The target sample included 44 companies. We contacted each and asked for KT responsible persons mainly located in the HR, IT department, or specialized KT units such as corporate universities and education departments. In case we were able to identify a person, we asked to conduct a case study on a KT project of the company. Fifteen companies agreed to participate in our empirical study. The other firms refused because (a) of internal guidelines not to participate in research projects ($n = 14$), (b) no KT project could be identified ($n = 2$), (c) no time/capacities were available ($n = 5$), and (d) confidentiality concerns could not be resolved ($n = 8$). From the 15 companies interviewed, four companies rejected to answer our unstructured core questions (see data collection), although interview contents were outlined before. Thus, 11 cases will be analyzed and discussed in the paper.

Data collection

The empirical research was carried out in summer 2004. We set up interviews with a minimum of two companies' KT project team members at a case location. The respondents were deeply involved in the KT projects right from the beginning and knew the project in its different facets. We required a minimum of two project team members to control for differences in the perceived characteristics of KT. Each interview was conducted by one researcher, who asked questions and audio-recorded the statements. By this, we ensured that respondents were not overstrained by multiple interviewers and recorded data can be analyzed by all members of the research team later on. The different perspectives of multiple investigators 'increase the likelihood of capitalizing on any novel insight which may be in the data' and 'enhance confidence in the findings' (Eisenhardt, 1989).

Qualitative in-depth interviews were conducted semi-structured for two reasons (Kreiner *et al.*, 2006). A *structured* part was needed to raise the attention of respondents to the contextual and configurational factors derived from literature and incorporated in the contingency framework. The structure-building approach introduces proven theoretical insights by discussion, enhances intuition, develops common language, and delineates the exploration space of the novel field under observation. At this, we verbally presented each factor and subsequently asked the respondent 'to describe evidence of the factor in the own KT project' as a preparing act. Based on that, the *unstructured* core part of the interview was required to deeply dive in the exploration of the relationships between KT fits, as specific combinations of the pre-structured contextual and configurational factors, and KT success. Following a common procedure in case study research (e.g. Kreiner *et al.*, 2006), we used a broad and open-ended question to receive deep insight on the novel subject. We asked the respondents 'to discuss reasons for success and failure of the own KT project in terms of benefits and costs.' The subsequent discussion between KT project team members was neutrally moderated by the interviewer. At the end of data collection, we transcribed the tape-recorded respondent statements from all cases, which represented the qualitative data for our analysis.

Case analysis and propositions

To enhance familiarity with each case as a stand-alone entity, we start by giving important background information from the structured interview part in Table 1 before analyzing the unstructured core part for proposition development.

In the derivation of propositions from our unstructured core data, we faced the reality that people are strongly influenced by the vividness (Nisbett & Ross, 1980) or elite respondents (Miles & Huberman, 1984) and tend to misleadingly discard disconfirming evidence (Nisbett & Ross, 1980). To limit these biases and thus to enhance the likelihood of building empirically valid propositions from the data, we looked for congruencies and contradictions across cases (Eisenhardt, 1989). Our approach follows the logic of replication by using each case to confirm or disconfirm propositions (Yin, 1984). Therefore, we took

Table 1 Case presentation

Case	*LEXIUS*	*DELTA*	*META*	*TERRA*	*HEPTA*	*OMEGA*	*WITA*	*ALPHA*	*KAPA*	*STRADA*	*ZONTA*
Founding	1985	1997	1997	1995	1989	1984	1981	1979	1980	1989	1983
Ownership	Ltd.	Ltd.	Ltd.	Inc.	Ltd.	Inc.	Inc.	Inc.	Inc.	Inc.	Ltd.
Sales (in Mio. €)	100–200	50–100	500–700	300–400	700–900	1500–2000	1200–1500	500–700	400–600	700–900	50–100
Products	Games	Anti-Virus	OS	CAD	SCM ERP CRM	SCM	SCM ERP CRM	Office software	CRM	SCM ERP	Middle ware
Regions	Global	Home	Global	Global	Global	Global	Global	Home	Home	Global	Global
Back-ground	Innovation strategy	Customer acquisition	Training on the job	Rapid international-ization	Integration of CRM specialist	Strategic alliance	Quality program	Sales information campaign	Distribution reorganisation	HR development initiative	Procurement efficiency project
Context: receivers	Game designers	Private households	New accounting staff	German sales/service staff	Implementation consultants	Boards	Production employees	Subsidiary sales forces	Partner consultants	Middle management	Local procurement managers
Context: senders	Frequent players	Production department	Education unit	External instructors	Consulting department	Boards	Production department	Marketing department	Production unit	HR department	Procurement department
Context: knowledge	Game ideas and concepts	Security features of software	Accounting knowledge	Languages (negotiation technology)	Fragmented CRM documentation	Alliance development	Production process standards	New office software USPs	Implementation standards	Career options and implications	Material specifications
Configuration: title	Brain-storming session	Download platform	Controller course	Language workshop	Learning interface	Digital video conference	Process standard system	Virtual classroom	Consultant extranet	Career week	Procurement system
Configuration: channel	Class-room	Internet	Classroom	Classroom	Intranet, VPN	Secure satelite line	Intranet	Internet	Extranet	Classroom	Intranet
Configuration: knowledge	Flip charts	HTML	Task summary	Scripts	PDF PPT	Protocols	PDF	Summary e-mail	PDF PPT	Career plan	MS Excel

each statement made by the respondents on the relationships between KT fits and KT success, and searched for congruencies or contradictions in the other cases. We detected congruencies on six relationships, which we summarized in our propositions P_1 to P_6. Furthermore, we identified six relationships with only one observation. Despite no replication could be applied, we formulated our propositions P_7 to P_9 on three of them since we found strong reasoning. The other relationships were not addressed in proposition formulation as well as three additional relationships with evident contradictions across cases. For example, statements from the WITA case revealed serious contradictions to initially formulated propositions leading to their subsequent abandoning in the process of case analysis.

Flexibility needs and temporal dimension

We derived our first proposition from congruent evidence in three cases. META, a global provider of operating systems for business applications, accomplished a KT project in the accounting department. New accounting employees were institutionally trained on the job. Instructors from the education department conducted the so-called classroom sessions within the corporate headquarter and delivered task-specific knowledge. Multiple comments from the project team hinted at a high goodness of fit between the synchronous transfer mode (i.e. instructors and trainees meet at a specific point in time) and the low flexibility needs of trainees. The project leader told us: 'our turnout rates in the classroom – the essential learning pre-condition – were consistently high as our trainees have rigid schedules and no conflicting appointments.' In the case of TERRA, a global computer added design (CAD) producer, the temporal dimension was designed analogically but the flexibility needs differed distinctively. TERRA launched a KT project to execute its rapid internationalization. German senior sales and service employees were trained on major international languages in workshops over 1 year. The knowledge included fine-grained negotiation and technology vocabulary, grammar, and pronunciation. TERRA had to acknowledge during the interview that synchronous transfer diminished KT benefits as the high flexibility needs of senior sales and service people were not addressed sufficiently. Many of them 'frequently missed workshops' or 'left the room to receive customer calls.' In the case of HEPTA, we found evidence that high flexibility needs can be better managed with asynchronous KT. In the project under observation, HEPTA organized the transfer of functional knowledge on the recently released CRM flagship product to their ever-busy implementation consultants. Knowledge included fragmented IT documentation. The project team configured an e-Learning Interface operated directly from the consulting department. HEPTA draws a positive picture of the project's success. On the benefit side, there was a broad agreement that consultants were sufficiently able to introduce CRM at the customer after transfer. The reasons were manifold. One manager responsible for knowledge packaging commented: 'Because of enormous flexibility demands it was important to provide access to a download platform over the intranet so that consultants were able to learn whenever they had time.' Moreover, he praised the 'coordination costs of zero,' which would otherwise be very high for synchronous transfer with consultants.

Our case evidence supports the notion that in KT contexts shaped by high degrees of flexibility needs, asynchronous KT configurations have a benefit advantage against synchronous configurations because they allow for self-determinable transfer times. Asynchronous configurations decouple senders and receivers in time and, thus, enable receivers to determine when they want transfer to take place. Moreover, it seems that asynchronous configurations possess a cost advantage against synchronous ones as they generate lower coordination costs. However, at decreasing levels of flexibility needs, the benefit advantage is likely to erode. Thus, we propose that:

P_1: *Asynchronous KT configurations will be more successful than synchronous ones after the degree of flexibility needs has passed a certain threshold.*

Geographical dispersion of senders and receivers and provision of knowledge

Based on congruent empirical evidence in three cases, we developed our second proposition. In the interview with the game software provider LEXIUS, we received statements on a misfit between distributed receivers and not-networked KT. LEXIUS conducted a KT project within their overall innovation strategy. In order to generate ideas for the design team, which should flow into the development of new blockbuster-games, frequent players were asked to participate in brainstorming sessions. During these workshops, taking place in hotels of major international cities, trends in gaming areas such as strategy, business simulation, and action were discussed and captured on flip charts. The head of design commented self-critically: 'the costs of our traditional face-to-face provision of knowledge in many cities all over the globe have been a real burden for the project.' Because of the dispersed players, he intends to switch to 'live internet brainstorming sessions' in the next projects. In our above-described TERRA case, however, comments on traditional, not-networked knowledge provision were very positive because the receiver group of sales and service personnel was centralized in the headquarter. A manager from the corporate university department mentioned: 'benefits from face-to-face communication and low infrastructure costs.' In our OMEGA case, we observed a good fit between distributed receivers and networked knowledge provision. After having established an important strategic alliance, OMEGA conducted a KT project aiming at providing both management boards with a platform for sharing alliance development

information. OMEGA's management board was located in the German headquarter whereas the partner's board was working in the U.S. The board assistants, responsible for the project, decided to employ a monthly digital video conference with two fully equipped conference rooms and a secured satellite connection. The assistant of OMEGA's CEO commented: 'The financial expenses associated with the project were lower than expected as the boards did not have to travel.' Also concerns on the appropriateness of 'new economy methods' in a traditional environment were unjustified since KT would have been 'very effective.'

Thus, case evidence tells us that if geographically distributed receivers and senders characterize KT contexts, high transportation costs (e.g. flight tickets) arise to bring them together, or to send them the knowledge by not-networked transfer. Networked configurations deliver knowledge virtually with transportation costs close to zero. Nevertheless, fixed network infrastructure costs have to be taken into consideration if no existing infrastructure can be used for free. The cost advantage of networked configurations exceeds the benefit disadvantage due to slightly higher decision-maker's willingness to pay for not-networked ones. A phenomenon well known in the new economy (Shapiro & Varian, 1999). Nevertheless in KT contexts shaped by centralized receivers and senders, the cost advantage of networked configurations will decrease and thus is not able to make up for the benefit disadvantage. Thus, we propose that:

P_2: *Networked KT configurations will be more successful than not-networked ones after the degree of geographical dispersion of senders and receivers has passed a certain threshold.*

Time pressure and tracking of learning progress

We developed our third proposition based on congruent evidence from four cases. In the case of TERRA, which transferred language knowledge to sales and service employees to support internationalization, one reason for the overall KT success was stated to be the certification program because it 'enforced participation under high time pressure.' Supporting this view, the accounting director in our META case attributed failure of the above-described KT project to the inexistence of 'performance tests,' which would have enhanced 'learning motivation' in a situation where 'fast learning is indispensable.' We found more evidence in the case of DELTA, an anti-virus software firm, which exclusively serves the German market. Its business model requires the transfer of security codes via the internet to private households. DELTA customers make an initial download of the program and afterwards updated files are automatically detected and installed. The marketing director hinted at the importance of download progress tools for success. In a 'busy internet environment,' many customers would only activate the update button if download time is indicated. In the STRADA case, time pressure was very different and so was the successful configuration of tracking of learning progress. Within the scope of an HR development initiative, STRADA arranged an annual career week for middle management in the Swiss Alps. Apart from the stress of daily business, managers were introduced to career options and implications, and career plans were developed in one-by-one meetings. The program head told us that expensive material related to the tracking of learning progress has been used for several years. In the last two career weeks, the material was completely removed because 'in a relaxed working atmosphere people taking notes and documenting their learning progress pretty well by themselves. The money we had spent on the material just was not worth it.'

Based on our empirical evidence, the following relationship seems to be likely. In cases where KT contexts are shaped by high-time pressure, KT configurations enabling tracking of learning progress have a benefit advantage compared to those not enabling tracking because they support faster learning by reducing introduction times and redundancies as well as enhancing learning motivation. Most likely, the benefit advantage against configurations not enabling tracking outbalances the cost disadvantage associated with higher knowledge packaging costs. Contrary at decreasing levels of time pressure, the cost argument becomes relatively stronger and tracking tools should be increasingly avoided. Thus, we propose:

P_3: *KT configurations enabling the tracking of learning progress will be more successful than not-enabling ones after time pressure has passed a certain threshold.*

Value creation link of knowledge and organizational link of sender

From congruent observations made in four cases, we derived our fourth proposition. In our META case, in detail explained above, the project failed after 2 years in operation. According to multiple comments, this was caused largely by the inability of instructors to transfer the knowledge, which was truly needed in the accounting department. The accounting director told us: 'How should people from the education unit know, what my people here need at hand?' A senior education manager admitted difficulties in identifying and articulating 'peripheral accounting knowledge' and 'department-specific routines.' We obtained critical comments in a similar direction from ALPHA, which transferred sales argumentation (e.g. unique selling propositions) for their new office software from the central marketing department to each subsidiary sales force in virtual classrooms. A subsidiary head commented on the success of the project: 'The whole thing was a disaster. Our marketing bureaucrats in the headquarter have no idea what our sales people at the sharp end need to sell a product. Thus, we ignore what they are telling and organize our own local sales trainings.' In the OMEGA case, where alliance information has to be transferred between the two

company boards, it was positively commented that from every division, where alliance information emerged, the responsible division head participated in the discussion. This good fit was referred to as 'claim for identity in organizational origin of knowledge and sender.' Members of the project team in the ZONTA case, concerned with transfer of material specifications from the procurement department to local purchasing managers, would have agreed to this claim. They attributed large proportions of the successful transfer to the 'tight and productive working relationships between internal and external procurement employees.'

Based on the case evidence presented above, it seems to be likely that if a direct value creation link of knowledge (i.e. knowledge used in primary value chain functions such as production) exists, configurations linking the sender directly to value creation by placement in primary value chain functions have a benefit and cost advantage against configurations linking the sender indirectly over secondary value chain functions (e.g. HR). The reason for this is that they can use existing routines for transfer between primary functions and they can easily access the function-specific knowledge. KT configurations linking the sender indirectly are causing knowledge selection problems and frictions. Prior argumentation holds also in reverse direction. If knowledge is indirectly linked, a sender anchored in secondary value chain functions is appropriate. Thus, we propose that:

P_4: *KT configurations linking the sender directly to value creation will be more successful than indirectly linking ones if the value creation link of knowledge is direct.*

Codification of knowledge and mode of communication

Based on congruent evidence in four cases, we developed the fifth proposition. In our LEXIUS case, concerned with the idea transfer for game software between players and designers in brainstorming workshops, the project team was very satisfied with the richness of applicable ideas received and attributed this success to their decision of using a highly interactive mode of communication and involving receivers (i.e. game designers) in knowledge selection to grind out and catch the player's extremely tacit knowledge. From the OMEGA case, covering the transfer of alliance information between two management boards in digital video conferences, we obtained similar comments. The assistant of OMEGA's CEO stated: 'we realized fast mutual understanding, despite of the highly experience-based knowledge, by ensuring interactivity.' In a contrary context characterized by a high codification of knowledge, DELTA praised the KT success on the cost as well as benefit side achieved by a non-interactive KT configuration. The CIO stated: 'nothing is cheaper and more effective than the transfer of 100% explicit security-codes to a great audience over a one-way network. You need no expensive feedback, when nothing has to be explained and – most notably – the marginal costs of knowledge provision to additional receivers approach zero.' Similarly, the project head of KAPA, concerned with the transfer of CRM software implementation standards from production unit to partner consultants over the Extranet, lauded the 'real nice cost–value ratio of one-directional transfer for implementation standards in PDF format.'

Concluding, there is a significant likelihood that in KT contexts shaped by low degrees of codification of knowledge (i.e. tacit knowledge), interactive configurations possess a benefit advantage against non-interactive configurations since they are allowing for feedback loops and thus can step-by-step transfer components of the sender's tacit knowledge. For example, receivers are able to ask questions or to demand demonstrations. The benefit advantage against non-interactive configurations outbalances the cost disadvantage stemming from higher communication costs. With increasing levels of codification (i.e. explicit knowledge), the benefit advantage of interactive configurations decreases and non-interactive configurations become more and more favorable. Consequently, we propose that:

P_5: *Interactive KT configurations will be more successful than non-interactive ones after the degree of tacitness of knowledge has passed a certain threshold.*

Dynamism of knowledge and recentness of knowledge

Four cases provided us with congruent insights to derive our sixth proposition. The interview with DELTA, transferring update codes for anti-virus software over the internet, yielded one statement on the suitability of configurations securing high recentness of knowledge for dynamic knowledge environments. The head of marketing stated his position that fast update-cycles would be success-critical in the anti-virus business because 'hackers do not sleep' and 'valid programs become outdated overnight.' He added: 'some of our competitors underestimated this must-requirement and were forced out of business.' Evidence in a similar direction was expressed in the HEPTA case covering the transfer of functional knowledge on a recently released CRM flagship product to its implementation consultants over an e-learning interface. The consulting department director highlighted: 'the helpfulness of daily update routines for addressing the frequent changes in our CRM software codes.' Our case company ZONTA found itself in very different situation. In an efficiency project, the procurement department transferred material specifications to local purchasing managers over the intranet. The project manager told us: 'as our sourcing material only changes after several years, we decided to update our specification database cost-efficiently once a year and thus were successful not only in terms of benefits but also in terms of costs.' In the LEXIUS case, covering transfer of game ideas from frequent players to the design department in face-to-face brainstorming sessions, we received another statement on the cost dimension of KT success: 'Fortunately, we only need to conduct workshops every second year since game development is a time-

intensive task. Otherwise, we would hardly be able to meet our budget.'

Consolidating the evidence, we expect that in KT contexts with high dynamism of knowledge configurations with high degree of recentness of knowledge have a benefit advantage against configurations with a low degree of recentness because they communicate knowledge changes more frequently to receivers. We assume that the benefit advantage against configurations with a low degree of recentness exceeds the cost disadvantage arising from updating the knowledge base. However, if dynamism of knowledge decreases, suitability of configurations with irregular knowledge-update mechanisms increases.

P_6: *KT configurations with high degrees of recentness of knowledge will be more successful than low-degree ones after dynamism of knowledge has passed a certain threshold.*

Number of receivers and individualization of knowledge

For our seventh proposition, we built upon evidence from the HEPTA case. Transfer of functional knowledge for the acquired CRM software from the headquarter to HEPTA's implementation consultants by an e-learning interface has been evaluated as a success story. Consultants were able to implement the software at the customer and project costs were on a very acceptable level. One important building block of success, the responsible IT manager told us, was the 'right customization of knowledge for the given number of consultants.' Based on a survey of CRM pre-knowledge conducted with all receivers, the project team decided to individualize knowledge in two categories 'CRM-experienced' and 'CRM-inexperienced.' Thus, the IT manager added, 'we were confident that we addressed important knowledge differences for transfer.' The consulting department director endorsed that higher degrees of individualization in three categories would have been 'wishful' because of the 'substantial number of receivers,' but the 'additional costs were not acceptable.'

When we put the HEPTA evidence in general terms, it seems to be reasonably likely that in KT contexts with high numbers of receivers, configurations with a high degree of individualization of knowledge have a benefit advantage against low-degree ones since they address heterogeneous knowledge needs in the receiver group by delivering role-specific knowledge. We assume that the benefit advantage against low degree of individualization configurations outbalances the cost disadvantage associated with higher knowledge adjustment and packing costs. Nevertheless, at decreasing numbers of receivers the cost factor becomes inevitably stronger. Thus, we propose that:

P_7: *KT configurations with high degrees of individualization of knowledge will be more successful than low-degree ones after number of receivers has passed a certain threshold.*

Time pressure and individualization of knowledge

Following up the HEPTA case, we also derived our eighth proposition from this case evidence. Another building block for HEPTA's KT success, delineated by the project team, was the goodness of fit between time pressure and the above-described individualization of knowledge. In several comments, interviewees stressed that individualization was especially important due to the 'time-demanding task environment of our consultants.' The responsible IT manager stated 'we were able to deliver basic software principles in a targeted fashion to inexperienced consultants without forcing experienced ones to spend time on these contents.' A statement by the consulting director further supports the argument. 'Every minute saved by redundancy-avoiding transfer is a salvation for my consultants, but unfortunately it is also a cost driver in the phase of knowledge packaging.'

Concluding, we expect that if time pressure is high, configurations with high degrees of individualization of knowledge have a benefit advantage compared to low degree of individualization configurations as they reduce the time for transfer of selective unimportant knowledge for an individual or specific target group by delivering role-specific knowledge. We assume that the benefit advantage against low degree of individualization configurations exceeds the cost disadvantage associated with higher knowledge adjustment and packing costs. However, with decreasing time pressure low individualizing methods become more and more appropriate. Consequently, we propose that:

P_8: *KT configurations with high degrees of individualization of knowledge will be more successful than low-degree ones after time pressure has passed a certain threshold.*

Degree of homogeneity of learning speed among receivers and mode of communication

Based on case evidence from TERRA, which launched a KT project to execute its rapid internationalization, we developed our last proposition. German sales and service employees were trained on major international languages in workshops over 1 year. One statement of the chief strategist from the corporate planning department hinted at a relationship between the fit of degree of homogeneity of learning speed among receivers and mode of communication and KT success: 'Our staff significantly improved the language skills for daily business – we now have a clear voice to our international customers. In my view, the main success driver was the implementation of an interactive workshop format, which catalyzed the strong differences in learning abilities.' According to him, the learning speed especially of senior and junior staff was 'incredibly mixed.' Thus, the workshops with three attendant instructors 'worked well to receive and encounter feedback on KT pace.' Nevertheless, he was 'surprised by the costs of interactivity.'

With support from our empirical evidence, we assume that in KT contexts shaped by high degrees of

homogeneity of learning speed among receivers, the benefit advantage of interactive configurations – the detection of under- or over-challenged receivers by building on feedback loops and an adjustment of KT accordingly – will erode and thus cannot compensate the cost disadvantage against non-interactive configurations stemming from higher communication costs.

P_9: *Non-interactive KT configurations will be more successful than interactive ones after degree of homogeneity of learning speed among receivers has passed a certain threshold.*

Conclusions

Driven by increasing reports of KT problems, our paper opened with the question 'why do KT projects fail' and coherently led over to the question 'how enduring success can be achieved.' In the reports, we found initial evidence that a contingency view on KT, focusing on fits between context and configuration and the relationships between fits and success, can highly contribute to answer these questions. Existing literature on KT has properly explored the specific KT factors of context and configuration. Our literature analysis consolidated these factors. Under the concept of context, especially the factors codification of knowledge (tacit *vs* explicit knowledge), transfer culture (social ties and trust), and degree of homogeneity of learning speed or absorptive capacity received strong theoretical attention. Other contextual factors like time pressure and value creation link of knowledge were just recently brought into discussion and need more elaboration. With regard to configuration, in particular the factors mode of communication (interactive *vs* non-interactive), provision of knowledge (traditional *vs* network based), and individualization of knowledge are well developed. More attention can be directed to factors such as involvement of receivers in knowledge selection and organizational link of sender.

Overall, our findings indicate that state of research in the isolated areas of context and configuration has nearly reached conceptual closure. However, research on the fits between context and configuration and the relationships between fits and success is in a very early conceptual phase (Chen, 2004; Levin & Cross, 2004). Since only integrated success-orientated research can contribute to answer the urgent questions of the business community, more research has to be undertaken in this direction. Our contingency framework provides the theoretical foundation for these efforts by specifying constituting factors for the relationships. Nevertheless, theory-building approaches have to derive specific propositions for conceptual closure. We undertook the first step in this direction by case study research in the software industry. The empirical evidence supported our general idea of a contingency view on KT. Our qualitative data on the reasons for success and failure of KT projects indicated that fits between context and configuration really do matter for KT success in the software industry. Thus, we were able to derive nine propositions on the subject. Interestingly, nearly all contextual factors and configurational factors were mentioned. On the one hand, these scattered fits enhance confidence in the empirical validity of the framework as its whole scope was reflected in the interviews. On the other hand, it hints at the potential of currently unexplored fits need to be addressed in future research.

Practical implications

The findings of our paper have practical implications for managers engaged in KT for example in the HR, IT, and sales department or specialized KT units. In the kick-off phase of a project, awareness of the multiple configuration options especially in the light of technological change needs to be raised. Besides traditional configurations like mentoring or storytelling, a rich repertoire of network-based configurations ranging from simple database systems to complex e-learning interfaces can be exploited. Nevertheless, managers should keep in mind that new or 'trendy' configurations are not *per se* the right choice even if eager consultants would like to evoke this impression. Managers can build on the discussed factors to develop a deep understanding of the opportunities in configuring KT. Most importantly, managers should take a contingency perspective by incorporating KT context in their decision-making on KT configuration. For this purpose, they can use the derived contextual factors as starting point for their analysis. Simple customized checklists can effectively support this analysis of context and configuration. Within the project team, a starting list with factors can be discussed, adjusted, and filled with factor values. Resulting communication can highly improve common understanding, language, and rationality. A related issue is team composition. From our experience, it operates well to include at least one manager from each KT-involved value chain function and staff familiar with the employed transfer technology. Usually, the first group brings in deep knowledge on the context, whereas the second group can contribute by configurational competence.

In the decision-making phase of the project, managers should align configuration in a way that constitutes a good fit with context to achieve KT success. Scoring models can perfectly support this task quantitatively. A simple approach requires to define values for each considered factor, derive fits between contextual and configurational factors, and to evaluate these fits with scores. Thus, alternative configurations and the underlying context can be described with factor values. Afterwards, the score of each alternative in each derived fit can be determined and totalled over all fits. The highest score alternative is expected to be most successful. Of course, managers should complement the decision-making process by qualitative elements such as group discussions. After decision-making and KT roll-out, continuous improvement based on feedback (push and pull) is strongly recommended. For example, the success-criticalness to

include learning tracking tools becomes evident after the first receivers have complaint about difficulties to follow the transfer.

Limitations and future research

We started to explore the relationships between KT fits and KT success by deriving nine propositions from 11 case studies in the German software industry. Even so, future case study research is needed in other industries and regions to enhance generalizability and to develop other ones. Since our contingency framework is not industry or region-specific, we invite KT researchers to use it as a theoretical foundation. There is much space for exploration as the derived contextual and configurational factors constitute numerous possible fits. When theory-building case study research has reached conceptual closure with a sufficient number of well-developed propositions, hypotheses-testing research needs to be applied for empirical validation.

Extensive efforts will be necessary to build up measures for each factor of the contingency framework and to obtain quantitative data from the field. Secondary data on KT are almost not accessible because companies do not report this information publicly and KT research databases have not been developed. Thus, primary data will be the key for future hypotheses-testing research. For the measurement of some factors reliable (i.e. acceptable Cronbach's α) and valid (i.e. acceptable correlations) scales have already been developed. Regarding the *contextual factors*, scales are evident for codification of knowledge (Molina *et al*., 2004), degree of homogeneity of learning speed among receivers (Chen, 2004; Ko *et al*., 2005), degree of homogeneity of pre-knowledge among receivers (Szulanski *et al*., 2004), and transfer culture (Karlsen & Gottschalk, 2004; Szulanski *et al*. 2004). The *fits* between contextual and configurational factors have already been measured as 'interactions' by multiplying the underlying measures (Levin & Cross, 2004). To avoid problems with multicollinearity, 'mean centering' of each measure should be conducted. Scales for the measurement of *KT success* have been employed by Chen (2004) and Molina *et al*. (2004) with regard to the benefit factor and by Levin & Cross (2004) addressing the cost factor. However, researchers need to build up new scales for the remaining contextual factors in our framework such as time pressure for conducting transfer, flexibility needs, value creation link of knowledge, dynamism of knowledge and all *configurational factors* in the framework such as involvement of receiver in knowledge selection and individualization of knowledge. Preliminary work on scale development in other disciplines such as marketing and psychology (Goldsmith, 1992; Agarwal, 2003; Fornaciari *et al*., 2005) provides a valuable foundation. Most urgently needed are efforts on the configurational factors. Only after the first scales have been developed in this area, hypotheses-testing research can start to validate propositions on the relationships between KT fits and KT success. Nevertheless, we are confident that the joint efforts of case study and hypotheses-testing research will contribute to answer the questions 'why do KT projects fail' and 'how enduring KT success can be achieved.'

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