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CATEGORIES OF TECHNOLOGY ALLIANCES

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Abstract

Companies engage in strategic alliances for industrial, commercial, financial or technological reasons. Technological alliances can be "vertical," where the main purpose is to get access to a technological capability, or "horizontal," where the main purpose is to secure access to a market. Another key variable in the categorization of strategic alliances in technology is the position of the allied companies with regard to competition, "pre-competitive alliances" or alliances of competing companies.

Technological alliances are likely to have an impact later when the industrial and commercial stages are reached. This research indicates that technological alliances are often established without the appropriate consideration of their impact on the long-term overall competitiveness of the firm. The four categories of technological alliances (vertical/horizontal; pre-competitive/competitive) are considered to be useful in analyzing and understanding them and for generating suggestions for improving their management.

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CATEGORIES OF TECHNOLOGY ALLIANCES

Introduction

Previous work by the current authors explored the evolution of technology strategy formulation in Europe.[1] The European environment is increasingly conducive to technological alliances. Most European countries are committed to stimulating technological development, while the European Economic Community and its member countries launch a wide variety of programs to support innovation and technology.[2] At the European level, the EUREKA project is also a sign of the official commitment to the competitiveness of Europe through technological leadership.

The EEC budget for technology development programs in 1986 was roughly one billion ECU. Most EEC or pan-European support programs are compatible with other sources of support (at the country or region level), with the result that a support program might stimulate other sources of support and the total research and development budget of a project becomes substantially leveraged.

Many European research programs (such as those of the EEC and EUREKA) require that companies and or institutions of different countries establish a formal alliance to qualify for program support. As a result, the research programs act as catalysts for different types of alliances.[3]

Several reasons can be found in the background of the European frameworks: reaching a critical mass for R&D can be achieved by pulling together scarce research resources; avoiding duplication of similar R&D efforts throughout Europe is easier if channels of communication are established and cooperation is rewarded; less emphasis is put on national priorities and there is more concern with getting better results in the competition, perceived as global, with the United

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[1] Nueno, Pedro and Jan Oosterveld, "The Status of Technology Strategy in Europe", Technology in Society, Vol. 7, pp. 241-262.

[2] Commission of the European Communities, Incentives for Industrial Research, Development and Innovation "Didier Report" London, Kogan, Page, 1986.

[3] Commission of the European Communities, The Community of Science and Technology, Brussels: Commission of the European Communities, 1987, (Com [86] 129 final).

States and Japan; a shift is taking place in most countries from industrial policies of adjustment to re-industrialization policies; and all types of linkages, including technological alliances, are well received by public companies finding themselves under the privatization pressures imposed by their government owners.

Although most of the data for this study have been gathered in Europe, the researchers clearly perceived a more open attitude to technology alliances from companies in the United States and Japan, and this trend has also been reported in the literature.[4,5]

Technology Strategy in Europe. Coalitions. Technology Alliances

The need to integrate technology in the process of strategy formulation has been felt by corporations, scholars, and consultants.[6] Nevertheless the problem has not yet been solved in a comprehensive and satisfactory way.[7] Many approaches to the problem are only partial: integration of technology and marketing,[8] increasing the efficiency of the technology function,[9] improving the linkage between R&D and manufacturing, etc. The major consulting companies offer a variety of models to formulate strategy which do not appropriately include the technology variable; sometimes they make a "correction for technology" at the end, or they offer models for technology strategy that are implemented without the deep involvement of the other major functions of the corporation, i.e., marketing, manufacturing and finance. The research on the relationship between generic strategy and key management variables[10] is weaker in the technological area.

The research on coalitions is abundant although the differences among different categories of coalitions have often not been taken into account.[11] A recent study on the patterns of international coalitions[12] indicates that, out of a sample of 2245 alliances classifiable by purpose for entering the coalition, technology development was the governing motivation in 20% (compared with 42% for operations and logistics, and 22% for marketing).

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[4] Potes, Mark and Peter Behr, "Para forjar alianzas empresariales estrategicas," Perspectivas Económicas (Washington: United States Information Agency; 1987/3) pp. 24-29.

[5] Norris, William C., "Applying Technology: The Key to the Future," *The Journal of Business Strategy*, Vol. 6, No 3, Winter 1986, pp. 38-46.

[6] Scarpello, Vida, William R. Boulton, and Charles W. Hofer, "Reintegrating R&D Into Business Strategy," *The Journal of Business Strategy*, Vol. 6, No 4, Spring 1986, pp. 49-57.

[7] Sommers, William P., Josep Nemec, Jr., and John M. Harris, "Repositioning With Technology: Making It Work," *The Journal of Business Strategy*, Vol. 7, No 3, Winter 1987, pp. 16-28.

[8] Ruekert, R. W. and O. C. Walker, J., "Interactions Between Marketing and R&D Departments in Implementing Different Business Strategies," *Strategic Management Journal*, Vol. 8, No 3, May-June 1987, pp. 233-248.

[9] Foster, William K. and Austing K. Pryor, "The Strategic Management of Innovation," *The Journal of Business Strategy*, Vol. 7, No 1, Summer 1986, pp. 38-43.

[10] Herbert, Theodore T. and Helen Deresky, "Generic Strategies: An Empirical Investigation of Typology Validity and Strategic Content," *Strategic Management Journal*, Vol. 8, No 2, March-April 1987, pp. 135-147.

[11] Porter, Michael (ed.), "Competition in Global Industries" (Boston: Harvard Business School Press, 1986), see Porter, Michael and Mark Fuller, "Coalitions and Global Strategy," pp. 315-343.

[12] Porter, Michael (ed.), op. cit., see "Patterns of International Coalition Activity," pp. 345-365.

Technology alliances or coalitions have increased substantially in the last four years in Europe as a result of the different frameworks which have been established to stimulate them. The most important of these frameworks are: ESPRIT (European Strategic Program for Research and Development in Information Technology), BRITE (Basic Research in Industrial Technologies for Europe), RACE (Research and Development in Advanced Communications Technology for Europe), and EUREKA. All require alliances between partners from different European nationalities and the total number of companies involved in these programs is well over one thousand. In all cases, the driving force for the alliance must be, in theory at least, technology development.

Objectives of the Study, Data and Methodology

This study is exploratory in nature and this paper is part of a long-term research effort whose ultimate objective is to offer suggestions for improving the management of technological alliances. This paper focuses on the various alliance categories in order to provide a conceptual scheme for the analysis of these structures and to identify major differences among them, as well as specific aspects which might lead to managing them better. The research is based on the in-depth analysis of fifteen technological alliances amongst European companies. In all cases, extensive interviews were conducted with the managers most directly concerned with the coalition. In a few cases, it was possible to look at the alliance from the perspective of more than one partner. In most cases, the companies involved had a certain experience accumulated from previous alliances or were involved in other alliances, different from the one under analysis; in these instances the researchers gathered relevant information from experience as well as from collateral ventures. All the cases analyzed in this study involved alliances that were very important for the company either due to the amount of resources associated (relatively to the size of the company), or the importance of the technology being developed for the long-term competitiveness of the company, or for other strategic reasons.

Driving Forces

There are a variety of reasons for corporations to engage in technological alliances. Reducing the costs of access to a technological capability appears in most cases as one of the driving forces. With only one exception, the subsidies associated with the projects or the savings due to sharing the costs of the research effort were considered a strong incentive to join the alliance. In one third of the cases studied, the company would not have entered the alliance if the joint project had not had a certain level of financial support associated with it. Two companies made it very clear that the only reason they had entered the alliance was to meet the research subsidy's qualifying criterion, i.e., an alliance with a company from another European country. Some evidence was found showing that companies from countries that leverage supranational support with additional research subsides are attractive partners in international alliances.

Achieving the critical mass necessary to undertake a given research effort was also a generalized driving force in the situation studied, particularly in pre-competitive, long-term, and basic projects or when medium-sized companies were involved. It was obvious in several cases that the company could never have engaged in the research effort using only its own resources.

Another aspect that was mentioned in several cases was the creation of commitment. A large company involved in several projects within the ESPRIT and EUREKA frameworks indicated that the performance of R&D in projects within collaborative frameworks was better than in projects undertaken by the company alone. Top managers in charge of important projects said that the analysis required before submitting a project to a framework program, the need to discuss it extensively with partners, and the implicit competition with partners to meet research targets within schedule and budget, all contribute to the improved performance in technological alliances.

Two companies made clear that the most important driving force had been survival, and other companies included survival as one of their driving forces. In one case, where two companies were involved and survival was the key driving force, the researchers interviewed the two partners. These companies were competing in the European market with similar products and were planning to continue to compete in the future but neither company could afford the development costs associated with a new key component of their product. The new component was necessary if they were to compete with other companies within their industry. They decided to organize a partnership for the development of this component which they would share in the future, with the result that future competition between the two companies could not be based on aspects of the product related with the common component.

In addition, most companies mentioned other driving forces that were not considered primary motives for entering the alliance but were considered as important advantages: for instance, the notoriety gained from participating in Pan-European technological programs. This is especially important for small and medium firms, but even large firms find that working towards something perceived by society as an objective beyond the company's immediate interest, such as European competitiveness, creates a certain motivational dimension for personnel and contributes to the image of a 'good corporate citizen.' Alliances also have the advantage of opening various communication channels: with competitors, with the European officials in charge of technological programs, and with European government agencies responsible for technological stimulation and support. These channels are considered by most companies interviewed to be excellent opportunities. Contrasting capabilities with competitors or measuring the gap between a company's current position and the 'state of the art' are also mentioned as important advantages.

Top leaders in European industry and government seem to be in agreement about the advantages of technological cooperation and put this into practice, thereby also creating a certain culture which has a pull effect throughout Europe.[13,14]

Negative Aspects

As companies accumulate experience in collaborative research ventures, they also identify negative aspects. There is growing concern about several problems for which no general

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[13] Merritt, Giles "Knights of the Round table: can they move Europe forward fast enough?, *International Management*, July 1986, pp. 22-26.

[14] van del' Klugt, C. J., President and Chairman of the Board, Philips, " International Competition and Cooperation in the Field of High Technology," presented at the forum Technology Development and Management in the 1990's, Electronic Industries Association of Japan, Tokyo, October 3, 1986.

solution has yet been found. Companies are concerned with the potential unplanned loss of knowledge through coalitions. It is difficult to control what exactly goes on in the many meetings between scientists from the different companies involved in a common project. Some companies indicated that it might be possible for a group of scientists from a company to gather elements of information which allow them to identify the position of another company within a technological field or its major lines of advance. Concern was also expressed about the relevance of the research to the competitiveness of the company; a company might be driven into an irrelevant line of research by another company. A large company and a smaller one might engage in a technological coalition to which both companies must commit resources. The large company may commit five percent of its resources to the venture while the small company may need to put sixty percent of its resources to have a meaningful participation. The large company has, as a result, a certain indirect control upon the research resources of the smaller company.

The "motto" of most European programs is "competition and cooperation," but some companies start questioning themselves when there is real cooperation in technological coalitions and when the coalition already involves some elements of competition. It is difficult to establish whether these doubts are the result of the alliance partners' different objectives or due to the existence of "second agendas" purposely prepared to incorporate competitive ingredients from the start of the coalition. Three of the companies interviewed had gone through experiences where they or a partner had abandoned a technological alliance.

About one half of the companies studied also expressed deep concern for the evolution of technological alliances once the research and development phases are completed. Some companies indicated that the investments required in the industrial and commercial stages are often much more important than the R&D investments. The question is to what extent the companies involved in the technological alliance (often subsidized) will have the necessary resources and/or will be willing to commit them to the industrial/commercial stages. Two companies involved in EUREKA alliances clearly suggested the need for an "Industrial-EUREKA," this is to say, a framework program with some type of incentive to facilitate the transition from R&D to industrial exploitation. Questions also arise about the nature of the industrial/commercial partnerships and the relationships between them and the technological coalitions.

Some executives interviewed were concerned by the different speeds and types of learning experienced by different members of the coalition and the possibility of "opening competitors' eyes" to opportunities. They were afraid of new competitors appearing in the market as a result of learning which could be attributed to technological alliances.

In general, most executives interviewed indicated that coalitions are too focused on the research and development stage. They expect their companies to be more careful in the future, going through more comprehensive analysis of the technological alliances they get into, particularly with regard to the impact of technological alliances on future competition.

Categories of Technological Alliances

The most important difference among technological alliances seems to be whether they are intended to facilitate access to a technological capability or they seek access to a market. The current authors define "vertical" alliances as those in which the partners are concerned with the

acquisition of a technological capability and "horizontal" alliances as those in which the partners want to create, define or secure a certain market.

Figure 1 shows an example of what the authors call a "vertical" alliance. In this case, four companies engage in a joint technological venture to have access to a capability in the field of superconductivity. This field is perceived of critical importance by the four companies although they compete in different markets with different products. Superconductivity is important in different stages of the value added chain for different companies and covers different scopes of the total value added chain for each one. Each company might be at a different time-distance from industrial exploitation of the superconductivity capability and will exploit it in a different way. The alliance in this case is driven by the technology.

Figure 1

Vertical Technological Alliance

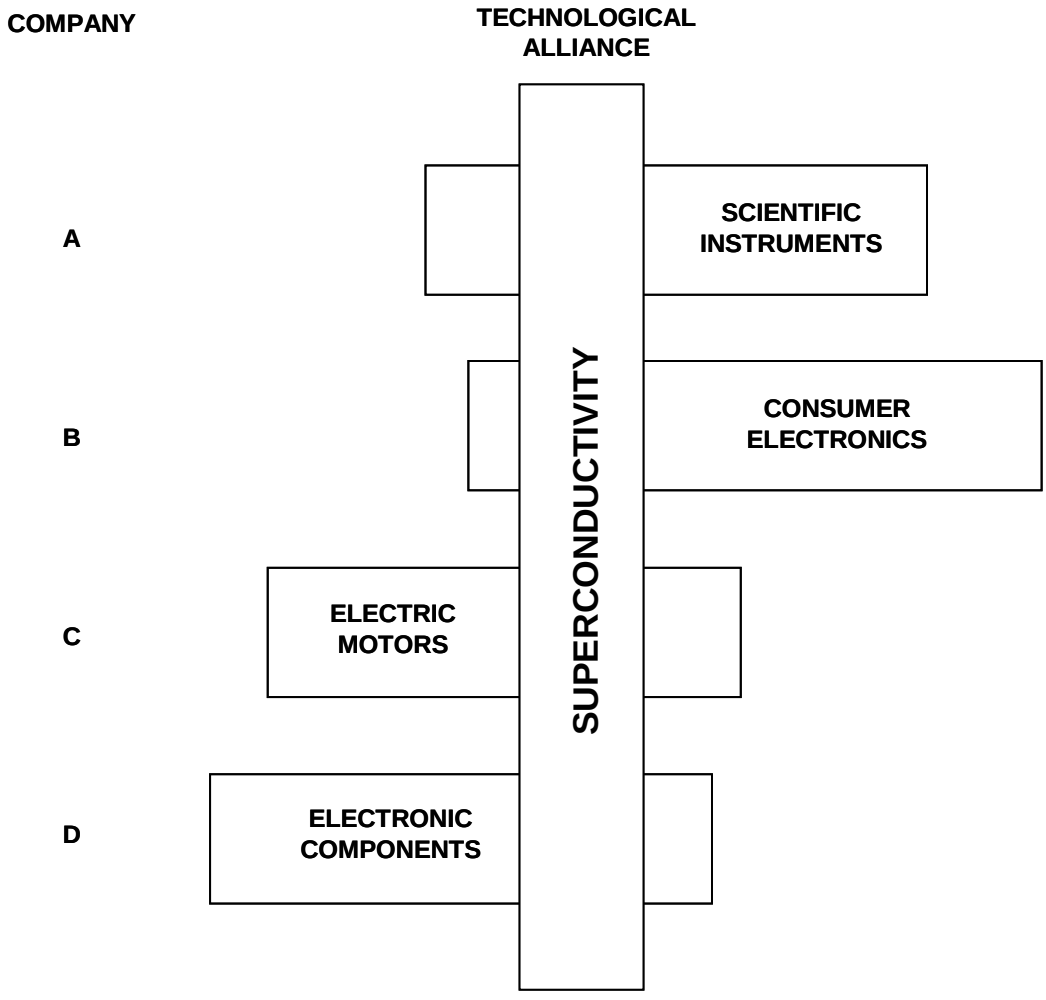
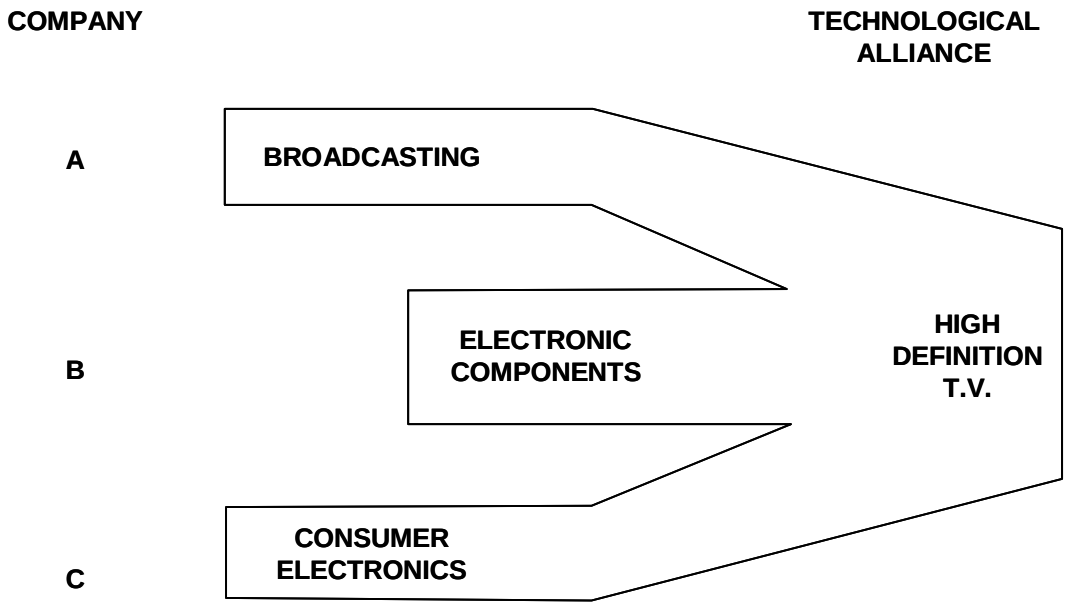


Figure 2 shows an example of a "horizontal" alliance, High Definition T.V. In this case, several companies work together to define a future market in which some of them might compete. They are interested in setting some technological standards and this requires a lot of cooperation in research and development. Once the standards are defined, all companies have a clear idea about the key characteristics of the products which will go to that market. Development

capabilities, quality, reliability, cost, speed in the introduction of the products, marketing or other variables might still provide some companies with a differentiation or a competitive advantage, but the basic aspects of the technology will have been agreed and researched in collaboration. These alliances are therefore market driven.

Figure 2

Horizontal Technological Alliance



If "vertical" and "horizontal" seem to be two useful criteria for categorizing technological alliances, the distance of the alliance from real market competition also provides a criterion to identify major differences. Technological alliances can thus be classified as "pre-competitive," when the technological effort associated is far from the industrial/commercial phase, and "competitive" when the companies involved in the alliance are competitors or the result of the alliance will provide two competing companies with a common component or product which will be integrated in their competing products or product lines.

The examples shown in Figures 1 and 2 would both be "pre-competitive" cases. Figure 3 shows the example of two steel producers engaged in a technological alliance on the continuous casting of flat shapes (plate and/or sheet). Since the companies are already competing in long products, and if they succeed in the alliance, they are likely to engage immediately in competition with the newly developed continuous flat-casting technology. This competition might take different forms however: each company might decide to license the technology to other companies, make new investments to manufacture flat products with the new technology, transform their old facilities to produce only the more competitive flat products, or do nothing. This case would be a "vertical/competitive" technological alliance.

Figure 3

Vertical/Competitive Technological Alliance

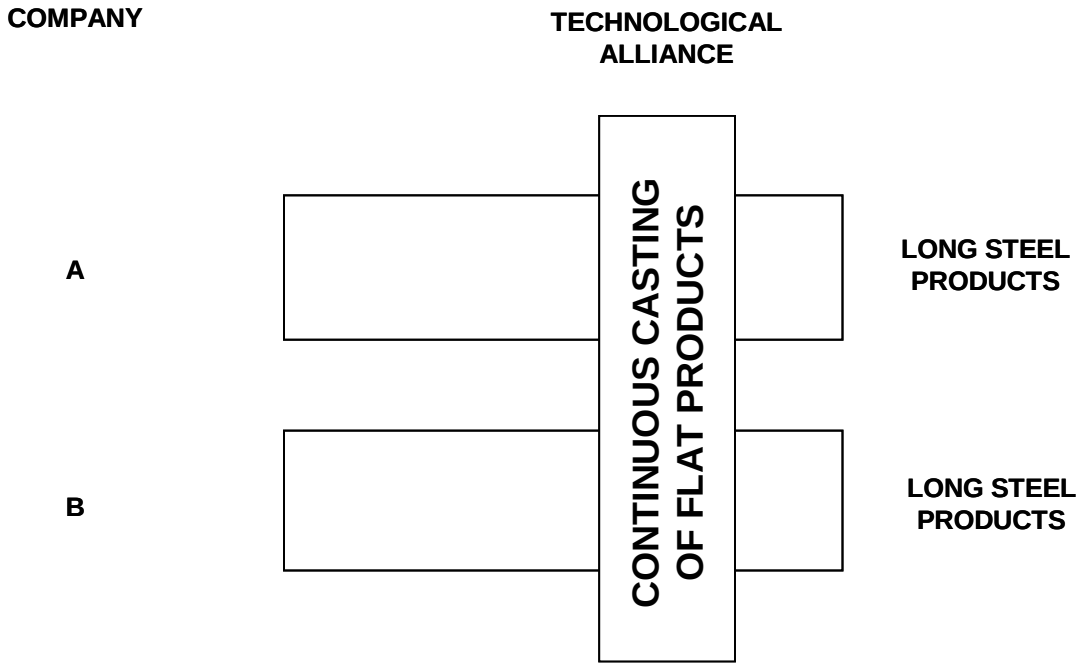
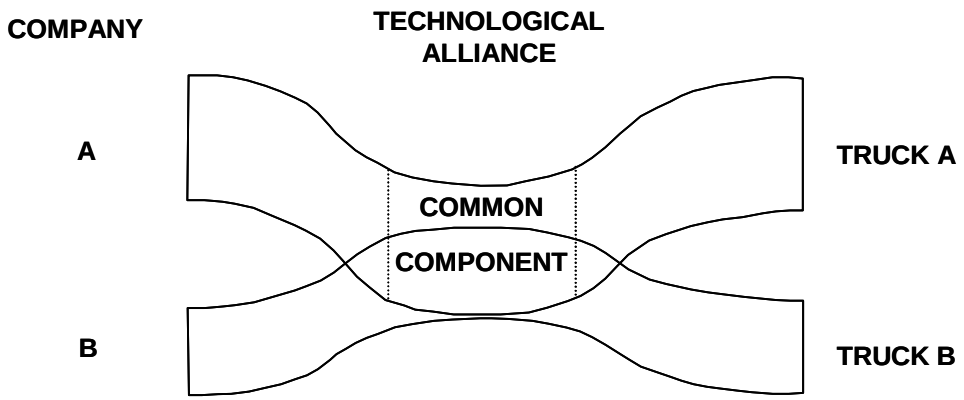


Figure 4 shows an example of a "horizontal/competitive" technological alliance. In this case, two truck manufacturers with similar products competing in similar markets decide that neither of them can singly afford to develop a new cabin for the trucks. The new cabin is necessary if these companies want to compete with third parties. Since the development of a cabin is a complex and expensive project, the two companies organize a separate entity to coordinate research, development, manufacturing, purchasing and subcontracting of the new cabin. In the future, the two companies will share this component and they will continue to compete by offering similar products with a common component.

Figure 4

Horizontal/Competitive Technological Alliance



Difference Between the Various Categories of Technological Alliance

The four criteria allow the identification of four categories of technological alliances, as shown in Figure 5. The authors selected some aspects to differentiate alliances in each category. These aspects were:

a) objectives

b) level at which the decision is made

c) time horizon

d) number of partners

e) impact on the value-added chain

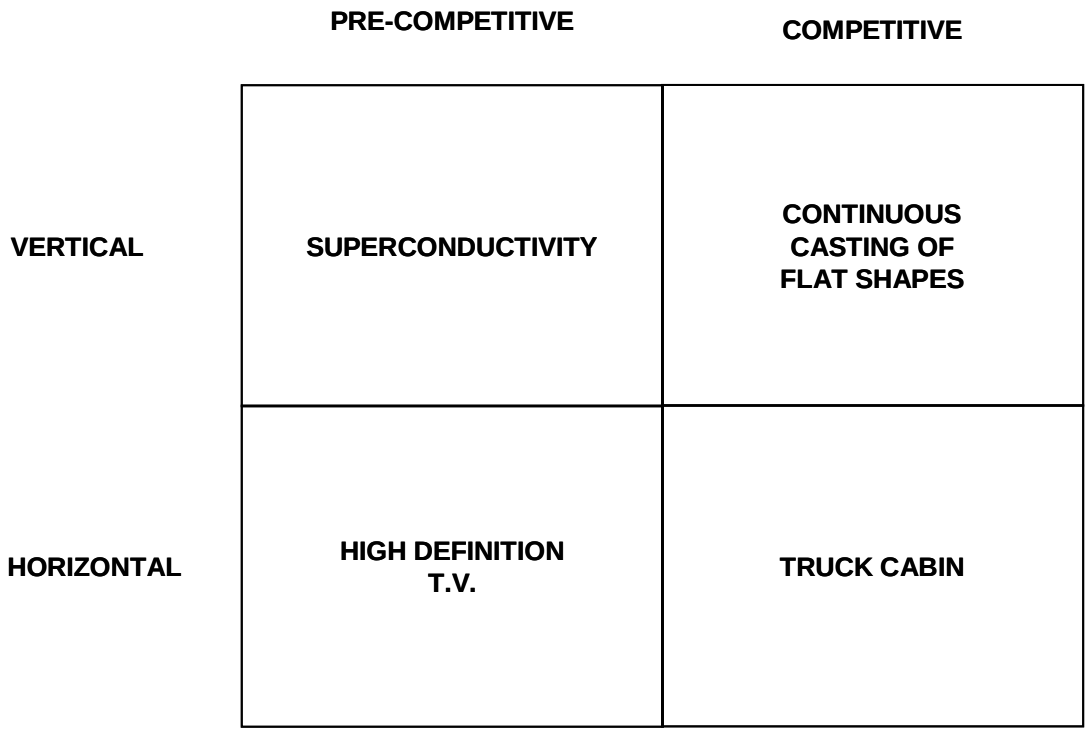
f) evaluation of risk

g) existence of framework

h) stability of the alliance

Figure 5

Categories of Technological Alliances



a) *Objectives.* Some alliances had clear objectives which could be related to the strategies of the companies, such as "securing access to market X in year Y with product Z." Others had loose objectives not directly related to an explicit strategy of the company, such as "building a technological capability in technology X which might be important for the company in the future."

b) *Level at which the decision is made.* In some of the companies interviewed alliances were coordinated at top level, in other companies were left at lower levels of the organization. For example: the top management (the president and senior directors of the SBUs) of a corporation knew that their company was involved in a EUREKA project, that the total budget of the project was over 50 million dollars with a time horizon of 10 years and that, in addition to their company, companies from five other European countries were involved. They did not know, however, any aspects of their involvement. The decision to participate in the project had been taken at the R&D level of one of the SBUs and all the negotiations had been conducted at that level.

c) *Time horizon.* 64 EUREKA projects with a total budget of three billion dollars have an average timescale of 4.86 years, with a range of a minimum of one year (one project), and a maximum of ten years (four projects). This is a good indication of the time horizon variance found in most of the technological alliances observed. The results for the sample of fifteen cases studied is very similar, with projects going from three to twelve years and an average of five to six years.

d) *Number of partners.* Some of the alliances studied have two partners bound by a well-defined structure, with its own facility, managers and budget assigned to the alliance. Other cases involve loose agreements which can be entered by new partners or left by others.

e) *Impact on the value added chain.* If a company becomes involved in a research and development effort, one has to assume that, at least in most cases, the company will later on engage in the industrialization of the innovated products. The type and scope of the research will have a related impact on the position and scope of the commitment that the company will have to make in the value-added chain of the manufacturing activity. Some of the companies analyzed have evaluated the type of commitment they can make in the future manufacturing venture, and have defined their technological coalition combining both their industrial and their technological resources. Other companies accept in their coalitions a research scope which they know they will not be able to transfer completely to the industrial level.

f) *Evaluation of risks.* The evaluation of risks associated with the specific aspect of participating in technological alliances seems to be a weak point in most cases. The facts described earlier in the paper as “driving forces” seem to have more weight than the aspects described as “negative aspects”.

g) *Existence of frameworks.* All but three of the cases studied were about alliances included in European frameworks for the development of technology.

h) *Stability of the alliance.* Although most alliance managers interviewed considered that their venture was stable, many had experience of alliances which had collapsed completely or where one or more partners had pulled out.

Table 1 shows the results of the analysis of the fifteen situations studied. In spite of the richness of the data gathered in the field research, it is not possible to draw statistically meaningful conclusions. Therefore, the authors show their exploratory conclusions warning that more

research will be needed to test their findings. Discussions with top managers interviewed for the research, however, indicate that the conclusions have practical relevance and help these managers to better understand the types of decisions they make and their foreseeable consequences.

Table 1

Summary of the analysis

1. Unclear objectives. 2. Decision-making at technical level. 3. Long-term horizon (>5 years). 4. Many framework-induced partners. 5. Little consideration of future impact on V.A.C. 6. Weak evaluation of risk. 7. Projects with frameworks. 8. Low stability.	1. Reasonably defined objectives. 2. Technical/Top decision-making. 3. Medium term (3 + 5 years). 4. Few self-selected partners. 5. Future impact on V.A.C. considered. 6. Strong evaluation of risk. 7. Projects within/outside frameworks (but most often subsidized) 8. Medium/high stability.
1. Well-defined objectives. 2. Top decision-making. 3. Long/medium term (5 years). 4. Several self-selected partners. 5. Little consideration of future impact on V.A.C. 6. Weak evaluation of risk. 7. Projects within/outside frameworks. 8. Medium/high stability.	1. Very well defined objectives. 2. Top decision-making. 3. Short term (3 years). 4. Very few self-selected partners. 5. High consideration of future impact on V.A.C. 6. Strong evaluation of risk. 7. Projects outside frameworks. 8. High stability.

The analysis indicates that horizontal coalitions have better defined objectives than vertical coalitions. Horizontal/pre-competitive coalitions are established to secure access to a future market while horizontal/competitive coalitions often hope to obtain differentiation in an existing market, or just survival in a very competitive existing market.

The objectives of vertical coalitions are more difficult to relate to the competitive strategy of the company. The closer the coalition to competition, the better the definition of the objectives. Vertical/competitive coalitions tend to be associated with market distribution and/or cross-licensing.

Involvement of top management is higher in horizontal coalitions. The number of partners and the time horizon seem to evolve in parallel, going down from vertical/pre-competitive, horizontal/pre-competitive, vertical/competitive to horizontal/competitive. Pre-competitive alliances tend to benefit more and/or are more induced by frameworks. Vertical/pre-competitive are relatively open, while the others tend to be more closed, with one or two partners acting as leaders in the formation of the coalition and having a say on those who enter and those who are not accepted. Horizontal/competitive are the extreme, where two to four partners get together and, in some cases, create a specific infrastructure for the coalition.

The consideration of the future impact on the companies' value added chain when the industrial/commercial exploitation stage is reached is a generalized weakness of pre-competitive coalitions, as is the technological risk evaluation. As a result, it is possible to

expect important problems in the years to come when most technological coalitions reach maturity and require industrial and commercial investments and, consequently, a new negotiation between the partners to establish how they share the results of their joint research and how they go from cooperation to competition. Problems might also arise if coalition partners enter markets where they were not present before starting and thereby directly compete with their technological coalition partner companies.

Finally, pre-competitive coalitions show less stability than competitive coalitions, an observation supported by more instances in which partners have left a coalition and even coalitions which have collapsed.

Conclusions

The previous analysis leads to three major conclusions. The first is that technological coalitions might produce a lot of unexpected results. Companies must evaluate the extent to which entering into a coalition is a cooperative or a competitive move. The answer depends largely on the other partners' objectives. Through coalitions, some companies might be partially driven by competitors. Competitors might gain strength through coalitions. Unplanned transfers of technology might take place and unexpected competitors might appear as a result.

The second conclusion is based on the fact that the closer to competition the higher the concern about the impact on the value added chain and the more formal the linkages amongst partners. If these linkages tend to consolidate, then technological alliances are likely to evolve into more solid structures such as joint-ventures and/or acquisitions. Working together over several years in a technological alliance might open a channel of communication which can facilitate the dialogue leading to consolidation.

The third conclusion is based on the perception of increasing managerial complexity as technological alliances advance into the industrial stage. Managing technological alliances is a complex task and it is likely to become more complex as cooperation approaches competition.