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# FACTORS RELATED TO R&D PERFORMANCE and technical collaboration in HIGH TECHNOLOGY PROJECTS

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## ABSTRACT

This paper, a work in progress, explores the factors related to technical collaboration in research and development (R&D) among firms in the information technology projects. Technical collaboration includes informal collaboration, strategic alliances and acquisitions. The factors are divided into three main categories: Causes or motivations for establishing such technical collaboration; consequences or impact of the technical collaboration on the innovation rate, R&D intensity and the firm performance; and finally critical success factors for achieving a positive outcome from establishing such technical collaboration among firms within the information technology industry. The overview from the literature results in a total of 74 factors, classified into the three categories. Furthermore, the paper shows that in the literature of strategic management, the impact of the technical collaboration on the performance is contradictory and incomplete. A more holistic approach is proposed.

## INTRODUCTION

The information technology industry is different than any other industry. Firms established in this knowledge intense sector of the economy face turbulent environmental challenges. The information technology products are technically complex and the embedded knowledge is tacit in nature, non codified and non transferable as a public good. The rate of innovation of new technologies and products is high and the industry faces continuous waves of new technological generations and disruptive technologies, which render the product obsolete, possibly even before being launched to the market and received by the end user customers. In fact the rate of obsolescence is higher than the time required to recover the skyrocketing investment needed in research and development in order to produce new products and technologies that would be built on the core competencies of the company and sustain competitive advantage. The complexity of the technology is coupled with a high level of uncertainty due to a lack of dominant

standards, a lack of credible forecast for the potential new product and a lack of specific requirements from the customers' side.

Facing those environmental challenges, firms established in the information technology industry tend to use alliances, acquisitions or both, to survive, enhance their performance, and guarantee their growth. Working together would reduce the level of uncertainty and risk imbedded in the required high investments in research and development. Moreover, it would give access to external resources of innovation, which are strategic assets that would complement or supplement the firm's existing assets. Sharing the cost of research and development would produce economies of scale and scope and achieve synergetic opportunities, producing efficiency and net gain. The formation of an alliance or acquisition would give access to new products, reduce the product life cycle and penetrate new markets and industry segments, which would increase the firm's market position and power.

Research and development is categorized historically as a first, second, third and fourth generations of the evolution of the management of R&D activities. In the third generation R&D, the strategic objectives of the firm are aligned to the R&D projects, which produce a coordinated portfolio of products. The whole company collaborates in the development of a joint plan, including the research and development teams, the marketing and finance departments and the top management team, including the CEO. Therefore the strategic management dimension in the full integration of R&D projects, budget and objectives in the overall strategic plan of the firm. In the fourth generation R&D, the boundaries of the firm allow for the cooperation with other firms and the collaboration between different operational teams, including the research and development human assets. Innovation is not based only on the internal resources of the organization, but rather on the combination of internal and external source of innovation, including partnerships between the government labs and the universities' research centers, the government and the privately owned firms and among the private firms. In the later category, firms form alliances and acquisitions to collaborate on research level and the development of new products, while sharing risk and cost, and reducing uncertainty.

To fully understand the factors related to the R&D collaboration among the firms in the technology industry, a holistic approach to the study of strategic management would be not only useful but essential. The issue of alliance and acquisition formation is a complex issue, and fragmenting all of its components would give some explanations, but stay short of describing the whole picture and prescribing valuable and pertinent recommendations.

Therefore, this paper intends to explore the factors related to the formation of alliances and acquisitions, within the context of research and development in the information technology industry. The holistic approach is used and the factors are classified and divided into three main categories. First are the motivations of the formation of alliances and acquisitions. Second, the consequences or impact of the formation of the alliance or acquisition on the firm. Finally, the critical success factors related to the successful implementation of joint R&D projects within the formation of a new alliance or acquisition.

The paper is divided into an introduction, followed by three parts each describing the motivations, impact and critical success factors. In the comments section, a table is provided listing the factors covered and researched in this paper and their classification between alliance and acquisition. The paper ends with a bibliographic list.

This paper fills a gap in the literature of the management of research and development and it provides a valuable contribution to the literature of strategic management and technology management.

## 1. Causes and Motivations of Technical Collaboration

Technical collaboration including alliances and acquisitions are motivated and triggered by different sources. The context in

which the alliances and acquisitions take place is an important factor. The specific industry, the industrial sector and the market segment may all influence whether firms in this sector rely more on alliances and acquisitions for developing their strategy, penetrating new markets or acquiring new technologies. Environmental challenges faced by firms in a specific sector or industry, such as the high technology industries, may force firms to choose alliances or acquisitions or a combination of both, as the strategy for achieving sustained competitive advantage.

In a general term alliances and acquisitions may be motivated by the desire to maintain growth (*Feeser & Willard, 1990; Walter & Barney, 1990*) over a certain period of time. If growth cannot be achieved internally based on an increase in sales, penetrating new markets, developing new products or innovating new technologies, external sources of growth could be the alternative, by using either alliances with other strategic partner or acquisitions of target firms. Technological firms could choose alliances or acquisitions for the purpose of empire building (*Trautwein, 1990*), by acquiring large firms in either related or unrelated diversification, which would have a positive impact on their market share, global coverage and operations, stock performance and market value. In some instances, the desire for acquisitions is motivated by the external ties of the firm's leadership and the CEO's hubris (*Hayward & Hambrick, 1997*), which is defined as the desire for more power, control based on an exaggerated self-pride or self confidence.

Market failure and the firm's need to transition towards a hybrid form or hierarchy (*vertical integration*) is another motivation for using alliances and acquisitions. In order to reduce the transaction costs (*Borys & Jemison, 1989; Eisenhardt, 1989; Teece, 1982; Walker & Weber, 1984; Williamson, 1975; Williamson, 1986, 1999*) in dealing with the market, the firm may opt for forming a strategic alliances with a partner based on a preferential term, long term contract and shared risk and commitment. Also the firm could decide to vertically integrate its supplier, which could produce other costs in term of complexity and sunk costs. In both cases this would require more management control, and a specific governance regime. For both cases, resource endowment (*Gulati, 1999; Hoffman & Schaper-Rinkel, 2001*) is essential in forming either alliances or acquisitions, as without enough resources the firm would not be in a market power position to negotiate an alliance nor would it have the economic power to acquire the target firm. The existence of those resources could be the motivation behind alliance or acquisition moves. The external ties of the firm's executives, informal technical collaboration of the engineers, the reputation of the R&D scientists and their collaboration with their peers in standard bodies and professional association, their personal friendships with other firms' employees, all form the social capital (*Geletkanycz & Hambrick, 1997; Gulati, 1999; Hoffman et al., 2001*) of the firm, which facilitate and may trigger the desire to form alliances or acquisitions, whether decided from top-down or bottom-up. This social capital exists and is facilitated specially among firms located in an agglomeration of firms such as industrial parks, technological incubators or technology free zones, where links and personal relationships are closer due to the closer proximity (*Ferrary, 2003; Mayer & Kenney, 2004*) of the firms with each others.

In the high technology industries, including information technology, biotechnology and aerospace, firms face a challenging environment including a high level of uncertainty, a continuous fast pace of change, the emergence of disruptive technologies, the shortening cycle of product development, the high rate of obsolescence of technologies and products, the intensity of the research and development required, the volatility of the market and the extremely high cost of innovation. In this challenging environment the uncertainty (Bettis & Hitt, 1995; Hoffman et al., 2001; Quelin, 2000; Roberts & Liu, 2001) is a result of technological uncertainty (Quelin, 2000; Roberts et al., 2001; Robertson & Gatignon, 1998; Walker et al., 1984) due to the lack of standards being still under development, competing technologies without a clear potential winner and the intensive emergence of disruptive technologies which render existing products obsolete; demand and market uncertainty (Quelin, 2000; Roberts et al., 2001; Robertson et al., 1998) due to the lack of credible demand forecast for competing and under developed technologies, the ignorance of the customers' perception of the potential new products; and product uncertainty (Quelin, 2000; Roberts et al., 2001) due to the lack of understanding of the potential customers' preferences for the future products' specifications and requirements.

This uncertainty is amplified because of the limitations facing the firm in this environment and in dealing with its challenges. One of those limitations is the embedded nature of the technical knowledge required to deal with uncertainty. This technical knowledge is not codified, and has a tacit nature. It is in the mind and experience of the technical engineers and scientists and cannot be transferred as a public good without a price to pay and an effort to make. This tacit knowledge (Oliver, 1997) could be in the technical expertise and know-how of the technical teams, the research and development capabilities, the management practice, the entrepreneurial spirit or the innovation track record. This knowledge cannot be transferred to the firm simply by recruiting or by the free mobility of its agents. It is related to a technical idiosyncrasy and specific assets as part of the research, development, operations and maintenance phases. The asset specificity (Coff, 1997; Hoffman et al., 2001; Oliver, 1997; Robertson et al., 1998; Williamson, 1975; Williamson, 1999) owned by a firm determines the potential for it to join in an alliance or to be acquired by a larger firm. Those highly specialized assets could be human, physical, or material and would represent for the potential partner or acquirer external assets needed to maintain a sustained competitive advantages. Those strategic assets (Hagedoorn & Duysters, 2002; Oliver, 1997; Peteraf, 1993) are characterized by being unique, inimitable, difficult to duplicate and part of the core competencies of the firm. If the firm finds those assets in its environment, it could either form an alliance to have access to them or form an acquisition to acquire them internally, as an external source of innovation. The objective for the acquirer or the allied firm is to build upon the core

competencies (Hitt, Hoskisson, Ireland, & Harrison, 1991; Prahalad & Hamel, 1990, 1994; Quelin, 2000; Singh & Montgomery, 1987) of the firm by relying on external sources.

When choosing alliances or acquisitions, the firm would evaluate and target the partner or the acquired firm's existing products line and portfolio of technologies. Those potential products for alliances and acquisitions could be supplementary or complementary products. Supplementary products (Shelton, 1988; Wernerfelt, 1984) are similar in nature to the firm's existing products portfolio and complementary products (Mayer et al., 2004; Shelton, 1988; Wernerfelt, 1984) are different products that combine well with the firm's existing products' lines. The firm would choose to have access to those resources through an alliance or acquire them through an acquisition, in order to increase its core competencies and improve its product portfolio competitiveness (Ferrary, 2003), which would ensure a sustained competitive advantage (Oliver, 1997; Porter, 1980; Prahalad et al., 1994). In addition to supplementary and complementary products, a firm could choose to acquire a target firm because of the competitive threat of substitute products or technologies (Gawer & Cusumano, 2002), which could result in barriers to entry (Wernerfelt, 1984; Yip, 1982) for the acquirer firm. By acquiring those substitute products, the firm would reduce the competitive threat and produce new entry barriers to other firms developing similar technologies and products, which would ensure a better market positioning (Gulati, 1999; Hopkins, 1987; Walter et al., 1990; Yip, 1982) and a sustained competitive advantage.

Firms also enter into alliances or acquisitions with other firms in their related or unrelated technology sectors, to reduce the risk by sharing it with their partners or acquired firms. Risk (Roberts et al., 2001; Walter et al., 1990) is inherent in this challenging and turbulent environment which is characterized by uncertainty and fast pace of change, among others. The operation risk could include the skyrocketing research and development cost, while the R&D intensity by competitors, the high rate of obsolescence, the ever shorter product cycle and the continuous threat of the emergence of disruptive technologies, could prevent the firm from recovering the R&D cost (Roberts et al., 2001), before the product is replaced or cannibalized by another from the same company or a competitor. Sharing the research and development cost would be a high priority for firms in innovation and knowledge intense industries such as the information technology.

Furthermore, when forming alliances and acquisitions, information asymmetry (Coff, 1997; Eisenhardt, 1989; Hoffman et al., 2001) is an important factor in dealing with management control, technology and knowledge transfer, non-codified tacit knowledge and technical expertise. In alliances, information asymmetry could prevent the allied firms from aligning their strategy, objectives and product portfolios due to a gap in the information exchange among them. However,

information asymmetry especially technical know-how between firms regarding strategic assets and external sources of innovation could be a motivation for forming an alliance or acquiring a firm. Bounded rationality (Coff, 1997; Eisenhardt, 1989; Williamson, 1975; Williamson, 1999) would mean that the firm could not develop its internal needed resources to sustain competitive advantage. Also, it means that in evaluating potential and target firms for alliances or acquisitions, the firm would be rationally bounded as it would not be able to process all the available information and would select from a limited number of choices. In this phase of evaluation and selection, there is always the danger of moral hazard (Coff, 1997; Eisenhardt, 1989; Hoffman et al., 2001), as the parties could misrepresent their respective information, based on their personal or corporate self interest and opportunistic behavior. The degree of opportunism (Eisenhardt, 1989; Hoffman et al., 2001; Williamson, 1975; Williamson, 1999) could be qualified as higher in alliances' pre and post formation phases when compared to acquisitions respective phases. In the pre-alliance phase, the lack of access to the potential partner's internal information for evaluation could prevent a solid evaluation of their market value, potential technologies, internal capabilities, and financial strength. In the post alliance phase, the governance structure within this hybrid form, may not guarantee the information flow between the hierarchy and among the partners, which could create a greater potential for opportunism and agency problems. Furthermore, in alliances when dealing with the evaluation of an alliance or in the post alliance phase, there is the danger of appropriation (Hoffman et al., 2001) of proprietary technology, know-how and expertise. If the danger of appropriation is significant and persistent, and if the related products or technologies are part of the core competencies of the firm, the later could have a preference for forming acquisitions rather than alliances. In fact, alliances could pave the way for acquisition formation, as in the alliance phase the future acquirer and acquired would gather the need internal and critical information necessary for a solid evaluation with respect to an alliance formation.

Two issues remain critical for the success of either the alliance or acquisition formation: Complexity (Bettis et al., 1995) in its broad meaning and strategic fit (Jemison & Sitkin, 1986; Mayer et al., 2004; Paine & Power, 1984; Shelton, 1988; Wernerfelt, 1984) as defined by the strategic management literature. There is a certain amount of complexity during the formation and post alliance or acquisition phases. In either contractual or non-contractual forms, alliances represent a challenge in aligning the strategies of the allied firms and in producing synergetic operational objectives in achieving the desired alliance goals. After the decision to acquire a firm takes place, the following complex task would be to integrate the two companies including their physical locations, assets and capabilities, finances, information systems, sales forces and product portfolio. Complexity is also inherited in the

nature of the knowledge intensive and tacit nature of the technologies and products involved. This complexity makes it difficult to evaluate the products and the technologies in the pre alliance and acquisition phase and in challenging in the implementation phase when taking the task of integrating the different technological components in a modular fashion. Therefore, strategic fit between the potential partners for an alliance or acquisition, must include the complexity of integrating the technologies and the product to create a unified portfolio. Moreover, the two companies must evaluate the fit with respect to organizational culture (Datta, 1991; Jemison et al., 1986; Mayer et al., 2004; Nahavandi & Malekzadeh, 1988), management style, training and education, etc... Clashing or dissimilar cultures would not integrate or work well, thus hindering the alliance or acquisition objectives. Finally, the two or more firms should have compatible, or better complementary, organizational and corporate objectives (Mayer et al., 2004).

## 2. Consequences and Impact of Technical Collaboration

One of the main objectives of alliances and acquisitions is to increase the core competencies (Hitt et al., 1991; Prahalad et al., 1990, 1994; Quelin, 2000; Singh et al., 1987) of the allied firms in the case of an alliance or of the acquired firm in case of an acquisition. This is done by accessing or acquiring key resources categorized as strategic assets (Hagedoorn et al., 2002; Oliver, 1997; Peteraf, 1993) required for sustaining the competitive advantage of the firm. Those resources are unique, inimitable and difficult to duplicate. The other main objective in the formation of alliances and acquisitions is the improvement of economic performance (Lubatkin, 1983; Singh et al., 1987) of the firm, otherwise, the alliance or acquisition would not serve the interest of the firm and its "raison d'être". This is due to and as a consequence of the alliance or acquisition formation, to the increase of the economy of scale and scope. The increase in the economies of scale (Duysters & Man, 2003; Hoffman et al., 2001; Singh et al., 1987; Walter et al., 1990) is due to the access to new geographic market and industry segment, the use of complementary manufacturing facilities, and the aggregation of supplementary and complementary research, development, and production capabilities. The increase in the economies of scope (Hoffman et al., 2001; Lubatkin, 1983; Singh et al., 1987) is due to the efficient use of combined resources such as R&D labs, marketing and publicity costs, sales forces, administrative structure, integrated information system, and transportation, warehousing and production facilities.

Those economies of scope and scale would significantly reduce the operational expenses and cost (Walter et al., 1990), which would result in a net gain



(Trautwein, 1990) for the combined allied partners or the acquired firm in case of an acquisition. Alliances and acquisitions should, as one of its objectives and a consequence to its formation, penetrate new market (Walter et al., 1990) segments or geographic territory. This will be facilitated by the access to the new assets or the acquirement of the new strategic resources. Those new resources would improve the development cycle of new products, which could result in reducing the product time to market or the temporal gap between the initial idea and the product launch. Reducing the product life cycle and penetrating new markets would increase the alliance's joint venture or the acquirer's market share (Brush, 1996; Mayer et al., 2004; Walter et al., 1990) due to the attractiveness of the new combined portfolio or due to the acquisitions of the acquires market share. Furthermore, the combined resources whether supplementary or complementary products and technologies would create entry barriers (Wernerfelt, 1984; Yip, 1982) to competitive firms, resulting in an increase in monopoly status (Trautwein, 1990). All those efforts and positive effects of alliances and acquisitions formation would improve the firm's position within its network. The firm position (Gulati, 1999; Hopkins, 1987; Walter et al., 1990; Yip, 1982) could be based on its economic power, bargaining power, influence, reputation, technical capabilities, market share, and product competitiveness and organization culture in a knowledge intense industry. The firm's central position within its immediate network would positively influence its acquisition capabilities and influence in forming more alliances with strategic partners. Intensive alliances and acquisitions could lead the firm to reach a platform leadership (Gawer et al., 2002), due to the aggregation of the combined dominant or promising technologies and the modularity (Gawer et al., 2002) of the portfolio of products.

On the less positive side, alliances and acquisitions could represent a threat to the firm's key resource; the tacit knowledge (Oliver, 1997) that the firm holds and protects as part of its core competencies. This tacit knowledge could be embedded in the technical know-how, research techniques, business practices, operation processes and procedures, marketing skills and innovative talents. When forming an alliance the danger is from the appropriation of proprietary non-codified and non-patented technology and know-how, by one or the two firms. In acquisitions, the danger of appropriation (Hoffman et al., 2001) could result from the departure of key agents such as top executives or technical scientists and engineers.

Furthermore, increasing the alliances and acquisitions intensity (Hitt, Hoskisson, & Ireland, 1990; Hitt, Hoskisson, Johnson, & Moesel, 1996) whereby the firm would rely strategically on alliances or acquisitions for achieving its objectives could result in reducing the research and development intensity (Hitt et al., 1991; Hitt et al., 1996) and thus affecting negatively the internal innovative capabilities of the firm. Such firms would opt for using a more adaptable and flexible "acquisition and development" (A&D) (Mayer et al., 2004) strategy instead of a research and development (R&D) one. This could be due to the lack of internal resources for continuous innovation, but could hinder those same resources if available. Internal research and development activities is performed as in 'learning-by-doing' (Hoffman et al., 2001; Pennings, Barkema, & Douma, 1994) and relying more on access to products through alliances or off the shelf acquisitions would not permit for the continuation of the process of learning which involves trial and errors and constitutes the path upon which technical expertise, know-how practices, skills and talents are created. This path is

time and resource dependent in a cumulative fashion. Not utilizing those resources would create an irreversible path dependent situation and would negatively impact the internal rate of innovation (Hitt et al., 1990; Hitt et al., 1991; Hitt et al., 1996).

It is important to highlight some of the critical success factors related to the consequences of alliances and acquisitions. First, the formation of alliances and acquisitions would endow the firm with the experience gained during the different phases including the scanning of the environment, the evaluation of potential firms, the decision making process, the integration, and the post alliance or acquisition's phases. This alliance and acquisition's experience (Haleblian & Finkelstein, 1999; Jemison et al., 1986; Pennings et al., 1994) is critical for the success of an intensive alliance or acquisition strategy. The best of class criteria for the selection of target firms, the speed of the integration, the expertise in combining valuable assets, and the transparency of the process to the end-user customers, are all some of the valuable skills gained by alliances and acquisitions experience. Second, in the post alliance and acquisition phase, creating overall efficiency is critical to the success of the integration process and the overall performance of the firm. Efficiency (Trautwein, 1990; Walter et al., 1990; Williamson, 1999) would result from the better use of the combined resources, avoiding duplications and redundancies and the better utilization of synergetic opportunities created by the new alliance or acquisition. Third, achieving a superior technical or technological performance is critical to the success of any alliance and acquisition. Technical or technological performance (James, Georghiou, & Metcalfe, 1998) could result from a better and more advanced technology, setting new standards, achieving a greater level of modularity, versatility and utilization, improving technical support, reducing time to market, increasing the product portfolio competitiveness (Ferrary, 2003) compared to rival firms.

### 3. Critical Success Factors in Technical Collaboration

Forming alliances or acquisitions is mainly with the objective of sustaining competitive advantage (Oliver, 1997; Porter, 1980; Prahalad et al., 1994) with all its underlying conditions such the efficient management of strategic assets and building on core competencies, which remain one of the critical success factors. In a pre alliance and acquisition phase, one critical success factor remains crucial to the strength of the formation of a partnership between compatible partners: Trust (Eisenhardt, 1989; Jemison et al., 1986; Williamson, 1975; Williamson, 1999). Without trust, conflict of interest, opportunistic behavior and moral hazard could weaken the potential for a mutually beneficial relationship. During the scanning phase to evaluate potential partners, the reputation of the target firm and the personal relationships between its agent and the acquirer would speed up the process of accessing internal information and would reduce the lengthy negotiations. In alliances, trust between the partners would create synergetic opportunities (Brush, 1996; Chatterjee, 1986; James et al., 1998; Lubatkin, 1983; Walter et al., 1990; Wernerfelt, 1984) and a healthy organizational culture.

Compatible organizational cultures (Datta, 1991; Jemison et al., 1986; Mayer et al., 2004; Nahavandi et al., 1988) between the partners, either in an alliance or an acquisition are another

critical success factor to guarantee an alignment between the two organizations and produce a high level of synergy. Culture is sometime termed the informal structure of the organization and a healthy structure produces a winning strategy. In fact, a high level of compatibility between the two organizations, in which the strategic objectives and missions of the two are aligned, would create a strategic fit. Compatible organizational objectives (Mayer et al., 2004) are a key success factor. The success of an alliance and acquisition rely on the strategic choice made in the evaluation and selection process, in which one company among many is believed to be the best in complementing the resources of the principal firm and aggregating to it external strategic assets. In the post formation phase and during the integration phase of an acquisition or the implementation phase of an alliance, the partners should work together to combine the resources and devise a plan for financial synergy (Chatterjee, 1986; Hoffman et al., 2001; Trautwein, 1990). Among the expectations of alliances and acquisitions are the production of significant economies leading to a net gain, while increasing the rate of growth and maintaining the strategic objectives. This would not be achieved without the integration of the firms' value chains and physical assets, producing significant improvement in the operation level and a high level of operational synergy (Chatterjee, 1986; James et al., 1998; Trautwein, 1990). A healthy organization culture that is based on trust, the full integration of the two firms' information system infrastructures resulting in reducing the asymmetry of information, the integration of the acquired firm into the acquirer by establishing a clear channel of communication and command, would eventually create managerial synergies (Trautwein, 1990).

Moreover, the different components of synergy, such as the financial, operational and managerial synergies, depend on the success of the integration process and the degree of integration (James et al., 1998; Jemison et al., 1986; Mayer et al., 2004; Nahavandi et al., 1988; Paine et al., 1984); In other words, its scope, depth and quality. An enormous and serious effort should start immediately after the alliance or acquisition's decision is completed, to integrate the two firms. During the scanning and evaluation process, the integration plan should be conceived and the complexity of the integration should be compared among the different choices of potential and target firms. Therefore, plans should be devised in an early stage, which would guarantee a full speed progress and project implementation after the decision. As the degree of integration is a critical success factor, the complexity of the integration and the length of the process would depend on related factors. The target firm's relative size (Datta, 1991; Jemison et al., 1986; Kusewitt, 1985) would affect the scope of the integration, the length of the integration process and the amount of resources dedicated to complete the integration. Those resources and all the resources owned by the firm should be utilized in the production of goods and services, and borrowing from those resources would limit the firm from reaching its full potential.

The proximity (Ferrary, 2003; Mayer et al., 2004) of the two firms would facilitate the movement of the personnel between the two entities and the exchange of information in a more personal way through meetings and personal contacts. This would increase the quality of communication and collaboration, fomenting trust. The idea behind an alliance or acquisition is to access or acquire strategic resources from an external source, which is in the high technology industry's highly technical expertise and know how that is tacit in nature. When those resources are transferred to the other firm or absorbed by the partner firm in an alliance, a new

process of learning and knowledge transfer begins. Teams from the two firms would work together, reaching a consensus on the way ahead and forging plans for the development of objectives, products and results. The level of synergy resulting from the combined effort is based on the absorptive capacity (Hoffman et al., 2001) of the teams working together and the degree of product relatedness (Feeler et al., 1990; Hopkins, 1987; James et al., 1998; Roberts et al., 2001; Wernerfelt, 1984), in a related diversification move. The more the products are related, the easier the integration between them and the creation of levels of modularity and versatility. The degree of modularity (Gawer et al., 2002) is influenced mainly by the compatibility of the parts and their full interoperability. The technical complexity (Hitt et al., 1996) embedded in high technology products would make the integration process of modular parts a more difficult task. Dealing with this complexity would require lengthy planning, dedicating the best resources available from the two firms.

In the post alliance and acquisition formation, management control (Eisenhardt, 1989) and the governance structure is a key to success. The structure would follow the strategy and ensure the achievement of both strategic control (Hitt et al., 1990; Hitt et al., 1996) in terms of allocating the valuable resources owned by the firm and the alignment of the strategic objectives with those resources; and financial control (Hitt et al., 1990; Hitt et al., 1996) to produce economies, efficiencies and gain. Guarding and protecting the resources is critical to maintaining a sustained competitive advantage. In some cases, after the formation of an alliance or an acquisition, some valuable human resources such as experience managers, talented engineers or skilled scientists could depart the firm, because of a conflict of loyalty because they do not fully agree with the new formation or because their position or power is affected by the new arrangements. The departure of those human assets could negatively impact the success of the alliance and the acquisition and prevent the firm from achieving its desired and planned objectives. Talent retention (Cannella & Hambrick, 1993; Coff, 1997; Mayer et al., 2004) is a success factor in ensuring a smooth integration and could be achieved by both economic and non economic incentives (Paine et al., 1984), such as equity share for the acquired management team, relative power for the team leader and project managers of the acquired firm, and the maintenance of a certain degree of autonomy for the creative teams acquired, to ensure the non disruption of the creative environment, procedures and routines.

### 4. Conclusion

Firms establish alliances or acquisitions for different motivations. There are critical success factors for the success of alliances or acquisitions. The paper explored those motivations and described the consequences or impact of the alliances and acquisitions on the firm's performance. It also listed key critical success factors.

The following **Table** is a list of the motivations, consequences and critical success factors of the formation of alliances and acquisitions. Each variable or concept is given its reference from the bibliographical list. In addition, each concept is categorized as belonging more to alliance formation, the acquisition formation or to both.

Causes			Consequences			Critical Success Factors		
11 R&D cost	Collaboration Alliances	<i>Cited by</i> (Roberts et al., 2001)	5 Barriers to Entry	Collaboration Alliances and acquisitions	<i>Cited by</i> (Yip, 1982) (Wernerfelt, 1984)	1 Competitive Advantage	Collaboration Alliances	<i>Cited by</i> (Porter, 1980) (Pralalad et al., 1994) (Oliver, 1997)
20 Moral hazard	Acquisitions	(Eisenhardt, 1989) (Hoffman et al., 2001) (Coff, 1997)	6 Cost	Alliances and acquisitions	(Walter et al., 1990)	2 Synergy	Alliances	(Brush, 1996) (James et al., 1998) (Walter et al., 1990) (Chatterjee, 1986) (Lubatkin, 1983) (Wernerfelt, 1984)
21 Degree of opportunism	Acquisitions	(Eisenhardt, 1989) (Williamson, 1975) (Hoffman et al., 2001; Williamson, 1999)	14 Increase economies of scale	Alliances	(Duysters et al., 2003) (Walter et al., 1990) (Hoffman et al., 2001) (Singh et al., 1987)	3 Market power	Alliances	(Galbraith & Stiles, 1984)
22 Bounded rationality	Alliances and acquisitions	(Eisenhardt, 1989) (Williamson, 1975) (Williamson, 1999) (Coff, 1997)	15 Increase economies of scope	Alliances	(Hoffman et al., 2001) (Lubatkin, 1983) (Singh et al., 1987)	7 Firm's size	Alliances	
24 Asset specificity	Alliances	(Hoffman et al., 2001) (Williamson, 1975) (Williamson, 1999) (Oliver, 1997) (Coff, 1997) (Robertson et al., 1998)	16 Increase Core competencies	Alliances and acquisitions	(Hitt et al., 1991) (Pralalad et al., 1990) (Pralalad et al., 1994) (Quelin, 2000) (Singh et al., 1987)	8 Incentives	Alliances and acquisitions	(Paine et al., 1984)
26 Tacit knowledge	Alliances	(Oliver, 1997)	19 Danger of appropriation	Alliances	(Hoffman et al., 2001)	9 Talent retention	Alliances	(Mayer et al., 2004) (Cannella et al., 1993) (Coff, 1997)
28 Information asymmetry	Alliances	(Eisenhardt, 1989) (Hoffman et al., 2001) (Coff, 1997)	35 Platform leadership	Alliances	(Gawer et al., 2002)	10 Absorptive capacity	Alliances	(Hoffman et al., 2001)
29 Uncertainty	Alliances	(Quelin, 2000) (Roberts et al., 2001) (Hoffman et al., 2001) (Bettis et al., 1995)	36 Economic performance	Alliances	(Lubatkin, 1983) (Singh et al., 1987)	12 Degree of integration	Alliances and acquisitions	(James et al., 1998) (Paine et al., 1984) (Mayer et al., 2004) (Jemison et al., 1986) (Nahavandi et al., 1988)
30 Technological uncertainty	Alliances	(Quelin, 2000) (Roberts et al., 2001) (Robertson et al., 1998; Walker et al., 1984)	47 Product time to market	Alliances and acquisitions		13 Management control	Alliances	(Eisenhardt, 1989)
31 Market uncertainty	Alliances	(Quelin, 2000) (Roberts et al., 2001) (Robertson et al., 1998)	49 Market share	Alliances	(Brush, 1996; Walter et al., 1990) (Mayer et al., 2004)	18 Trust	Acquisitions	(Eisenhardt, 1989) (Williamson, 1975) (Jemison et al., 1986) (Williamson, 1999)
32 Product uncertainty	Alliances	(Quelin, 2000) (Roberts et al., 2001)	53 Net gain	Alliances	(Trautwein, 1990)	33 Proximity	Alliances and acquisitions	(Ferrary, 2003) (Mayer et al., 2004)
38 Complementary product / technology	Alliances	(Shelton, 1988) (Mayer et al., 2004) (Wernerfelt, 1984)	54 Increase monopoly	Alliances	(Trautwein, 1990)	34 Degree of modularity	Alliances and acquisitions	(Gawer et al., 2002)

Causes			Consequences			Critical Success Factors		
39 Suplementary product / technology	Collaboration Alliances	<i>Cited by</i> (Shelton, 1988) (Wernerfelt, 1984)	58 Increase positioning	Collaboration Alliances and acquisitions	<i>Cited by</i> (Hopkins, 1987) (Walter et al., 1990) (Yip, 1982) (Gulati, 1999)	41 Degree of product relatedness	Collaboration Alliances	<i>Cited by</i> (Feeser et al., 1990) (Hopkins, 1987) (James et al., 1998) (Roberts et al., 2001) (Wernerfelt, 1984)
40 Substitute product / technology	Alliances and acquisitions	(Gawer et al., 2002)	59 R&D intensity	Alliances	(Hitt et al., 1991) (Hitt et al., 1996)	42 Compatible organizational culture	Alliances	(Jemison et al., 1986) (Mayer et al., 2004) (Datta, 1991) (Nahavandi et al., 1988)
44 Level of strategic asset	Acquisitions	(Hagedoorn et al., 2002) (Oliver, 1997) (Peteraf, 1993)	60 Increase acquisition & development	Alliances and acquisitions	(Mayer et al., 2004)	43 Compatible organizational objectives / strategy	Alliances	(Mayer et al., 2004)
48 Growth	Alliances and acquisitions	(Feeser et al., 1990) (Walter et al., 1990)	63 Acquisition intensity	Alliances and acquisitions	(Hitt et al., 1996) (Hitt et al., 1990)	50 Financial synergies	Alliances and acquisitions	(Trautwein, 1990) (Chatterjee, 1986) (Hoffman et al., 2001)
55 Empire building	Alliances and acquisitions	(Trautwein, 1990)	68 Learning by doing	Alliances	(Hoffman et al., 2001) (Pennings et al., 1994)	51 Operational synergies	Alliances	(Trautwein, 1990) (Chatterjee, 1986; James et al., 1998)
57 CEO's hubris	Alliances and acquisitions	(Hayward et al., 1997)	73 Penetrate new markets	Alliances	(Walter et al., 1990)	52 Managerial synergies	Alliances	(Trautwein, 1990)
66 Transaction cost	Alliances and acquisitions	(Teece, 1982) (Williamson, 1986) (Williamson, 1975) (Borys et al., 1989) (Eisenhardt, 1989) (Williamson, 1999) (Walker et al., 1984)				64 Strategic control	Alliances	(Hitt et al., 1996) (Hitt et al., 1990)

Causes / Critical Success Factors		
4 Complexity	Collaboration Alliances and acquisitions	<i>Cited by</i> (Jemison et al., 1986)
45 Strategic fit	Alliances and acquisitions	(Shelton, 1988) (Paine et al., 1984) (Mayer et al., 2004) (Jemison et al., 1986) (Wernerfelt, 1984)

Causes		
69 Resource endowment	Collaboration Alliances	<i>Cited by</i> (Hoffman et al., 2001) (Gulati, 1999)
72 Risk	Alliances	(Walter et al., 1990) (Roberts et al., 2001)
74 Social capital	Alliances	(Hoffman et al., 2001) (Geletkanycz et al., 1997) (Gulati, 1999)



Critical Success Factors		
65 Financial control	Collaboration Alliances	<i>Cited by</i> (Hitt et al., 1996) (Hitt et al., 1990)
70 Target firm relative size	Alliances and acquisitions	(Kusewitt, 1985) (Jemison et al., 1986) (Datta, 1991)

Consequences / Critical Success Factors			Causes / Consequences		
37 Technological performance	Collaboration Alliances	<i>Cited by</i> (James et al., 1998)	23 Resource dependency	Collaboration Alliances	<i>Cited by</i> (Pfeffer, 1972)
46 Experience in Alliances / Acquisitions	Alliances	(Haleblian et al., 1999) (Jemison et al., 1986) (Pennings et al., 1994)	25 Path dependency	Alliances and acquisitions	(Oliver, 1997) (Singh et al., 1987)
56 Efficiency	Alliances	(Trautwein, 1990) (Walter et al., 1990) (Williamson, 1999)	27 Technical complexity	Alliances	(Bettis et al., 1995)
61 Rate of internal innovation	Alliances	(Hitt et al., 1991) (Hitt et al., 1996) (Hitt et al., 1990)	62 R&D investment	Alliances	(Hitt et al., 1991)
71 Degree of portfolio competitiveness	Alliances	(Ferrary, 2003)	67 Risk sharing	Alliances	(Walter et al., 1990) (Roberts et al., 2001) (Lubatkin, 1983)



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references

Bettis, R. A., & Hitt, M. A. 1995. The new competitive landscape. Strategic Management Journal, 16: 7-19.

Borys, B., & Jemison, D. B. 1989. Hybrid arrangements as strategic alliances: Theoretical issues in organizational combinations. Academy of Management Review, 14(2): 234-249.

Brush, T. H. 1996. Predicted change in operational synergy and post acquisition performance of acquired businesses. Strategic Management Journal, 17: 1-24.

Cannella, A. A., & Hambrick, D. C. 1993. Effects of executive departures on the performance of acquired firms. Strategic Management Journal, 14: 137-152.

Chatterjee, S. 1986. Types of synergy and economic value: The impact of acquisitions on merging and rival firms. Strategic Management Journal, 7: 119-139.

Coff, R. W. 1997. Human assets and management dilemmas: Coping with hazards on the road to resource based theory. Academy of Management Review, 22(2): 374-402.

Datta, D. K. 1991. Organizational Fit and Acquisition Performance: Effects of Post-Acquisition Integration. Strategic Management Journal, 12: 281-297.

Duysters, G., & Man, A.-P. d. 2003. Transitory alliances: an instrument for surviving turbulent industries? R&D Management, 33(1): 49-58 (10 pp.).

Eisenhardt, K. M. 1989. Agency theory: An assessment and review. Academy of Management Review, 14(1): 57-74.

Feesser, H. R., & Willard, G. E. 1990. Founding strategy and performance: A comparison of high and low growth high tech firms. Strategic Management Journal, 11: 87-98.

Ferrary, M. 2003. Managing the disruptive technologies life cycle by externalizing the research: social network and corporate venturing in the Silicon Valley. International Journal of Technology Management, 25(1/2).

Galbraith, C. S., & Stiles, C. H. 1984. Merger strategies as a response to bilateral market power. Academy of Management Journal, 27(3): 511-524.

Gawer, A., & Cusumano, M. A. 2002. Platform Leadership: How Intel, Microsoft, and Cisco Drive Industry Innovation: Harvard Business School Press.

Geletkanycz, M. A., & Hambrick, D. C. 1997. The external ties of top executives: Implications for strategic choice and performance. Administrative Science Quarterly, 42(4): 654-681.

Gulati, R. 1999. Network location and learning: The influence of network resources and firm capabilities on alliance formation. Strategic Management Journal, 20: 397-420.

Hagedoorn, J., & Duysters, G. 2002. External sources of innovative capabilities: The preference for strategic alliances or mergers and acquisitions. Journal of Management Studies, 39(2).

Haleblian, J., & Finkelstein, S. 1999. The influence of organizational acquisition experience on acquisition performance: A behavioral learning perspective. Administrative Science Quarterly, 44(1): 29-56.

Hayward, M., & Hambrick, D. 1997. Explaining the premiums paid for large acquisitions: Evidence of CEO hubris. Administrative Science Quarterly(42): 103-127.

Hitt, M. A., Hoskisson, R. E., & Ireland, R. D. 1990. Mergers and acquisitions and managerial commitment to innovation in m-form firms. Strategic Management Journal, 11: 29-47.

Hitt, M. A., Hoskisson, R. E., Ireland, R. D., & Harrison, J. S. 1991. Effects of acquisitions on R&D inputs and outputs. Academy of Management Journal, 34(3): 693-706.

Hitt, M. A., Hoskisson, R. E., Johnson, R. A., & Moesel, D. D. 1996. The market for corporate control and firm innovation. Academy of Management Journal, 39(5): 1084-1119.

Hoffman, W. H., & Schaper-Rinkel, W. 2001. Acquire or ally? - A strategy framework for deciding between acquisition and cooperation. Management International Review, 41(2): 131-159.

Hopkins, H. D. 1987. Acquisition strategy and the market position of acquiring firms. Strategic Management Journal, 8: 535-547.

James, A. D., Georgiou, L., & Metcalfe, J. S. 1998. Integrating technology into merger and acquisition decision making. Technovation, 18(8/9).

Jemison, D. B., & Sitkin, S. B. 1986. Corporate acquisitions: A process perspective. Academy of Management Review, 11(1): 145-163.

Kusewitt, J. B. 1985. An exploratory study of strategic acquisition factors relating to performance. Strategic Management Journal, 6: 151-169.

Lubatkin, M. 1983. Mergers and the performance of the acquiring firm. Academy of Management Review, 8(2): 218-225.

Mayer, D., & Kenney, M. 2004. Economic action does not take place in a Vacuum: Understanding Cisco's acquisition and development strategy. Industry and Innovation, 11(4): 299.

Nahavandi, A., & Malekzadeh, A. R. 1988. Acculturation in Mergers and Acquisitions. Academy of Management Review, 13(1): 79-90.

Oliver, C. 1997. Sustainable competitive advantage: Combining institutional and resource based views. Strategic Management Journal, 18(9): 697-713.

Paine, F. T., & Power, D. J. 1984. Merger strategy: An examination of Druker's five rules for successful acquisitions. Strategic Management Journal, 5: 99-110.

Pennings, J. M., Barkema, H., & Douma, S. 1994. Organizational learning and diversification. Academy of Management Journal, 37(3): 608-640.

Peteraf, M. A. 1993. The cornerstones of competitive advantage: A resource-based view. Strategic Management Journal, 14: 179-191.

Pfeffer, J. 1972. Merger as a response to organizational interdependence. Administrative Science Quarterly, 17: 382-394.

Porter, M. 1980. Competitive Strategy: Free Press.

Prahalad, C. K., & Hamel, G. 1990. The core competence of the corporation. Harvard business review: 79-91.

Prahalad, C. K., & Hamel, G. 1994. Competing for the future. Boston: Harvard Business School Press.

Quelin, B. 2000. Core competencies, R&D management and partnerships. European Management Journal, 18(5): 476-487.

Roberts, E. B., & Liu, W. K. 2001. Ally or acquire? MIT Sloan Management Review.

Robertson, T. S., & Gatignon, H. 1998. Technology development mode: A transaction cost conceptualization. Strategic Management Journal, 19: 515-531.

Shelton, L. M. 1988. Strategic business fits and corporate acquisition: Empirical evidence. Strategic Management Journal, 9: 279-287.

Singh, H., & Montgomery, C. 1987. Corporate acquisition strategies and economic performance. Strategic Management Journal, 8: 377-386.

Teece, D. J. 1982. Towards an economic theory of the multiproduct firm. Journal of Economic Behavior and Organization, 3: 39-63.

Trautwein, F. 1990. Merger motives and merger prescriptions. Strategic Management Journal, 11: 283-295.

Walker, G., & Weber, D. 1984. A transaction cost approach to make-or-buy decisions. Administrative Science Quarterly, 29(3): 373-391.

Walter, G. A., & Barney, J. B. 1990. Management objectives in mergers and acquisitions. Strategic Management Journal, 11: 79-86.

Wernerfelt, B. 1984. A resource-based view of the firm. Strategic Management Journal, 5: 171-180.

Williamson, O. E. 1975. Markets and Hierarcies, analysis and anti-trust applications: A study in the economics of internal organizations. New York: Free Press.

Williamson, O. E. 1986. Transaction-cost economics: The governance of contractual relations. In J. B. Barney, & W. G. Ouchi (Eds.), Organizational Economics: 98-129: Jossey Bass.

Williamson, O. E. 1999. Strategy research: Governance and competence perspectives. Strategic Management Journal, 20: 1087-1108.

Yip, G. S. 1982. Diversification entry: Internal development versus acquisition. Strategic Management Journal, 3: 331-345.