Linkage between strategic alliances and firm's business strategy: the case of semiconductor industry

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Abstract

We have investigated the linkage between a firm's business strategy and its selection of alliance activities. Referring to two economic theories, resource-based theory and social exchange theory, we propose an analytical framework of alliance activities with attention to two factors: "resources to be exchanged" and "partners to exchange such resources". The alliance matrix is proposed as a tool to analyze strategic alliances, as it depicts the two factors defined above on the two-dimensional axes of the matrix. A firm's business strategy is categorized according to its growth strategy and propositions are defined to explain how firms undertake strategic alliances for the purpose of executing such business strategies. These propositions have been tested using the empirical data from the semiconductor industry. Our results indicate that firms are trying to utilize strategic alliances in order to execute specific business strategies.
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1. Introduction

This paper investigates the linkage between strategic alliances undertaken by firms and the characteristics of their business strategy. Strategic alliances have become central to competitive success in the fast changing global markets (Doz and Hamel, 1998). With tens of thousands of alliances reported worldwide in recent years, they are clearly one of the most important organizational forms to emerge in the past decade (Anand and Khanna, 2000). The dramatic increase of strategic alliance has been attributed to the strategic responses firms have made to various environmental changes, including accelerating technological innovation, increasing capital requirements, globalization of markets and the importance of customer relationships. Strategic alliances appear to have become indispensable measures for firms to carry out business strategy and may even determine a firm's potential for future growth. In analyzing alliance activities, it is important to take a view that focuses on the linkage between the alliance and the business strategies of the firms involved, as such strategies are distinctly reflected in alliance activities.

The many papers investigating strategic alliances published during the past several years have categorized research in this area into several streams such as:

- Formation of strategic alliances, which includes motivation, identification of inducing factors, and modeling of formation process (Das and Teng, 1998; Mahoney, 2001; Ahuja, 2001).
- Structure of strategic alliances, which includes comparisons of governance structures in equity-based and contract-based alliances, analysis of environmental effects of its preferable structure, and the correlation between structure and technology phases in alliance life cycles (Das and Teng, 2001; Roberts and Lu, 2001; Chen, 2003).
- Alliance management, which includes its learning effect, the role of alliance managers, and implication for effective alliance management (Spekman et al., 1996; Kumar and Andersen, 2000; Anand and Khanna, 2000).
- Factors contributing to the success of alliances, which include analyzing successful alliance, developing guidelines for success, and examining reasons for failure (Bleeke and Ernst, 1993; Douma et al., 2000; Hoffmann and Schlosser, 2001; Chen and Chen, 2002a).
- Performance of strategic alliances, which includes valuation using share price response, the process of performance evaluation, and analysis of the determinants of alliance

performance (Gersonys, 1996; Chan et al., 1997; Cravens et al., 2000; Gulati et al., 2000).

- Learning dynamism in strategic alliances, which includes inter-firm knowledge transfer, learning procedures, and knowledge protection in alliances (Mowery et al., 1996; Khanna et al., 1998; Norman, 2002).

In addition, there are studies on various aspects of strategic alliances, including motivation, formation, structure, performance, and management in a comprehensive manner. In analyzing such aspects, they apply certain theoretical frameworks, such as resource-based theory and social network theory (Gulati, 1998; Das and Teng, 2000; Ireland et al., 2002).

Although various aspects of strategic alliances have been studied in depth, as we have seen, the research approaches on strategic alliances in terms of linkage to a firm's business strategy are limited. Analysis of strategic alliances from this viewpoint is desirable, considering the increasing importance of utilizing other firm's resources in the current business environment. This paper attempts to study strategic alliances from this aspect, and proposes an analytical framework appropriate for that purpose. It also defines several propositions regarding the linkage between alliance activities and the firm's business strategy, categorizing such alliance activities on the basis of the proposed analytical framework. The propositions defined here have been tested by empirical research in the semiconductor industry.

Including this introduction, this paper has six sections. The second section proposes the analytical framework utilized in this study. Certain related theories are referred to, such as resource-based theory and social exchange theory. The third section provides propositions that are defined in accordance with the proposed analytical framework. The fourth section describes the research method to test the propositions. The fifth section discusses the research results and managerial implications of this study. The paper ends with some general conclusions and suggestions for future research.

2. Analytical framework

This section provides the analytical framework used in this study with reference to related economics theories. In analyzing strategic alliances from the aspect of linkage with firm's business strategy, resource-based theory provides useful insights. Resource-based theory views a firm as equivalent to the broad set of resources that it owns, with its competitive position being defined by its bundle of unique resources (Das and Teng, 2000). Resource-based theory has been used to analyze various aspects of corporate activities, such as developing new capabilities (Alvarez and Busenitz, 2001), creating competitive advantage (Tyler, 2001), and aiming for international growth (Andersen and Kheam, 1998). Resource-based theory is also utilized for the analysis

of strategic alliances. It sees them as strategies used to access other firm's resources, for the purpose of garnering otherwise unavailable competitive advantages and values. Based on this view, Das and Teng (2000) discuss four major aspects of strategic alliances, which are rationale, formation, structural preferences and performance. Peng (2001) also uses resource-based theory to discuss the primary motivation for firms to enter alliances. Because resource-based theory posits that a firm would select the strategy that best exploits their resources and capabilities relative to external opportunities (Grant, 1991), it is the most suitable means for considering alliance activities in terms of linkage with business strategy.

A strategic alliance is defined in the literature as "independently initiated inter-firm link that involves exchange, sharing or co-development": (Gulati, 1995), or "purposive strategic relationship between independent firms that share compatible goals, strive for mutual benefits, and acknowledge a high level of mutual dependence" (Mohr and Spekman, 1994). In accordance with the perspective of resource-based theory, strategic alliances can be viewed as exchange of resources between firms (Perks and Easton, 2000). Chen and Chen (2002b) distinguish between two kinds of strategic alliances: 'exchange alliances' and 'integration alliances'. They argue that the resources are exchanged and utilized independently by each partner in "exchange alliances", while "integration alliances" bring united resources in an organization designed by the partners to perform prescribed functions and to serve a common purpose understood by the partners. In this case, a firm expects to access resources from the other firm through creation of such an organization, and also provides the organization with its resources, as expected by the other firm. Accordingly, "integration alliances" can also be interpreted as exchange of resources between partners.

In viewing strategic alliances as an "exchange of resources" between partners, it would be useful to study the nature of the exchange by referring to social exchange theory. Social exchange theory was developed by Blau (1964) to explain social relations and forecast the outcome of their interactions with others. The theory is also applied to social networks, paying attention to the power of actors involved as the key feature of exchange relations and networks (Grembowski et al., 2002). For example, Chetty and Holm (2000) studied the dynamics of how firms develop networks and internationalize by reference to social exchange theory. Zhao and Reddy (1993) view technology transfers as an inter-organizational exchange and apply social exchange theory to show that both social and economic processes exert influences on eventual outcomes.

In social exchange theory, exchange phenomena can be categorized according to multiple dimensions. One categorization pays attention to the nature of subjects to be exchanged, such as exchange between homogeneous subjects or exchange between heterogeneous subjects. Another categorization pays attention to the people making

exchanges, such as exchange with the aim of creating relationship with specific person or exchange without any care of relationship as far as the subjects are exchanged (Kuji, 1984). These two dimensions give useful insight into the study of strategic alliances. Because strategic alliances are viewed as exchanges of resources with other firms, these two dimensions represent two essential factors of strategic alliance: "resources to be exchanged" and "partners to exchange such resources".

By analogy to the categorization of the social exchange theory, we categorize strategic alliances according to two different dimensions. In one dimension where attention is directed to the nature of resources, strategic alliances are categorized by whether or not the same kinds of resources are exchanged (a "symmetrical alliance") or different kinds of resources are exchanged (an "asymmetrical alliance"). In the other dimension, where attention is paid to the relationship of the partners, strategic alliances are categorized by whether or not the partners belong to the same industry (a "horizontal alliance") or to different industries (a "vertical alliance"). This approach is visualized by depicting a matrix with two axes, each of which corresponds to each of two dimensions as mentioned above. In other words, the vertical axis categorizes symmetrical alliance and asymmetrical alliance, while the horizontal axis categorizes horizontal alliance and vertical alliance. This establishes four zones, as shown in Fig. 1, and each specific strategic alliance is positioned in one of those zones. This matrix, we call it as an alliance matrix, provides a useful tool for analyzing strategic alliances.

The alliance matrix has several merits as a tool for analyzing strategic alliances. First, its vertical axis shows the relationship of the resources to be exchanged, which indicated the firm's intention as to what kind of resources is expected in the alliance. Firms enter into strategic alliances for specific reasons. They may want to learn technology from a partner or to strengthen a certain capability by combining it with the similar capability owned by a partner (Sorensen and Reve, 1998). The underlying strategies behind alliance activities can be successfully analyzed by observing the relationship of the resources to be exchanged.
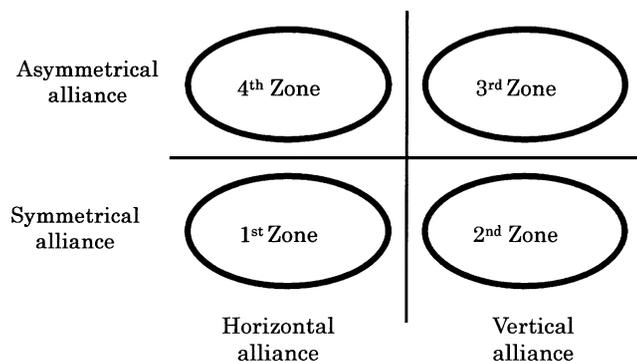

Fig. 1. Alliance matrix, which categorizes symmetrical alliance and asymmetrical alliance in the vertical axis, and horizontal alliance and vertical alliance in the horizontal axis.

Second, the horizontal axis shows the relationship of partners who exchange resources, indicating another aspect of the firm's intentions and the purpose of the alliance. A firm might enter an alliance to try to create a new market through collaboration with customers in a different industry (Oishi, 2002). Or it might want to try to strengthen its position in a current market by combining its efforts with those of a partner in the same industry. These strategies are clarified by observing the relationship of the partners. Third, the alliance matrix shows the two relationships described above in one space. Considering that the firms' strategies behind strategic alliances are most straightforwardly described in ways such as "what kind of resources are exchanged with which partners", the relationship of resources and that of partners are two essential elements in strategies for pursuing strategic alliances. By positioning each strategic alliance in each of the four zones of the alliance matrix, strategy behind their alliance activities is capably analyzed. Finally, as the matrix is two-dimensional, it is easily viewed. This gives visual expression to the outcome of analytical work.

3. Testable propositions

In the previous section, it was shown that the four zones of alliance matrix could be used to characterize the business strategy of firms undertaking strategic alliances. This means that each firm tends to focus on a specific zone of alliance matrix, depending on the characteristics of its strategy. The following looks in more detail at the characteristics of business strategies corresponding to each zone of the alliance matrix.

In characterizing business strategy, we use Ansoff's (1965) product-market expansion matrix. This classifies the alternative options for business growth that are central to strategy. Ansoff classified four types of growth strategies. (1) Product development, where growth is achieved by retaining a presence in the existing markets with new products. (2) Diversification, where growth is achieved by entering new markets with new products. (3) Market development, where growth is achieved by entering new markets with existing products. (4) Market penetration, where growth is achieved by staying in present markets with present products. In this way, a firm's business strategy is characterized as a combination of (a) new markets or existing markets, and (b) new products or existing products.

In penetrating new markets, it is useful to form alliances with customers, namely vertical alliances. When a firm is unfamiliar with a market, it faces the challenge of understanding appropriate products to develop and the methods to market them. Because customers know their market well, a firm can access market information and learn how to enter new markets through alliances with customers (Miotti and Sachwald, 2003). Customers may play the role of competence source for a firm in this situation

(Thomke and Hippel, 2002). On the other hand, a company looking to enhance competitiveness in a familiar market might well find it more effective to form alliances with partners in the same industry, namely horizontal alliances. For example, manufacturing joint ventures to reduce costs or sales alliance to expand channels are best done with partners in the same industry. Especially in high technology industries with turbulent competition and sweeping regulatory changes, the firms desire to develop horizontal alliances for offensive and defensive reasons in the existing markets (Perry et al., 2002).

Changing the viewpoint from markets to products, a firm is most concerned about development efficiency if its focus is on the development of new products. A single firm cannot afford to provide all the resources—engineering talent, intellectual property and capital, etc.—required for the development of a range of new products. Especially in situations where the development costs and technical uncertainties are high, firms need to reduce costs and risks through sharing resources, which enables them to meet development requirements (Yoshida, 2002). For this purpose, a firm and its partners are most likely to contribute and share similar resources with one another, which creates symmetrical alliances. On the other hand, if sales increase with the existing products is the goal, the firm's concern will be on how to strengthen the competitiveness of such products. A firm may ally with partners who are specialized in manufacturing, and consign product manufacturing to such partners as a means of cost reduction (Hsieh et al., 2002). A firm may also consign product sales to partners who have strong sales channels in a specific market, thereby enhancing the sales position of the products. In these alliances, where partners aim at inter-dependence among innovative processes, they will contribute complementary but different resources, creating asymmetrical alliances.

Based on the above observations, together with categorization of business strategy as a combination of (a) new markets or existing markets and (b) new products or existing products, the following propositions can be inferred.

Proposition 1. A firm with a product development strategy that stays in its existing markets with new products prefers horizontal, symmetrical alliances. Strategic alliances undertaken by such firms are most likely to be positioned in the first zone of the alliance matrix.

Proposition 2. A firm with a diversification strategy, entering new markets with new products, prefers vertical, symmetrical alliances. Strategic alliances undertaken by such firms are most likely to be positioned in the second zone of the alliance matrix.

Proposition 3. A firm with a market development strategy, entering new markets with existing products, prefers vertical, asymmetrical alliances. Strategic alliances

undertaken by such firm are most likely to be positioned in the third zone of the alliance matrix.

Proposition 4. A firm with a market penetration strategy, staying in existing markets with existing products, prefers horizontal, asymmetrical alliances. Strategic alliances undertaken by such firms are most likely to be positioned in the fourth zone of the alliance matrix.

4. Research method

The empirical study in this work is focused on the semiconductor industry. This is an industry characterized by extreme competition in price and product features, in which the ability to develop new technologies is central. All firms that hope to remain competitive must undertake substantial R&D (West and Iansiti, 2003). Huge capital investments are also required if firms are to stay at the leading edge of production (Hara, 2002). No firm in the industry can afford to meet all these requirements from its own resources, and it is necessary to acquire resources from partners through strategic alliances (Asakura, 2002). Because strategic alliances play a central role in the strategy for most firms, they are many and frequent. As a result, the semiconductor industry provides an ideal setting to test propositions about the linkage between strategic alliances undertaken by firms and the characteristics of their business strategy.

In this empirical study, the 10 largest firms in the industry were selected, using the sales ranking published by *IC Insights* (2002). There are a large number of players in the industry, from giants to small start-ups, and it is not appropriate to study the alliance activities of all firms. Considering that this study tries to carefully evaluate the business strategy of each firm and its linkage with alliance activities, it is more appropriate to select a specific number of influential firms and focus on them. The top 10 firms selected, in the order of sales, were Intel, Samsung, Texas Instruments, STMicroelectronics, Toshiba, Infineon, NEC, Motorola, TSMC (Taiwan Semiconductor Manufacturing Corporation) and Philips. The sales of these firms are shown in Table 1.

The main features of each firm's strategy are reviewed, using its most recent annual reports. Messages by CEO or other top management described in those annual reports discuss their most important strategic issues and their views on strategic options, including alliances. Extracting key words and phrases from those messages allows each company to be characterized in terms of Ansoff's growth strategy. For example, Intel emphasizes its efforts to pursue future opportunities in new areas beyond the PC market. It occupies a dominant position in microprocessor products, and finds growth potential in new markets, using the competitive position achieved by its existing products. This is expressed in the message of CEO, in sentiments such as:

Table 1
Sales revenue of top 10 semiconductor firms in the first half of 2002

Rank	Firm	Sales (in million dollars)
1	Intel	11,800
2	Samsung	3,885
3	TI	3,282
4	STMicro	2,885
5	Toshiba	2,875
6	Infineon	2,503
7	NEC	2,435
8	Motorola	2,309
9	TSMC	2,303
10	Philips	2,153

Source: IC Insights (2002).

"we believe that a long period of continued pervasive worldwide deployment of digital technologies is still ahead of us. To pursue these future opportunities, we have developed innovative product architectures in new areas beyond the PC" (Grove and Barret, 2001). Given this, Intel's growth strategy of existing products in new markets can be categorized as "market development". On the other hand, Samsung emphasizes its mission as the 'digital convergence revolution', which provides total solutions to customers through proliferation of its product portfolio. This is expressed in the CEO's message: "Our first task in this mission is to create an internal climate for innovation that encourages convergence and collaboration on the technical, product, and business levels" (Yun, 2001). Its strategy is to transform itself into a "digital e-company" capable of achieving its vision through innovation of new products for the existing markets, namely "product development".

STMicroelectronics puts its priority on the focus on specific new markets, as expressed in the following part of the CEO's message: "From the beginning, we have focused on specific market segments and applications that are benefiting greatly from strong trends in the market place". It tries to achieve this through creating innovative solution-oriented products, system-on-chip (SOC), suitable for such new markets. "The convergence era is a direct outgrowth of SOC, both requiring a broad range of capabilities including technology, system know-how, strategic alliances, and intellectual property portfolio" (Pistrio, 2001). In this way, STMicroelectronics strategy is characterized by its focus on new markets with new products, namely "diversification". TSMC has a unique feature in its strategy because of its dedication to a specific function, namely manufacturing with leading edge technology. This business model is called the foundry business, and the firm differentiates its competitive position by concentrating its resources on this function. The CEO's message is "Greater efforts will be devoted to establish a new semiconductor Virtually Integrated Value Chain that combines our silicon foundry expertise with the expertise of out customers, equipment

suppliers…" (Chang et al., 2001). It expresses the intention to further strengthen its competitive capability, with existing products in the existing markets, and use it as a leverage to enlarge its customer's base. This strategy is categorized as "market penetration".

In this way, all 10 firms are characterized with their business strategy based on Ansoff's category. They are summarized in Table 2, showing growth strategies and the key words from CEO's messages that characterize those strategies.

Strategic alliances undertaken by the 10 firms selected have been identified from the news database supplied by *IC Insights*. All alliances announced by the firms from January 1, 2000 through December 31, 2002, have been extracted, along with detailed information on the profile of the deals and the partners. Yoshino and Rangan (1995) exclude certain forms of inter-firm links from the definition of strategic alliances, such as licensing and M&A, because of their deficiencies in a certain strategic nature. As already discussed, we view strategic alliances as "exchange of resources between firms". In this study, our alliance cases cover a wide range of inter-firm link, including joint R&D, licensing, sourcing arrangement, joint marketing, and joint venture, as far as there exist exchanges of resources between firms.

A total of 509 strategic alliances were identified. Texas Instruments had the most, 87, while TSMC was the lowest, with 22. The number of alliance cases for each firm is shown in Table 3. By carefully evaluating the resources exchanged and the industry positioning of the alliance partner, each case is classified as (a) symmetrical alliance or asymmetrical alliance, and (b) horizontal alliance or vertical alliance. This allocates each case to one of the four zones of the alliance matrix, and we have 10 alliance matrices for the 10 selected firms, with all their alliance cases positioned in one of the four zones.

5. Research results and managerial implication

The results of the empirical research described in the previous section are summarized in Table 4. Each strategic alliance undertaken by the 10 selected firms is classified into one of the four zones of the alliance matrix, and the number is shown in the table. Considering the large difference in the number of cases among firms, it would be appropriate to show the ratio value (percentage) of cases positioned in each zone, for the purpose of comparing the case distribution in the alliance matrix. Table 5 shows such a ratio for each firm, and is useful as a means to recognize how alliance activities are focused in the alliance matrix. For example, it is recognized from this table that Intel's alliance activities are focused in the third zone, while Samsung's major focus is in the first zone.

As shown in the previous section, each firm's business strategy is characterized by its focus on a specific growth

Table 2
Growth strategies of the top 10 firms and key words from CEO's message

Firm	Growth Strategy	Key words from CEO's message
Intel	Market development	"A long period of continued pervasive worldwide deployment of digital technologies is still ahead of us. To pursue these future opportunities, we have developed innovative product architectures in new areas beyond PC" (Grove and Barret, 2001)
Samsung	Product development	"Our first task in this mission is to create an internal climate for innovation that encourages convergence and collaboration on the technical, product, and business levels" (Yun, 2001)
TI	Diversification	"Invest in the future, expanding technology leadership through aggressive R&D, and enhancing our capabilities to address the most promising end-equipment markets" (Engibous, 2001)
STMicro	Diversification	"From the beginning, we have focused on specific market segments and applications that are benefiting greatly from strong trends in the marketplace" (Pistrio, 2001)
Toshiba	Product development	"We will strengthen design technology and process development capabilities. We are also strengthening our product lines" (Okamura, 2002)
Infineon	Diversification	"With our range of core competencies and our system level integration abilities, we are in an extraordinarily strong position to create these exciting convergence technologies" (Schumacher, 2002)
NEC	Product development	"NEC is also pursuing a strategy designed to refocus resources on key business fields. It is focusing sharply on system LSIs, general purpose semiconductors, and compound semiconductor devices, the key devices used in optical communications systems" (Tosaka, 2002)
Motorola	Market development	"We are setting ambitious goals to ensure that Motorola is well positioned to take advantage of the resumption of strength in our marketplace" (Galvin and Breen, 2001)
TSMC	Market penetration	"Greater efforts will be devoted to establish a new semiconductor Value Chain that combines our silicon foundry expertise with the expertise of our customers, equipment suppliers" (Chang et al., 2001)
Philips	Product development	"Production outsourcing will allow us to still extract benefit… while we develop new cutting-edge technologies and products with the potential to deliver significantly higher margins" (Kleisterlee, 2001)

Table 3
Number of alliance cases for the selected 10 firms

	Intel	Samsung	TI	STMicro	Toshiba	Infineon	NEC	Motorola	TSMC	Philips
Cases	60	24	87	66	46	86	35	52	22	31

strategy categorized by Ansoff's product-market expansion matrix. We pay attention to the linkage between focus on a certain growth strategy and the firm's alliance activities, as characterized by the alliance matrix, for the purpose of testing the propositions. The type of growth strategy is captured by dummy variables PD (product development), DV (diversification), MD (market development), and MP (market penetration). Firms with a strategy of "product development", such as Samsung, take a value of 1 for PD and 0 for all others. Likewise, firms with a strategy of "diversification", such as STMicroelectronics, take a value of 1 for DV and 0 for all others. Firms with strategy of "market development", such as Intel, take a value of 1 for MD and 0 for all others, and firms with strategy of

Table 4
Number of alliance cases in each zone of alliance matrix

Zone	Intel	Samsung	TI	STMicro	Toshiba	Infineon	NEC	Motorola	TSMC	Philips
1	7	11	9	6	20	22	17	12	3	10
2	13	5	46	35	10	22	5	13	0	6
3	24	4	20	16	1	17	0	14	7	5
4	16	4	12	9	15	25	13	13	12	10
Total	60	24	87	66	46	86	35	52	22	31

Table 5
Ratio of alliance cases in each zone of alliance matrix

Zone	Intel (%)	Samsung (%)	TI (%)	STMicro (%)	Toshiba (%)	Infineon (%)	NEC (%)	Motorola (%)	TSMC (%)	Philips (%)
1	12	46	10	9	43	26	49	23	14	32
2	22	20	53	53	22	26	14	25	0	20
3	40	17	23	24	2	19	0	27	32	16
4	26	17	14	14	33	29	37	25	54	32
Total	100	100	100	100	100	100	100	100	100	100

"market penetration", such as TSMC, take a value of 1 for MP and 0 for all other variables.

In this way, each firm is assigned with values (1 or 0) for four dummy variables, PD, DV, MD and MP. We use Pearson's correlation model in which the correlation coefficients estimate the impact of the independent (dummy) variables on the ratio value of alliance cases allocated in each specific zone of alliance matrix. According to the model, the cut-off p-value is 0.05. Then, if there is a p-value less than 0.05 and a positive sign for the coefficient factor in the correlation between a certain independent (dummy) variable and a certain zone of alliance matrix, it supports the proposition that a firm with growth strategy corresponding to such variable is most likely to focus its alliance activities characterized by that zone of the alliance matrix.

Table 6 displays correlation coefficients and p-values as results of the correlation analysis. It has a high overall explanatory power, with a significant chi-square of 290.2 ($p = 0.000$). For the first zone of the alliance matrix, PD has a positive coefficient with a p-value (0.000) less than 0.05, and all other independent variables show no correlation. For the second zone of the alliance matrix, DV has a positive coefficient with a p-value (0.007) less than 0.05, and all other independent variables show no correlation. For the third zone of alliance matrix, MD has a positive coefficient with a p-value (0.081), which is slightly greater than 0.05, while PD has a negative coefficient with a p-value (0.007) of less than 0.05. All other independent variables show no correlation. For the fourth zone of alliance matrix, MP has a positive coefficient with a p-value (0.012) less than 0.05, and all other independent variables show no correlation.

The above results are summarized as follows: (1) PD has a strong correlation with the first zone, but no positive correlation with other zones. This supports Proposition 1, which insists on the linkage between a strategy of "product development" and the first zone of alliance matrix. PD also has a strong negative correlation with the third zone. The third zone is characterized by alliances with partners in a different industry, exchanging different resources. This type of alliance would be effective for creating new markets, however would be inefficient measure for developing products because of the difficulty in matching product related resources between such partners. This may be one reason for the negative correlation between PD and the third zone. (2) DV has a strong correlation with the second zone, but no correlation with other zones. This supports

Proposition 2, which insists on linkage between "diversification" strategy and the second zone of the alliance matrix. (3) MD has a weak correlation with the third zone, but no correlation with other zones. This provides weak support for Proposition 3, which insists on the linkage between "market development" strategy and the third zone of the alliance matrix. (4) MP has a strong correlation with the fourth zone, but no correlation with other zones. This supports Proposition 4, which insists on linkage between "market penetration" strategy and the fourth zone of the alliance matrix.

We have tested four propositions through empirical research in the semiconductor industry, and validated all of them except for the third. Considering that the third proposition is also weakly supported by the test, we are confident that the analytical approach used for defining the propositions is justified. Validation of the propositions produced a number of merits. First of all, it provides evidence of linkage between a firm's business strategy and the characteristics of alliance into which it enters. This helps us to understand each specific case of an alliance in connection with the firm's strategic business objectives. This solves the problem of placing an undue emphasis on the alliance outlook, overlooking the strategic reasoning behind it. Secondly, using the validated propositions, we can identify the firm's fundamental business strategy by evaluating the characteristics of alliance activities with the alliance matrix. This is a useful approach in analyzing the competitiveness of firms in the industry, through allocating each case of a firm's alliance activities in the alliance matrix. Thirdly, the effectiveness of alliance matrix as a tool of analysis is affirmed. Because the propositions are founded on the framework of the alliance matrix, the validation of

Table 6
Results of correlation analysis

	First zone	Second zone	Third zone	Fourth zone
PD	0.897	−0.344	−0.785	0.117
	0.000	0.330	0.007	0.747
DV	−0.509	0.785	0.112	−0.518
	0.133	0.007	0.758	0.125
MD	−0.304	−0.065	0.577	−0.113
	0.394	0.859	0.081	0.756
MP	−0.282	−0.551	0.342	0.750
	0.430	0.099	0.333	0.012

Upper number: correlation coefficient (R^2), Lower number: p-value.

such propositions with empirical data enhances the confidence level of this analytical framework.

6. Conclusions and future research

In this paper, we have investigated the linkage between a firm's business strategy and its selection of alliance activities. Referring to two economic theories, resource-based theory and social exchange theory, we propose an analytical framework of alliance activities with attention to two factors: "resources to be exchanged" and "partners to exchange such resources". The alliance matrix is proposed as a tool to analyze strategic alliances, as it depicts the two factors defined above on the two-dimensional axes of the matrix. A firm's business strategy is categorized according to its growth strategy, as shown in Ansoff's product-market expansion model, and propositions are defined to explain how firms undertake strategic alliances for the purpose of executing such business strategy. The alliance matrix is the basis of these propositions, in which alliance activities positioned in each of its zones are understood to embody each corresponding category of the firm's growth strategy. These propositions have been tested using the empirical data from the semiconductor industry.

Our results show that our propositions except for one (Proposition 3) are strongly supported, which indicates that the firms are trying to utilize strategic alliances in order to execute specific business strategies. Our findings of the linkage between firm's business strategy and its selection of alliance activities provide a new aspect of analysis for strategic alliances, and are also useful for a firm's planning of alliance activities as a measure of achieving their business objectives. An additional interesting finding in our study is that there is one strong negative correlation between certain categories of business strategy and alliance activities (product development strategy and the third zone of alliance matrix). This suggests that certain "undesirable" characteristics of alliance activities have an adverse impact on the execution of specific business strategy. Although we need further evaluation of this linkage, this would also have important implications for avoiding negative elements in alliance activities.

One missing factor in our study is the role of equity ownership in alliance activities. There are several studies that focus on the analysis of equity-based alliances vs. contract-based alliances. Narula and Hagedoorn (1999) discuss the growing use of non-equity alliances, which appear to be a superior means of undertaking technological developments in high technology and fast evolving sectors. On the other hand, firms in international alliances have tended to prefer equity agreements, because it is much harder to secure legal resources without equity ownership. They argue that a firm's choice of equity vs. non-equity alliances is related to its strategic reasoning on alliances. Selection of equity vs. non-equity alliances is also discussed in relation to the complexity of environmental elements and various characteristics of partners (Chen, 2003), as well as the risk factors in a prospective alliance (Das and Teng, 2001). In this way, "equity or non-equity" provides another key factor for characterizing the strategic reasoning behind alliances. This factor will be incorporated in a future study to investigate the linkage between a firm's business strategy and its selection of alliance activities. Our proposed analytical tool of the alliance matrix will also be improved to incorporate this factor, in order to support investigation of such future themes.

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References

Ahuja, G., 2001. The duality of collaboration: inducements and opportunities in the formation of interfirm linkages. Strategic Management Journal 21, 317–343.

Alvarez, S.A., Busenitz, L.W., 2001. The entrepreneurship of resource-based theory. Journal of Management 27, 755–776.

Anand, B., Khanna, T., 2000. Do firms learn to create values? The case of alliances. Strategic Management Journal 21, 295–316.

Andersen, O., Kheam, L.S., 1998. Resource based theory and international growth strategies: an exploratory study. International Business Review 7, 163–184.

Ansoff, H.I., 1965. Corporate Strategy, McGraw-Hill, New York.

Asakura, H., 2002. Business performance is in a deficit as a whole: organization strength to be turned into an advantage. Nikkei Microdevices 204, 62–69.

Blau, P.M., 1964. Exchange and Power in Social Life, Wiley, New York.

Bleeke, J., Ernst, D., 1993. Collaborating to Compete, John Wiley & Sons, New York.

Chang, M., Tseng, F.C., Tsai, R., 2001. Letter to the shareholders. In: 2001 Annual Report. TSMC Corporation, Hsinchu.

Chan, S.H., Kensinger, J.W., Keown, A.J., Martin, J.D., 1997. Do strategic alliances create value? Journal of Financial Economics 46, 199–221.

Chen, C.J., 2003. The effects of environment and partner characteristics on the choice of alliance forms. International Journal of Project Management 21, 115–124.

Chen, H., Chen, T.J., 2002aa. Asymmetric strategic alliance: a network view. Journal of Business Research 55, 1007–1013.

Chen, H., Chen, T.J., 2002bb. Governance structure in strategic alliances; transaction cost versus resource-based perspective. Journal of Worldwide Business 129, 1–12.

Chetty, S., Holm, D.B., 2000. Internationalization of small to medium sized manufacturing firms: a network approach. International Business Review 9, 77–93.

Cravens, K., Piercy, N., Cravens, D., 2000. Assessing the performance of strategic alliances: matching metrics to strategies. European Management Journal 18(5), 529–541.

Das, T.K., Teng, B.S., 1998. Resource and risk management in the strategic alliance making process. Journal of Management 24(1), 21–42.

Das, T.K., Teng, B.S., 2000. A resource-based theory of strategic alliances. Journal of Management 26, 31–61.

Das, T.K., Teng, B.S., 2001. A risk perception model of alliance structuring. Journal of International Management 7, 1–29.

Doz, Y.L., Hamel, G., 1998. Alliance Advantage, Harvard Business School Press, Boston.

Douma, M.U., Bilderbeek, J., Idenburg, P.J., Looise, J.K., 2000. Strategic alliances: managing the dynamic of fit. Long Range Planning 33, 579–598.

Engibous, T.J., 2001. To our stockholders. In: 2001 Annual Report. Texas Instruments, Dallas.

Galvin, C.B., Breen, E.D., 2001. To our stockholders and other friends. In: 2001 Annual Report. Motorola Inc., Schaumburg.

Gersonys, N., 1996. Sectoral effects on strategic alliance performance for new technology firms. The Journal of High Technology Management Research 7(2), 175–189.

Grant, R.M., 1991. Resource based theory of competitive advantage: implications for strategy formulation. California Management Review Spring, 114–135.

Grembowski, D.E., Cook, K.S., Patrick, D.L., Roussel, A.E., 2002. Managed care and the US health care system: a social exchange perspective. Social Science and Medicine 54, 1167–1180.

Grove, A.S., Barret, C.R., 2001. Letter to our stockholders. In: 2001 Annual Report. Intel Corporation, Santa Clara.

Gulati, R., 1995. Does familiarity breed trust? The implications of repeated ties for contractual choice in alliances. Academy of Management Journal 38, 85–112.

Gulati, R., 1998. Alliance and networks. Strategic Management Journal 19, 293–317.

Gulati, R., Nohria, N., Zaheer, A., 2000. Strategic networks. Strategic Management Journal 21, 203–215.

Hara, Y., 2002. IBM partners for consumer SOI development. Electronics Engineering Times 4/8, 6.

Hsieh, Y.C., Lin, N.P., Chiu, H.C., 2002. Virtual factory and relationship marketing: a case study of Taiwan semiconductor manufacturing company. International Journal of Information Management 22, 109–126.

Hoffmann, W.H., Schlosser, R., 2001. Success factors of strategic alliances in small and medium sized enterprises: an empirical study. Long Range Planning 34, 357–381.

IC Insights, 2002. First half 2002 top 10 semiconductor ranking (7/23). Scottsdale.

Ireland, R.D., Hitt, M.A., Vaidyanath, D., 2002. Alliance management as a source of competitive advantage. Journal of Management 28, 413–446.

Khanna, T., Gulati, R., Nohria, N., 1998. The dynamics of learning alliances: competition, cooperation and relative scope. Strategic Management Journal 19, 193–210.

Kleisterlee, G., 2001. Dear shareholder. In: 2001 Annual Report. Royal Philips Electronics, Eindhoven.

Kuji, T., 1984. Exchange Theory and Sociology, Shinsen-sha, Tokyo.

Kumar, R., Andersen, P.H., 2000. Inter firm diversity and the management of meaning in international strategic alliances. International Business Review 9, 237–252.

Mahoney, J.T., 2001. A resource-based theory of sustainable rents. Journal of Management 27, 651–660.

Miotti, L., Sachwald, F., 2003. Co-operative R&D: why and with whom? An integrated framework of analysis. Research Policy 1607, 1–19.

Mohr, J., Spekman, R., 1994. Characteristics of partnership success. Strategic Management Journal 15, 135–152.

Mowery, D.C., Oxley, J.E., Silverman, B.S., 1996. Strategic alliances and interfirm knowledge transfer. Strategic Management Journal 17, 77–91.

Norman, P.M., 2002. Protecting knowledge in strategic alliances: resource and relational characteristics. Journal of High Technology Management Research 13, 172–202.

Narula, R., Hagedoorn, J., 1999. Innovating through strategic alliances: moving towards international partnerships and contractual agreements. Technovation 19, 283–294.

Oishi, M., 2002. A succession of chip manufacturers announce relationship with Sony and Matsushita. Nikkei Electronics 821, 59–68.

Okamura, T., 2002. Regeneration of Toshiba. In: 2002 Annual Report. Toshiba Corporation, Tokyo.

Peng, M.W., 2001. The resource-based view and international business. Journal of Management 27, 803–829.

Perks, H., Easton, G., 2000. Strategic alliances: partner as customer. Industrial Marketing Management 29, 327–338.

Perry, M.L., Sengupta, S., Krapfel, R., 2002. Effectiveness of horizontal strategic alliances in technologically uncertain environments: are trust and commitment enough? Journal of Business Research 5871, 1–6.

Pistrio, P., 2001. Message from the president. In: 2001 Annual Report. STMicroelectronics, Geneva.

Roberts, E., Lu, W.K., 2001. Ally or acquire? How technology leaders decide. MIT Sloan Management Review Fall, 26–34.

Schumacher, U., 2002. Letter to the shareholders. In: 2002 Annual Report. Infineon Technologies, Munich.

Sorensen, H.B., Reve, T., 1998. Forming strategic alliances for asset development. Scandinavian Journal of Management 14(3), 151–165.

Spekman, R.E., Isabella, L.A., MacAvoy, T.C., Forbes, T. III, 1996. Creating strategic alliances which endure. Long Range Planning 29(3), 346–357.

Thomke, S., Hippel, E.V., 2002. Customers as innovators. Harvard Business Review 80(4), 74–81.

Tosaka, K., 2002. NEC electron devices. In: 2002 Annual Report. NEC Corporation, Tokyo.

Tyler, B.B., 2001. The complementarity of cooperative and technological competencies: a resource based perspective. Journal of Engineering and Technology Management 18, 1–27.

West, J., Iansiti, M., 2003. Experience, experimentation, and the accumulation of knowledge: the evolution of R&D in the semiconductor industry. Research Policy 32, 809–825.

Yoshida, J., 2002. Three forge R&D team in France. Electronics Engineering Times 4/8, 8.

Yoshino, M.Y., Rangan, U.S., 1995. Strategic Alliances: an Entrepreneurial Approach to Globalization, Harvard Business School Press, Boston.

Yun, J.Y., 2001. Dear customers, partners, and shareholders. In: 2001 Annual Report. Samsung Electronics, Seoul.

Zhao, L., Reddy, N.M., 1993. Managing international technology transfer negotiation: a social exchange perspective. Technovation 13(6), 383–397.

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