

Transitional Governance in External Technology Sourcing Trajectories: Complementing the Real Option Perspective

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Abstract Collaboration and acquisition have traditionally been observed as two alternative strategies to get access to external technologies. However, real option scholars have recently argued that firms can also engage in transitional technology sourcing trajectories where collaboration and acquisition are used as complementary strategies. While these real option scholars have identified factors that influence *when* partners are likely to shift from collaboration to acquisition, they remain silent on *how* such a transition can be effectively managed. Based on a multiple case-study of four transitional technology sourcing trajectories between one entrepreneurial and one established firm, this study therefore explores how the pre-acquisition collaboration stage and the post-acquisition integration are related to each other. Our findings suggest that entrepreneurial companies may use the pre-acquisition collaboration stage as a period to evaluate the goodwill of the established partner. In addition, we point to the presence of pre-acquisition integration efforts and the extent of strategic convergence during the pre-acquisition collaboration stage as factors that substantially influence the success of the post-acquisition integration process in transitional governance trajectories.

Key words transitional governance, technology sourcing, real option

1 Introduction

In the last two decades, we have witnessed a shift from a closed innovation model, where established companies focused on internal development of new technologies, to an open innovation model, where established companies increasingly relied on interactions with entrepreneurial companies to get access to new technologies (Chesbrough, 2003; Hagedoorn, 2002). In line with this evolution, scholars (e.g. Hagedoorn & Duysters, 2002; Pisano, 1990; Williamson, 1991) have sought to understand whether established firms should source technologies through collaborations or integrate technologies through acquisitions. While this external technology sourcing literature initially framed collaborations and acquisitions as two alternative strategies, it is increasingly realized that these two external technology sourcing strategies are complementary. In particular, real option scholars (e.g. Folta, 1998; Folta & Miller, 2002; Kogut, 1991; McGrath, 1997) show that acquisitions of firms are frequently preceded by more collaborative approaches. Moreover, these studies provide evidence that factors such as uncertainty of the target technology and valuation of the target company determine the timing of a shift from a collaborative to an integrative approach.

While existing studies on external technology sourcing provide valuable insights in *when* companies are likely to shift from collaboration to acquisition, they remain relatively silent on *how* this transition is actually managed. The existing literature on technology acquisitions – i.e. acquisitions of small technology-based firms by large, established firms (Puranam, 2001) - however, emphasizes that successfully acquiring entrepreneurial firms is not a straightforward task. In particular, they argue that the management of technology acquisitions triggers a fundamental organizational dilemma (Birkinshaw, Bresnman & Hakanson, 2000; Grimpe, 2007; Puranam, Singh & Zollo, 2006; Ranft & Lord, 2002). While preservation of the acquired firm's main technological capabilities asks for substantial autonomy of the acquired firm, the synergistic exploitation of these technological capabilities demands substantial integration of the acquired firm (Ranft & Lord, 2002). According to these acquisition scholars, the most feasible option to deal with this dilemma is to apply a gradual post-acquisition integration trajectory, where the acquired firm initially maintains substantial autonomy and becomes more integrated later on (Bannert & Tschirky, 2004; Birkinshaw et al., 2000; Haspeslagh & Jemison, 1991). However, it needs to be stressed these existing studies on the post-acquisition integration process apply a quite atomistic perspective on acquisitions, neglecting the possibility that acquired firm and acquiring firm share a history of prior collaboration. Actually, these studies seem to implicitly assume that the involved firms did not collaborate before the acquisition. A systematic analysis of how pre-acquisition collaboration and post-acquisition integration are related therefore seems to be necessary.

The purpose of this research is to build theory on how the pre-acquisition collaboration process influences the post-acquisition integration process. In order to do so, we conducted a multiple-case study of 4 technology sourcing trajectories between one entrepreneurial and one established company in which a shift from a collaborative to an integrative approach was realized. For each case, we conducted interviews with managers and engineers of both involved companies and executed a systematic archival analysis of public as well as private documents.

From a theoretical perspective, our findings contribute to a richer understanding of transitional governance in external technology sourcing trajectories. While real option scholars stress that established firms can rely on pre-acquisition collaboration in technological sourcing trajectories to assess the feasibility of the technological *competencies* of the entrepreneurial firm, we argue that entrepreneurial firms can apply this collaborative stage in the technology sourcing trajectory to evaluate the *goodwill* of the established partner. In addition, we point to the presence of pre-acquisition integration efforts and the extent of strategic convergence during the pre-acquisition collaboration stage as factors that can substantially influence the success of the post-acquisition integration process in transitional governance trajectories. From a managerial perspective, our findings suggest an alternative acquisition integration trajectory that allows addressing the dilemma between preserving value and realizing operational synergies in technology acquisitions.

2 Methodology

2.1 Research design

The purpose of this paper is to explore how pre-acquisition collaboration influences post-acquisition integration. Although case studies have remained rather rare within the technology sourcing literature, this design is appropriate for our study because it allows us to 1) answer ‘how’ questions about a contemporary set of events over which the investigator has little or no control (Yin, 1984), 2) mobilize multiple observations on complex relational processes such as collaboration and integration (Eisenhardt, 1989; Eisenhardt & Graebner, 2007; Parkhe, 1993), and 3) draw in the significance of various interconnected levels of analysis such as the operational and managerial level (Faems, Janssens, Madhok & Van Looy, In Press; Hall, 2006; Pettigrew, 1990).

As we wanted to inductively build theory on the shift from collaboration to acquisition in external technology sourcing trajectories, our objective was to study a small number of external technology sourcing trajectories in great detail (Birkinshaw et al., 2000). We limited our study to high-tech settings (i.e. advanced material industry) to minimize extraneous variation (Eisenhardt, 1989) that might be derived from differences between technology intensive settings and settings where technology is less dominant. In the end, we managed to get access to 4 external technology sourcing trajectories, situated in the Advanced Materials industry. Table 1 summarizes the major characteristics of the selected cases. The names of companies, products, and individuals are disguised to ensure confidentiality.

Table 1 Overview of Cases

External Technology Sourcing Trajectory	Involved Companies	Pre-acquisition relationship	Technology Acquisition
Coating Trajectory	MAT: international company active in the domains of metal transformation and advanced materials FRCOAT: high tech SME, specialized in the development of advanced coatings	2001 – 2003: Equity relationship	June 2003: FRCOAT acquired by MAT
Combustion Burner Trajectory	MAT: international company active in the domains of metal transformation and advanced materials GBURN: high-tech SME, specialized in development and production of gas burners	1999-2001: Equity relationship	February 2001: GBURN acquired by MAT
Optical Glass	GCOMP: international company	1998 – 2001:	July 2001:

Trajectory	active in the domains of materials and metals OPTICS : high-tech SME specialized in development of optical lenses	Equity relationship	OPTICS acquired by GCOMP
Substrate Polishing Trajectory	GCOMP : international company active in the domains of materials and metals POLISH : high-tech SME specialized in processing Silicon substrates	1994 – 1995: Technology transfer agreement 1995 – 1996: Collaborative production agreement	September 1996: POLISH acquired by GCOMP

2.2 Data Collection and Analysis

Data on the four external technology sourcing trajectories were collected in a retrospective way, allowing for a much more focused data gathering process (Leonard-Barton, 1990; Poole et al., 2002). At the same time, unconsciously accepting respondent bias might occur in retrospective studies, leading to confusion about cause and effect relationships (Leonard-Barton, 1990). We therefore triangulated our data, applying multiple data collection techniques, including interviews and archival review of documents (see Table II). Applying the suggestions of Pettigrew (1990) and Pentland (1999), we made an explicit distinction between three different stages in our theory building process, representing an evolution of surface levels to deeper levels of data collection and analysis.

For each external technology sourcing trajectory, we first conducted unstructured interviews with two key informants (i.e. senior managers) and studied relevant documents (i.e. contracts, reports of managerial and operational meetings, and publicly available data). Based on this information we constructed a graphical representation of the chronology of the major events that had taken place within each trajectory.

In the second stage, we conducted semi-structured interviews (Kvale, 1996) for each case with both managers and engineers of the involved organizations. We interviewed in total 32 persons (see Table II). Interviews were conducted individually, face-to-face, and in the native language of the interviewee to maximize the informant's ability to express its thoughts, feelings, and opinions. The interviews were structured along the chronology of the major events, asking the respondents to describe these events and the kind of interactions these events triggered between the partners. The average length of the interviews was between one and two hours. The transcribed interviews were sent back to the interviewees to give them the opportunity to hand over additional comments. At this stage, we also reexamined the available documents to verify whether the content of the interviews was consistent with the content of the documents. When discrepancies between these two data sources were observed, we again contacted respondents to ask for additional comments. After semi-structured interviews were completed, a case study report was written for each external technology sourcing trajectory. In these reports, we made extensive use of citations from interviews as well as documents, achieving a high level of accuracy (Langley, 1999). We discussed these case study reports with managers of the involved firms in order to assure that they provided a realistic representation of the history of the alliance. These discussions provided additional data, which allowed us to fine-tune the case study reports.

Table 2 Overview of interviews and documents

External Technology Sourcing Trajectory	Number of interviews	Private documents
Coating Trajectory	MAT: 8 interviews FRCOAT: 2 interviews	Contracts Minutes of board meetings Slides of board meeting presentations Minutes of technological meetings
Combustion Burner Trajectory	MAT: 5 interviews GBURN: 2 interviews	Contracts Minutes of board meetings Slides of board meeting presentations
Optical Glass Trajectory	GCOMP: 7 interviews OPTICS: 2 interviews	Contracts Minutes of board meetings
Substrate Polishing Trajectory	GCOMP: 3 interviews SCOMP: 3 interviews	Contracts Minutes of board meetings Fax correspondance

The purpose of the third stage was to interpret the narrative, developed in the previous stage in order to answer our research questions. In this stage, we used an inductive approach, relying on an iterative process that coupled within-case analysis with between-case analysis (Eisenhardt, 1989; Yin, 1984). We started with conducting a within-case analysis for each observed trajectory. We re-assessed each case, focusing on the shift from collaboration to acquisition. In specific, we searched for linkages between the process of collaboration during the pre-acquisition stage and the process of integration during the post-acquisition stage. After the completion of these within-case analyses, we compared the findings across the three cases. Based on the identification of similarities and differences across cases, new iterations of within-case and across-case analysis were subsequently initiated. This procedure was repeated until dominant findings emerged.

3 Result

3.1 Pre-Acquisition Collaboration

3.1.1 Pre-acquisition collaboration to evaluate goodwill of the established partner

Real option scholars (e.g. Folta & Leiblein, 1994; Folta & Miller, 2002) argued that, in external technology trajectories, established partners can rely on pre-acquisition collaboration to evaluate the value of the entrepreneurial partner's technology without having the obligation to make irreversible commitments. Two of our cases (i.e. Combustion Burner Trajectory and Substrate Polishing Trajectory) were in line with this real option argument. In these cases a collaborative strategy was seen as the ideal option to get acquainted with the technology of the entrepreneurial partner without having to make substantial investments. The following statement of one MAT manager regarding MAT's decision to buy an equity stake of 51% in GBURN is an illustrative example in this respect:

'GBURN's burner technology perfectly fitted in our strategy of forward integration... [However], our board was not ready to radically invest in this technology as it was not really linked to our core activities... [Therefore], we decided to first buy 51% and also negotiate an option to move to 100% later on.' (MAT manager)

In the two other cases (i.e. Coating Trajectory and Optical Glass Trajectory), however, we observed that the established partner actually wanted to immediately acquire the entrepreneurial partner as the technology of the entrepreneurial partner was of high strategic importance for the established company. In these cases, it was the entrepreneurial partner that insisted on engaging in a pre-acquisition collaboration stage in order to evaluate the good intentions of the established partner. In particular, the entrepreneurial partner wanted to use pre-acquisition collaboration as a stage to find out whether the established partner was really committed to further apply and develop their technology. The Coating Trajectory is an illustrative example in this respect. After scanning the coating industry, MAT identified FRCOAT as a company that possessed an Advanced DLC technology. MAT was very interested in this technology as it could help MAT in improving its existing DLC/DLX technology. MAT therefore wanted to acquire FRCOAT in order to get access to this technology. Although the CEO of FRCOAT was interested in closer collaboration with MAT as this could trigger important technological, commercial and operational synergies, he did not want to immediately sell his company to MAT. In November 2001, MAT and FRCOAT therefore signed a collaborative agreement, allowing MAT to buy 49% of FRCOAT's shares. This agreement was called a 'marriage d'essai' (i.e. an attempt to marry) and stipulated that FRCOAT had the right to stop the collaboration after two years and buy back MAT's shares. The CEO of FRCOAT explicitly stressed that the intention of this collaborative agreement was to test the reliability of MAT:

'I wanted to collaborate but I also wanted to have the opportunity to end the collaboration in two years when I would feel that the collaboration did not work out. The purpose of the marriage d'essai was not to limit the collaboration. I believed that this agreement would force each party to conduct the necessary efforts to get to know the other partner and to really think about the different opportunities to work together. (FRCOAT manager)'

In sum, while real option scholars emphasize that established partners can use pre-acquisition collaboration to assess the technological competencies of the entrepreneurial partner, our data indicate that entrepreneurial partners can rely on pre-acquisition collaboration to evaluate the good intentions of the established partner.

3.1.2 Pre-Acquisition integration efforts

Acquisition scholars refer to integration efforts as 'the making of changes in the functional activity arrangements, organizational structures and systems, and cultures of combining organizations to

facilitate their consolidation into a functioning whole' (Pablo, 1994: 806). While the existing acquisition literature has focused on integration efforts during the post-acquisition stage, we observed that, in our cases, integration efforts were already initiated during the pre-acquisition stage (see Table III).

In the Coating Trajectory, for instance, partners initiated pre-acquisition integration efforts to consolidate their technology platforms. As already mentioned, MAT wanted to apply FRCOAT's Advanced DLC technology in order to improve its existing DLC/DLX technology. However, interviewees emphasized that, during the first six months of their collaboration, transfer of knowledge between engineers of MAT and FRCOAT advanced with difficulty. Although engineers of both partners were motivated to exchange knowledge, interviewees indicated that they were not able to arrive at a common understanding of their respective technologies. After six months, managers of both companies therefore decided to conduct efforts in order to create a joint technology platform. In particular, it was decided to install each other's coating systems: a FRCOAT coating system was installed at MAT, while a MAT coating system was installed at FRCOAT. In addition, joint training sessions for MAT and FRCOAT engineers were organized to support this exchange of technology equipment. As one FRCOAT engineer expressed, it was the installation of each other's technological equipment that allowed getting a fine-grained understanding of the partner's technology:

'It is a very interesting step because you first think that the partner's technology is very good. However, by using the machines you start experiencing problems. In a similar vein, MAT people experience problems with using our FRCOAT coaters. In this way, it becomes possible to list the strong and weak characteristics of both coating systems. For me this was the fundamental step in the collaboration which really meant that both parties started working with each others technology (FRCOAT engineer)'

In the Combustion Burner Trajectory and the Substrate Polishing Trajectory, similar kinds of integration efforts were conducted to consolidate partners' technology platforms. During the pre-acquisition collaboration stage of the Burner Combustion Trajectory, one GBURN engineer regularly visited the MAT facilities in order to come to a common platform for media that could be used for combustion burner applications. In the Substrate Polishing Trajectory, one GCOMP engineer visited POLIISH to learn about the entrepreneurial partner's capabilities in polishing silicon substrates. Next, this transferred knowledge was applied within GCOMP to develop capabilities for polishing anonium substrates. These anonium substrate polishing capabilities were subsequently transferred back to POLISH. In this way, a common technology platform emerged that allowed GCOMP and POLISH to conduct similar anonium substrate polishing activities for the same customer.

We did not only identify pre-acquisition efforts to come to a consolidated technology platform, but we also observed that, during the collaborative stage of the Optical Glass Trajectory and the Substrate Polishing Trajectory, partners made efforts in consolidating their operational production system. In the Optical Glass Trajectory, for instance, GCOMP and OPTICS had agreed at the start of their collaboration to jointly industrialize OPTICS' Optical Glass technology for commercial applications in the automotive industry. In order to do so, the OPTICS team, consisting of three people (i.e. CEO and two engineers), had to start developing industrial prototypes of the optical glass technology, while the GCOMP was responsible for the worldwide promotion of OPTICS' optical glass technology. However, during the first year of their collaboration, it quickly became clear that the OPTICS team, which had been very experienced in conducting explorative activities such as fundamental research and conducting laboratory experiments, did not really have the motivation and ability to conduct exploitative activities (i.e. standardization, upscaling, and fine-tuning), which were necessary to industrialize the Optical Glass technology:

'The people at OPTICS really were still R&D people... They were not used to do process engineering. Their reasoning was: 'let's try something; if it works we have a process.' (GCOMP engineer)'

'GCOMP wanted to commercialize as quickly as possible... [However], we were specialists. We first wanted to achieve perfect quality before initiating production. (OPTICS engineer)'

Moreover, the existing facilities of OPTICS did not really allow for high-quality production, which clearly hampered the ability to move to large-scale industrialization of the technology:

'They were not used to do production. They were working in a laboratory... You had to put things into the oven; then you had to wait for a while; next you had to open the oven, remove a lid and again put it into the oven. This was not a process. This would not be possible on an industrial scale.' (GCOMP engineer)'

While OPTICS was struggling in developing industrial prototypes, GCOMP made progress in

marketing the optical glass technology on an international scale. One year after the start of their collaborative endeavor, GCOMP had succeeded in attracting the interest of several potential customers. However, as OPTICS had achieved little progress in exploiting its technology for large-scale applications, it was impossible to hand over industrial prototypes of optical lenses to these potential customers. GCOMP therefore decided that interventions at OPTICS were necessary in order to adjust their production system. GCOMP therefore decided to send, on a regular basis, one process engineer to OPTICS for several days in order to find out which operational problems were encountered at OPTICS and how GCOMP could contribute to solve these problems. During his visits this process engineer tried to make interventions that 'could make the life of the OPTICS engineers easier' (GCOMP engineer). For instance, he arranged that OPTICS engineers got free access to equipment of GCOMP, which could be used for improving OPTICS' existing production process. In addition, he invited engineers of OPTICS to GCOMP to show them how GCOMP addressed some of the operational problems that OPTICS was facing. Gradually, this process engineer became a liaison person who helped OPTICS engineers contacting other GCOMP engineers for the solution of specific operational problems that OPTICS engineers faced in adjusting their production system. In addition to this human support, GCOMP also stimulated OPTICS to move to a new production facility. As OPTICS had limited financial resources, GCOMP provided financial support to build a new facility that would allow high-quality production of Optical Glass products. The human and financial support of GCOMP in adjusting the operational production system of OPTICS quickly started to pay off. In 2000, first industrial prototypes of optical glass lenses for large-scale optical applications were delivered to interested customers.

In the Substrate Polishing Trajectory, similar kinds of integration efforts were conducted to consolidate the production systems. Also in this case, the established partner (i.e. GCOMP) sent on a regular basis one engineer to the facilities of the entrepreneurial partner (i.e. POLISH) to adjust the existing production system and provided the necessary financial support, allowing the entrepreneurial partner to move to a new facility.

In sum, our cases provide evidence that, during the pre-acquisition collaboration stage of external technology sourcing trajectories, partners can already initiate integration efforts to consolidate 1) the technological platform of both partners and/or 2) the operational production systems of both partners. Regarding these pre-acquisition integration efforts, we have to make two important additional remarks. First, we observed that, in most of the cases, it was the established company that took the initiative to initiate pre-acquisition integration efforts. At the same time, the established partner introduced these integration efforts in a very careful manner. Instead of imposing changes on the entrepreneurial partner, the integration efforts were launched as suggestions towards the entrepreneurial partner and they were introduced in a very gradual manner. The initiation of the pre-acquisition efforts in the Optical Glass trajectory is an illustrative example in this respect. As already mentioned, GCOMP decided to send on a regular basis a project engineer to OPTICS in order to improve their operational production system. Both GCOMP and OPTICS interviewees emphasized that this kind of operational support was carefully introduced at OPTICS. According to the GCOMP interviewees, this careful approach was necessary in order to avoid feelings of disruption at the entrepreneurial partner:

'You can not enter there and say: 'guys, from now on we do it our way'. I was of the opinion that I could not do that. They would no longer be behind the steering wheel and would lose direction. This needs to go step by step. In this way, you can build a good understanding... In this small entity, it did not make sense to implement heavy project management programs that explicitly stipulated what should be done. In this case they would look as if one has been poleaxed and they would fear that they had to spend half of their precious time on administration. (GCOMP engineer)'

At the same time, one GCOMP manager acknowledged that, as GCOMP only was a minority shareholder in OPTICS, they did not have the power position to impose changes on this entrepreneurial company:

'At the beginning we could not do much more than providing advice. During board meetings, I said what I thought about it, but they [OPTICS] were free to do with this information what they wanted. Because we only possessed 40% of the shares, we did not have any decisive power. (GCOMP project manager)'

A second important additional observation was that, in our cases, the pre-acquisition integration efforts seemed to contribute to the emergence of a solid relational foundation between the engineers of the involved companies. In the Coating Trajectory, for instance, interviewees referred to the exchange of the coating equipment and the joint training sessions as events that triggered positive relational dynamics on the operational level:

‘In the beginning, people on the operational level have to get used to each other. After we had visited FRCOAT to learn about their technology and FRCOAT engineers had visited MAT to learn about our technology, the ice was broken though. People started to see each other as comrades. Consequently, when we experienced a problem with their coating system, they were always willing to give us assistance. (MAT engineer)’

In a similar vein, interviewees stressed that the pre-acquisition integration efforts in the Optical Glass Trajectory contributed to the emergence of a more trustful relationship:

‘When you introduce such a project manager and you support the building of a new facility, you create a platform of trust on which you can continue to build the relationship.’ (GCOMP manager)

3.2 Post-Acquisition Integration

3.2.1 Initiation of post-acquisition integration process

Real option scholars (e.g. Folta & Miller, 2002; Kogut, 1991) argue that, when the future value of the technology becomes less uncertain, partners are likely to shift from a collaborative to a more integrative governance approach. Our data affirm this reasoning. In the Optical Glass Trajectory, for instance, a shift from collaboration to acquisition was made after it had become clear that some customers were interested in buying substantial amounts of the Optical Glass product. In particular, the CEO of the entrepreneurial company (i.e. OPTICS) asked the established partner (i.e. GCOMP) whether they were willing to acquire the remaining shares and to take the lead in moving towards large-scale manufacturing of the Optical Glass product:

‘OPTICS had to change into a higher gear to address the emerging market opportunities. The CEO of OPTICS realized that he would not be able to achieve this acceleration in growth by itself, neither from a financial perspective nor from an organizational point of view. He therefore asked GCOMP to take over 100% of the OPTICS shares. (GCOMP manager)’

In all cases, we also observed that, when a shift from collaboration to acquisition was realized, substantial additional integration efforts were made (see Table 4). Although integration already had taken off during the pre-acquisition collaboration, additional efforts in consolidating the technology platform and/or the operational production systems were conducted. In addition, while the entrepreneurial partner had maintained structural autonomy during the collaboration stage, structural integration of the entrepreneurial unit was initiated after the acquisition. In three cases (i.e. Coating Trajectory, Optical Glass Trajectory, Substrate Polishing Trajectory), structural absorption (Haspeslagh & Jemison, 1991) was observed, meaning that the entrepreneurial unit was integrated in the existing structures of the established company. In the Optical Glass Trajectory, for instance, the acquired OPTICS unit became structurally embedded in the existing optics business division of GCOMP. In one case (i.e. Combustion Burner Trajectory), structural symbiosis (Haspeslagh & Jemison, 1991) was observed, meaning that the structures of the entrepreneurial and established partner were merged together to create a new structure. In this case, the acquired GBURN unit was merged together with MAT’s existing combustion burner division, triggering a new structure which was physically situated at the GBURN facilities. Interviewees referred to the changed power position of the established partner as the main explanation for these additional post-acquisition integration efforts. In particular, it was argued that, as the established partner now became the main shareholder, they wanted to get a ‘full grip on the operational activities at the acquired firm’ (GCOMP engineer).

While the established firms initiated substantial additional integration efforts after the acquisition, they continued to apply a quite careful approach regarding their relationship with the original management of the entrepreneurial partner. In all cases, the established partner tried to minimize the amount of management changes at the acquired firm (see Table IV). In the interviews, two reasons were mentioned to explain this careful approach. First, it was stressed that the former CEO of the acquired firm possessed critical technological knowledge and critical customer relationships, which needed to be preserved as much as possible. The Optical Glass Trajectory provides an illustrative example in this respect. During the pre-acquisition collaboration stage, it had become clear that there was some strategic divergence between the OPTICS CEO and the GCOMP management was not really the same. While the GCOMP management wanted to focus all activities on commercializing the Optical Glass technology as fast as possible for large-scale applications, the CEO of OPTICS also wanted to look at the possibilities of the Optical Glass technology for blue-sky applications. After the acquisition, GCOMP therefore decided to appoint a new CEO at OPTICS who would be responsible for moving towards large-scale manufacturing. However, as the technological knowledge of the former CEO was perceived to be very important, they also decided to keep the former CEO within the company and to give him the title of CTO:

‘We were dependent on his knowledge that was not codified... If he [=CEO of OPTICS] would leave the company, we would have bought an empty box.’ (GCOMP manager)

A second reason to minimize management changes was to avoid instability at the operational level. In the Substrate Polishing Trajectory, for instance, the management team of the entrepreneurial partner (i.e. POLISH) turned out to be quite incompetent with respect to conducting large-scale manufacturing. After a while, GCOMP therefore decided to acquire POLISH and to make substantial additional investments in turning POLISH into a high-quality production unit. However, despite their proven incompetence, GCOMP decided to maintain the original management in order to give the operational people a feeling of stability:

‘After the acquisition, we have left the management intact. We opted not to change the General Manager... We thought that we needed a transition stage to guarantee the survival of the group, to make sure that everything did not fall apart and give them a feeling of continuity.’ (GCOMP manager)

3.2.2 Need for management changes during post-acquisitions process

While extensive additional integration efforts were planned in all observed cases, we also observed that, during the first year after the acquisition, the actual implementation of these integration efforts turned out to be difficult in most of the cases. In the Substrate Polishing Trajectory, for instance, the purpose of the additional post-acquisition integration efforts had been to further consolidate the production systems of GCOMP and POLISH in order to ‘speak as one team toward the customer’ (GCOMP manager). However, instead of reaching further consolidation, huge difficulties emerged with respect of the production activities of POLISH. Moreover, it turned out to be quite difficult for GCOMP to get a grip on these problems:

‘Production of substrates reached a peak in 1997. At that moment, a number of critical events took place during which production was completely stopped at the SCOMP site and our customer refused to accept substrates. All at once, I was sent there to completely restart the production process. The problem was that, after I had returned to Belgium, the same problems emerged again. (GCOMP engineer)’

In the Combustion Burner trajectory and the Optical Glass trajectory, similar difficulties were observed. In the Combustion Burner trajectory, centralization of R&D activities and burner production activities at the facilities of GBURN triggered huge problems. In the Optical Glass trajectory, it turned out to be quite difficult to transform OPTICS into a production unit that was ready for large-scale manufacturing.

Interviewees referred to the management of the entrepreneurial firm as the main reason to explain these difficulties in achieving successful post-acquisition integration:

First we naively thought: ‘We let these people do it by themselves. We talk with them, we visit them. In this way, we will be able to motivate them to make their quality system more rigid and to provide their employees with the necessary training.’ This however did not work out...It was very difficult to convince them [= management team of POLISH] to do it differently.’ (GCOMP manager)

‘The General Manager of GBURN tended to keep MAT at a distance, which made it difficult to integrate MAT’s burner activities in the GBRURN activities.’ (MAT manager)

‘The former CEO of OPTICS had difficulties to renounce its former responsibilities. Tensions and conflicts between the old and new CEO consequently emerged. Rationally, he [= former CEO of OPTICS] knew that he no longer was the optimal guy to lead OPTICS, but emotionally he was not able to remain distant. In this way, a critical situation arose.’ (GCOMP manager).

In each of the three cases, the original management of the entrepreneurial firm tended to disturb the additional integration efforts, triggering huge relational conflicts between the management of the acquired firm and the management of the acquiring firm. In the end, drastic management changes were made at the entrepreneurial unit in all three cases. In the Burner Combustion trajectory and the Optical Glass trajectory, the management team of the acquired firm was fired and replaced by a new management team. In the Substrate Polishing trajectory, one GCOMP manager was sent to the POLISH unit to take charge of the integration activities. In all three cases, these drastic management changes quickly started paying off. We observed that swift progress was made in further consolidating the technology platforms and/or the operational production systems of the acquired and acquiring firm. In the Substrate Polishing trajectory, for instance, the GCOMP manager, who now was in charge of managing the POLISH unit, managed to implement a new quality system based on ISO-9002 principles and succeeded in streamlining the communication procedures within this entrepreneurial unit.

It needs to be stressed that, in contrast to the established firm’s initial expectations, the execution of drastic management changes did not result in significant loss of technological knowledge or significant instability at the operational level. The Optical Glass Trajectory is an illustrative example in this respect.

As already mentioned, GCOMP's management had initially feared that removing the former CEO of OPTICS would lead to substantial loss of fundamental knowledge. However, after GCOMP had fired the former CEO of OPTICS, it became clear that the two engineers, who had always worked with the former CEO, had been able to absorb most of the fundamental knowledge. Moreover, these two engineers turned out to be very motivated to stay involved within GCOMP. The build-up of a solid relational foundation during the pre-acquisition collaboration stage was mentioned as an important aspect to explain the willingness of the OPTICS engineers to stay involved within GCOMP:

'On the managerial level, tensions have emerged after the acquisition... [However], we had an excellent relationship with him and this relationship only intensified after the acquisition. On our level, there were no differences of opinion. We wanted to become successful and GCOMP could support us in this objective.' (OPTICS engineer)

Finally, it needs to be emphasized that in the Coating Trajectory the post-acquisition integration proceeded more smoothly. The presence of a convergent strategic vision between the management of FRCOAT and the management of MAT seems to explain this smooth implementation of additional integration efforts. In contrast to the three other cases, a clear common strategic vision had emerged in the Coating Trajectory during the pre-acquisition collaboration stage. According to the interviews, this common strategic vision facilitated the post-acquisition integration process:

'There is common, shared strategy. MAT acknowledges the advantages of FRCOAT and FRCOAT sees the advantages of MAT. They speak the same knowledge. There is no discussion about what we will do in 2 or 3 years... [In this way], the FRCOAT people could be integrated in MAT.' (MAT manager)

4 Discussion Conclusion

Previous studies (e.g. Folta, 1998; Folta & Miller, 2002; Kogut, 1991; McGrath, 1997) have pointed to the increased occurrence of transitional governance in external technology sourcing trajectories, where partners gradually shift from collaborative to more integrative approaches. In addition, these studies have identified a number of factors that influence *when* partners shift from collaboration to acquisition. However, much less is known about *how* this transition is made. Based on our findings, we present in this section a number of propositions that connect the pre-acquisition collaboration and the post-acquisition integration stages. Subsequently, we point to the main managerial implications of our study. Finally, we discuss the main limitation of our study and point to interesting avenues for future research.

4.1 Connecting pre-Acquisition collaboration and post-Acquisition integration

Real option scholars already provided evidence that greater technological uncertainty (i.e. uncertainty about the feasibility of the entrepreneurial partner's technology) increases the likelihood of transitional governance, where acquisition is preceded by a collaboration stage. In this way, the established partner can use the collaboration stage to evaluate the technology of the entrepreneurial partner. While we acknowledge the relevance of technological uncertainty as a factor that influences the choice for transitional governance, we also identify relational uncertainty as a second factor in this respect. In particular, we observed that, in some cases, the entrepreneurial partner preferred to first engage in a collaboration stage in order to evaluate the good intentions of the established partner. We therefore propose that:

Proposition 1: Greater relational uncertainty at the entrepreneurial partner (i.e. uncertainty about the good intentions of the established partner) increases the probability of the implementation of a collaboration stage before the acquisition.

While the acquisition literature has mainly focused on integration during the post-acquisition phase, we observed that firms can already engage in integration efforts during the pre-acquisition collaboration stage. In particular, we observed that, during the pre-acquisition collaboration stage, efforts were made to consolidate the technological platform and/or the operational production system of the involved companies. At the same time, it needs to be stressed that, during the pre-acquisition collaboration stage, the involved companies maintained structural autonomy and that the pre-acquisition integration efforts were introduced in a very careful manner. We also found first indications that the presence of these pre-acquisition integration efforts influenced the post-acquisition integration process. In particular, our data suggest that the presence of pre-acquisition integration efforts might facilitate preserving fundamental knowledge during the post-acquisition integration stage. We observed that the initiation of these pre-acquisition integration efforts contributed to the emergence of a solid relational foundation on

the operational level, which in-turn motivated key-technologists of the acquired firm to stay present after the acquisition, even when drastic management changes were made. We therefore propose that:

Proposition 2: The presence of pre-acquisition integration efforts increases the ability to preserve critical knowledge during the post-acquisition integration stage.

Our findings also indicate that, when partners shift from a collaboration to an acquisition mode, substantial additional integration efforts are made. In all observed cases, the acquired firm was structurally integrated in the acquiring firm. In addition, additional efforts were made to further consolidate technology platforms and operational productions systems. At the same time, though, management changes at the acquired firm remained limited in order to avoid loss of knowledge and instability. In three of the observed cases, post-acquisition integration turned out to be difficult, resulting in relational conflict between the management of that acquired and acquiring firm. In these cases, integration only became successful after substantial management changes were made at the acquired firm. In the fourth case, however, post-acquisition integration proceeded much more smoothly. The extent of strategic convergence, realized during the pre-acquisition collaboration stage, seems to explain these observed differences. In the first three cases, strategic convergence had been limited. In these cases, a common strategic objective had not yet emerged. In the fourth case, however, strategic convergence was observed during the pre-acquisition collaboration stage. In this case, the collaboration firm had come to a common strategic objective (i.e. developing a joint technology platform in order to get access to the automotive industry). Our data indicate that such strategic convergence hugely facilitated the post-acquisition integration process. We therefore propose that:

Proposition 3: The lower (higher) the strategic convergence between entrepreneurial and established firm during the pre-acquisition collaboration stage, the higher the need for substantial (limited) management changes at the acquired firm during the post-acquisition integration process.

4.2 Managerial Implications

Previous acquisition scholars have emphasized the relevance of implementing a gradual post-acquisition integration trajectory in order to address the tension between the need to preserve knowledge within the acquired firm and the need to realize synergies between the acquired and acquiring firm (see Figure 1). In particular, they suggest that, during the first years after the acquisition, focus should be on human integration or creation of positive attitudes towards the integration among employees on both sides' (Birkinshaw et al., 2000: 400). During this first stage, task integration or 'the identification and realization of operational synergies' (Birkinshaw et al., 2000: 400) should remain limited to initiating efforts to achieve acceptable performance in the individual operating units. When human integration is achieved and the performance of the individual operating units has reached an acceptable level, the second stage of the post-acquisition integration trajectory can be initiated. At this stage, more substantial task integration efforts are initiated in order to allow for achieving operational synergies across the individual operating units. The shared identity and mutual respect that have emerged during the first stage, provide the relational foundation for such closer task integration.

Based on examining four external technology sourcing trajectories, in which the acquisition of entrepreneurial companies was preceded by a collaboration stage, we suggest an alternative integration trajectory (see Figure 1). While the integration trajectory of Birkinshaw et al. (2000) only starts after the actual acquisition, our alternative integration trajectory is already initiated during the pre-acquisition collaboration stage. In particular, we argue that, during the pre-acquisition collaboration stage, the entrepreneurial partner can carefully initiate some task integration efforts to create a joint technological platform and to improve the operational production system of the entrepreneurial partner. These carefully introduced integration efforts will not only contribute to acceptable performance at the entrepreneurial partner, but also facilitates human integration (i.e. emergence of solid relational foundation at the operational level). In this way, the established firm can immediately shift to more substantial task integration after the acquisition of the entrepreneurial partner. Again, we want to emphasize that, during this second stage of this integration trajectory, the original management of the acquired firm can only remain intact when strategic convergence between acquired and acquiring firm has been established.

4.3 Limitations and Future Research

As a final reflection, we point to the main limitations of this study. First, our findings are based on an in-depth examination of a limited number of external technology sourcing trajectories in the advanced materials industry. Although this research design allowed us to compare the four trajectories relationships with a minimum influence of extraneous variation, its findings are contextualized. Particular characteristics of the technological trajectory or the involved companies themselves may have

influenced our findings. We acknowledge that the development of a more general theory on the linkages between pre-acquisition collaboration and post-acquisition integration requires additional case studies in other contexts.

A second limitation is related to our retrospective data-collection strategy. Despite our efforts to maximize the reliability of our data (i.e. multiple data collection techniques, feedback interviews with informants), our data-collection strategy restricted the ability to obtain a micro-level understanding of some essential processes and/or events. We therefore point to real-time research as a viable option to further elaborate on the findings that emerged from our study.

Despite these limitations, this study has managed to provide first insights in how pre-acquisition collaboration and post-acquisition integration are connected to each other in external technology sourcing trajectories. We hope that our findings may stimulate scholars to further examine the phenomenon of transitional governance in a wide variety of organizational settings. At the same time, we hope that our insights might help practitioners in further optimizing their technology sourcing and acquisition strategies.

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Table 3 Overview of pre-acquisition integration efforts

Pre-Acquisition Integration Efforts	Coating Trajectory (MAT and FRCOAT)	Combustion Burner Trajectory (MAT and GBURN)	Optical Glass Trajectory (GCOMP and OPTICS)	Substrate Polishing Trajectory (GCOMP and POLISH)
Integration efforts to consolidate technology platforms	Transfer of FRCOAT's coating equipment to MAT Transfer of MAT's coating equipment to FRCOAT Joint training sessions for MAT and FRCOAT engineers	Regular visits of GBURN project manager at MAT facilities		Transfer of POLISH's silicon substrate polishing capabilities to GCOMP Transfer of GCOMP's anionium substrate polishing capabilities to POLISH
Integration efforts to consolidate operational production systems			Regular visits of GCOMP project manager at OPTICS facilities Building of new OPTICS production facility, financially supported by GCOMP	Regular visits of GCOMP project manager at POLISH facilities Moving to new POLISH production facility, financially supported by GCOMP

Table 4 Overview of post-acquisition integration efforts and management changes

	Coating Trajectory (MAT and FRCOAT)	Combustion Burner Trajectory (MAT and GBURN)	Optical Glass Trajectory (GCOMP and OPTICS)	Substrate Polishing Trajectory (GCOMP and POLISH)
Post-acquisition integration efforts				
Structural integration efforts	Structural absorption of FRCOAT in the MAT's Diamond Group	Structural symbiosis of GBURN and MAT's combustion burner division	Structural absorption of OPTICS in the Optics business division of GCOMP	Structural absorption of POLISH in the Amonium business division of GCOMP
Integration efforts to consolidate technological platform	Development of a technology matrix to stimulate exchange of technology between different members of the MAT Diamond Group Joint R&D team to develop new coating technology for automotive application	Centralization of R&D activities at GBURN facilities	Codification of OPTICS' Optical Glass technology and production process by GCOMP engineer	Joint exploration of new application domains for POLISH's silicon polishing capabilities
Integration efforts to consolidate operational production systems	Introduction of MAT's operational standards and systems at FRCOAT	Introduction of MAT's operational standards and systems at GBURN Centralization of burner production activities at GBURN facilities	Introduction of GCOMP's project management systems	Introduction of GCOMP's project management systems
Post-acquisition management changes	No management changes (Former FRCOAT CEO continues managing FRCOAT unit)	Former GBURN CEO leaves the company but appoints himself a successor to manage GBURN unit	Former OPTICS CEO becomes CTO of OPTICS unit. GCOMP appoints new CEO for OPTICS unit	No management changes (Former POLISH CEO continues managing POLISH unit)

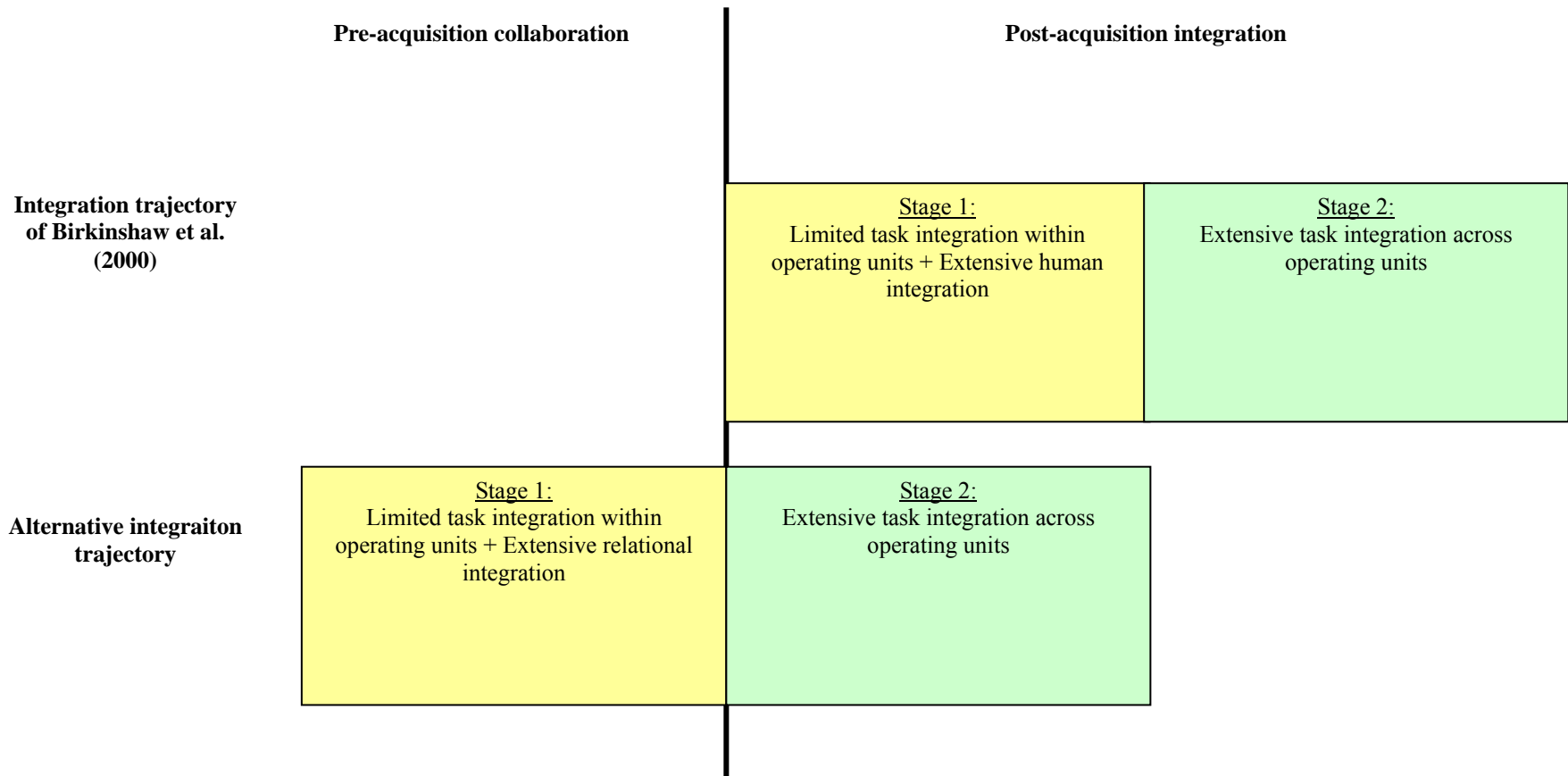


Figure 1 Traditional and alternative integration trajectory