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R&D MANAGEMENT

Structural ambidexterity, transition processes, and integration trade-offs: a longitudinal study of failed exploration

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In order to overcome the exploration–exploitation paradox, structural ambidexterity literature suggests establishing differentiated units for exploitation and exploration with a carefully managed exploration–exploitation interface supporting cross-fertilization without cross-contamination. Recent research demonstrates the crucial role of integration mechanisms (i.e. how knowledge exchange between exploratory and exploitative units can be organized) and related transition modes (i.e. how exploratory innovations can ultimately be transferred back into the exploitative structures of core business) to deal with this challenge. However, a systematic account of the diverse tensions, risks, and trade-offs associated with integration which may ultimately cause exploration failure is missing, so far. This paper presents a longitudinal process study uncovering the anatomy of an unsuccessful exploration of (green) technologies by a medium-sized entrepreneurial firm. We investigated their transition processes to understand how the managers dynamically configured and reconfigured the exploration–exploitation interface over time. Our theoretical contribution lies in providing a framework of six integration trade-offs (Exploratory-complementary linking vs. contamination; Seeking legitimacy early on vs. frustration at discontinuation of innovation; Boundary spanning through job rotation vs. carrying over of old culture; Early vs. premature transfer; Reorganization vs. capability mutation; and Improved access to core business resources vs. resource starvation) linked to three phases in the transition process (before, at, and after transfer). We also highlight mechanism, pulling-forward, and streamlining-related failures linked to integration trade-offs in resource-constrained contexts. Our implication for R&D and top management is that the use of integration mechanisms for structural ambidexterity bears the risk of cross-contamination between the exploitative and exploratory structures and are therefore inevitably linked to trade-offs. To minimize negative side effects and prevent exploration

Correction added on 24 November 2018, after first online publication: an error in the affiliation details of the first author has been corrected

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failure, organizations have to consciously select, schedule, operationalize, and manage (re)integration mechanisms along the transition process. Our framework of integration trade-offs systematically supports managers in their organizational design choices for integration mechanisms in the transition processes.

1. Introduction

In uncertain, volatile, and rapidly evolving industries, the simultaneous orchestration and balancing of exploration and exploitation is necessary for long-term survival (Cesaroni et al., 2005; O'Reilly and Tushman, 2008). Firms with this capability are called ambidextrous organizations. To facilitate cross-fertilization between exploitative and exploratory structures without cross-contamination (O'Reilly and Tushman, 2004), following the call for research by Raisch (2008), Lavie et al. (2010), Gassmann et al. (2012), and O'Reilly and Tushman (2013), recent research in ambidexterity has focused on the management of the exploration–exploitation interface. Of particular interest are integration mechanisms (or tactics) to loosely couple exploitation and exploration (Jansen et al., 2009) as well as related transition modes for ultimately reintegrating radical innovations back into the core business (Gassmann et al., 2012; Chen and Kannan-Narasimhan, 2015).

While current literature mostly considers the integration of differentiated units as key to tapping into the 'energizing potential' of the exploration–exploitation paradox (Andriopoulos and Lewis, 2009), some scholars emphasize the tensions, risks, and dysfunctional effects involved in bridging differentiated units (e.g. Raisch, 2008) and in reintegrating exploratory units back into the core business (Durisin and Todorova, 2012). It therefore seems that while integration mechanisms are crucial to dealing with the exploration–exploitation paradox, they are also linked to drawbacks and potential failure, together representing trade-off situations.

In the resource-constrained contexts often observed in small and medium-sized enterprises (SMEs), these tensions increase because maintaining differentiated units for exploration and exploitation is more difficult (Voss and Voss, 2013) and core business involvement is expected earlier in the transition process (Chen and Kannan-Narasimhan, 2015). Against this background, our overarching research question is: *What role do integration mechanisms play in exploration failure, particularly in resource-constrained contexts*? To answer this question, we ask: *What* integration trade-offs exist? *When* in the transition process are they relevant? And *how* do they lead to exploration failure?

To inform these research questions, we integrate previously scattered literatures on formal and informal integration mechanisms (Jansen et al., 2009; Chen and Kannan-Narasimhan, 2015), organizational linkages (Taylor and Helfat, 2009), cross-functional ambidexterity across product and market domains (Voss and Voss, 2013), transition modes (Gassmann et al., 2012), radical innovation capability (O'Connor and DeMartino, 2006), and capability mutation (Durisin and Todorova, 2012). Based on this interdisciplinary approach, we aim at studying structural ambidexterity and its related integration processes as dynamic phenomena unfolding over time. We follow methodological suggestions by Simsek et al. (2009) and answer the research questions using an in-depth longitudinal case study. In contrast to current studies using longitudinal research designs in large firm contexts (Gassmann et al., 2012; Zimmermann et al., 2015; Raisch and Tushman, 2016) or design consultancies (Andriopoulos and Lewis, 2009), we studied a medium-sized technology firm. Also, the focus of prior longitudinal studies was on success patterns in using integration mechanisms or tackled only individual trade-offs (Durisin and Todorova, 2012), while our aim is to systemize existing tensions and trade-offs. Investigating a period of 13 years enabled us to cover a full exploration and transition process, while other studies cover only part of the transition process (Zimmermann et al., 2015).

The results of this study enable us to contribute to theory in the following way: To the best of the authors' knowledge, our article is the first to give a systematic account of the tensions associated with using various integration mechanisms. More specifically, we develop a framework for analyzing integration trade-offs in the transition process. This gives insights into the dynamics of exploration–exploitation interfaces over time (Gassmann et al., 2012; Chen and Kannan-Narasimhan, 2015) at the 'ground level' (O'Reilly and Tushman, 2013, p. 327). Finally, we also contribute to the growing research on the exploration–exploitation interface in resource-constrained contexts (e.g. Lubatkin

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et al., 2006; Voss and Voss, 2013) and show that greater streamlining of integration processes leads to higher risks of cross-contamination.

2. Literature review

Pursuing exploration and exploitation simultaneously in a value-enhancing way is considered a challenge of managing paradoxes because these activities represent 'synergistic and interwoven polarities' (Smith and Tushman, 2005; Andriopoulos and Lewis, 2009; Raisch et al., 2009; Zimmermann et al., 2015). One way to managing the tensions linked to these paradoxes is to pursue both types of innovation in structurally distinct units while at the same time addressing the need for cross-fertilization (O'Reilly and Tushman, 2004) by bridging them through integration mechanisms (Andriopoulos and Lewis, 2009; Jansen et al., 2009; Gassmann et al., 2012). This paradoxical relationship is expressed as, for instance, interdependence between seeming opposites (Andriopoulos and Lewis, 2009), differentiated subunits with clearly defined interfaces (O'Reilly and Tushman, 2013), or separate units which are purposefully interdependent (Simsek et al., 2009).

According to O'Reilly and Tushman (2008, p. 191), the main leadership task is not to create structurally independent units but 'the processes by which these units are integrated in a value enhancing way' (cf. Jansen et al., 2009), which then represents a dynamic capability (Raisch et al., 2009). Indeed, integration is largely represented as the holy grail of managing the exploration–exploitation paradox successfully (Jansen et al., 2009; Gassmann et al., 2012; Chen and Kannan-Narasimhan, 2015). In the following, we engage in a critical review covering, on the one hand, how integration is pursued using overarching transition processes and individual integration mechanisms and, on the other, which new tensions emerge due to such integration measures.

2.1. Transition processes and resource-constrained contexts

In our longitudinal study, we focus on the time dimension and in particular transitions as the overarching context for integration. Transition processes begin after the initial ambidexterity structure has been put in place (see Zimmermann et al., 2015 for the charter definition process prior to implementation), and can be described as the phase in which innovations develop from the purely exploratory to the purely exploitative space (Raisch and Tushman, 2016). Particularly in technology-oriented contexts, when once strongly separate exploratory units enter later stages of the innovation life cycle, they may be switched to more integrated structures (Durisin and Todorova, 2012; O'Reilly and Tushman, 2013), following a natural sequence from discovery to commercialization (Simsek et al., 2009). In the transition process, research increasingly focuses on the time dimensions by shifting toward analyzing *when* and *how* to pursue a *re*integration from exploratory into exploitative spaces (Durisin and Todorova, 2012; Chen and Kannan-Narasimhan, 2015). We will refer to the overall process of reintegration as the transition process, while we refer to the actual switch of an exploratory innovation project into the institutionalized processes of the core business as the actual 'transfer'. O'Connor and DeMartino (2006) differentiate three sub-phases necessary before actual transfer: the generation of radical new ideas ('discovery'), new business models ('incubation'), and an adequate sales volume ('acceleration').

Though others have argued that exploration and exploitation are characterized by a parallel (i.e. both can be pursued simultaneously) rather than orthogonal (i.e. competing) relationship (O'Reilly and Tushman, 2008), on the organizational level both ultimately compete for scarce resources and require trade-offs (March, 1991; Lavie et al., 2010). Given that studies on transition processes have predominantly focused on large multinational corporations, this may have played a minor role. These companies usually pursue organizational ambidexterity with a *permanent* radical innovation unit producing a continuous stream of exploratory projects, which are then considered for reintegration (Gassmann et al., 2012; Chen and Kannan-Narasimhan, 2015; Raisch and Tushman, 2016). In contrast, competition for resources across exploitation and exploration is a significant challenge for SMEs (Cao et al., 2009). SMEs have in general fewer resources and specifically often lack slack resources (Chang and Hughes, 2012). SMEs are therefore much more constrained in managing and staffing physically and culturally separate units for exploration and exploitation as these parallel structures require more resources and increase internal complexity (Voss and Voss, 2013). SMEs are therefore particularly likely to pursue *temporary* ambidexterity because it is relatively resource efficient (Raisch,

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2008). Temporal or sequential ambidexterity is defined by periodic switches between exploitation and exploration phases (Lavie et al., 2010), in which the separate temporary exploration units (not only the individual projects) are ultimately reintegrated into the institutionalized processes of the core organization (Siggelkow and Levinthal, 2003; Durisin and Todorova, 2012).

Whether exploratory units are designed as permanent or temporary, recent longitudinal case research on transition processes (Gassmann et al., 2012; Chen and Kannan-Narasimhan, 2015) has unpacked the integration mechanisms involved and how they are dynamically orchestrated.

2.2. Integration mechanisms

Initially, integration was considered rather narrowly as the responsibility of the senior management team (O'Reilly and Tushman, 2004). However, in an early contribution by Jansen et al. (2009), integration is considered at various hierarchical levels, most importantly senior management and middle management. On these levels, both informal mechanisms (e.g. social integration, connectedness) and formal (e.g. cross-functional interfaces, rewards) coexist. Jansen et al. stress that while informal integration is necessary, more formal organizational integration mechanisms – which our paper focuses on – are required for ambidexterity. Following Jansen, more recently many scholars have focused explicitly on how the exploration–exploitation interface is improved by various formal and informal integration mechanisms (e.g. Durisin and Todorova, 2012; Gassmann et al., 2012; Chen and Kannan-Narasimhan, 2015; cf. O'Connor and DeMartino, 2006).

Most of the integration mechanisms used in early phases of the transition are based on loose coupling. They aim at deepening knowledge flows across differentiated units yet they retain contradictory processes and a time orientation (Jansen et al., 2009). In the context of this paper, we will refer to these loose coupling mechanisms as *linking* mechanisms. For example, Gassmann et al. (2012) show how 'integrative innovation planning' uses cross-functional boards (including representatives from exploratory and exploitative units) during the transition to involve core business management into radical innovation projects (still) hosted in the exploratory unit (Gassmann et al., 2012).

While linking mechanisms operate across exploitative and exploratory innovation spaces, the later phases of the transition process require a *reintegration* mechanism. Reintegration occurs when the exploratory innovation is transferred back into the exploitative space to benefit from core business strengths in commercialization. This transfer is considered key to successful strategy execution (Durisin and Todorova, 2012, p. 71) because otherwise innovation projects risk never finding their way out of the R&D-focused exploration unit.

2.3. Integration trade-offs as a source of failure

While integration mechanisms and the orchestration of transition processes are certainly important to dealing with the tensions linked to the exploration–exploitation paradox (Andriopoulos and Lewis, 2009; Andriopoulos and Lewis, 2010), it is unlikely to be resolved because 'at the heart of any theory that solves a paradox, is another, different paradox' (Poole and van de Ven, 1989). Comparably, in their theorizing on paradox, Smith and Lewis (2011) find that one source of paradox is the dialectic process in which contradictory and interrelated elements are temporarily integrated via synthesis, only to disintegrate later because a fundamental duality persisted.

Against this background, we argue that while integration and the use of integration mechanisms help to resolve the exploration–exploitation paradox on a higher level, they represent new paradoxes on lower levels. As Durisin and Todorova state,

> *there is little direct evidence on how organizational units for incremental and discontinuous innovation can be kept simultaneously separated to prevent cross-contamination and integrated to allow cross-fertilization. (*2012*, p. 69)*

Moreover, there are many risks linked to integration mechanisms and they have so far not been systematically taken into account in the current literature. First, integration always bears the risk of cross-contamination, as the case study analyzed by O'Connor and DeMartino (2006) shows. For example, a strong involvement of core business into decision-making processes concerned with the radical innovation constrains the degree of radicalness (Gassmann et al., 2012) and can weaken the ambition of sustainability innovations (Hahn et al., 2016). Job rotation can lead to contamination of the culture in exploratory units

by exploitative mindsets (Durisin and Todorova, 2012). Second, if transfer from exploration to exploitative units is not carefully timed – taking into the account discovery, incubation, and acceleration phases – it risks failure (O'Connor and DeMartino, 2006). In fact, the majority of new business ventures are perceived as immature and are therefore not accepted for transfer

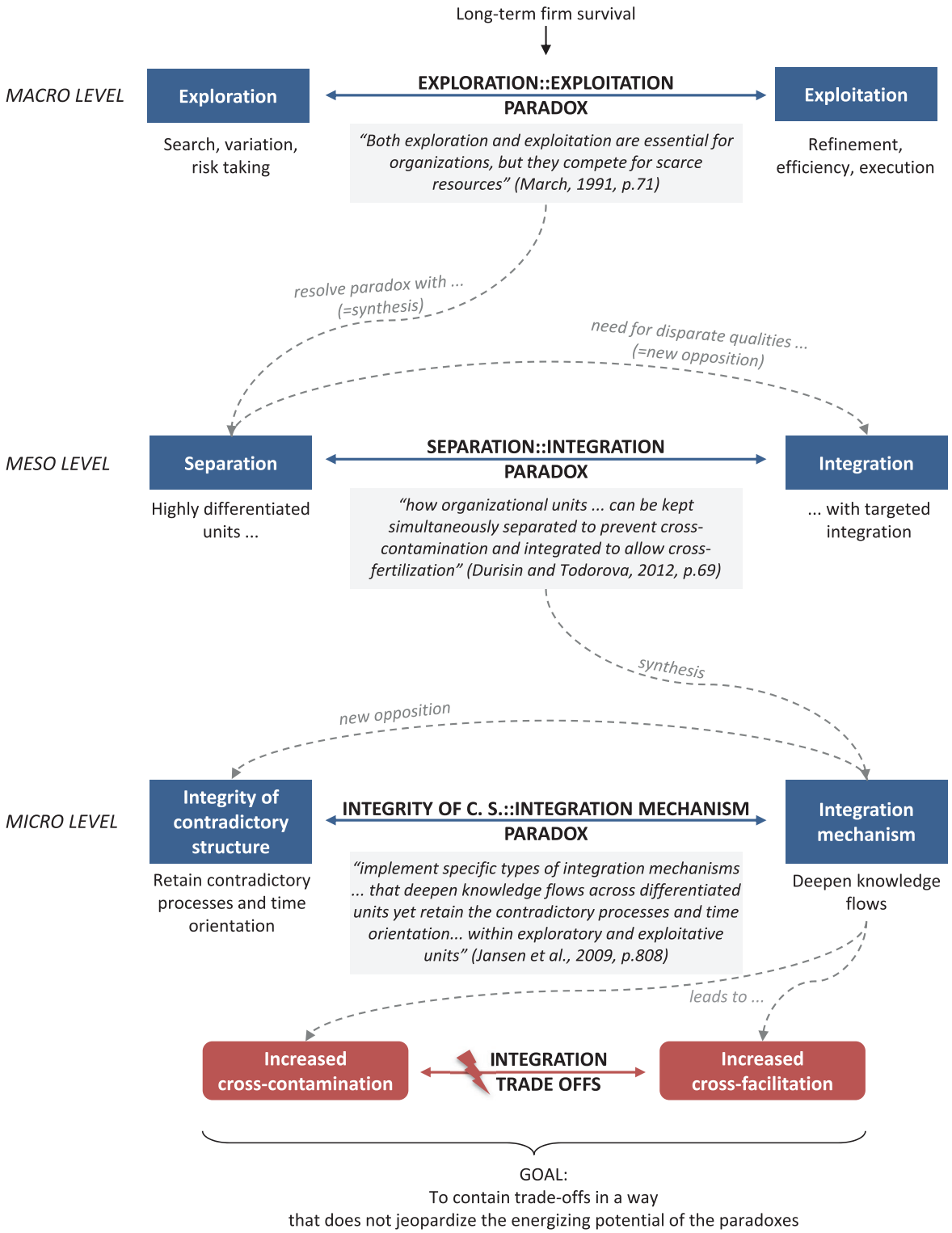

Figure 1. Nested challenges of exploration–exploitation paradox and integration trade-offs: based on a dialectical process following Smith and Lewis's (2011) theory of paradox. Note: C.S. = Contradictory Structure. [Colour figure can be viewed at wileyonlinelibrary.com]

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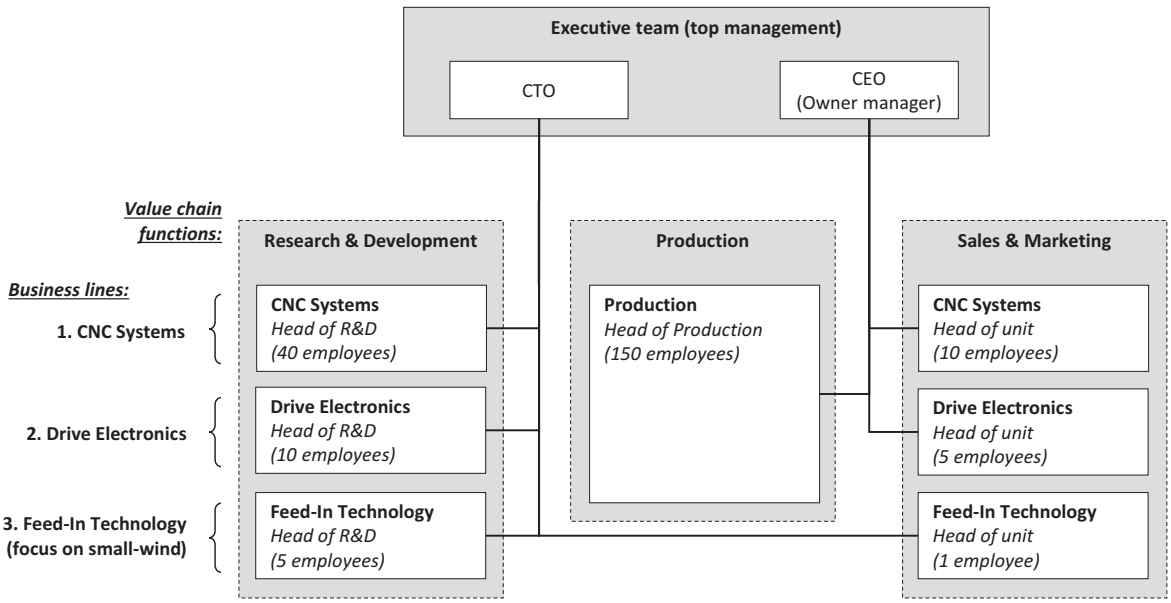

Figure 2. Organizational chart of TechLtd (based on Wicki et al., 2015, p. 8).

by the core business or are discontinued shortly thereafter (Gassmann et al., 2012; Chen and Kannan-Narasimhan, 2015). Therefore, it may be necessary to defend unit independency (Raisch and Tushman, 2016). Third, Durisin and Todorova (2012, p. 70) note that the actual 'reintegration of the new unit [into the core business] may have strong dysfunctional effects' leading to 'capability mutations'. All these examples show that obtaining the benefits of integration mechanisms is linked to some form of cross-contamination. This very well describes a trade-off 'meaning compromise situations when a sacrifice is made in one area to obtain benefits in another' (Byggeth and Hochschorner, 2006, p. 1420). If these trade-off situations are not consciously tackled by R&D and senior managers, they potentially lead to exploration failure.

In summary, the current literature on structural ambidexterity can be described using a dialectical process following Smith and Lewis's (2011) theory of paradox (see Figure 1): the competing demands of exploration–exploitation (*macro*-level) are synthesized by means of structural separation. However, separation leads to a new need for integration, described as a new separation-integration paradox (*meso*-level). Synthesizing these contradictory demands is the aim of integration mechanisms. However, new opposition occurs as the implementation of integration mechanisms also jeopardizes the integrity of contradictory structures (*micro*-level). Ultimately, this micro-level paradox is linked to integration trade-offs because the use of integration mechanisms for cross-fertilization also leads to a risk of cross-contamination. It is the task of the senior management team to carefully design the individual mechanisms within the larger transition process to contain that risk and prevent jeopardizing exploration success. With this understanding, we also contribute to the integration of contradictory perspectives – paradox vs. trade-offs – on the exploration–exploitation challenge (e.g. Andriopoulos and Lewis, 2009).

We now aim at better understanding the individual and cumulative effects of integration trade-offs in the transition process and how this relates to exploration failure through a longitudinal case study.

3. Method

3.1. Research design

Studying ambidexterity as a dynamic, unfolding phenomenon dictates a longitudinal focus typically involving qualitative research (Simsek et al., 2009; Khanagha et al., 2014). We undertook a longitudinal process study (Huber and van de Ven, 1995) in a medium-sized entrepreneurial high-tech firm (here referred to as 'TechLtd'). Such process studies of single organizations are important to unravelling the underlying dynamics of a phenomenon (Siggelkow, 2007), particularly in the case of *un*successful innovation projects (van Oorschot et al., 2013).

3.2. Case selection

We followed theoretical sampling (Eisenhardt, 1989, p. 537) with the aim of extending ambidexterity theory. We chose TechLtd as an entrepreneurial SME employing about 220 employees in Germany. The family business, founded in 1962, is owner-managed in the second generation and is a typical representative of a 'hidden champion' (Simon, 2009). It develops and produces electronic components they sell to system integrators. TechLtd has a flat hierarchy, with top management playing key roles in balancing exploration and exploitation (Figure 2).

The case of TechLtd is critical for our goal of theory development (Yin, 2014, p. 41): (i) TechLtd has engaged in exploration and a transition process using various integration mechanisms with an ultimate transfer back into their core business. Hence, while most qualitative ambidexterity studies focus on separation (O'Reilly and Tushman, 2013), our case focuses on reintegration. (ii) While most innovation studies are subject to a pro-innovation bias, our case presents an example of unsuccessful exploration. (iii) As a medium-sized company, TechLtd is a good representative for radical innovation in resource-constrained contexts.

Usually, it is relatively difficult to get (longitudinal) access to an unfolding innovation process, particularly when unsuccessful. We developed a close relationship via engaged scholarship (van de Ven, 2007) and gained intimate access to the organization – making the case also *revelatory* (Yin, 2014).

3.3. Data collection

We utilized a combination of retrospective data and real-time observations of the innovation process 'in the making' (Pettigrew, 1990; van de Ven and Poole, 1990; Rogers, 2003, p. 112), together covering a period of approx. 13 years (2002–2015). We were able to observe the last three years of the ongoing innovation process. To assure construct validity and to overcome bias involved in partially retrospective accounts, we used various data sources including semi-structured interviews, participatory observation, focus groups, and desk research (Table 1). We used these multiple sources to collect complementary evidence and, where necessary, triangulate the findings (Babbie, 2013). We covered top and middle management involved in the exploration, including former employees. Semi-structured interviews served to retrace events characterizing the innovation process. The triangulation of interview accounts from current and past organizational managers was particularly important for getting a holistic perspective on managerial decisions and failure and to rule out impression management, political action, and related interviewee tactics (Alvesson, 2003). Focus group sessions were used to understand the motivation of strategic and operational choices as well as to develop a deep understanding of the top management's cognitive representations as they evolved over time. We regularly presented timelines to the interviewees and participants in order to facilitate arrangement of new data, revising their order, or simply seek approval. The interviews were transcribed and other data (e.g. site visits, participant observation) was protocolled (Babbie, 2013).

3.4. Data analysis

Our analysis followed three steps. First, in line with the recommendations for longitudinal case

Table 1. Data collection methods

Data types	Sources		
	Internal: Top and middle management	External: Business partners and value chain actors	Total
Semi-structured interviews	8 interviews[1]	10 interviews	18
Participant observation	13 meetings	2 industry events	15
Focus group sessions	7 sessions	n.a.	7
Documents	25 internal documents (e.g. market studies, technical design descriptions, sales statistics, customer lists)	70 publicly available documents (e.g. industry reports, market analysis, newspaper and magazine articles and websites of industry actors)	95

[1]Includes interviews with former managers.

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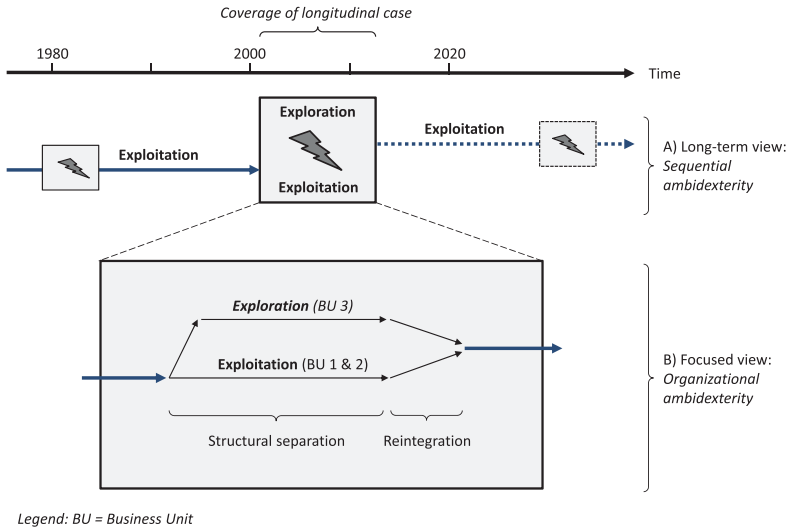

Figure 3. Sequential and organizational ambidexterity over time at case company. [Colour figure can be viewed at wileyonlinelibrary.com]

studies (van de Ven and Poole, 1990; Huber and van de Ven, 1995; Yin, 2014), we started the analysis by reconstructing the timeline of the innovation process. At TechLtd, there are two core business lines, one selling controllers for computerized numerical control (CNC) systems and one producing drive electronics. After a long period of exploitation, TechLtd decided to balance risks, particularly considering the core business was subject to high volatility and competitive pressure. Therefore, they engaged in a period of exploration with the ultimate goal of diversifying and founding a third business line, 'feed-in technology' (Figure 3). The aim of this new business line was to explore how the company could use its engineering competencies for renewable energy technology markets. With a new product for new markets, this third business line represented an ambitious diversification strategy for the company (Ansoff, 1957).

In a second step, we focused on the exploration phase and referred to the fireworks model for longitudinal analysis (Poole and van de Ven, 2000/1989) because it allows for a rich analysis of complex, non-linear exploration processes on the micro-level. Originally, we covered innovation projects targeting fuel cells, small wind turbines, flywheel energy storage, and waste heat recovery (Wicki and Hansen, 2016; see also: Wicki and Hansen, 2017). We analyzed (temporal) events along the innovation trajectory such as setbacks, changes in the search direction, fluid participation of personnel, involvement of top management, evolution in success metrics, cognitive representations, and routines based on tracking ideas, people, transactions, contextual events, and outcomes (Van de Ven and Poole, 1990). We then focused on the most important technology in the exploration process: the feed-in system for small-wind inverters. The exploration process led to a new product, which was transitioned back into the core business but was eventually terminated because of low sales (Figure 4; see also Wicki, 2015).

In the third step, we analyzed the exploration process with the focus on the integration trade-offs. We followed the 'Gioia methodology' (Gioia et al., 2013) by transitioning from inductive to abductive analysis in an iterative process between analysis of data and current literature. To link our emergent concepts with current theory, we used both open and a-priori coding for deriving the trade-offs and their components. Ultimately, we aggregated these codes to a longitudinal dimension representing the phases of the transition process (Figure 5; exemplary quotes in 2).

We employed measures to ensure the trustworthiness of our data (Lincoln and Guba, 1985; Shenton, 2004). To ensure credibility and objectivity, we used *triangulation* and reflexive interpretation (cf. Alvesson, 2003) for integrating diverse and partly contradictory perspectives from various informants. *Multiple investigators* were involved, each taking specific roles allowing for *peer scrutiny*. The first lead researcher was most deeply immersed in the empirical field and prepared the field notes, transcripts, and descriptive case report (Eisenhardt, 1989). The second lead researcher focused on the iterative process of data analysis and theory-building. At major milestones, in-depth discussions between the two lead researchers continued until consensus over the

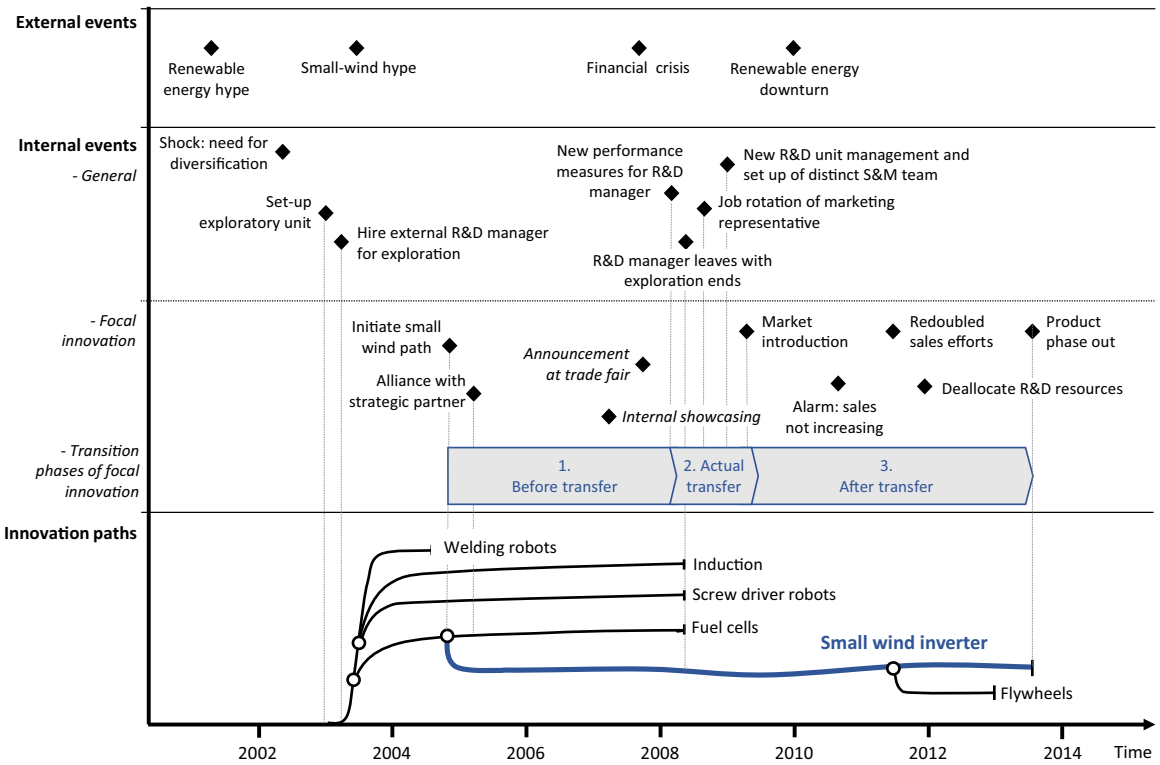

Figure 4. Visualization of the innovation process over time based on innovation phases, innovation paths, internal and external events. [Colour figure can be viewed at wileyonlinelibrary.com]

interpretations was achieved. A third researcher served as a 'critical friend', pointing out theoretical inconsistencies and providing fresh perspectives. *Member checks* were conducted with all management levels.

4. Findings

Our analysis of the unsuccessful radical innovation process results in a set of six integration trade-offs (benefits of integration vs. related risks) during various phases of the transition process (see Figure 6 and Table 3). A transition process from originally separate innovation spaces to a reintegrated innovation in the core business covers a considerable time period from (a) linkages in early phases *before transfer*, (b) the *actual transfer* from the exploratory unit to the receiving core business unit to (c) the reorganization and related activities necessary *after transfer*. It should be mentioned that integration trade-offs are not empirically distinct but overlapping and are sometimes causally dependent (e.g. premature integration increases the risk of resource denial by the core business). Each of the resulting integration trade-offs is further elaborated.

4.1. Before transfer

We identified three risks linked to integration mechanisms used before transfer: exploratory–complementary contamination when complementary assets are used, frustration with (failed) discontinued innovations when external validating or internal legitimacy-building activities were previously involved, and carrying over of the old culture through job rotation.

4.1.1. Exploratory-complementary linking vs. contamination (T1)

Benefits sought through exploratory–complementary linking. Exploratory units usually follow a mix of developing distinct capabilities and leveraging existing capabilities from established units (Raisch and Tushman, 2016), which we generally refer to as 'exploratory-complementary linking'. This term is derived from Taylor and Helfat's (2009) more specific term of 'core-complementary linking', which describes the use of complementary assets (e.g. marketing, production, financing) in the exploration of new core technologies. This linking intensifies communication across exploratory and

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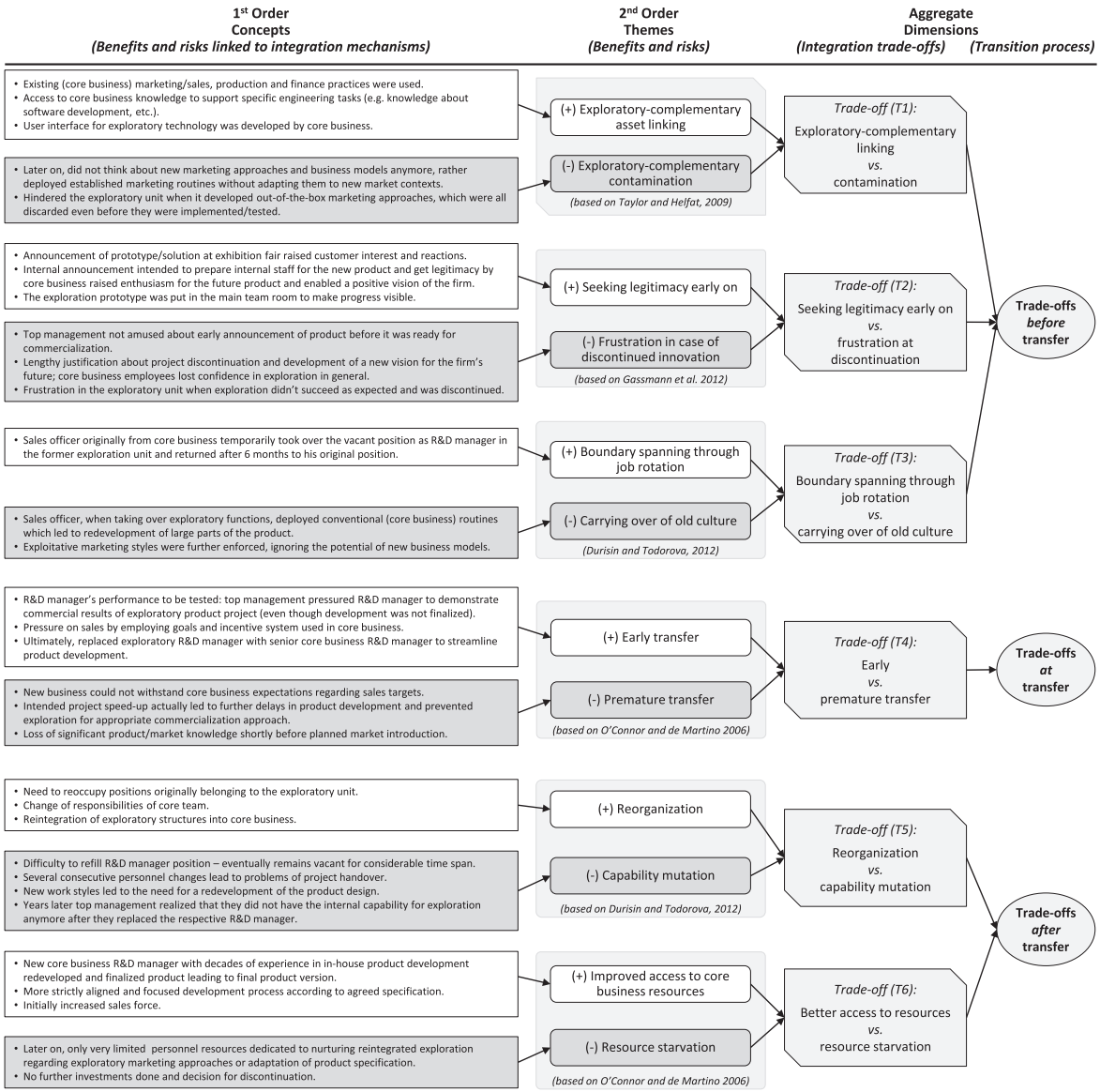

Figure 5. Data structure according to the Gioia Methodology: Integration trade-offs.

exploitative units and aims at increasing the successful commercialization of exploratory projects. This approach is also likely to leverage resource efficiency potential: resource-intense exploration is only done in one function and not in others (in our case, in R&D but not in marketing/sales), an approach also referred to as 'within-functional separation' (Voss and Voss, 2013) or, more generally, 'function domain separation' (Lavie et al., 2010).

At TechLtd, radical innovation in the domain of green energy technology was initially developed in a newly founded separate business unit dedicated to exploration. Therein, exploration initially involved both R&D and marketing activities. Later more and more responsibility for the commercialization of the product exploration shifted to the existing sales and marketing units:

I had a shared responsibility. Partly I have continued my responsibility for marketing and sales of our current products. With the rest of my time, I dealt with marketing and sales for the new small-wind project. (Head of Sales and Marketing)

Hence, while R&D exploration was done in the separate unit, commercialization was steered from within the core business structure, thus leveraging existing complementary assets.

The risk of exploratory–complementary contamination. While the tight coupling of the new exploratory R&D unit with existing complementary

Table 2. Interview data on integration trade-offs

Transition phase	Integration trade-offs	Quotations	
	Name	(+) Benefits sought through integration mechanisms	(-) Integration risks
Before transfer	Exploratory–complementary linking vs. contamination (T1)	CTO: 'At the beginning, for instance, the user interface of the new small-wind inverter was made by the drive electronics people of the core business'. Head of Sales & Marketing: 'In these newly emerging markets [which we explored in the radical innovation unit], we do not have the capacity needed to do effective sales and marketing. We also don't have the team of say five people who can only focus on doing this task … I had a shared responsibility. Partly I have continued my responsibility for marketing and sales of our current products. With the rest of my time, I supported the new small wind project with my knowledge about sales marketing'.	Head of Sales & Marketing: 'Regarding our sales approach, we only do business with OEMs, who then sell to the end-users. In fact, we very rarely have a direct contact with the end-user. We don't like to do that'. [The CEO later stated that a different approach would have been needed] CTO: 'We are used to delivering components to system integrators, but we didn't know much about final customers [of the system] and so we aren't used to delivering full products that satisfy the needs of final customers'. CTO: 'Since in our existing businesses – which were based on close [B2B] customer relationships with rather established and professional firms – we trusted in [end] market information from our immediate customers, such as sales forecasts. However, the information given by these rather new and unestablished customers in immature markets often turned out to be misleading'. CEO: 'It's a good question, in retrospect, whether we shouldn't be dealing more strongly with the final customers, rather than only with our immediate customers as we are used to doing'.
	Seeking early legitimacy vs. frustration at discontinuation (T2)	CEO: 'He [the externally hired R&D manager] sold the project very well to the employees as a project paving the way for the future. As a result, the employees were very enthusiastic about it and stuck very much to it'. CTO: 'We placed a prototype of the Aeocon [name of the product] in the staff meeting room so that people could see what it looked like and become familiar with the new product'. CEO: 'The externally hired R&D manager showed the product publicly at industry fairs. Potential customers were interested and even expressed intentions to purchase'.	CEO: 'We were dissatisfied with the R&D manager because he launched our prototype in the marketplace far too early, before we knew about the schedule for the final product design and its commercialization'. CEO: 'It [the discontinuation of radical innovation project] is an important leadership challenge to know how to handle the emotions or disappointments of the people involved [in discontinued radical innovation projects], both in the exploratory units as well as in the core business'.
	Boundary spanning through job rotation vs. carrying over of old culture (T3)	CEO: 'Sending the internal sales manager to the small-wind team who already had experience in the exploration allowed for further intensifying the sales and marketing competences in this team and, without the need to hire an additional person, represented a quick solution'. Sales Manager (working temporarily in R&D): 'Then I moved for about half a year to the new business unit. At that time I was the technical manager … With my team I dealt only with the technical development part'.	CEO: 'Since TechLtd makes money by selling products [physical artifacts, not services], no one questioned that we [the new unit] needed to develop a product as well. This logic was also strongly pushed by the sales manager. He believed that an [R&D] idea is only profitable if it can be turned into a product'. Sales Manager (working temporarily in R&D): 'I am to some extent also biased. I only see how we [in the core business sales & marketing department] work and I've been here for 16 years now. Maybe the big industry players like Siemens work differently, but in the drive electronics area where I come from, this is the usual way [to set up a new product development project]'.

(*Continued*)

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Table 2. Continued

Transition phase	Integration trade-offs	Quotations	
	Name	(+) Benefits sought through integration mechanisms	(-) Integration risks
Actual transfer	Early vs. premature transfer (T4)	CEO: 'In an important meeting, which my father [the retired founder] also attended, he argued that each business unit needed to be profitable from the beginning … This gave the impulse that a specific product needed to be developed [and commercialized] as rapidly as possible. Therefore we changed the performance metrics of the R&D Manager from innovation-related to actual sales targets, which forced him to commercialize the product'. CEO: 'It is not that we ran out of money but still the amount spent was relatively large and it seemed too large to justify continuing exploration on a similar scale'.	CEO: [In retrospect] 'The changes in performance indicators in the feed-in business unit came in a very abrupt way and much too early! This change put the [externally hired] R&D manager under huge pressures to quickly generate positive sales figures'.
After transfer	Reorganization vs. capability mutation (T5)	CEO: 'We suddenly had the thought: why the hell are we developing a product twice? We need to bundle these products better! Our expertise lies in power electronics … In the end, feed-in is just a part of that, nothing else. Having realized the technological proximity between the feed-in and the drive electronics unit, we began to better integrate them into one business line'.	Sales Manager (small wind project): 'We never really made it to serial production. We only produced about 100 units'. CEO: 'We were unsatisfied with the R&D manager's performance regarding product development and commercialization. But actually, by firing the R&D manager, we lost the capability to explore further – he was really driving that. Afterwards, the exploration unit never worked again in the way it was founded – in fact we lost it'. CEO: 'If we had this vision today [of an ambidextrous organization] and knew the risks [of exploration failure], the externally hired R&D manager would still be in the company today! It was a mistake to fire him'.
	Improved access to core business resources vs. resource starvation (T6)	CEO: 'After the externally hired R&D manager left [after integration], the technical development was led by a senior product developer, an internal guy. He already knew the topic because he built a similar device in the past. He brought 40 years of product development experience with him'. CEO: 'I see us as high-speed control provider. Whether that is in the PCB board market or elsewhere, this is and will also be our brand image in the future … In sum, in the feed-in business unit, we also provide high-speed control and that's why we could easily merge it with the drive electronics unit. In the end, we take a high-speed inverter, buy the feed-in component, assemble them and sell them as one product [in renewable energy markets, in a way we do the same as we do in our other markets]'.	CTO: 'But as I said, we didn't find a market for the small-wind inverter. And then, by the end of 2012, we were already starting to slow down a bit on the staff side and finally in 2013 we slammed on the brakes [and definitely closed the feed-in unit]'.

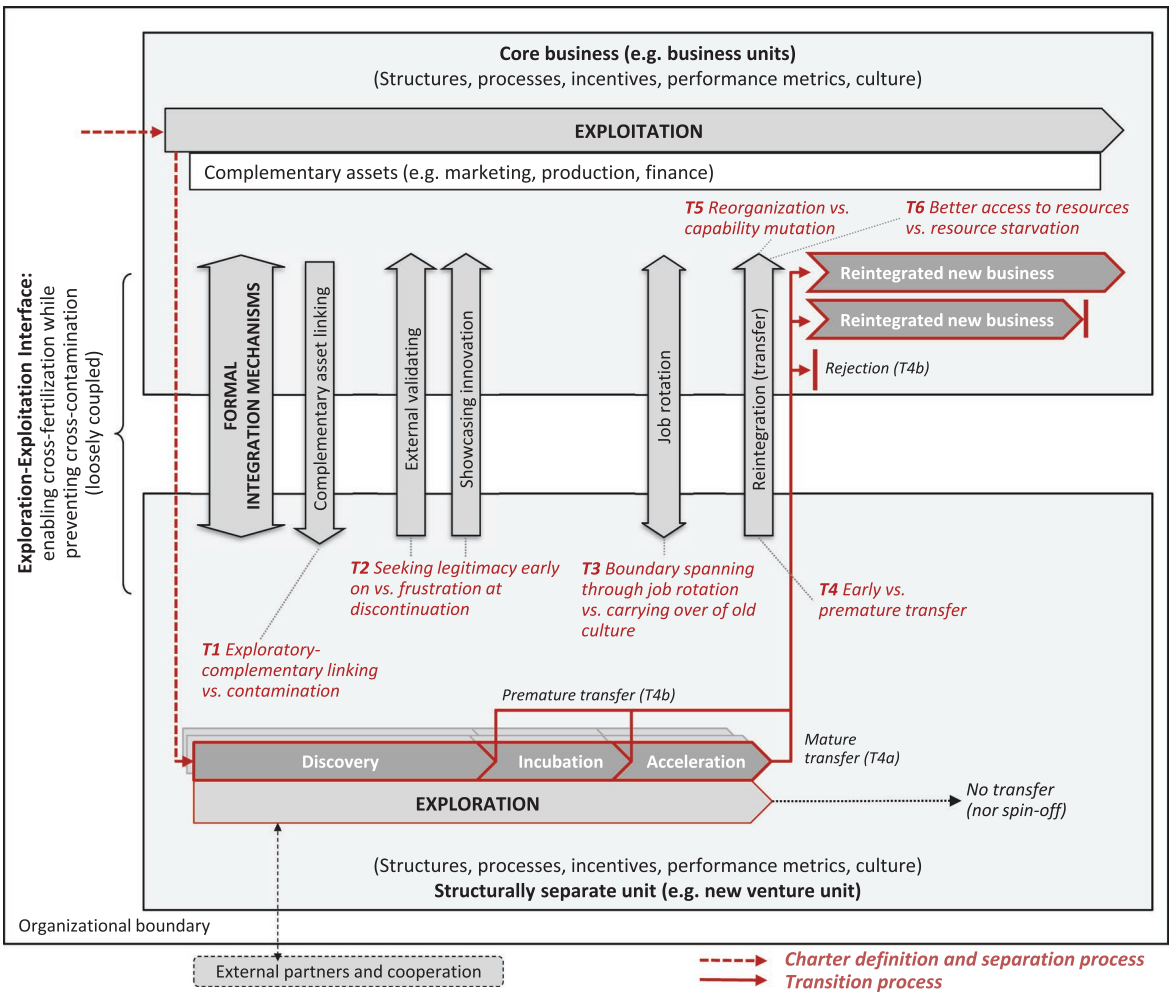

Figure 6. Integration trade-offs in the transition process. [Colour figure can be viewed at wileyonlinelibrary.com]

assets in the exploitative marketing unit through exploratory–complementary linking provided potential for cross-fertilization by increasing communication and coordination and leveraging resource efficiencies, it also risked (exploratory-complementary) contamination of the exploratory space with the exploitative culture. At TechLtd, even though the new markets entered were fundamentally different to the known ones (Table 4), they trusted in their core marketing competences and experience. They also focused on traditional product sales as used in the established business units. As the CEO put it:

TechLtd makes money by selling products [physical artifacts, not services], no one questioned that we [the new unit] needed to develop a product as well. This logic was also strongly pushed by the sales manager. He believed that an [R&D] idea is only profitable if it can be turned into a [physical] product.

While initially successful with the acquisition of a limited number of new customers, the marketing unit's assumptions about the new market proved to be wrong. It became clear that if they wanted to have any prospects at all in the premature market, they would need to question their traditional role in the value chain and its related business model and offer full service packages directed at end users by bundling technology with various services which had so far been offered separately in the market. For example, the CTO stated,

we are used to delivering components to system integrators, but we did not know much about final customers [of the system] and so we aren't used to delivering full products that satisfy the needs of final customers.

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Table 3. Integration trade-offs along the transition process

Transition phase	Integration trade-offs				
	Name	Related integration mechanism	Benefits	Risks	Further risks due to streamlining in resource-constrained contexts
Before transfer	Exploratory–complementary linking vs. contamination (T1)	Exploratory–complementary asset linking	Use of complementary assets from core business (e.g. marketing, production, finance) by new business creates synergies and prevents double asset structures	Cross-contamination (particularly marketing) by increased cross-functional interaction; Use of exploitative core complementary assets prevent exploration and development of new approaches (particularly marketing) eventually needed for developing and commercializing a truly radical innovation	For resource efficiency reasons, organizations may strongly rely on core complementary assets in disregard of the type of exploration project. While effective in conventional product development, this may be ineffective for pure explorations usually requiring dedicated marketing exploration skills.
	Seeking legitimacy early on vs. frustration at discontinuation of innovation (T2)	External validating; internal showcasing	Internal showcasing allows the core business to become acquainted with radical innovations early on. External validating presents product idea to lead customers and clarifies market needs. Together, the legitimacy of radical innovation is increased in the organization.	In (likely) case of failure of a specific exploration project, internal showcasing makes it more difficult to unlink emotional bonds; frustration of core business members can follow, possibly hindering future exploration projects External validating raises customer expectations, which need to be managed in case of failure.	Organizations need to demonstrate commercial results quickly and, therefore, may be more prone to communicate early on about exploration results externally with customers or internally with core business staff. This increases likelihood of tying expectations to innovation projects, which are still linked to considerable uncertainty and potential failure.
	Boundary spanning through job rotation vs. carrying over of old culture (T3)	Job rotation	Competencies can be rotated between exploitation and exploration units and personnel develop ambidextrous mindset. Once back in the exploitation unit, job rotators are ideal for working on reintegrated innovation projects.	Cross-contamination by carrying over of old culture, particularly from exploitative to explorative units.	Organizations may use job rotation primarily for efficiency potential, for example, using existing personnel (instead of external hiring), thus accelerating the set-up of the exploratory unit. Streamlining may also lead to overuse of dual responsibility positions in exploitative and exploratory units. This makes development of an exploration-oriented culture impossible in the first place, despite a separate unit.

Transition phase	Integration trade-offs				
	Name	Related integration mechanism	Benefits	Risks	Further risks due to streamlining in resource-constrained contexts
Actual transfer	Early vs. premature transfer (T4)	Reintegration (transfer from exploratory to exploitative unit)	Early reintegration saves resources and enables the early use of established structures and capabilities often necessary for scaling up and commercialization	Phases of incubation and acceleration – necessary for innovative product to reach maturity – are either skipped or moved through too rapidly, leading to premature reintegration and ultimately to rejection or resource denial by core business	Reduction of resource spending in exploration project or unit and high pressure to shorten exploration increases risk of premature transfer and rejection.
After transfer	Reorganization vs. capability mutation (T5)	Reintegration (after transfer)	Once exploratory innovations (or the entire unit) are reintegrated into the core business, redefining structures, processes, and responsibilities becomes necessary and bears the potential for synergies.	Reintegration generally leads to capability mutation (i.e. loss of groups and processes in exploratory and exploitative units) requiring further investments for capability (re)building. Hence, reintegration can lead to losing money, time, and competencies.	Organizations may underestimate efforts and resources required for reorganization. Moreover, these contexts increase risk for premature reintegration (see T4), which leads to stronger capability mutations.
	Improved access to core business resources vs. resource starvation (T6)	Reintegration (accommodation within core business)	After reintegration, accommodation within core business saves resources and enables the use of established structures and capabilities needed for commercialization	In comparison to established core business activities, unaligned or premature innovation projects are not considered interesting enough, leading to resource denial, starvation, and ultimate phase out. Also, additional budgets for remaining or additional exploration activities are much more difficult to obtain in core business.	Given tighter budgets in resource-constrained contexts, core business will be a more hostile environment for unaligned, premature, or otherwise needy innovation.

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Table 4. Comparison between old and new markets

Market criteria	Market of main business line (CNC systems)	Market of new business line (feed-in technology for small-wind turbines)
Maturity	High	Low
Volatility	Low	High
Dominant design	Available	Not available
Customer-specific development	Important (made-to-order)	Less important
Nature of customers	Large companies	Mostly micro-companies; few medium/large companies
No. of customers	20-30 international buyers (medium to large international companies)	300 very diverse international buyers (micro, small and medium-sized companies alike)
Regulatory complexity	Low	High (diverse national regulatory environments for renewable energies increase complexity)

Overall, two integration drawbacks were faced at TechLtd: First, the attempt to benefit from resource-saving complementary asset reuse, particularly the shared use of sales and marketing staff, led to cross-contamination in that tactics from the core business were reproduced although they were not necessarily appropriate for the new market. The commercialization challenge was ultimately underestimated. Hence, TechLtd followed a 'cross-functional exploration' strategy, although the attention of new markets required 'pure exploration' including both R&D and marketing (Voss and Voss, 2013).

Second, the sales officer divided his time across tasks in both the core and the new businesses, leading to severe time constraints and an opportunistic use of exploitative approaches learned from the core business. Hence, the use of exploitative marketing and commercialization approaches can stem from the dual demands of exploitation and exploration put on individuals – a severe challenge, as research in contextual ambidexterity discusses (Gibson and Birkinshaw, 2004; O'Reilly and Tushman, 2013). Indeed, initially the externally appointed R&D manager of the radical innovation unit also engaged in the exploration of new marketing and sales approaches. But later, when the exploratory–complementary linking was strengthened, this was considerably constrained – not without resistance and disappointment from the R&D manager.

4.1.2. Seeking legitimacy early on vs. frustration at discontinuation (T2)

Benefits sought through external and internal legitimacy seeking. We also identified a trade-off linked to integration mechanisms used in early phases in order to inform, inspire, and prepare the core business with the exploration results and legitimatize the existence of the exploratory activities. Gassmann et al. (2012) identified two mechanisms coined 'internal showcasing' and 'external validating'. Internal showcasing was used by TechLtd, for example, when the prototype of the new small-wind inverter was placed in the company's main conference room. According to the top management, this enabled core business employees to get in touch early on with the innovation. As the CEO recalls the R&D manager's actions:

He sold the project very well to the employees as a project paving the way for the future. As a result, the employees were very enthusiastic about it and stuck very much to it.

Indeed, the exploratory technology became the subject of frequent discussions among the employees. External validating was also pursued: the R&D manager of the exploratory unit involved potential customers early on at trade fairs by announcing commercialization of a superior new technology, trying to create market pull and legitimize the exploration efforts internally.

The risk of frustration at discontinuation of the exploratory project. Internal and external showcasing at TechLtd also led to unintended side effects. Technology exploration was no longer perceived as merely trial and error (without a guarantee for success), but rather expectations emerged which were tied to the innovation. This peaked when the prospects

of the new technology were exaggerated and it was promoted internally as the successor to the declining core business technologies – so that core business workers developed strong emotional bonds to the innovation and were desperately looking forward to the new technology. Once, however, top management felt more uncertain about its success, they had difficulties detaching core business expectations from the exploration. As the CEO recalls:

It is an important leadership challenge to know how to handle the emotions of the people involved, both in the exploratory units as well as in the core business.

This also constrained or delayed decision-making regarding the discontinuation of technology exploration, thus wasting exploration resources.

This process was further intensified by the attempts for early *external validating* by the R&D manager because 'going public' with the premature technology sent additional signals of hope to internal constituencies, which later went unmet. Also customer demand was raised although the company could not immediately satisfy this demand nor give details about the technology's positioning (e.g. pricing). When top management became aware of the independent external validating activities, they held back the R&D manager and installed a more restrictive policy for external communication, as used in their traditional business culture. This shows that integration mechanisms must also fit organizational culture, particularly when the exploratory unit is supervised by top management with ultimate responsibility for integration (Jansen et al., 2009).

4.1.3. Boundary spanning through job rotation vs. carrying over of old culture (T3)

Benefits sought through job rotation. One important integration mechanism involves transferring personnel (in contrast to shared use, as in exploratory–complementary *linking* described in T1) through job rotation, enabling boundary spanning between exploitative and exploratory spaces (Durisin and Todorova, 2012; Gassmann et al., 2012). Job rotation can also help save time and resources. This is particularly valuable for SMEs, which often have difficulties to effectively staff and manage multiple differentiated subunits (Voss and Voss, 2013). Job rotation can be used already at the beginning of a transition processes to partially staff the new exploratory unit with core business personnel. But such mechanisms also play important roles later in the transition process. Independent of the timing of the job rotation, employees from the core business can temporarily take over responsibilities in radical innovation projects and then return to the core business, better equipped with an ambidextrous mindset (Gibson and Birkinshaw, 2004). In such a 'liaison channeling', they remain inactive until the transfer of a radical innovation is undertaken in order to bypass the NIH syndrome (Gassmann et al., 2012).

At TechLtd job rotation occurred in the intermediate stage of the transition process, closely linked to the transfer from exploration to exploitation. In this process, top management decided that the sales manager already involved in the exploration (see T1) should fully enter the exploration team. This yielded much knowledge and experience in technology marketing to the explorative unit and strengthened the identification of the core business team with the innovation, but also changed the nature of the exploration process.

The risk of carrying over of old culture. With the job rotation put in place at TechLtd, the gradual process from exploratory to *more exploitative* orientation intensified, particularly in the marketing domain. Despite exploratory–complementary linking, some marketing exploration still took place in the exploration unit. However, when the sales manager from the core business temporarily took over complete responsibility for marketing in the exploration unit, a further crowding out of the more exploratory marketing activities could be observed and finally came to an end. The rotated sales manager's approach was to focus on scaling up the current sales strategy and multiplying sales contacts to drive sales volume.

Since employees often tend to retain their values, mental frames, and routines, job rotation bears the risk of carrying over the culture from the core business to the exploratory unit, which can lead to cross-contamination (cf. T1). Consequently, the culture of the old business is replicated, making it difficult to stimulate entrepreneurial behavior (Durisin and Todorova, 2012). Hence, switching successfully between exploration and exploitation needs much more than workforce flexibility (Simsek et al., 2009).

4.2. Actual transfer

Further trade-offs exist during the time in which exploration results are actually *transferred back* into the core business.

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4.2.1. Early vs. premature transfer (T4)

Benefits sought through early transfer. Generally, it is in the best interest of any firm to transition innovations into its core business as soon as they are mature (i.e. early) and it has received first positive market signals. Particularly for SMEs, a timely reintegration into the core business can be critical, as there are usually few slack resources and at some point in time resources spent in exploration are missing for necessary investments to maintain the core business. At the same time, defending unit autonomy may be important to successfully scale up exploratory business (Raisch and Tushman, 2016) and maintain its orientation (Hahn et al., 2016).

At TechLtd, after five years of exploration and discoveries within the new exploratory structure, the top management reassessed its reintegration strategy. They realized that they had spent considerable resources for exploration and, while this had yielded many discoveries, there was still no viable product. The small-wind inverter was in the process of being incubated, a first generation prototype existed, and market experience through first attempts of commercialization had been gathered. It is not that they were unable to invest more, as top management clarified, but the amount invested was relatively large and it seemed too large to justify continuing exploration on a similar scale.

A full transfer of the temporary exploration unit to the core business was intended from the beginning (Siggelkow and Levinthal, 2003), but it was then initiated much earlier than planned. In a critical executive board meeting showing dissatisfaction with the exploration process, top management decided to bring exploration under tighter control to speed up commercialization. In a first step, they introduced performance targets (i.e. sales-related targets). Also, the exploratory activities were refocused on the main project (small-wind inverter). When performance failed to increase, they replaced the exploratory R&D manager with another employee from within the company. Together modifications in staff responsibilities and performance metrics demonstrate the actual shift from exploration to exploitation and from a clearly demarcated radical innovation unit to a rather conventional R&D project managed in core business fashion.

The risk of premature transfer. Before shifting toward exploitation, the small-wind inverter was technologically mature, but not fine-tuned to the multiple customer needs. The innovation team had not spent sufficient resources for the incubation, necessary for exploring alternative business models to successfully commercialize the technology – therefore representing a premature transfer. The CEO later recalled that the meeting central to the initiation of the switch toward exploitation as follows:

The changes in performance indicators in the feed-in business unit came in a very abrupt way and much too early! This change put the R&D manager [of the exploratory unit] under huge pressures to quickly generate positive sales figures.

After the new business unit had become subject to performance expectations derived from the core business, more units of the product were sold, but commercial expectations remained unfulfilled. Not meeting the new sales targets made the R&D manager suddenly look bad. His work, hitherto characterized by experiments in both R&D and marketing domains, was considerably constrained. Moreover, his past success in leading the firm into a complex exploration of new technologies and markets became quickly irrelevant and he was ultimately dismissed.

As will be described in detail in the next section, this premature transfer also contributed negatively to subsequent phases of the transition, which met with a disruption of the organizational structures (see T5) as well as starvation and discontinuation (see T6). This is because a premature shift to exploitation can jeopardize support for exploratory innovations and cause resistance to folding them back into the core business (O'Connor and Maslyn, 2004; Chen and Kannan-Narasimhan, 2015).

Determining the right point in time to achieve an *early* but not *premature* reintegration can be difficult. But it seems more likely that a new business will survive and thrive when enough time for incubation and acceleration is provided (O'Connor and DeMartino, 2006): incubation involves developing a business model to profit from the new technology (cf. Siggelkow and Levinthal, 2003); acceleration involves implementing repeatable processes (e.g. manufacturing), a set of qualified customers, and predictable sales forecasts. If any of the latter elements is not fully achieved, nurturing such premature businesses in transitional business units may serve as a temporary solution before actual transfer to the core business (Chen and Kannan-Narasimhan, 2015). This strategy, however, was not pursued at TechLtd. Overall,

while streamlining incubation and acceleration phases can save resources in the short-term, this advantage can be easily offset by integration failure in the mid to long-term.

4.3. After transfer

The process of reintegration into the core business does not end with the formal transfer from one space to the other. Instead, considerable follow-up activities are necessary for ensuring its ultimate success, which come along with additional trade-offs.

4.3.1. Reorganization vs. capability mutation (T5)
Benefits sought through reorganization. Reintegrating a new innovation from the exploratory unit into established structures requires diverse measures of reorganization (Durisin and Todorova, 2012), such as changes in formal structure, routines, leadership styles, systems of reward and control, and resource allocation (Simsek et al., 2009). The receiving unit takes over teams and management positions while other now unnecessary positions are terminated. At TechLtd, top management's decision for reintegration provided potential for synergies and was followed by a complete reorganization with considerable change in organizational structures, staffing, and innovation trajectory. The new technology was ultimately integrated with the existing business line in drive electronics, with which it had the most technological similarities.

The risk of capability mutation. At TechLtd, we witnessed two main negative consequences: complex staff replacement processes and the partial loss of the exploration structures and related capabilities. The first negative consequence relates to staff hiring and the related reorganization of work and innovation processes, leading to instability, additional expenses, and considerable delays – much the opposite as intended. The position of the fired R&D manager needed to be filled – but remained vacant for some time and was re-staffed twice before an experienced internal manager was put in position. Also, many R&D tasks were delayed not only because the handover between successors was done in a rush, but also because the new internal R&D manager preferred a different approach toward product design. As a result, while the switch to reintegration into the core business was intended to speed up the commercialization, it took several years after the reorganization to move from prototype to final product and commercialization.

Such lost or damaged structures, processes, and teams – and their re-cultivation – are considered by Durisin and Todorova (2012) as inevitable capability mutation in reintegration processes. Capability mutation is also linked to other integration risks: mutation is higher in the case of premature transfer (see T4) and capability mutation increases the risk of subsequent resource denial by the core business (see T6).

A second and even greater damage linked to reintegration at TechLtd is the partial loss of exploration capability. Consistent with their objective of temporary exploration, reintegration led to the discontinuation of the separate exploration unit. Still, this was also linked to 'unintended consequences' and hence capability mutation (Durisin and Todorova, 2012). In a retrospective attempt, the CEO reflects:

If we had this vision today [of an ambidextrous organization] and knew the risks [of exploration failure], the externally hired R&D manager would still be in the company today! It was a serious mistake to fire him.

Hence, only when the single project prioritized in the transition process had ultimately failed did top management realize that they no longer had a dedicated unit and the related capability to pursue alternative exploratory pathways in the same way and intensity as before. In retrospect, top management understood that they also lost key personnel and thereby intellectual capital and networking competencies for exploration. It is not unusual for SMEs to follow sequential ambidexterity using temporary exploration units with the ultimate aim of reintegration (Siggelkow and Levinthal, 2003) following a natural sequence from technology discovery to commercialization (Simsek et al., 2009). However, given the high failure rates of exploration, it is quite unreasonable to close down the (temporary) exploration *unit* before a single exploration *project* has ultimately succeeded toward commercialization. The timing for switching from exploration to exploitation is therefore crucial.

4.3.2. Better access to resources vs. resource starvation (T6)
Benefits sought through core business accommodation. It is largely established that radical

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innovation units are not able to commercialize an innovation on their own (Gassmann et al., 2012) and mainstream business often provides the complementary assets necessary for commercialization (Taylor and Helfat, 2009). While complementary asset linking is pursued before transfer, the completion of transfer allows the radical innovation to become accommodated in and an actual part of core business structures and thus benefit directly from resource richness and professionalization – all objectives for final commercialization and the related market diffusion.

Similarly, at TechLtd, based on the reorganization (see T5), the small-wind inverter entered the more established product development process, thus benefiting from core business expertise and resources. Professional product development routines were used to finalize the product, which led to the first commercially available product version. Given the limited sales success in the domestic market, the sales team carried out an international market study and was strengthened with additional employees to intensify customer acquisition.

The risk of resource starvation and termination. Once transferred to the core business and when their professional marketing efforts did not yield expected sales, TechLtd focused on selling the current product version in newly identified international markets, but prevented more investment in further product exploration or on-going exploration of innovative ways to market the product. As top management also recognized in retrospect, the company retained a rather reactive stance toward new business proposals, which could have however increased commercialization success (O'Connor and DeMartino, 2006). In general, it can be observed that while on the surface a new business may seem to be integrated, there are tendencies to, 'starve nascent business of resources and talent' (O'Connor and DeMartino, 2006, p.493) and terminate results when success does not immediately follow transfer (Chen and Kannan-Narasimhan, 2015).

At TechLtd, after reintegration without a fully functioning business proposal, further resources needed to explore a viable business model which could potentially increase sales were denied by the top management. They allowed the sales manager to continue for a limited time of another six months, without however providing resources to adjust the sales approach or explore other business models. The CTO recalls the phasing out as follows:

We didn't find a market for the small-wind inverter. And then, by the end of 2012, we were already starting to slow down a bit on the staff side and finally in 2013 we slammed on the brakes.

As a result, top management decided in favor of market withdrawal and closed the feed-in exploration unit.

5. Discussion

With this fine-grained process study of the failed integration of a radical innovation project – involving a carefully planned separation, followed by cross-contaminating linking mechanisms, and ultimately rushed reintegration leading to capability mutation – we shed light on the existence, character, and timing of integration trade-offs in transition processes. Next we discuss integration trade-offs in general and within resource-constrained contexts. Finally, we discuss limitations and managerial implications.

5.1. Integration trade-offs in the transition process

Given that managing the exploration–exploitation interface involves trade-offs and that they occur during the entire transition process, our main contribution is a *framework of integration trade-offs in transition processes*. With our focus on the entire transition process, our framework gives insights into the *dynamics* of the exploration–exploitation interface *over time* and also considers the cumulative effects of trade-offs which may lead to failure. We further deepen the research on processes of *how and when separation and integration occurs* (Gassmann et al., 2012; Chen and Kannan-Narasimhan, 2015) and thereby contribute to the time dimension in organizational research (Ancona et al., 2001). This also reflects the conclusion of Simsek et al. that 'little is known about what drives a unit to shift between episodes of exploration and exploitation, or precisely how this shift takes place' (2009, p. 888). Last but not least, with the focus on trade-offs leading to failure, we also overcome the pro-innovation bias and contribute to the rather thin body of literature analyzing *innovation failure* (Khanna et al., 2016). The existence of trade-offs does not necessarily lead to failure per

se. Instead, these trade-offs should be carefully analyzed and contained so that they do not jeopardize the 'energizing potential' of the overarching exploration–exploitation paradox.

While we have identified a significant set of integration trade-offs, given the context of a single organization, they are surely not complete. For example, while cross-functional decision making is also likely to be part of an integration trade-off, because it bears the risk of lowering the degree of radicalness (Gassmann et al., 2012), it was not relevant in our case context and therefore not included. Hence, future studies should extend our framework by complementing it with other relevant trade-offs or further developing existing ones. Moreover, we suggest further analyses of the conscious or unconscious combination, customization, and scheduling of integration mechanisms by top and middle management and the effects on trade-offs. Last but not least, the present study's context of renewable energy technology also indicates another fruitful research avenue: to focus on the context of green technology and broader sustainability-oriented innovation (Hansen et al., 2009; Schaltegger and Wagner, 2011; Schiederig et al., 2012), with its relevance for ambidexterity (Seebode et al., 2012). Studying the role of integration mechanisms and trade-offs in this context seems important because the tensions between exploitation and exploration are stronger. In addition to integrating radical and incremental innovation perspectives, ambidextrous organizations embarking on the sustainability journey also have to bridge conventional technology innovation directed at customer and business growth with innovations generating broader societal benefits. This puts new demands on individual integration mechanisms and their orchestration.

5.2. Integration trade-offs in resource-constrained contexts as a source of failure

Our research confirms that in resource-constrained contexts organizations may have difficulties to fund an independent exploratory unit so that it remains independent for longer time spans, making early or mid-stage involvement of the core business likely (Chen and Kannan-Narasimhan, 2015). Resource-constrained organizations must pursue ambidexterity more efficiently, making trade-offs between exploration and exploitation a necessity (Cao et al., 2009). Against this background, and independently of the phase-specific trade-offs and risks presented in our framework of the transition process, we see three generic sources of failure when integration mechanisms become subject to resource-efficiency considerations:

1. *Mechanism-related (inherent) failure:* The implementation of integration mechanisms may itself become a vehicle for (resource-saving) synergies between exploitation and exploration (e.g. linking the exploratory unit with complementary assets in core business enables reuse of existing resources; job rotation allows the reuse of existing personnel). Such a misuse of integration mechanisms is particularly prone to weaken separation and lead to cross-contamination. It may even contradict the intended separation strategy (e.g. strong exploratory-complementary linking in the domain of marketing when in fact a pure exploration was intended).
2. *Pulling-forward-related failure:* Integration mechanisms are pulled forward in the transition to accelerate the process, which may backfire. For example, while cutting incubation and acceleration saves resources in the short term, the premature transfer of exploration projects back into the core business ultimately leads to failed commercialization.
3. *Streamlining-related failure*: Integration mechanisms are implemented in a simplified or partial way, however, to an extent that their functioning can no longer be assured (e.g. job rotation scheme poorly integrated in the overall ambidexterity strategy).

Overall, we find that the more integration processes are streamlined, the higher are the respective risks of cross-contamination and ultimate exploration failure. It is therefore important to carefully weigh both benefits and risks related to streamlining transition and related integration processes. Future research should further examine and potentially expand these modes of failure in resource-constrained contexts.

5.3. Limitations

Our study is limited in three ways. First, while our longitudinal study investigates processes leading

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to failed innovation, we do not know whether the trade-offs observed in the integration processes were the only causes of failure. The difficult characteristics of an immature market may have also constrained innovation success. Second, we experienced the well-known challenge of building analytically distinct concepts to achieve conceptual clarity despite empirical overlap. For example, there is an overlap among our early vs. premature transfer trade-off (T4) and the subsequent trade-offs. We dealt with this limitation as far as possible by detailing the linkages among the trade-offs.

5.4. Managerial implications

Our results are crucial for top management, R&D managers, and other middle managers (e.g. marketing) involved in the innovation process who want to prevent exploration failure, whether in resource-constrained contexts or in large organizations. Structural ambidexterity has been the preferred approach for managing the dual challenges of exploration and exploitation successfully. This suggests that both types of activities should be undertaken in separate units while engaging in targeted integration. Integration can be achieved by a broad set of mechanisms such as use of complementary assets from the core business, cross-functional decision-making structures, job rotation, external and internal legitimacy seeking, and the actual transfer back into and accommodation within established structures of the core business organization. Integration mechanisms always bear the risk of cross-contamination, which could damage the separate exploration and exploitation structures – thus, they are inevitably linked to trade-offs. This does not mean that integration mechanisms should not be implemented; they are a necessary element in managing the tensions involved in the exploration–exploitation paradox. Rather, organizations have to consciously design and schedule (re)integration mechanisms along the transition process in order to minimize potential negative side-effects.

Finally, each integration mechanism also bears the potential for saving resources, which makes it particularly prone to resource-thin contexts such as SMEs. However, a motive of resource savings when applying integration mechanisms may backfire in the form of mechanism, pulling-forward, and streamlining-related failure. Managers should carefully weigh the benefits of resource savings with the increased risks of exploration failure.

6. Conclusion

Integration mechanisms have been presented as a panacea for managing the exploration–exploitation paradox. We agree that they are certainly relevant, and may in fact be the most important elements of an organizational design for ambidexterity. However, while integration mechanisms are implemented in pursuit of cross-fertilization, they simultaneously hold the risk for cross-contamination – two sides of the same coin. It is therefore crucial for organizations to carefully choose, customize, and time – that is, orchestrate – the integration mechanisms along the transition process.

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