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Collaboration and innovation: a review of the effects of mergers, acquisitions and alliances on innovation

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1. Introduction

Over the past decades, a strong upheaval in the use of alternative forms of organization gave way to increased attention in the academic literature to the performance effects of, in particular, strategic alliances and mergers and acquisitions (M&A). Whereas mergers and acquisitions and strategic alliances are primarily known for their ability to facilitate entry into new markets and their effectiveness in achieving scale and scope economies we would like to focus on their effects on the innovative performance of companies involved.

In spite of the vast and rapidly growing body of literature on the use and structure of strategic alliances and mergers and acquisitions, there are hardly any studies that address the question of whether one mode of partnering is superior to the other in terms of strengthening the innovative capabilities of the partners involved. Moreover, no extensive review of the empirical literature on this specific research topic is available. Given the growing importance of innovation for the competitive position of companies (Porter, 1990) and the fact that innovation is shown to be one of the driving forces of 20th century growth (Franko, 1989) it is of eminent importance that we study the effect of alternative governance mechanisms on the innovative performance of companies (Vanhaverbeke et al., 2002). Since, no general conclusions have been drawn based on the existing literature, knowledge accumulation is inhibited. It is unclear which research questions have already been answered and which are still open for further exploration. The lack of a coherent overview also implies that practitioners have no empirically validated guidelines when preparing for the best mode of organizing for innovation. Should managers opt for M&A or an alliance

if they intend to increase innovation? What specific circumstances affect this choice? What type of alliance is best suited to a particular situation? The absence of an exhausting overview of empirical findings so far, makes it impossible to even begin answering these questions. Hence, there is a necessity for a review of empirical studies on the effect of M&A versus alliances on innovation.

2. Trends in strategic technology alliances and M&A

The label ‘strategic alliance’ has been used to denote a variety of interfirm relationships (Hagedoorn and Osborn, 1997). We refer to strategic alliances as co-operative agreements in which two or more separate organizations team up in order to share reciprocal inputs while maintaining their own corporate identities. Although strategic technology alliances were virtually unknown before the 1980s they have become much more prevalent during the past two decades (see Fig. 1).

Over this period, the growth in the number of newly established strategic technology alliances has been very high, especially in the second half of the 1980s. This period of strong growth coincided with an era of worldwide structural and technological change. During the 1980s, a rapidly growing number of companies started to trade their traditional internal innovation practices for new forms of co-operation such as joint ventures, joint development agreements and various types of technology-sharing agreements. At that time, firms seemed to discover that these new forms of agreements gave them a previously unknown degree of flexibility in terms of their ability to deal with complex rapidly changing technological environments. At the end of the 1980s, the number of newly established strategic technology alliances seems to level off. During this period, companies became increasingly aware of the fact that strategic alliances were not a panacea to all their problems.

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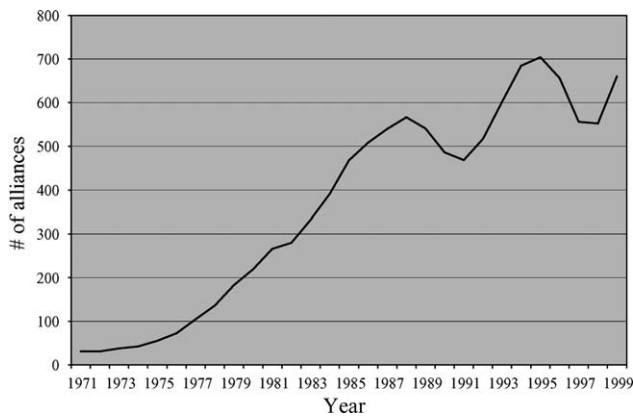


Fig. 1. Number of newly established strategic technology alliances per year (1970–2000), 3-year moving averages, source: MERIT-CATI.

Firms started to report an increasing number of alliance failures. At that time, mortality rates of alliances were estimated at figures between 50 and 70%. The inherent unstable character of alliances in combination with the difficulties associated with the management and control of such alliances induced firms to be particularly careful in undertaking alliances with other companies. However, a further increase in competitive pressure and the ever-rising costs of R&D in conjunction with shrinking technology/product life cycles accelerated the formation of strategic technology agreements once again in the mid 1990s. Today, alliances have become an important vehicle for keeping up with turbulent technological change, even though average alliance success rates remained poor. Whether the strategy to increase innovation by means of alliances is effective, will be discussed in the ensuing review of studies into this issue.

2.1. Mergers and acquisitions

Apart from the use of strategic technology alliances as a means to externally acquire innovative capabilities, full integration of innovative capabilities through mergers and acquisitions remains another option. Mergers and acquisitions occur when independent companies combine their operations into one new entity. Such combinations can refer to the merging of two more or less equal companies as well as to acquisitions where one company obtains majority ownership in another company (Hagedoorn and Duysters, 2002). Recent contributions in the innovation literature have clearly pointed at the growing importance of mergers and acquisitions in the knowledge acquisition process. Whereas strategic alliances started to emerge in the 1970s, mergers and acquisitions have a much longer-standing history. The first M&A wave can be traced back to the turn of the century in the united states. The second wave took place in the late 1920s whereas the third and fourth wave peaked in 1968 and the mid 1980s, respectively. Until the year 2000, we were in the middle of a significant merger wave (see Fig. 2), which according to company reports was mainly induced by technological change.

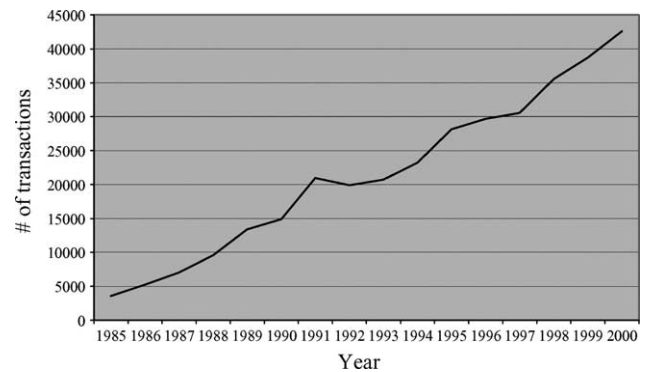


Fig. 2. Number of newly established mergers and acquisitions per year (1985–2000). Source: Thomson Financial.

Over the past decade, we have witnessed unprecedented growth levels in the number of M&A transactions per year. Within 5 years, the total transaction value of M&As went up from an already impressive \$1 trillion in 1995 to over \$4 trillion in the year 1999. Throughout the 20th century, the primary motivation of companies for entering into M&As has changed dramatically. Whereas, during the first M&A wave, firms were primarily trying to achieve market domination, the second wave was clearly characterized by a move towards vertical integration and product-line extension. During the 1950s, tougher US anti-trust laws set the stage for a new era in which conglomerate mergers replaced vertical and horizontal mergers. In the 1980s and 1990s, vertical integration and diversification became in vogue again. The most recent merger wave is sparked by the emergence of the Internet, the growing importance of biotechnology and the need for many 'brick and mortar' companies to prepare themselves for a 'click and mortar' future. Although the role of innovation as a motive for mergers and acquisitions has been largely neglected in the older literature (Link, 1988; de Jong, 1976) more recent work has addressed the growing importance of this motive for companies engaged in M&As (Chakrabarti et al., 1994; Grandstrand et al., 1992; Hitt et al., 1991; Gerpot, 1995; Hagedoorn and Duysters, 2002). Today, M&As are found to be increasingly used to absorb complementary external technological capabilities needed to compete successfully in radically changing economies. Whether this is an effective strategy compared to entering into alliances can be clarified by studying the existing empirical literature about this topic. Before turning to this, we will briefly summarize the theoretical arguments concerning the relation between alternative organizational forms and innovation success.

3. Theory on the effect of M&A and alliances on innovation

Although traditional M&A motives such as, market entry, growth, improved efficiency, diversification and risk reduction have been described extensively in the academic

literature (Hitt et al., 1996) we would like to focus on those particular motives that are associated with innovative renewal. M&A may stimulate innovation for a number of reasons. Technological know how is often tacit and can therefore not be easily transmitted from one firm to another (Larsson et al., 1998). In order to avoid high transaction costs, firms may be inclined to engage in an acquisition in order to solve problems related to the transmission of tacit knowledge (Bresman et al., 1999). Furthermore, M&As may raise the overall R&D budgets of companies involved. This allows them to reap economies of scale and enables them to tackle larger R&D projects than each individual firm could have done. In this way, fundamental research may receive more attention, leading to more advanced technologies being developed. Also, a larger budget enables a company to enter into more research projects, thus spreading the risk of innovation. Furthermore, firms having complementary knowledge can combine their specific strengths and develop new technologies or products that each partner on its own would not have been able to create (Gerpott, 1995). This may have two effects: either an innovation emerges which would not have been possible without the collaboration or an innovation is realized much faster than when the partners would not have collaborated. Finally, companies are rarely efficient at all aspects of innovation management. Companies are likely to employ different innovation management techniques. An exchange of best practices within the merged entity will raise R&D productivity: i.e. with the same budget more new technologies can be developed.

On the other hand, M&As face some grave barriers to innovation as well. The most obvious one is that mergers require so much time of so many individuals involved that it diverts management attention away from innovation. This may be a short run effect, but in quite some cases the organizations of the partners have not yet integrated, many years after the merger was announced. Furthermore, the failure rate of mergers in general is high. Even when the merger is successful in terms of the integration of R&D departments, in other business areas the merger may not be a success, prompting a disintegration of the company. Positive effects on innovation will then be undone. Post-merger integration management apparently is not an easy task (Chakrabarti et al., 1994). Finally, a disadvantage of M&A is that it involves entire companies whereas the advantages for knowledge exchange may be limited to only a small part of the companies involved. In mergers and acquisitions, knowledge that is not required at all is acquired as well. So-called cherry picking, like in the case of alliances, is therefore not possible. This may cause indigestibility: a company may acquire more knowledge than it can use in a meaningful way (Hennart and Reddy, 1997).

Alliances may stimulate innovation for similar reasons as M&A. Co-operative agreements can ease a number of transactional and contractual differences (Williamson,

1975, 1985; Hennart, 1988; Jarillo, 1988). In particular, when asset specificity is intermediate, alliances are considered to be the governance mode of choice. Furthermore, lower risk of large research projects and the integration of complementary knowledge may also increase innovation through alliances. Costs of developing new generations of chips, aircrafts or computers may be up to billions of dollars. Only very few firms are able to finance these projects by themselves. Even the largest companies try to lower the risks associated with these projects by spreading the costs over a number of partners. Teaming up with competent partners may also lead to a significant reduction in lead times. In high-tech markets where prices sometimes decline by more than 30% a year, it is obvious that the ability to bring products to the market more rapidly can offer a significant competitive advantage. An alliance specific reason why alliances may increase innovativeness lies in the radar function of alliances (Duysters and de Man, 2003). Alliances enable firms to scan their environment for promising new technologies at low cost. Instead of investing in all technological opportunities, alliances make it possible for a firm to get a ‘sneak preview’ of a variety of technological opportunities without fully committing to them. The most promising technology may be brought into the company. Less promising technologies can be abandoned. A wider variety of technological opportunities thus become available to the company. Finally, in contrast with the indigestibility argument of M&As, alliances can aim at a very specific piece of knowledge. All other knowledge and technologies can be excluded from the alliance. This form of precision targeting (or cherry picking) is likely to make alliances more successful than M&As in generating new products and processes.

Alliances may also have a negative effect on innovation because knowledge transfer across organizations is notoriously difficult. Differences in corporate culture, processes and knowledge base may impede a smooth transition of knowledge (Lane and Lubatkin, 1998). Another reason for alliances to fail at innovating may be that partners in alliances are often competitors. Fear of helping a competitor to develop a new technology may be an incentive to hold back in the alliance, for example, by not assigning the best people to the alliance or by withholding certain research results. Firms are often said to enter an agreement with a ‘secret agenda’. These firms do not participate in the co-operation for mutual benefit but have the incentive to absorb the other partner’s knowledge, skills and other assets (Duysters, 1996). Finally, although failure rates of alliances are lower than those for M&A, they still are around 50%. An alliance can break up for many reasons even when it is a technological success. Strategic, operational and cultural differences between partners play an important role in this.

This non-exhaustive overview of the success and failure reasons of M&As and alliances shows that there is no theoretical reason, a priori, to favor one over the other.

Both appear to have their pros and cons and no convincing theoretical proposition has been advanced to sway the argument. Hence it is all the more necessary to look at the empirical evidence in order to decide on the relative merits of alliances versus M&A for increasing innovation.

4. Selection of papers

Papers for the review have been selected based on a number of criteria. First of all, only large-scale empirical studies are included. Numerous case studies have been executed into the relationship between alliances, M&A and innovation. They have delivered quite some insights into the processes underlying innovation management. Because of the limited sample of case studies, however, it is often not possible to draw general conclusions from them. That is why case studies have not been incorporated in this literature overview. Secondly, a clearly defined measure of success has to be present in the papers. A considerable amount of papers studies the use of either M&A or alliances under certain conditions, but only a limited amount of papers actually take an in-depth look at the success of these strategies. This is especially true for complex alliance strategies and network level effects. Empirical studies into networks are available (Gulati, 1999; Hite and Hesterly, 2001; Uzzi, 1996, 1997), but only a handful actually connects network strategies and network positions to success measures. Thirdly, papers have to be published in refereed journals or need to be presented at a renowned, refereed academic conference. This criterion is added in order to guarantee a certain level of quality. When papers have gone through a review process for a journal or conference, an independent check on its accuracy and reliability has taken place. Fourthly, innovation is defined narrowly in terms of R&D. Non-technological aspects of the innovation process as well as innovation in service sectors were not included. Likewise, the effect of alliances and M&A on the diffusion of innovation is excluded from this research. This narrow focus limits the scope substantially, thereby making it easier to draw well-founded conclusions about the topic of collaboration and innovation. Finally, for alliances a relatively broad definition of alliances is used, following Duysters and Hagedoorn (2000b). This includes the entire spectrum from licensing via R&D consortia to minority investments. Research into the performance of networks is also included.

In our study, it turned out that these criteria are rather strict. In total, some 30 papers on alliances and 15 papers on mergers and acquisitions were able to meet these criteria (see Appendix A). Undoubtedly, the application of these criteria means that a large part of research in this area is not reflected in this paper. This approach, however, guaranteed a meaningful comparison between different research results.

5. Review of literature: alliances

The articles selected on technology alliances can be divided into two main categories. The first category consists of articles measuring the effect of alliances on the technology position of companies. Success measures that are used in these papers reflect the number of patents, R&D investments, assessments of product and process innovation, R&D productivity and licenses. The second category of papers investigates the effect of technology alliances on the economic performance of the firms involved. The latter papers measure whether companies entering into technology alliances exhibit higher share prices, margins, return on investment, survival rates or growth. First, the general findings of the review are discussed. Next, a more detailed discussion of the impact of success measures, the regional spread and the sectoral background of the reviewed articles is provided.

Fig. 3 shows the percentage of articles that show a positive, neutral or negative effect of alliances on innovation. The figures pertain to the number of hypotheses studied in the articles reviewed. For example, Anand and Khanna (2000) find a positive effect of joint ventures but a neutral effect of licensing. Both these findings have been taken into account in Fig. 3. Below a more detailed discussion of the research findings is presented. The first preliminary finding is that research is surprisingly uniform in its conclusions. Almost three quarters of the hypotheses tested, find that alliances increase innovation.

Two qualifications apply to this positive result. First, the impact of collaboration on innovation increases when the management of the firms involved is better equipped to manage alliances (Anand and Khanna, 2000; Gray et al., 2001; Powell et al., 1996; Takeishi, 2001). Firms with more alliance experience or firms that have more alliance management tools in place clearly outperform firms without a well-developed capability to manage alliances. Second, alliances of which the partners have an overlapping or similar knowledge base outperform alliances in which companies have no similar knowledge background

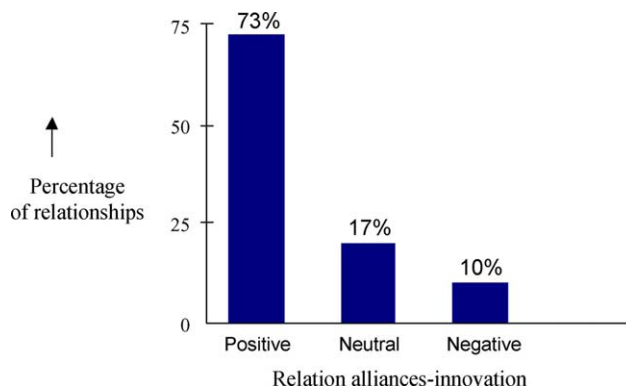


Fig. 3. Relationship between alliances and innovation according to the articles reviewed.

(Chan et al., 1997; Koh and Venkatraman, 1991; Lane and Lubatkin, 1998; Mowery et al., 1996).

In seven instances, a neutral effect of alliances on innovation is found. Comparing these results with the other articles leads to three main conclusions. The first conclusion is that intensive forms of alliances have a positive impact on innovation, whereas looser forms of collaboration like licensing have a neutral impact (Anand and Khanna, 2000; Hagedoorn and Schakenraad, 1994). Among the studies finding a positive effect of alliances on innovation, similar conclusions have been put forth (Dyer, 1996, 2000): more intense collaboration in alliances increases innovativeness. An explanation for this may be that the knowledge exchange required for innovative renewal requires close collaboration between organizations, because that improves the transfer of knowledge between people. A second conclusion emanating from a closer look at the studies showing a neutral impact is that the issue of networks of alliances raises some further questions. There seem to be network strategies that are more conducive to innovation than other strategies (Powell et al., 1996; Rowley et al., 2000). The optimal number of alliances and the optimal density of alliance networks depend on specific circumstances. For example, having many alliances in combination with dense networks (with all partners connected to each other) does not raise innovativeness. The number of studies into this topic is limited and as a consequence, it is impossible to draw any definite conclusions. But the studies that have been carried out show that the optimal alliance network depends on the specific context of the organization. A third and final conclusion about studies finding a neutral impact relates to government related alliances. Government sponsored research alliances and alliances between universities and companies show mixed results. Most studies present a neutral or marginally positive effect of this type of partnerships on the innovative strength of the companies involved. However, government related alliances do seem to lower the cost of innovation.

A negative relationship between alliances and innovation is found in only four cases. Duysters and Hagedoorn (2000a) find that alliances are not effective for developing core competences in the short run. This seems logical because most alliances have a short lifespan, whereas competence building is a lengthy process. Vanhaverbeke et al. (2001) show that a sub-optimal network strategy can diminish firm innovation. Organizations with a large internal knowledge base and a small alliance network or a small internal knowledge base with a large network have higher rates of innovation than firms pursuing other strategies. This further reinforces the point made above about the impact of networks on innovation. Sakakibara (1997a) finds that R&D expense diminishes when alliances are entered with the primary objective of cost saving. In general, the literature assumes that higher levels of R&D expenditures are better than lower ones. This seems to ignore the fact that more effective innovation processes or economies of scale may

actually lead to lower R&D expense. The ‘negative’ finding of Sakakibara may therefore not be negative at all: it seems to be evident that R&D expense diminishes when cost saving is the aim of an alliance. Similarly, Irwin and Klenow (1996) find that the Sematech consortium led to a decrease of R&D spending of the partners involved. The consortium did have a cost-saving effect. In short, the negative findings in our review only pertain to very specific situations or relate to cost-saving objectives of alliances.

5.1. Success measures and time horizon

In theory, the specific choice of success measures may influence the results. An alliance scoring well on one measure of success may not necessarily score well on another (Gomes-Casseres, 1996). However, there appears to be a high correlation between different measures of success (Draulans et al., 2003; Hagedoorn and Cloudt, 2003). Naturally output measures like patents are preferred over input measures like R&D expense. As noted above, somewhat surprisingly higher R&D expense is always seen as an indication of a higher rate of innovation in the literature. This ignores the fact that some companies have a higher R&D productivity than others. Especially when collaboration between companies leads to an exchange of best innovation practices, lower levels of R&D expenditures not necessarily lead to a lower rate of innovation. Fig. 4 shows which particular criteria for success are used by the articles reviewed in this study. Twenty percent of the articles measure patenting behavior; a group of similar size used other output of R&D as a measure of success. Another 20% studies the effect of R&D alliances on financial indicators like margin or revenue. Seventeen percent involves event analysis of stock market reactions to the announcement of a technology alliance. Ten percent looks at R&D input measures like R&D budgets or number of researchers assigned to the alliance. As already discussed previously, some of the studies using R&D input measures (Sakakibara, 1997a; Irwin and Klenow, 1996) find a negative relationship between alliances and innovation. They find that alliances have a cost-saving effect. Alliances in that case do not increase the level of innovation, but they do enable companies to innovate at lower cost. Apparently, the realized cost savings are not reinvested in R&D.

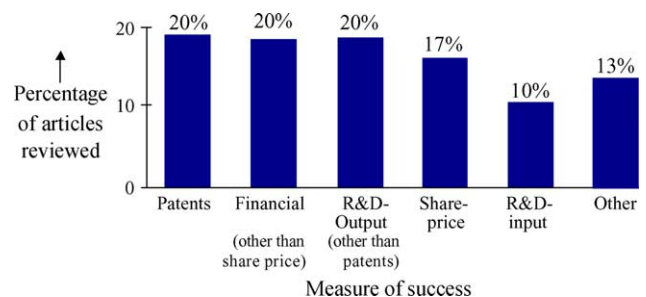


Fig. 4. Success measures used in alliance articles reviewed.

The time horizon of studies differs in relation to the success measure used. Event analysis studies time periods between a few days and a few months. Other research has a time horizon of a few years, with 3 years being the most prevalent. The choice of time horizon has no effect on the performance of alliances. Both short and long time horizons find on average a positive effect of alliances on innovation.

5.2. Geographical setting

Fig. 5 shows the regional background of the studies. The larger part of the studies relates to alliances in North America (37%). Japan has received quite some attention as well: 17% of the studies focus on this country. Europe has only been looked at in 10% of the cases. The rest either studies alliances with partners from a combination of these three regions or did not specify the geographical background. Mowery et al. (1996) provide some more insight into the impact of nationality on success. They find that there is no difference between the innovative performance of Japanese alliances and the performance of American companies entering into alliances. Likewise, Dyer (2000) finds that alliances in the car industry have a positive impact on performance in both Japan and the USA. Further comparative studies are not available.

5.3. Sectoral background

The majority of the articles reviewed study a high-tech sector. Thirteen articles looked at the innovative potential of alliances in IT and five articles examine biotechnology. The other articles study a variety of different sectors. Only two studies compare sectors. Ernst and Halevy (2000) show that in turbulent sectors like high-tech and media, alliances outperform mergers and acquisitions. Rowley et al. (2000) find that flexible forms of alliances are successful in the semiconductor industry, whereas stable forms of alliances are more effective in the steel industry. This result appears to contradict the idea that more intense relationships stimulate innovation. The network perspective chosen by these authors may provide an explanation for this.

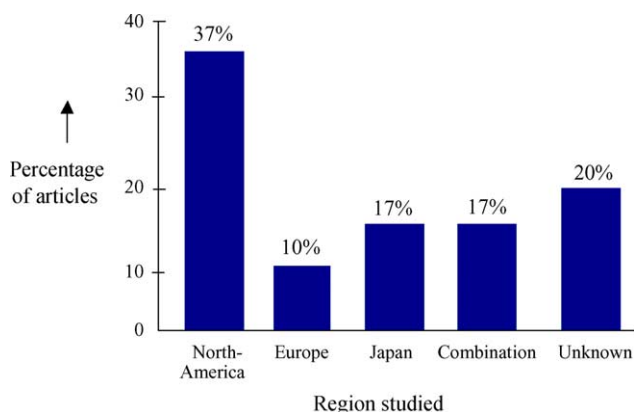


Fig. 5. Regional background of alliance articles reviewed.

Looser forms of alliances may not increase innovation by themselves, but they may serve another purpose in terms of the radar effect that was mentioned previously. By entering into loose and flexible arrangements with partners developing competing technologies, a firm will increase its chances of having access to a successful technology. The impact of a single relationship may be limited or neutral, but the impact of the entire portfolio of relationships may be considerable. In a large portfolio of flexible alliances, quite some alliances will not come to fruition. But the upside is that the chances of missing out on a promising technology are drastically reduced as well. If this option theory of alliances holds, it does not make much sense to look at the innovative potential of one singular alliance. Rather, the innovative potential of a company's portfolio needs to be assessed. Given the paucity of research into sector and network differences, it is not yet possible to draw definite conclusions on this issue.

5.4. Conclusion on alliances

Overall, we can conclude that alliances increase the innovativeness of firms. There are some conditions that enhance this effect, like similar knowledge backgrounds of the partners, a higher level of alliance capability and more intense relationships. Alliances involving public support or a public partner do not increase innovation, although they do lower the cost of innovation. A major gap in the existing research is associated with sector differences. Also, differences among countries have not yet received much attention. One implication for further research is that it does not make much sense to lump all types of alliances together. Clearly, different types of alliances like licensing, joint ventures, publicly funded partnerships, etc. need to be distinguished in order to meaningfully clarify the innovation effect of alliances.

The most promising avenue for research appears to be in the network area. Research into networks has shown that entering into more and tighter alliances is not always better. Some types of networks may have a neutral and perhaps even a negative impact on innovation. As yet, precise conclusions cannot be drawn. However, the studies currently available clearly raise the question whether it is meaningful at all to look at the effect of individual alliances on innovation. Abstracting from the network perspective may paint a brighter picture about the innovative potential of alliances than warranted.

6. Review of literature: M&As

The number of studies into the relationship between M&As and innovation is small. In a review by Shleifer and Vishny (1991) of studies looking into the performance of M&As, the emphasis is exclusively on financial performance. In the course of the 1990s, a limited amount of studies

Table 1
Effects of M&A on innovation in the articles reviewed

Type of success measure	Positive	Neutral	Negative
Input-measure	0	3	1
Output-measure	0	1	3

into M&A and innovation have been published (see Appendix A). These studies which can be divided into two main types. The first type measures the direct impact of M&A on indicators of R&D. The second type are studies about the conditions under which a merger or take-over improves innovative performance. The latter type is listed in Appendix A in italics. For the current review, the first type of studies is most relevant. The second type of studies is reviewed here as well, because they may give interesting clues about differences across sectors and countries.

Of a total of 15 studies that have been reviewed, eight belong to the first category and seven to the second category. Table 1 summarizes the results of the first category. Horizontally, the table shows whether studies find that M&As have a positive, neutral or negative effect on innovation. Vertically, it shows the type of success measure used; i.e. input or output. This element is particularly relevant for M&A because the possibilities for cost saving in M&A are much higher than for alliances. Input measures may therefore decline steeply, giving the impression that innovativeness declines, whereas in reality innovativeness may remain at the same level but at lower cost. Especially for M&As output measures are expected to provide the most accurate measure of innovation.

Therefore, the results in Table 1 are striking. Especially, studies using output measures show that companies engaging in mergers and acquisitions face a decline in innovation. Studies using an input measure come up with a neutral effect. These studies show that some economies of scale can be reaped, but only to a limited extent. Finally, there are no studies that find a positive effect of M&A on innovation.

An analysis of the remaining seven studies shows that innovation is better served when the firms involved have an overlap in their knowledge base. Diversifying mergers and acquisitions do worse in terms of innovation than M&As among related companies. Secondly, when the process of acquisition and integration runs smoothly the innovative performance is higher as well. A well-developed post-merger integration process therefore enhances innovation.

Unclear is the role of size in mergers and acquisitions. Different and partly conflicting hypotheses have been supported:

- Ahuja and Katila (2001) find that large company should focus their M&A activity on small targets if they would like to increase their innovative performance;
- Chakrabarti et al. (1994) find that innovative performance diminishes when a large company takes over a small

one and that M&As between companies of equal size perform better;

- Hagedoorn and Duysters (2002) also find that M&As between companies of similar size perform better.

Clearly, the issue of size has not yet received sufficient attention in research in order to be able to draw a definite conclusion.

6.1. Time horizon

The choice of time horizon is even more important in the case of M&As than it is for alliances. The real benefits of M&As will become clear only after quite some time has passed and hence time horizons need to be relatively long. The median time horizon of studies is 3 years. The maximum time horizon is 5 years. There appears to be no significant impact of the choice of time horizon on the research results. Studies either find a neutral or a negative effect on innovation, irrespectively of studying a 3-year or a 5-year period.

6.2. Geographical setting

Five articles study M&As in the USA, another three articles study acquisitions with an American firm as the acquirer. Other studies have focused on Germany and Japan. Five studies examine international samples. In as far as it is possible to draw conclusions from this limited amount of variety, there appear to be no significant differences regarding the innovation success of mergers and acquisitions in different countries.

6.3. Sectoral background

Three studies are performed in high-tech sectors, five in industrial sectors, six across a variety of sectors and one study does not report on the sector. Studies comparing sectors are non-existent. Ernst and Halevy (2000) come closest with their comparison of the use of alliances and M&As in high-tech and non-high-tech sectors. They find that M&As perform worse in high-tech sectors as compared to non-high-tech sectors. Link (1988), however, finds the opposite result. The difference in time and focus may explain these contradictory results. Link's study was carried out before the latest boom in alliance activity and before the period in which high-tech mergers and acquisitions reached their pinnacle. Overall, there is not much clarity about sectoral differences in innovative performance of mergers and acquisitions.

6.4. Conclusion on M&A

The main conclusions about the relationship between mergers and acquisitions and innovation are: first, they have a neutral or negative effect on innovation; second, mergers

and acquisitions may lead to some scale economies thereby lowering the cost of innovation; three, well managed M&As and M&As among related firms outperform poorly managed M&As and diversifying M&As, respectively; fourth, research is too scarce to draw meaningful conclusions about the effects of size, national and sector differences.

7. Conclusions: M&A versus alliances

Despite the large number of publications about M&As and alliances, few researchers have consistently compared the effect of these modes of partnering on innovation. Nonetheless, the studies reviewed here point to a very clear overall conclusion: alliances are outperforming M&As in terms of their effect on innovation. Except for the possibilities offered by M&As to reap some economies of scale in R&D, alliances outperform M&As on almost each conceivable point. There is just one possible negative exception, which is the network effect: some types of alliance networks perform better than others.

The results on M&As are in line with other research about M&A effectiveness (Schenk, 1996). In general, the failure ratios of M&As are close to 70%, when stock market reaction to M&As is measured. This effect is clearly replicated in this study, which finds at best a neutral effect of M&As on innovation. The exact causes for this are unclear. Of the theoretical reasons for M&A failure, only one is studied in the empirical articles we have reviewed: effective post-merger integration has a soothing effect. However, there is no research yet that shows that sound post-merger integration ensures mergers success.

The success of alliances in enhancing innovation is somewhat surprising given the fact that alliances have high failure rates as well. Average success rates are somewhat better than for M&As, but with 50–60% they lead the field by only a narrow margin. Our review shows that research is in general very positive about the innovation effect of alliances. A possible explanation for this is that R&D alliances are more successful than other types of alliances. Others have shown that alliances that incorporate learning as a goal outperform other alliances (Accenture, 2000). Since learning is always relevant for R&D alliances, the fact that R&D alliances appear to perform better than the average alliance may therefore be explained. Another explanation relates to the set up of this review. We examined the number of hypotheses tested in the literature and their outcome. An article finding a positive relationship between alliances and innovation on average may still be based on a dataset in which 40% of the technology alliances fail. This explanation may be true, but it is in our view not very likely. With failure rates of 50% and higher, more negative results might have been expected. Moreover, this explanation does not provide a reason for the gap between our findings on M&A versus those on alliances.

There is no agreement in the current body of literature on the explanation for these widely varying results in the innovative performance of M&As and alliances. Looking at the theoretical reasons for success and failure of alliances versus M&As, the indigestibility argument is the most distinctive reason, which may help to explain this difference in performance. Empirical research into this phenomenon has yet to be carried out.

8. Implications for research, management and governmental policy

8.1. Research implications

The implications for research into the innovative effect of collaboration emanate directly from the previous discussion. The first research question that needs to be addressed is why the track record of M&A is so poor. There is no satisfactory explanation for this. The continuing popularity of M&A in practice suggests that there should be benefits to M&A, also in terms of innovation. Large-scale empirical research does, however, not support this view.

A second research question, which needs to be answered in more detail, pertains to the sectoral differences in alliance activity. Available studies show that different types of alliances may be more effective in different industry conditions. A full-blown account of which types are best under which conditions is absent. Empirically only a few industries have been studied. Besides, there is a shortage of theoretical explanations for this sector effect.

The most promising research trajectory, however, pertains to networks. Looking from a network perspective, some studies have shown that it is not just the performance of individual alliances that should be measured. Rather, it is the combination of alliances that determines a firm's ability to innovate. Some combinations may hamper innovation; others may stimulate it. Relevant issues in this regard are the relationship between a firm's internal technology portfolio and its external portfolio, the key characteristics of networks and their effect on innovation, and whether the optimal network characteristics differ per sector.

8.2. Management implications

The literature review has several implications for R&D managers. The first conclusion is related to the optimal organization mode of collaboration. Alliances are to be favored over M&As and they are an important source of innovation. The road taken by many firms to enter into alliances in order to develop new technologies is not a management fad. Empirical research shows that alliances increase innovation and that this technology strategy is successful. The opposite conclusion holds for M&As. Managers should not engage in M&As for innovative renewal, unless cost saving in R&D is their goal.

A second conclusion relevant to managers is that they should take a critical look at alliances with partners whose knowledge base does not overlap with that of their own firm. As alliances with similar companies have more potential for innovation, alliances with dissimilar companies should be looked at critically. Of course some case study evidence shows that even dissimilar companies can create innovations, but the overall record is worse.

Third, companies need to build up capabilities to manage alliances. Experience with alliances increases the chance that collaboration leads to innovative success. Learning from experience and investing in alliance specific management methods (Draulans et al., 2003) will help firms to raise their alliance success rate and their innovative potential.

8.3. Implications for governmental policy

The first implication for governments pertains to anti-trust policy. In as far as anti-trust policy has as an objective to increase innovation, anti-trust authorities should allow alliances in most of the cases. The theoretical arguments put forth by Jorde and Teece (1990) to be lenient towards alliances find empirical support. However, anti-trust policy also has the objective to avoid collusion in the market. There is a chance that alliances, which start out in basic research, may continue to exist when products are marketed. The original technology partners may then collude in the market and set higher prices and gain monopoly rents from their innovation. Whether R&D alliances generally lead to marketing alliances is a question that lies outside the scope of this research. In the articles reviewed, there is one such incidence of technology collaboration extending into the market. Bekkers et al. (2002) show that in GSM technology cross-licensing has led to a dominant group of producers in the market. Whether this has any negative economic effects, however, cannot be easily judged. Anti-trust policy may be more critical concerning M&As, as M&A activity does not appear to stimulate innovation.

For innovation policy, the previous study holds some implications as well. Most clearly for cluster policy (Porter, 1990; Jacobs and de Man, 1996), which aims to stimulate collaboration between companies in order to enhance innovation. At first sight, this policy seems to be corroborated by empirical research. However, there are some qualifications. As not all types of collaboration are fruitful in all industries, an industry specific approach may be required. However, with the current state of our knowledge, it is not possible to develop a more tailored approach. Governments should therefore proceed with caution. A second qualification pertains to the network effect. There is a limit to the number alliances and the composition of networks that favor innovation. Although encouraging collaboration in clusters may have positive effects in most of the cases, it cannot be excluded that it may have a negative impact in others. Again, research is not clear about the best network strategies, making it more difficult for governments to develop correct

policies. A third qualification concerns the role of public private partnerships in clusters. Cluster policies assume that collaboration between industry and universities and other government sponsored research institutions has a positive effect on innovation. This view is supported by empirical research, although most studies find that the effect of such collaboration is only marginally positive. Governments should not expect public private partnerships to have a significant impact on the competitive advantage of industries. Likewise, government sponsored R&D consortia only have a limited effect on innovation, in spite of their effect on lowering the cost of innovation.

Given the problems governments face in determining efficient innovation policies with respect to alliances, another policy suggestion might be more interesting. Governments may support the diffusion of alliance management capabilities. Instead of stimulating collaboration as such, which runs the chance that governments stimulate the wrong type of collaboration, governments can redirect their focus to stimulating the ability to collaborate. Although this type of policy may be less eye-catching, it is a no regret policy. By means of drawing attention of managers to alliance management, sponsoring courses and workshops and stimulating research into alliance best practices, awareness of alliances and alliance management may increase. Overall, it increases the alliance capabilities of firms. This will certainly help companies to prepare for the challenges of the network economy, which is taking shape in an increasing number of innovative industries.

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Appendix

Table A1.

Table A1
Papers reviewed

Alliances	Mergers and acquisitions
Adams et al. (2001)	Ahuja and Katila (2001)
Anand and Khanna (2000)	Bresman et al. (1999)
Baum et al. (2000)	Chakrabarti et al. (1994)
Bekkers et al. (2002)	Duysters and Hagedoorn (2000a)
Branstetter and Sakakibara (1998)	Ernst and Halevy (2000)
Caloghirou et al. (2001)	Gerpott (1995)
Chan et al. (1997)	Hagedoorn and Duysters (2002)
Duysters and Hagedoorn (2000a)	Hall (1990)
Dyer (1996, 2000)	Healy et al. (1992)
Ernst and Halevy (2000)	Hitt et al. (1991)
Ernst et al. (2001)	Hitt et al. (1996)
Gray et al. (2001)	Ikedo and Doi (1983)

(continued on next page)

Table A1 (continued)

Alliances	Mergers and acquisitions
Hagedoorn and Schakenraad (1994)	<i>Link (1988)</i>
Irwin and Klenow (1996)	National Science Foundation (1989) as quoted in Hall (1990)
Koh and Venkatraman (1991)	<i>Reuer (2001)</i>
Lane and Lubatkin (1998)	
Link et al. (1996)	
Mitchell and Singh (1992)	
Mowery et al. (2001)	
Mowery et al. (1996)	
Powell et al. (1996)	
Rowley et al. (2000)	
Sakakibara (1997a,b)	
Schut and van Frederikslust (2000)	
Shan et al. (1994)	
Stuart (2000)	
Takeishi (2001)	
VanHaverbeke et al. (2001)	
Zucker and Darby (2001)	

References in normal type refer to studies investigating the direct effect of M&A on innovation. References in italics refer to studies, investigating the relative effectiveness of M&A under different conditions.

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