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Innovation-Expansion In The ICT-Industries: R&D Acquisition And Integration Success From A Knowledge Perspective

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Abstract

This paper investigates the role of early stage integration mechanisms in acquisitions where the prime goal is to acquire the research and development capabilities of the target firm, i.e. the knowledge of the target firm. We term this transaction 'R&D acquisition'. This is most relevant for industries with extreme hunger for external knowledge like the IT-, telecommunication- and media- (ICT) industries. Based on a review of the related knowledge transfer and post merger integration literature and based on an existing model for clustering R&D units by Birkinshaw (2002), we develop a testable model for the relationship between the choice of early stage integration mechanisms and R&D acquisition success. We argue that this relationship is moderated by the knowledge characteristics of the target firm. We suggest specific early acquisition integration mechanisms for the successful integration of three distinct and practically observable target firm R&D constellations. We illustrate our model with a telecommunication case example.

1 Introduction

The information and telecommunication (ICT) industry as well as the media industry are fertile parents to a plethora of electronic (e) and mobile (m) products and applications (Sorenson et al. 2002). A common denominator of these industries is that they are based on a fast paced and converging technology development. Winners of the market are in most cases also technology leader or capable of turning a base technology into a superior product that meets customer needs. While access to technology and know-how become increasingly important to succeed in the market, size, history and equity become less and

less critical requirements. On the one hand this allows e- and m-start-ups to realize tremendous growth rates and on the other hand spurs the quest for external knowledge sourcing both at the established players and start-ups.

Hence, it is not surprising that the telecommunication industry in Europe is heavily relying on external R&D-collaboration or buy-in of know-how within the product development process (Arundel & Bordoy 2002). However, time pressure in innovation as well as the need to internalize key technologies make the ICT and media industries also very active players in mergers and acquisitions (M&A's) (Deogun & Scannel 2001, Warner 2003). Scholarly research has identified the need to speed up the sourcing of technology and know-how as a key motivation for the increase in M&As (Capron et al. 1998, Bresman et al. 1999). Especially for the ICT and media industry, acquisitions are an increasing popular choice for expansion of the firm's technology and knowledge base (Chaudhury & Tabrizi 1999, Hagedoorn & Duysters 2002).

A company's knowledge base can generally consist of diverse kinds of knowledge, such as knowledge required in manufacturing or knowledge related to new product development. In our paper we focus on acquisitions where the prime goal is to acquire the research and development capabilities (i.e. knowledge related to new products) of a target company to achieve synergies with existing operations[1,2]. We term this transaction an 'R&D acquisition'. These acquisitions are quite frequent (Wysocki 1997) and can be a major source of value (Ahuja & Katila 2001). A successful R&D acquisition that leads to synergies requires an integration of the acquired company or business unit (Haspeslagh & Jemison 1991). However, the integration process is difficult and often the integration fails (Jemison & Sitkin 1986), and the acquiring company destroys value. For example, Bert et al. (2003) report a failure rate of around 50%. Clearly, a seamless integration of the relevant information systems (IS) is an integral and complex task within the M&A environment (Sumi & Michio 2002).

Academic research has not yet addressed this problem adequately. A multitude of studies have been conducted on M&A's, however, as King et al. (2004) report, there is a discordance about the significance of success factors in acquisitions. More specifically, little research has focused on acquisitions, where managing the systematic growth of a firm's knowledge base is at the center of interest (Ahuja & Katila 2001, Heo & Yoo 2002) and the impact of different types of integration mechanisms (Napier 1989).

We aim to address this research gap by developing a knowledge focused, testable model of R&D acquisition success. By considering the characteristics of the key asset - the R&D knowledge - a most relevant variable for post acquisition merger activities, we derive distinct early integration strategies. These strategies set the stage for integration momentum and effective enhancement of the innovation capabilities. Keeping the introductory description of the ICT industry in mind, we propose a model that might generate useful insights for various ICT-practitioners in the field of M&A, such as internal M&A departments, investment bankers and consultants. The approach can also help to schedule and focus the integration of information systems in relation to business integration. The illustration of our findings with an actual mobile media case study will help to clarify the applicability of the model for young as well as established companies.

[1] Obviously there are valuable acquisitions where the realization of synergies with existing R&D operations is not the prime concern (for example when the parent company pursues a pure portfolio management approach), however such acquisitions are not the focus of this paper.

[2] Other modes of access to external knowledge are excluded from our investigation. These would comprise the spectrum of R&D collaboration from transactions to contracting and licensing. For an overview see Chiesa and Manzini (1998).

2 Theory And Background

2.1 Knowledge Transfer As The Key To Synergies And Acquisition Success

Generally, acquisitions involve two major components, each of which influences their success: (1) strategic and financial analysis before making the deal (Hitt et al. 2001) and (2) firm integration after the deal is closed (Haspeslagh & Jemison 1991). In this paper we focus on the second component, the integration of the firm and its pre-acquisition assessment. We assume that the acquisition makes sense from a strategic and financial perspective. An R&D acquisition is successful if the buyer can integrate the acquired company in a way that it increases performance through the realization of knowledge synergies. Knowledge synergies are achieved, for example, when the parent and the acquired unit increase revenues or reduce costs through jointly developed new products and the use of previously unknown process know-how. All these activities presume knowledge transfer[3] from the acquired company to the parent and vice versa. Therefore, we start with a review of the literature on knowledge transfer related to the acquisition of R&D intensive firms. From the review emerges a considerable gap concerning the mode and timing of integration mechanisms in R&D acquisitions. Consequently, we focus on that aspect and develop a testable model that links different integration mechanisms in the early stage of an R&D acquisition to integration success based on the knowledge characteristics of the target. We then illustrate the model with a practice case and conclude the paper with a discussion of the findings.

2.2 Knowledge Transfer In Context Of R&D Acquisitions

Knowledge transfer occurs at various levels of the organization: between individuals, groups of individuals, organizational functions, business units and organizations themselves. We focus on knowledge transfer at the functional (R&D unit) and business unit level which leads to two relevant literature streams: (1) knowledge transfer within the firm (intra-company knowledge sharing), and (2) knowledge transfer in acquisitions including the literature on post merger integration. Appendix 1 gives an overview over the reviewed studies.

2.2.1 Knowledge Transfer Within The Firm

Research on knowledge transfer within the firm emerges from studies on the choice of international knowledge transfer modes (see Bresman et al. 1999 for a review). By now, a large body of research has investigated the factors that influence intra-firm knowledge. The factors that are influencing intra-company knowledge transfer can be separated in two broad categories: (1) factors related to the characteristics of the transferred knowledge and (2) organizational factors. The predominant factors related to knowledge characteristics are the degree of codification, observability, complexity (Zander & Kogut 1995), the degree of embededness, and knowledge distance (Cummings & Teng 2003). The degree of codification expresses the extent to which knowledge can be articulated in

[3] In this paper knowledge includes all forms of technology. Therefore if we talk about transferring knowledge, technology transfer is included.

documents and software (Zander & Kogut 1995). This factor is identical to what Bresnan et al. and Cummings & Teng refer to as 'articulability of knowledge' (Bresman et al. 1999, Cummings & Teng 2003). The degree of embededness expresses "how many knowledge elements and related sub-networks will need to be transferred, absorbed, adapted and adopted by the recipient, and/or how many other recipients will be required to do so to allow the knowledge to be applied to the recipient" (Cummings & Teng 2003). Knowledge distance is the "degree to which the source and the recipient possess similar knowledge" (Cummings & Teng 2003).

Organizational factors influencing knowledge transfer are: Organizational structure in terms of formal hierarchical structure and informal lateral relations (Tsai 2002), length of network paths (Hansen 2002), intensity of communication (Tsai 2002, Cummings & Teng 2003), norm distance (Cummings & Teng 2003), tie strength (Hansen 1999, 2002) and absorptive capacity of the recipient (Szulanski 1996, 2000). Norm distance is the degree to which knowledge transfer parties share the same organizational culture and value systems (Cummings & Teng 2003). Absorptive capacity of the recipient is the ability of the recipient to exploit outside sources of knowledge (Szulanski 1996).

2.2.2 Knowledge Transfer In Acquisitions

The literature on knowledge transfer and extension in acquisitions is still immature although knowledge access is a major driver for acquisition activities (Ahuja & Katila 2001). A branch of research on mergers and acquisitions which focuses on post-acquisition integration touches the topic (e.g. Haspeslagh & Jemison 1991). However, the central concern of this research stream is not on factors facilitating knowledge transfer but on the issue how knowledge transfer may lead to overall value creation (Capron et al. 1998, Bresman et al. 1999). Another line of research which is slowly evolving explicitly studies the knowledge transfer process after an acquisition. Bresman et al's study of forty-two international acquisitions identified articulability of knowledge, degree of communication and level of use of integrating mechanisms as the key factors influencing knowledge transfer after acquisitions. Finkelstein and Halebian (2002) add similarity of industrial environments in acquirers and targets as an important factor. Their argument is that an acquirer from a similar industry is likely to have similar standard processes, shared experiences and internal arrangements which ease communication and knowledge transfer.

The review showed that the factors that facilitate knowledge transfer after acquisitions are similar to the factors that facilitate knowledge transfer within the firm.

2.2.3 Determinants Of Knowledge Transfer

Based on the literature review, figure 1 summarizes the factors that influence knowledge transfer. The "plus" or "minus" after the variable indicates the influence of the factor on knowledge transfer. A "neutral" (o) was assigned when the relationship between the factor and knowledge transfer was moderated by additional variables (which are not presented in the model). In order to pre-assess an R&D acquisition the decision maker needs to understand the organizational and management requirements that are necessary to facilitate knowledge transfer after the acquisition. The overview in figure 1 helps the acquisition manager in various ways: It allows him to assess in advance (1) whether the potential knowledge he plans to acquire is likely to lead to knowledge synergies based on the knowledge characteristics, (2) whether a successful integration is feasible based on the organizational characteristics (of parent and target company), and (3) roughly what organizational changes would be required for 'optimal' knowledge synergy achievement.

The overview can give a first hint to these questions but is too undifferentiated to provide specific answers. It is beyond the scope of this paper to develop more thorough case specific integration models. However, an interesting point emerges from our review of the knowledge transfer literature: The positive impact of the intensive use of integration mechanisms such as joint R&D meetings, joint R&D personnel and training programs on post merger integration performance is unquestioned (Jemison & Sitkin 1986, Haspeslagh & Jemison 1991, Bresman et al. 1999, Birkinshaw et al. 2000). Similarly, the criticality of IS-integration is a prevalent topic in academia (e.g. Heo & Yoo 2002) and practice (e.g. Picard & McConville 2000). One of the most prominent success cases based on a superior performance in post merger R&D integration coupled with IS-integration can be seen in Cisco Systems (Kraemer & Dedrick 2002). However, the research as of today neither considered the timing of the application of different integration mechanisms nor did it relate specific integration mechanisms to knowledge characteristics of the target firm. This is a significant shortcoming; especially as recent research (e.g. Bert et al. 2003) suggests that the window of opportunity to realize merger synergies in R&D acquisitions has a very limited time span[4] which in turn implies that wrong timing and/or application of integration mechanisms early in the process can be fatal for acquisition success. We therefore enhance the approach to link knowledge base characteristics to the selection and timing of post merger integration mechanisms.

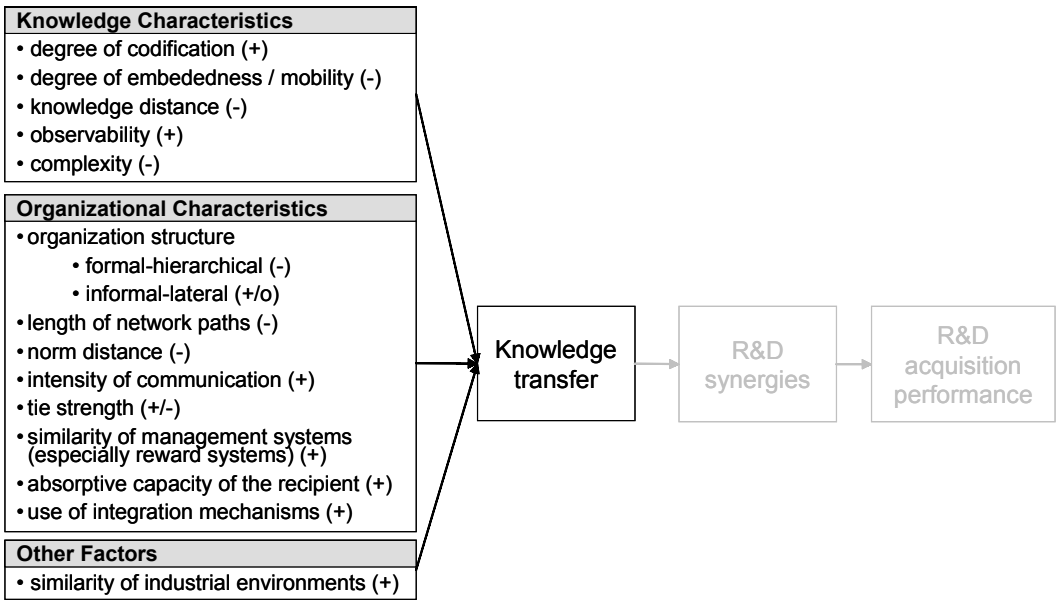

***Figure 1**: Factors Influencing Knowledge Transfer*

[4] Best practise mergers realize a minimum of 70% of total synergies within the first year after acquisition. After year two the synergy potential is close to zero.

3 A Knowledge Based Model For The Selection And Timing Of Post Merger Integration Mechanisms

3.1 Principal Model Structure - Linking Knowledge Asset Specification To Acquisition Success

The general logic of our model is the following: Based on a set of knowledge asset characteristics, we infer certain organizational characteristics of the target firm which in turn suggest a specific early integration mode (see figure 2). In line with Bert et al's (2003), "early integration" covers a time period up to one year after the acquisition. We argue that the choice of the early integration mode is critical for acquisitions success. We simplify our model by deferring the knowledge characteristics and the organizational structure of the acquiring firm.

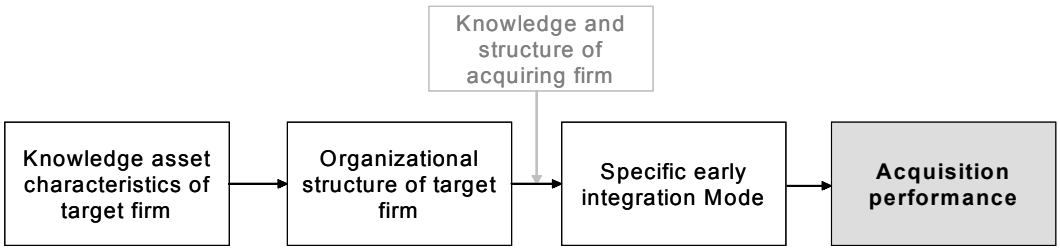

***Figure 2**: General Logic Of The Model*

To establish the link between knowledge asset characteristics of the target firm and its organizational structure we draw on research by Birkinshaw (2002). He empirically proved a correlation between R&D knowledge characteristics and the structure of R&D centers[5]. Birkinshaw consolidated knowledge characteristics from Zander and Kogut (1995) into the two constructs 'observability' and 'mobility'. Observability is "the extent to which the knowledge-base can be understood through observation" (Birkinshaw 2002), and mobility is "the extent to which the knowledge base of the R&D center can be separated from its physical setting" (Birkinshaw 2002). The observability construct is related to the degree of codification, and complexity. Mobility can be paraphrased as the opposite of embededness (Birkinshaw 2002). Birkinshaw measured the two construct by conducting a multi-item scale questionnaire survey. A similar questionnaire is included in Appendix 1. Based on the two dimensions, Birkinshaw identifies three archetypes of R&D centers which differ in structure through the level of autonomy, defined as "resource and decision power" and the level of network integration, defined as "the integration with other R&D units" (Birkinshaw 2002). We refer to these three archetypes as case 1, 2 and 3. Key relationships are illustrated in Fig. 3.

[5] We assume that the form and structure of the target in the R&D acquisition is comparable to what Birkinshaw (2000) refers to as ‚R&D Center'.

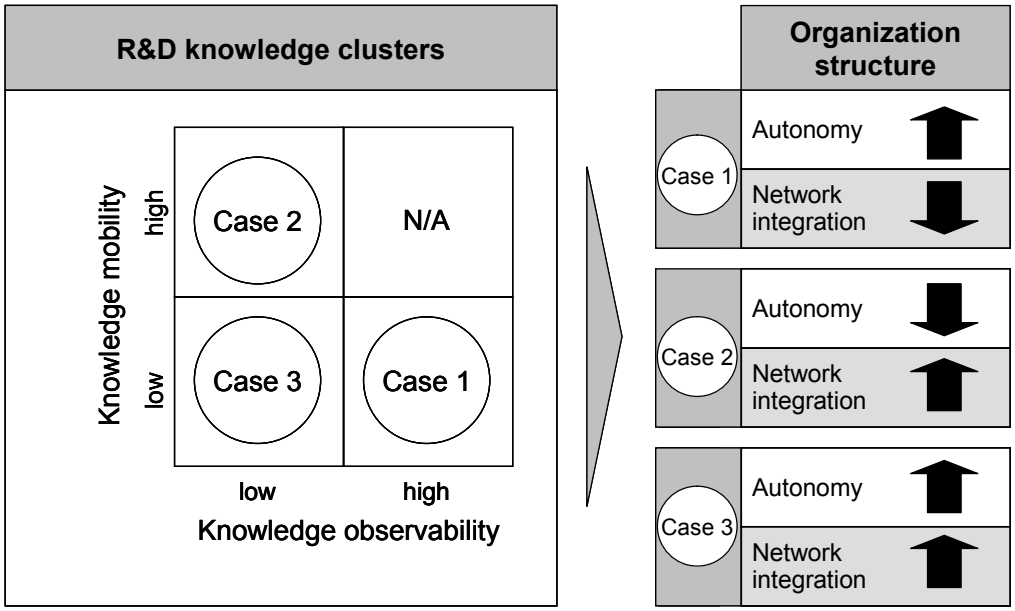

***Figure 3**: Relationship Between R&D Knowledge Clusters And R&D Center Structure (Adopted From Birkinshaw (2002))*

Based on the organization structure of the different types of R&D centers we derive a specific set of integration mechanisms for the early stage of the integration for each case. We therefore link knowledge characteristics of R&D centers to specific post merger integration mechanisms. We distinguish 'task integration' and 'human integration' as two major sets of post R&D merger integration activities (Birkinshaw et al. 2000). 'Task integration' focuses on resource sharing and transfer mechanisms such as joint R&D meetings or the use of a knowledge management system, whereas 'human integration' emphasizes the "creation of positive attitudes towards the integration among employees on both sides" (Birkinshaw et al. 2000).

The two integration modes are not completely independent but generate useful conceptual pathways and indicators for early integration foci for achieving acquisition success.

Contra-intuitive effects of collaboration systems and tools occurring during M&A activities emphasis the necessity of the two pathway concepts. To achieve relevant degrees of task integration, companies employ a variety of tools and systems. In the realms of R&D management, companies build on instruments like knowledge repositories for data sharing and integration approaches like the Quality Function Deployment. Interestingly, it was found that the usage of these instruments enhances the quality of collaboration within the group of involved employees, but hinders the company wide integration (Griffin & Hauser 1993, Calabrese 1997). This effect is even amplified in M&A situations, where a cross-company collaboration becomes important (Heo & Yoo 2002). To plan a successful post merger integration, this effect must be considered and might be countered only with human integration.

3.2 Model Based Propositions

In the following we develop a testable model in the form of propositions for the relationship between the choice of early stage integration mechanisms and R&D

acquisition success based on (i.e. moderated by) the knowledge characteristics 'mobility' and 'observability' (see figure 4).

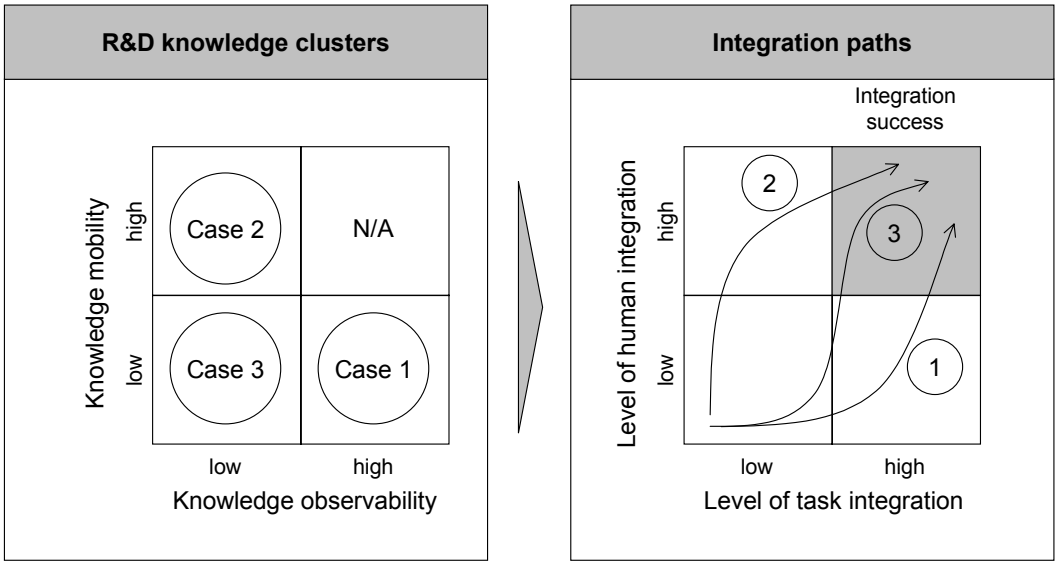

***Figure 4**: The Relationship Between Knowledge Clusters And Successful Integration Paths (Adopted From Birkinshaw (2000, 2002))*

Case 1: Mobility low & observability high. R&D centers based on knowledge which is rather immobile but highly observable usually portray a high degree of organizational autonomy due to a successful research history and are rather focused on a specific research task. These centers are more vertically integrated into the organization, have fewer horizontal links to other R&D centers and are deeply rooted in the local economy (Birkinshaw 2002). Hence, the acquirer needs to establish a clear definition of the exchange relationship between the newly acquired R&D center and the vertical organization of the parent company. Interface design and task integration should therefore be the prime foci. Due to the high level of autonomy, human integration is rather a peripheral concern in the early stages of the integration process. Therefore:

***Proposition 1:** Integration success of R&D acquisitions involving a low level of knowledge mobility and a high level of knowledge observability is positively associated with high levels of task integration and low levels of human integration during the early integration period.*

Case 2: Mobility high & observability low. The "case 2 R&D centers" are typically small R&D units with proprietary knowledge residing in a team of a few researchers. These R&D centers usually display high mobility and low observability of knowledge. To orchestrate and control the R&D effort this requires limited autonomy and a strong integration into the R&D network (Birkinshaw 2002). The key success factor in the acquisition most likely is team integration to (1) reduce the risk of know-how loss through employee fluctuation and to (2) create a sense of belonging to the parent company to increase the willingness to share knowledge. Therefore human integration should be the focus in the early phase of the integration:

***Proposition 2:** Integration success of R&D acquisitions involving a high level of knowledge mobility and a low level of knowledge observability is positively associated with low levels of task integration and high levels of human integration during the early integration period.*

Case 3: Mobility low & observability low. Low observability and low mobility frequently result from significant R&D unit size, old age and considerable reach of the research conducted. These factors generate high complexity for post merger integration activities[6]. R&D centers of this type serve a wide range of products, have deep local roots and an own way of doing things which is hard to change from the outside. These R&D units should be granted a high level of autonomy to allow self-organization. Furthermore, they should be tightly integrated into the R&D network of the overall organization to achieve knowledge synergies (Birkinshaw 2002). In order to achieve integration success a threefold process should be pursued: In a first step task integration should target the overall regulation of resource sharing to define the areas of synergy. The second step needs to addresses the human integration in order to build a positive employee attitude as fundament for the third step, a renewed task integration to achieve the full synergy potential. The integration mode in case 3 is clearly long term and must ensure the self organization capability of the acquired unit. Therefore:

Proposition 3: *Integration success of R&D acquisitions involving a low level of knowledge mobility and a low level of knowledge observability is positively associated with high levels of task integration and low levels of human integration during the early integration period. However, a strong ramp up of human integration is inevitable after quick win realization.*

Stressing the importance of taking the appropriate integration path in the early integration phase our model provides a decision maker with the means of identifying the most appropriate integration mode dependent on an acquisitions target's knowledge assets. He then must assess whether his own corporation has the resources to manage the integration process to set up a best fit R&D organization structure in the required time.

3.3 Model Enhancement And Planned Research Implementation

We aim to test our model in a large scale quantitative survey-based study on acquisitions in the ICT and media industry in Germany, Switzerland and Austria. We currently operationalize our constructs using measures which have already been established in prior studies. For mobility and observability we use measures from Zander and Kogut (1995) and Birkinshaw (2002). For the constructs human integration and task integration we use measures from Birkinshaw's (2000) study. All items are measured on 7-point Likert scales. In order to capture acquisition performance, we use multiple measures: (1) a subjective measure asking executive to rate the integration success on a 7-point Likert scale. This is necessary because some of the smaller transactions may not be significantly reflected in the accounting data and stock prices. (2) Accounting measures of profitability established in numerous M&A studies, such as ROA, ROE, ROS. (3) We monitor stock price performance. We monitor the accounting measures and the stock prices up to 3 years after the acquisition. We assume that all synergies from the transaction should be realized by then, i.e. the acquisition should be fully integrated. A longer time period would make it difficult to logically link performance variance to a single acquisition due to possible strategy changes (Harrison et al. 1991). Data on completed acquisitions is being derived from standard financial databases (e.g. Genios M&A database).

[6] Typically these types of acquisition are not driven by mere R&D access but other strategic acquisition objectives (e.g. customer base, sales channels, scale). One practical example is the acquisition of Volvo by Ford.

4 Case Example: R&D Acquisition In The Mobile Communication Technology Market

For the illustration of the model designed above we have chosen a technology company "Bamboo Mediacasting Inc"., which is active in the market for mobile telecommunication technology. We interviewed two executives of the company[7]. Please refer to Appendix 2 for the questionnaire. The company is a venture financed start-up company founded in the year 2000 in Israel. Its major business activity as of today lays in the development of mobile multicasting technology (14 of the 21 employees are R&D engineers). Based on its R&D the company achieved innovation leadership. However, its resource position might not allow a full set up of marketing and sales operations in the relevant markets in Europe, USA and Asia. As the incumbent technology providers lack the multicasting expertise but posses the market access an acquisition of the entire company might be a likely scenario.

Bamboo fits into the case 2 of R&D units. The technology consists of proprietary software and hardware, which has to be integrated in a mobile telecommunication network to enable multicasting functionality. The knowledge resides within a few highly skilled engineers with partly international education backgrounds. Additionally technical documentation is not very advanced because resources are scarce and occupied with operational start-up activities. The knowledge thus has low observability and high mobility, which in turn requires a potential buyer to strongly integrate the R&D activities with a reasonably low level of autonomy into its own R&D network.

The speed and intensity of integration will be major success factors. Today the engineers are strongly tied to the start-up company by stock option plans and emotional binding. After an acquisition this mechanisms needs to be replaced to certain degree by monetary items but also by the creation of a consistent feeling of belonging to the new company. Speed plays a critical role not only due to the rapid market development but also because the exist of a small number of engineers can impact the R&D performance and provide competitors with access to the technical know-how.

Therefore, a potential buyer must focus on the human integration first and generate a strong level of leadership, strong bilateral communication, provide retention plans and improve individual personal situations.

5 Conclusion And Implications

The paper contributes to the discussion on the success factors in the integration of acquisitions where the main goal is to acquire the R&D capabilities of the target firm. The ICT- and media-industry is significantly permeated with this type of M&A's. A glance at the historic performance, however, shows that this strategy so far is a risky game with mediocre outcomes. Furthermore, research is immature and to a large part discordant on the reasons for the suboptimal behavior. We argue that the choice of early stage integration mechanisms, i.e. integration mechanisms which are applied within the first year of the acquisitions, have a significant influence on the acquisition success. We propose that (1) R&D acquisitions involving a low level of knowledge mobility and a

[7] Information on the company has been generated through an interview with the company's CEO and COO (questionnaire presented in table of figures), discussion in a joint research project and internet research (http://www.bamboomc.com).

high level of knowledge observability should focus on task integration, (2) acquisitions involving a high level of knowledge mobility and a low level of knowledge observability should focus on high levels of human integration, and (3) acquisitions involving a low level of both observability and mobility should focus on high levels of task integration at the early stage of the integration process. The model is currently being operationalized and prepared for implementation in a research study in the ICT and media industry.

For practitioners the insights of this research will help to better understand the role of early stage integration mechanism in successful R&D acquisitions. This will aid managers in (1) assessing potential R&D acquisitions depending on their firm's integration capability, (2) deciding which kinds of integration mechanism to focus on in the early phases of R&D integrations, and (3) timing their R&D acquisitions depending the resource availability for the required integration mechanism. Focused actions can also be derived for the IS-based knowledge management systems, which need to be integrated in a post merger in order to effectively leverage the merged R&D-knowledge base. Eventually, our research might help to lift the returns on the extreme levels of R&D investments in the ICT industry to a sustainable level.

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Appendix 1: Review Of Knowledge Transfer Literature

Author	Study	Findings
Knowledge transfer within the firm		
Cummings & Teng (2003)	Study of sixty-nine firms in fifteen industries to identify the key factors affecting knowledge transfer success	Transfer success increases with decreased (1) knowledge embeddedness (2) knowledge distance and (3) norm distance between source and recipient and with (4) increased articulability of knowledge
Hansen (1999)	Study of 120 new product development projects in 41 business units in a large electronics company to examine the task of developing new products in the least amount of time	Weak links help a project team to quickly search for useful knowledge in other subunits Weak interunit ties speed are suitable for knowledge transfer (transfer speed) if knowledge is not complex. If complex knowledge is transferred, strong interunit ties are required.
Hansen (2002)	Study of 120 new product development projects in 41 business units of a large multiunit company to explain effective knowledge sharing	Project teams with short interunit network paths to units that possess related knowledge obtain more existing knowledge from other units and complete their projects faster While established direct relations mitigated problems of transferring noncodified knowledge, they were harmful when the knowledge to be transferred was codified, because they were less needed but still involved maintenance costs
Szulanski (1996)	Study consisting of 271 observations of 122 best-practice transfers in eight companies to analyze the internal stickiness of knowledge transfer. Stickiness refers to the difficulty in transferring knowledge.	The three most important origins of stickiness are (1) the lack of absorptive capacity of the recipient, (2) causal ambiguity, and (3) an arduous relationship between the source and the recipient.
Szulanski (2000)	Cross sectional analysis of primary data collected through a two-step survey of 122 best-practice transfers in eight companies.	A process model of knowledge transfer is derived from his 1996 study. The model identifies stages of transfer and factors that are expected to correlate with transfer difficulties at different stages of the transfer.
Tsai (2002)	In depth case study of a large, multiunit petrochemical company to assess how a multiunit organization	Formal hierarchical structure, in the form of centralization, has a significant negative effect on knowledge sharing

	can coordinate its units and encourage them to share knowledge with their competitors inside the organization	Informal lateral relations, in the form of social interactions, have a significant positive effect on knowledge sharing among units that compete with each other for market share, but not among units that compete with each other for internal resources
Zander & Kogut (1995)	Study of forty-four major innovations of Swedish companies to examine the central proposition that the transfer speed and imitation of capabilities are related to the dimensions of the underlying knowledge	The degree of codification, the observability and the complexity of knowledge and how easily capabilities are taught has a significant influence on the speed of transfer
Knowledge transfer in acquisitions		
Bresman et al (1999)	Study of forty-two international acquisitions involving knowledge transfer to identify factors that facilitate knowledge transfer as well as patterns of knowledge transfer	Tacit knowledge is best transferred through intensive communication, with many visits and meetings, and when the acquisition is fully integrated Articulated knowledge (e.g. patent) can be made available to the other party with little personal interaction Over time, transfer of articulable knowledge decreases and transfer of tacit knowledge increases Intensive use of integrating mechanisms such as joint R&D meetings, mixed project teams and cultural training sessions eases implementation and helps retaining personnel
Finkelstein & Haleblian (2002)	Study of ninety-six organizations to examine positive and negative transfer effects in acquisitions	Acquisitions performance is positive associated with the similarity of industrial environments in acquirers and targets

Appendix 2: Questionnaire

In order to match your R&D activities with the knowledge terminology of Brikinshaw please answer the following questions:

1. Observability: To what extent do you agree with the following questions about your R&D unit? (where 1 = disagree completely to 7 = agree completely)

A competitor can easily learn how to develop our product by studying our employees at work	□1 □2 □ 3 □ 4 □ 5 □ 6 □ 7
A competitor can easily learn how to develop our product by taking a tour of the plant	□1 □2 □ 3 □ 4 □ 5 □ 6 □ 7
A competitor can easily learn how to develop our product by examining our machines	□1 □2 □ 3 □ 4 □ 5 □ 6 □ 7
New R&D personnel can easily learn their job by studying a complete set of blueprints	□1 □2 □ 3 □ 4 □ 5 □ 6 □ 7
New R&D personnel can easily learn their job by talking to experienced R&D personnel	□1 □2 □ 3 □ 4 □ 5 □ 6 □ 7
Educating and training new R&D personnel is a quick and easy job	□1 □2 □ 3 □ 4 □ 5 □ 6 □ 7

2. Mobility: To what extent do you agree with the following questions about your R&D unit? (where 7 = disagree completely to 1 = agree completely)

For our most important product, knowledge about many different technologies needs to be combined	□1 □2 □ 3 □ 4 □ 5 □ 6 □ 7
The tasks of R&D units can not be divided between units since all equipment	□1 □2 □ 3 □ 4 □ 5 □ 6 □ 7

must be kept in one location	
The tasks of R&D units can not be divided between units since the tasks demand daily face to face communication between personnel	□1 □2 □ 3 □ 4 □ 5 □ 6 □ 7
We can achieve satisfactory quality only because of our firm's long experience with the technology	□1 □2 □ 3 □ 4 □ 5 □ 6 □ 7
To achieve high product quality it is important that our R&D personnel has long experience in the specific R&D unit in which they are working	□1 □2 □ 3 □ 4 □ 5 □ 6 □ 7
Workers in important parts of the manufacturing process have to be in constant contact with engineers or product quality will go down R&D centre autonomy	□1 □2 □ 3 □ 4 □ 5 □ 6 □ 7

3. If you had to decide on an exit option for your company, especially one including a close/ exclusive co-operation in R&D with an established player, which of the below mentioned options would you prefer?

- Acquisition (typically least autonomy and strongest integration)
- Merger
- Licensing
- Minority Equity
- Joint Venture
- Joint R&D
- R&D Contract
- Research funding
- Consortium
- Networking
- Outsourcing (typically strong autonomy and least integration)

4. Please provide a brief description on your three most important decision criteria for answer 3.

Criteria 1:

Criteria 2:

Criteria 3:

5. If not included in 3.) what role do the characteristics of your company's R&D knowledge play in the question of co-operation?

6. Independent of any equity and governance related issues, if you had to join your R&D operations with a global telecommunication equipment provider, what would be the most successful type of co-operation?