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Strategic alliances influence on small and medium firm performance

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Abstract

This study examines whether the new ventures success of small and medium enterprises (SMEs) in the biotech industry relates with the characteristics of strategic alliances. The study advances a research conceptual framework. Using sampling data gathered from 189 Taiwan biotech firms through a benchmarking questionnaire, the study tests six hypotheses employing structural equations. The findings are generally consistent with the literature. The study supports all hypotheses. Consequently, the results show that strategic alliances improve SMEs' new venture success. This research provides managerial implications for both entrepreneurs and managers and some suggestions for future research.

Keywords: SMEs; Biotech new venture; Strategic alliance

1. Introduction

The emergence of biotechnology constitutes a radical innovation that breaches the barriers of entry into the pharmaceutical industry, among other industries (Pisano, 1990). Since the early 1970s, about 1600 new biotech firms have emerged to commercialize this technological breakthrough. Extensive inter-firm cooperation characterizes the commercialization of biotechnology. Indeed, the biotech industry has been identified as the industry with the highest alliance frequency among several industries of high alliance activity (Hagedoorn, 1993).

In the biotech industry, strategic alliances extend worldwide. Mowery and Rosenberg (1989) define strategic alliances as a vehicle for the diffusion of technological knowledge that can contribute to firm success. Alliances play increasingly important roles in drug discovery and development, not only complementing companies' internal technology and competencies, but also providing partners with access to pipeline products and capital. The collaboration between Millennium Pharmaceuticals and Bayer HealthCare AG, together creating one of the world's largest pharmacy/biotech alliances exemplifies this cooperation (Ziegelbauer and Farquhar, 2004).

The biotech industry offers the advantages of powerful market potentiality and long product life cycle, as well as the disadvantages of huge investment expenditure, time-span R&D, high risk, huge patents fee and complicated regulations/laws. In light of this balance, strategic alliances may be a faster way to help firms successfully enter into specific market domains and acquire complementary resources. As suggested by resource-based theory, the decision to choose alliance partners is predicated on mutual benefit, mutual potential to provide additional resource value of R&D, manufacturing and/or marketing. Inter-firm alliances have the ability to alter the opportunities and constraints faced by potential entrepreneurs (Kogut et al., 1992).

Market access is usually a major motivation for licensors to seek strategic alliances. Nevertheless, the need for risk reduction of commercialization within the biotech industry may be a more important reason for strategic alliances. McCutchen and Swamidass (2004) find that the third of the licensees are small firms in the biotech industry, not large firms. They also indicate that small biotech firms seeking strategic alliances were more likely to be motivated by R&D time-span reduction than larger firms.

Barley et al. (1992) propose that small and medium enterprises (SMEs) in the biotech industry need the capital and downstream capabilities that larger firms possess, such as expertise to deal with regulatory bodies, competence to develop timely clinical testing, ability to scale up the manufacturing of a product for large quantities, and established marketing and

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distribution capabilities. Sometimes alliances that require small biotech firms yield some of their autonomy and offer the larger firms an additional source of new products or expertise in a much quicker time frame than in-house product development efforts (Pisano, 1990). The literature on the biotech industry has noted that there are many vital differences between small biotech firms engaged in R&D and larger biotech firms that purchase R&D services from smaller firms (McCutchen and Swamidass, 1994).

As compared with Japanese, American, and European firms, most Taiwan manufacturers are smaller in size. Concurrently, investment in Taiwan biotech industry projects has increased yearly and individual companies now make greater efforts to develop biotech R&D. Despite this expanded effort, it remains unclear if the commercialization of Taiwan's biotech products has been successful. Limited resources compel Taiwan's biotech firms to choose strategic alliance integrating technological resources with partners.

This study examines whether the new ventures success of SMEs in the biotech industry relates with the characteristics of strategic alliances. Specifically, it endeavors to ascertain how alliance characteristics are associated with firm success. This study defines SMEs in the biotech industry as those generating under USD 10 million in annual revenue.

2. Literature review and hypotheses

2.1. Partners' technical capacities and new venture success

Reuber and Fischer (1997) find that, in the early phase of entering international markets, firms gather more information about foreign markets through international strategic partners. Biotech firm's survival depends almost exclusively on proprietary knowledge. However, they are generally not inclined to provide detailed R&D information to potential alliance partners. One consequence is that potential alliance partners may not accurately evaluate the firms' potential for product commercialization success. At the same time, if biotech firms disclose detailed R&D information, this may create new potential competitors who have gained specific patent knowledge from them. This dilemma is called "Arrow's paradox" (Arrow, 1962). Similarly, Lee and Burrill (1994) suggest that biotech firms attempt to enhance cutting-edge scientific R&D with resources from potential partners, but partners may hesitate to cooperate because they lack sufficient information to evaluate the scientific and commercializing capabilities of biotech firms. As biotech firms have few commercialized products and little sales revenue, potential alliance partners have difficultly ascertaining their actual strength (Coombs and Deeds, 2000).

Coombs and Deeds (2000) propose that three signaling mechanisms – scientific knowledge, firm location, and top management team's (TMT) international experience – can overcome information asymmetries, as well as aid the evaluation of a potential alliance partner's resource-base and product commercialization capacity. Three indexes of scientific knowledge are R&D expenditures/intensity, patents held and products in the pipeline. Knowledge is a key foundation of competitive advantage in science-based industries (Grant, 1996). The flow of knowledge among alliance participants determines their structure/management and in turn, influences their success (George et al., 2001). Coombs and Deeds (2000) find that the firm location is positively related to the amount of foreign alliance capital received. The hot spot in which a biotech firm is embedded provides a signal to potential foreign venture partners, and some important research will be done on the hot spot. Sambharya (1996) reports that the relative time of experience in overseas investment, experience homogeneity and the proportion of TMT with international experience are significantly related to the percentage of the firm's foreign sales and assets. Here, the term "technical capacities" indicates scientific knowledge, firm location, and TMT international experience — key factors of affecting technological innovation in new ventures. Hence,

Hypothesis 1. The technical capacities of alliance partners positively and significantly influence the success of biotech new ventures.

Biggadike (1979) mentions that, in the period of concept development, evaluation criteria include an index of survival, new product development, and satisfaction in proceeding business. In the commercialization period, upgrading brand awareness and sales growth are more important than survival. In the growth period, market share, cash flow and productivity are the core indexes for evaluating the success of a new venture. Finally, in the stability period, profit, market share, productivity, internal performance, and future development are the key factors determining new venture success (Zahra, 1996).

In accord with the literature noted above, evaluation of the success of a new venture uses the two observed variables of new product development (NPD) performance and commercial success. According to Cooper and Kleinschmidt (1995), this study proposes four criteria to benchmark the firm's NPD performance: (1) success rate of new product (NP); (2) technical success rating of NPD program; (3) the rated profitability of the company's NP program (over the previous 3 years) relative to how much was spent on it; and (4) NP success in meeting business objectives. Concurrently, this study proposes four criteria to benchmark the firm's commercial success: (1) impact of NP program on sales; (2) impact of NP program on profits; (3) NP success in meeting sales/profits objectives; and (4) profitability of NP program relative to competitors.

In addition, firm size also influences strategic alliance performance (Simonin, 1997). By effectively managing attractive and generative alliance partnerships, biotech firms can easily acquire and utilize new knowledge and upgrade their competitive advantage. This study uses "firm size" as a control variable. Firm size is measured in terms of employees and revenues.

2.2. Alliances structure and absorptive capacity

As many scholars and industry observers note, the appropriation regime surrounding biotechnological patents is unusually strong because the patented compounds are difficult to circumvent (Lerner and Merges, 1998). Baum et al. (2000) find that incumbents' horizontal alliances depress start-ups whereas vertical alliances stimulate start-ups in the Canadian biotech industry. They also advance that an incumbent biotech firm's patenting (an index of property rights) and alliance building (both a firm-level resource acquisition and industry-level integration mechanism) can deflect competition and influence rates of founding in the Canadian biotech industry.

George et al. (2001) address two characteristics of the alliance portfolio: structure and knowledge flow. The "structure" refers to whether an alliance is completed with a firm at the same level of the value chain (horizontal) or at a different level (vertical). Alliance structures, whether horizontal or vertical, are associated with varying degrees of innovativeness (Hagedoorn, 1993; Kotabe and Swan, 1995). There are several classes of alliances — horizontal ones with other biotech firms operating in the same sector(s) as the local firm, vertical (downstream) ones with pharmaceutical firms, chemical firms and marketing firms, and vertical (upstream) ones with universities, research institutes, government labs, hospitals and industry associations (Baum et al., 2000). George et al. (2001) also suggest that alliance characteristics designated by structure (horizontal or vertical alliances) and knowledge flow (generative or attractive) are related to the firm's absorptive capacity (ability to value and apply knowledge).

Lane and Lubatkin (1998) attempt to apply the concept of absorptive capacity to the learning process between alliance partners. They indicate that the relationship between absorptive capacity and the characteristic of strategic alliance was a dyadic construct called "relative absorptive capacity". It includes the ability to (1) recognize and value new external knowledge, (2) internalize new external knowledge, and (3) commercialize new external knowledge. George et al. (2001) recognize absorptive capacity as a combination of the ability to value knowledge and the ability to apply knowledge. They also indicate that alliance portfolio characteristics and absorptive capacity jointly influence performance, as indicated by a sample of 2456 alliances formed by 143 biopharmaceutical firms.

However, the structure of alliances can influence the development of the performance-enhancing capacities that exceed the development of a firm's absorptive capacity (Powell, 1998). Lane and Lubatkin (1998) indicate that the structure of alliances have a greater effect on firm performance than can be explained by absorptive capacity. They also suggest that horizontal alliances are likely to give the firm access to multiple types of knowledge. On the other hand, vertical alliance may provide access for biotech firms to commercialize their products or innovations, and meanwhile, increase speed to market as biotech firm frequently ally with larger pharmaceutical firms. This study attempts to observe such findings.

Hypothesis 2. The structure of strategic alliances positively and significantly influences the counterparts' absorptive capacity.

Hypothesis 3. The structure of strategic alliances positively and significantly influences the success of biotech new ventures.

Part of this process lies in the specific abilities of a firm, whereas part is accumulated from network embeddedness that is difficult to buy or acquire from the market. Innovation and productivity (Mowery et al., 1998), cooperative inter-organizational learning (Lane and Lubatkin, 1998), and practical intra-firm knowledge transfer (Szulanski, 1996) all widely utilize the concept of absorptive capacity.

Cohen and Levinthal (1990) identify absorptive capacity as a firm's ability to recognize the value of new external information and then assimilate this value in commercialization. They propose three constructs (evaluation, internalization, application) to evaluate absorptive capacity in researching 1719 SBUs of manufacturers. Kim (1998) indicates that absorptive capacity is formed from a prior knowledge base and intensity of effort. Lane et al. (2001) also argue that absorptive capacity is related to understanding, internalization, and application based on the data of 78 international joint ventures. Following to Zahra and George (2002), this analysis classifies the absorptive capacity into the four dimensions of acquisition, assimilation, conversion and exploitation; the former two imply potential absorptive capacity and the later two represent realized absorptive capacity.

2.3. Alliances type and new ventures success

Rothaermel (2001) investigating 889 strategic alliances of pharmaceutical companies and new biotech firms, finds that an incumbent's alliances with providers of new technology were positively associated with the incumbent's NPD, as well as that NPD was also significantly related to firm performance. Exploration alliances launch with the intent to discover something new, focused on the "R" in the R&D process (Koza and Lewin, 1998a,b). Rothaermel and Deeds (2004) link the exploration–exploitation framework of organizational learning to a technology venture's strategic alliances and argue that the causal relationship between the venture's alliance and its new product development depends on the type of the alliance. They also propose that a product development path begins with exploration alliances predicting products in development, which in turn predicted exploitation alliances, and concluded with exploitation alliances leading to products on the market.

Hypothesis 4. The type of strategic alliance positively and significantly influences the success of biotech new ventures.

2.4. Alliances partners' relationship and new ventures success

In his theory of social exchange, Blau (1964) proposes two main concepts of trust and commitment; the consequence of the social exchange process based on mutual interest was to produce appreciation, responsibility, and trust. Powell et al. (1996) indicate that the most basic factor of inter-organizational cooperation and innovation in the network of biotech industry was mutual interest. Doney and Cannon (1997) suggest that the most important factor for establishing a partners relationship was "trust"; the higher the ability and confidence of alliance partners, the higher the reliability of alliance partners in the exchange process. Mohr and Spekman (1994) also consider trust as an important attribute, as well as a determinant factor in affecting the success of a partner relationship. As for the measure of trust, Young-Ybarra and Wiersema (1999), in research on information technology alliances, propose that the overall extent of trust might influence cooperative behavior.

Homans (1958) argues that communication may establish a better relationship for exchange between partners. Lee and Kim (1999) also indicate that efficient communication between partners was a crucial factor in accomplishing a common goal. Dwyer et al. (1987) suggest that a good working relationship might not form if there was no good communication between buyer and seller. Regarding the correlation of communication and trust, Etgar (1979) finds that immediate communication can increase the degree of trust and decrease the conflict between the alliance partners. Anderson et al. (1994) and Anderson and Narus (1990) also find that good communication can produce closer trust. Morgan and Hunt's (1994) relationship marketing study proposes that communication will significantly and positively influence "trust". Lane and Lubatkin (1998) indicate that the extent of alliance members' reactions will affect the performance of knowledge/technology transfer. As for the criteria of communication, Young-Ybarra and Wiersema (1999) and Sivadas and Dwyer (2000) use the communication quality of cooperative partners.

Kauser and Shaw (2001) find that in international alliance coordination, commitment, trust and communication were predictable factors of strategic alliance success. Dwyer et al. (1987) argues that establishing a relationship exchange needs a combination of communication and coordination. Sivadas and Dwyer (2000) propose that the measure of "coordination" reveals the extent of co-working toward the alliance goal. Morgan and Hunt (1994) identify shared value as the combination of common behavior, goal, and policy between partners. Heide and John (1992) recognize that shared value was the norm. Dwyer et al. (1987) propose that shared value would play an importance in contributing to organizational commitment and trust. Therefore, in organizational theory the shared value was a variable of organizational commitment (Chatman, 1991). Morgan and Hunt (1994) verify that shared value will influence trust and commitment. Accordingly, this study proposes the following hypotheses.

Hypothesis 5. The relationship of alliance partners positively and significantly influences the success of biotech new ventures.

2.5. Absorptive capacity and new ventures success

Van den Bosch et al. (1999) argue that the key factors of absorptive capacity not only include relative pre-knowledge level, but also cover organizational form and combinative capabilities. Absorptive capacity is recognized as a new creative value from the combination of pre-knowledge base and external knowledge from outside. Baum et al. (2000) researching the relationship between biotech firms' new venture success and inter-organizational alliances, find that strategic alliances are an important means of accessing or transferring new knowledge and improve new innovative performance.

Success in science-based industries requires that a firm develop and hone its capabilities (Bogner et al., 1996).

Absorptive capacity is considered to be a set of capabilities, such as the ability to value, assimilate, and apply knowledge (Grandstrand and Sjolander, 1990). Gassel and Pascha (2000) find that cooperation in the biotech field primarily aims at gaining access to scientific resources and commercial success; it is an interactive "give and take" in order to combine both partners' strengths. Hence,

Hypothesis 6. The counterparts' absorptive capacity of strategic alliance positively and significantly influences the success of biotech new ventures.

3. Method

3.1. Factor analysis and reliability measures

This study uses factor analysis to better define the dimensions of six constructs: alliance partner characteristics, alliances structure, alliances type, alliance partner relationship, and absorptive capacity, and new ventures success. Hair et al. (1992) demonstrate that the general purpose of factor analytic techniques is to condense (summarize) the information contained in a number of original variables into a smaller set of new, composite dimensions or variates (factors) with minimum information loss — a process that involves searching for and defining the fundamental constructs or dimensions assumed to underlie the original variables. To identify the latent dimensions or constructs represented in the original variables and eliminate variance, this study uses factor analysis to extract these factors. Specifically, this study adopts Varimax rotated component analysis. Factor loadings are the correlation of each variable and a given factor. Loadings indicate the degree of correspondence between the variable and the factor, with higher loadings indicating that the variable is representative of the factor. These factors are named appropriately based on the subjective opinion of our research and hypotheses. Variables with higher loadings have a greater influence on the name or label that represents a factor. This analysis identifies these using eigenvalues larger than one and factor loading of each item is more than 0.5. Table 3 shows results.

In this study, the method of reliability measurement is Cronbach's coefficient α. Cronbach's coefficient α is calculated for each of these factors to assess the internal consistency of the model constructs. According to Price and Mueller (1986), a standard coefficient α of 0.60 or higher generally is considered acceptable when using a measure. If statistical significance is not achieved, the research may need to eliminate the indicator or attempt to transform it for better fit with the construct. However, the values of Cronbach's coefficient α of latent variables and observed variables all exceed 0.80 and that of some constructs even exceed 0.90. This indicates that the research has good consistency and stability (see Table 1). In addition, content validity should be relatively acceptable because this part of the question items is adapted from existing literature and also is reviewed closely by practitioners.

Table 1
Factor analysis results

	Items	Eigenvalue	Proportion (%)	Accumulated proportion (%)	Naming	Cronbach's α
Partners' technical capacities	12					0.92
	5	4.653	38.775	38.775	Scientific knowledge (y_1)	0.83
	4	2.814	23.450	62.225	Firm's location (y_2)	0.85
	3	1.829	15.241	77.466	TMT international experience (y_3)	0.82
Alliances structure	8					0.89
	5	3.564	44.550	44.550	Horizontal integration (y_4)	0.85
	3	2.463	30.788	75.388	Vertical integration (y_5)	0.80
Alliances type	8					0.93
	5	3.426	42.825	42.825	Exploitation alliance (y_6)	0.89
	3	2.737	34.213	77.038	Exploration alliance (y_7)	0.89
Alliance partners' relationship	11					0.95
	5	4.545	41.318	41.318	Trust (y_8)	0.92
	2	2.332	21.200	62.518	Communication (y_9)	0.90
	2	1.053	9.573	72.091	Coordination (y_{10})	0.87
	2	1.003	9.118	81.209	Shared value (y_{11})	0.94
Absorptive capacity	8					0.94
	5	4.221	52.763	52.763	Potential absorptive capacity (y_{12})	0.87
	3	2.058	28.298	81.061	Realized absorptive capacity (y_{13})	0.89
New ventures success	8					0.93
	5	4.286	53.575	53.575	NPD performance (y_{14})	0.91
	3	1.978	24.725	77.607	Commercial success (y_{15})	0.94
Firm size	4					0.96
	2	2.458	61.250	61.250	Employees (x_1)	0.90
	2	1.008	25.200	83.450	Revenues (x_2)	0.94

3.2. Conceptual framework

In accord with literature, this study establishes a conceptual framework and proposes six hypotheses to be tested using a Linear Structural Relations Model (LISREL). It uses factor analysis to derive the observed variables.

In this framework (Fig. 1), latent variables (and observed variables) include the following: partners' technical capacities

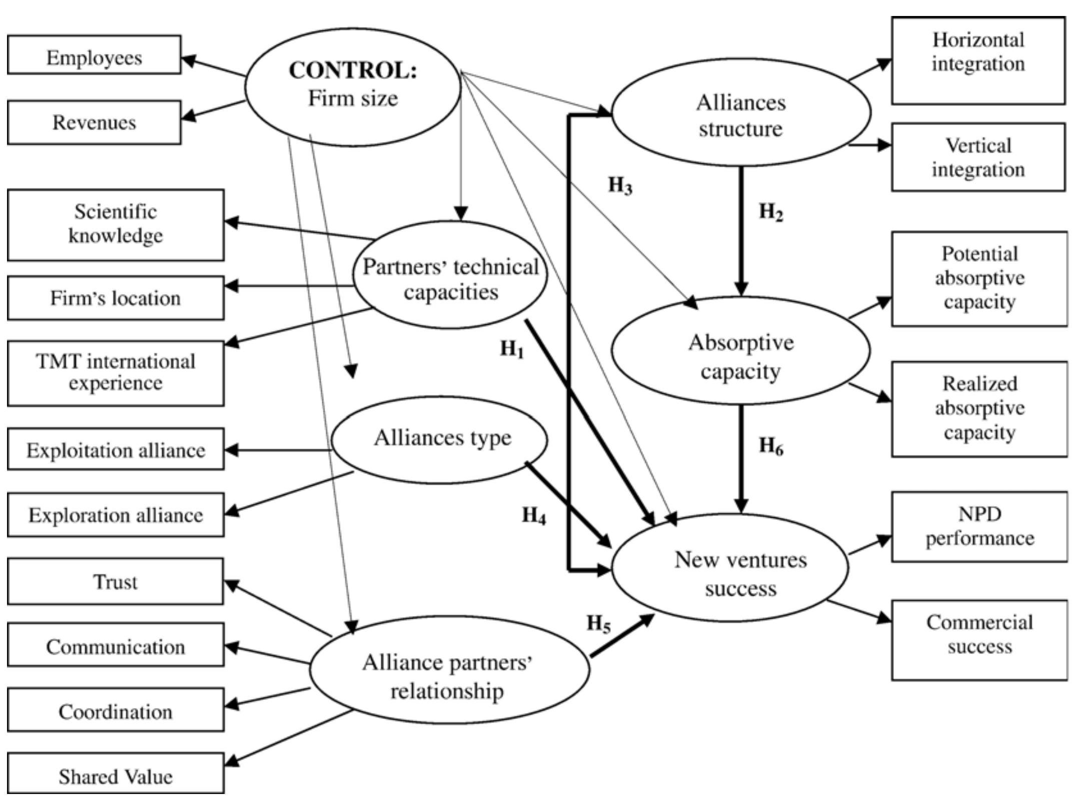

Fig. 1. Conceptual framework.

Table 2
Characteristics of individuals and firms in the sample

	Characteristics	Frequency
Job category	CEOs	78 (41%)
	International manager	54 (29%)
	Technical manager	27 (14%)
	Marketing manager	30 (16%)
Annual sales of firm	Less than USD 1 million	2 (1%)
	USD 1–2 million	20 (11%)
	USD 2–4 million	34 (18%)
	USD 4–6 million	32 (17%)
	USD 6–8 million	54 (29%)
	USD 8–10 million	42 (22%)
	More than USD 10 million	5 (3%)
Partner's home country	Europe (German, Italy, UK, etc.)	58 (31%)
	USA	43 (23%)
	Japan	32 (17%)
	Others (Korea, Taiwan, India, Australia, etc.)	56 (30%)

(scientific knowledge, firm's location, and TMT international experience); alliances structure (horizontal and vertical integration); alliances type (exploitation and exploration alliances); alliance partners' relationship (trust, communication, coordination and shared value); absorptive capacity (potential and realized absorptive capacity) and new ventures success (NPD performance and commercial success), and control variable (firm size).

3.3. Data collection and sample

This paper attempts to survey biotech firms located in Taiwan (Taiwanese and non-Taiwanese), as well as a wide range of biotech applications involving biomedicine, bio-agriculture, bio-food, bio-chemical, bio-environmental, and bio-service. In order to grasp the comprehensive configuration of this industry, our research conducts in-depth interviews with three larger biotech firms prior to the questionnaire investigation, and thereupon, sends the questionnaires to 500 companies listed in "2002 Taiwan Bio Industry". CEOs or the managers responsible for international affairs receive inquires. The result is 189 valid responses (37.8%). The 189 strategic alliances in our sample split into 37 exploration and 159 exploitation alliances. Only 17 alliances are targeted towards both. All 159 exploitation alliances are non-equity alliances, while the 37 exploration alliances split into 24 non-equity and 13 equity alliances. The average age of an alliance is more than 3 years old. Respondents discuss whether their companies have ever engaged in strategic alliances. More specifically, respondents indicate the degree of their involvement by answering the above-mentioned questions on strategic alliances.

To evaluate the relative importance of different absorptive capacity, each respondent specifies the relative importance of characteristics of alliance partners, structure of strategic alliances, type of strategic alliances and relationship of alliance partners on a 7-point Likert scale, indicating whether relative importance is very low (1) or very high (7). The question items are, for example, (i) You can require new medicines/products because of alliance partners' patents. (ii) Owing to partners' involvement in NPD, your new products are commercialized more successfully. (iii) You can improve the level of self-procurement through a horizontal integration (partners/competitors). (iv) You can improve the R&D capacity through a vertical integration (suppliers/buyers). Characteristics of the respondents are illustrated in Table 2, which shows a wide size distribution among responding firms.

4. Results

4.1. Descriptive statistics

This study simultaneously employs correlation analysis to assess the relationships between the variables. The correlation matrix indicates the relationship patterns of partner technical capacity, alliances structure, alliances type, alliance partners' relationship, absorptive capacity, new venture success, and firm size (see Table 3).

Table 3
Correlation matrix

	Mean	S.D.	y_1	y_2	y_3	y_4	y_5	y_6	y_7	y_8	y_9	y_{10}	y_{11}	y_{12}	y_{13}	y_{14}	y_{15}	x_1	x_2
y_1	5.80	0.82	1																
y_2	5.65	0.81	0.55	1															
y_3	5.69	0.75	0.33	0.21	1														
y_4	5.63	0.78	0.29	0.23	0.57	1													
y_5	5.89	0.75	0.19	0.21	0.16	0.18	1												
y_6	5.68	0.74	0.31	0.33	0.25	0.19	0.44	1											
y_7	5.34	0.90	0.19	0.24	0.13	0.12	0.14	0.22	1										
y_8	5.31	0.86	0.20	0.23	0.13	0.16	0.19	0.30	0.39	1									
y_9	5.62	0.77	0.42	0.31	0.25	0.31	0.44	0.26	0.23	0.27	1								
y_{10}	5.62	0.70	0.26	0.24	027	0.31	0.45	0.36	0.16	0.32	0.59	1							
y_{11}	5.75	0.82	0.24	0.27	0.18	0.23	0.31	0.26	0.17	0.24	0.49	0.55	1						
y_{12}	5.50	0.82	0.42	0.38	0.32	0.20	0.24	0.24	0.32	0.22	0.44	0.41	0.34	1					
y_{13}	5.75	0.85	0.33	0.42	0.24	0.32	0.32	0.22	0.27	0.35	0.37	0.32	0.28	0.41	1				
y_{14}	5.62	0.78	0.34	0.25	0.19	0.27	0.27	0.37	0.34	0.41	0.35	0.28	0.29	0.39	0.51	1			
y_{15}	5.47	0.72	0.30	0.41	0.30	0.19	0.31	0.35	0.45	0.19	0.24	0.22	0.31	0.35	0.27	0.38	1		
x_1	5.13	0.71	0.36	0.33	0.12	0.14	0.30	0.10	0.14	0.08	0.27	0.14	0.05	0.22	0.24	0.21	0.23	1	
x_2	4.42	0.68	0.34	0.32	0.35	0.33	0.28	0.11	0.09	0.16	0.13	0.23	0.15	0.16	0.21	0.08	0.30	0.87	1

Level of significance: $p<0.001$; $p<0.01$; $p<0.05$.

4.2. Measurement model

In order to specify the measurement model, this study makes the transition from factor analysis, in which the researcher has no control over which variables describe each factor, to a confirmatory mode, in which the researcher specifies which variables define each construct (factor). The manifest variables the respondents provide are "indicators" for the measurement model, because they provide a means to measure, or indicate the latent constructs (factors). The most obvious difference between the measurement model and factor analysis is that the former has a much smaller number of loadings and resembles the exploratory mode of factor analysis. Researchers can specify a measurement model for both exogenous constructs and endogenous constructs.

Table 4 presents λ_x and λ_y coefficients from a LISREL analysis of a hypothesized causal model of new venture success. All the coefficients are moderately high, approximately 0.58 or more. In addition, all the loadings are statistically significant. The strong statistically significant correlation between the factor and their measures suggests the presence of convergent validity.

Table 4
Measurement model parameter estimates

Latent variable	Observed variable	λ_x and λ_y	Error variance	Latent variance
Partners' technical capacities				0.279
	Scientific knowledge (y_1)	0.5877	0.516	
	Firm's location (y_2)	1.0488	0.179	
	TMT international experience (y_3)	0.5920	0.509	
Alliances structure				0.338
	Horizontal integration (y_4)	0.7165	0.392	
	Vertical integration (y_5)	0.7265	0.355	
Alliances type				0.246
	Exploitation alliance (y_6)	0.8918	0.071	
	Exploration alliance (y_7)	0.8118	0.305	
Alliance partners' relationship				0.117
	Trust (y_8)	0.8485	0.385	
	Communication (y_9)	0.7657	0.475	
	Coordination (y_{10})	0.8234	0.366	
	Shared value (y_{11})	1.0064	0.071	
Absorptive capacity				0.392
	Potential absorptive capacity (y_{12})	0.8122	0.366	
	Realized absorptive capacity (y_{13})	0.8863	0.266	
New ventures success				0.316
	NPD performance (y_{14})	0.7781	0.397	
	Commercial success (y_{15})	0.7017	0.522	
Firm size				–
	Employees (x_1)	0.9518	0.105	
	Revenues (x_2)	0.9882	0.342	

Level of significance: $p<0.001$.

These results may conclude that each of the six latent factors is well defined.

4.3. Structural model results

As Fig. 2 shows, path analysis indicates that six hypothesized paths are supported at a significant level (less than 0.05) — partners' technical capacities, alliances structure, alliances type, alliance partners' relationship, absorptive capacity and new ventures success. In the initial hypothesis, this study finds that partners' technical capacity positively and significantly influences new ventures success (path coefficient=0.67, t=5.83). There is support for H_1. Moreover, alliances structure is positively related to absorptive capacity (path coefficient=0.58, t=4.72), and new ventures success (path coefficient=0.72, t=7.06). The results support H_2 and H_3. The alliances type positively influences new ventures success (path coefficient=0.63, t=5.68). The findings support H_4. Alliance partners' relationship positively affects new ventures success (path coefficient=0.54, t=4.65). The findings support H_5. Finally, a significant and positive relationship exists between absorptive capacity and new ventures success (path coefficient=0.35, t=2.28). Hence, the findings support H_6.

4.4. Overall model fit

Various measures evaluate the fit of the model (Bentler, 1995; Sörbom and Jöreskog, 1982). Kelloway (1998) suggests that the use of chi-square test is reasonable when the study involves a large sample. The first measure is the likelihood ratio chi-square statistic. While the value has a statistical significance level above the minimum level of 0.05, the statistics support the argument that the differences of the predicted and actual matrices are insignificant, indicative of an acceptable fit. However, as the chi-square was very sensitive to sample size, the degree of freedom could be used as an adjusting standard to judge whether chi-square was large or small (Sörbom and Jöreskog, 1982). Therefore, in this study, when the chi-square per degree of freedom is below six, this shows a reasonable fit, while a ratio between one and two is an excellent fit. The ratio of the model is 2.029, indicating a fairly good fit. The model fit assessment approach is involved, using several diagnostics to judge the simultaneous fit of the measurement and structural models to data collected for this study. The goodness-of-fit index (GFI) is another measure LISREL provides. The adjusted goodness-of-fit index (AGFI) is an extension of the GFI, adjusted by the ratio of degrees of freedom for the proposed model to the degrees of freedom for the null model. The GFI for the overall model is 0.96 and the AGFI is 0.93.

Other types of fit measures include the Comparative-Fit Index (CFI), the Root Mean Square Residual (RMR), and the Standardized Root Mean Square Residual (SRMR). This study uses CFI to explain the difference between the model and the independent model without co-variables. The closer the value is to 1, the better the model fit. The RMR is the square root of the mean of the squared residuals — an average of the residuals between observed and estimated input matrices. Owing to

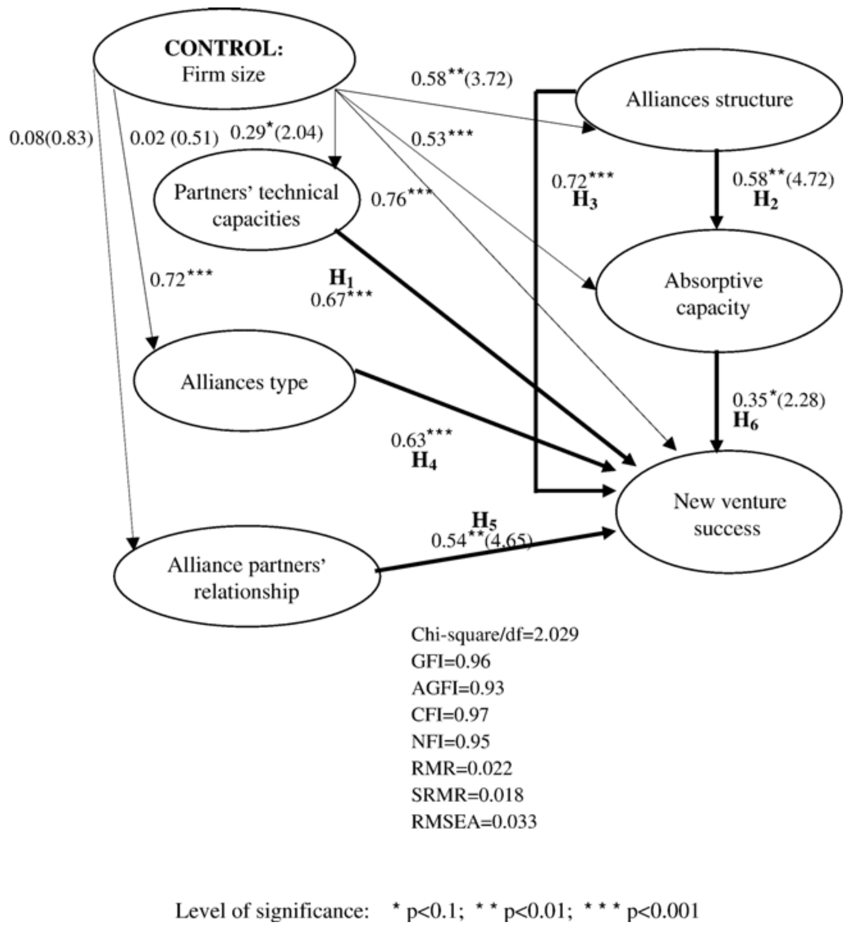

Fig. 2. Structural model results.

RMR's lack of standardization, however, comparison between coefficients is more difficult than with the standardized coefficients. Other diagnostics for this model include NFI = 0.95, CFI = 0.97, RMR = 0.022, SRMR = 0.018, and RMSEA = 0.033. This measure is quite similar to the parsimonious Normed Fit Index (NFI) and has a recommended acceptance level value greater than or equal to 0.90. Further, the model has a NFI value of 0.95, which means that 95% of the observed measure covariance is explained by the composition model. The structural model results in Fig. 2 show that overall model fit is within an acceptable level.

5. Discussion

5.1. Conclusions

The rate of new ventures success is becoming an important competitive dimension in many industries (Stalk and Hout, 1990). This study finds reasonably strong support for all hypotheses presented. Our research focuses are not only on product development, but also on the speed of market penetration as a result of new venture success. This research analysis looks at — the impact of strategic alliances on absorptive capacity and the impact of new venture success with different extents of absorptive capacity.

H_1 indicates that the impact of alliances upon the rate of new venture success might vary according to partners' technical capacities. For example, partners with less international experience are less likely to act opportunistically than those with abundant experience in biotechnology. In addition, developing the biotechnology industry relies on advances in scientific knowledge and its commercial exploitation, as Liyanage and Gluckman (2004) mention. Concurrently, this suggests that the future geography of biotechnology innovation will be limited to those locations with existing biotechnology research assets. This study emphasizes partner' technical capacity as an important factor in determining new ventures success.

Building from the results of H_2 and H_3, this paper argues that the successful development of biotech new ventures requires effective organizational structures and the co-evolution of two types of knowledge systems – scientific and innovative – for continuous growth of biotechnology firms. In addition, the research illuminates the strategic alliances of biotech firms harnessing the potential economic benefits of biotechnology networking, whether horizontal or vertical integration. Our investigation indicates that respondents highly agree with this item: "You can improve the R&D capacity through vertical integration." Accordingly, firms tend to withdraw from the product development path to discover, develop, and commercialize promising projects through vertical integration, as a technology venture grows. As Lee (2003) indicates, where M&A has technological motivation, post-M&A technological performance of the acquiring firm improves. Strategic alliances are complex events with various motivations. While SMEs decision-makers choose an appropriate alliance structure in compliance with their motivations, their new ventures success will be upgraded.

With regard to H_4, our results find that exploration alliances predict products in development, which in turn predict exploitation alliances. In addition, exploitation alliances predict products on the market, indicating not only that there are different motivations and goals for different types of alliances, but also that different alliance types proceed different outcomes (i.e., new venture success or failure). Rothaermel's (2001) study also indicates that incumbents exhibit a preference towards alliances that leverage complementary assets (exploitation alliances) over alliances that focus on building new technological competencies (exploration alliances).

Concerning H_5, our conclusions find that turning good science into commercially valuable biotechnology products not only requires specialized skills and knowledge, but also needs effective communication, coordination, shared values, and mutual-trust with counterparts. Marketplace realities are driven by a number of human, cultural, and political factors that work within the domain of the business of biotechnology (Kung et al., 2000). Market share of new ventures is important to investors and venture capitalists, people who keep the biotech industry alive and dynamic. Meanwhile, in developing a supply chain management via alliance, counterparts maintain close relationships in the first place. They will obtain a larger market share by improving product quality and reducing costs through cooperation and collaboration.

The result of H_6 suggests that a counterpart's absorptive capacity in a strategic alliance will influence new ventures success. As noted, biotech firms usually join multiple alliances to gain access to knowledge and skills across the various phases of their value chain. Building upon the dynamic capabilities view of the firm, the absorptive capacity is an important factor of SMEs' potential and realized capacities. The firm's potential and realized capacities can differentially influence the creation, sustenance, and advancement of its competitive advantage (Zahra and George, 2002).

5.2. Managerial implications

The contribution of this paper lies in creating links between inter-firm cooperation as a mechanism of new ventures to adapt to radical technological change, firm innovative output, and industry and firm performance in the post-innovation period. The results support the notion of incumbent survival through complementary assets (Tripsas, 1997), and the importance of differentiating between technological and market-related capabilities when adapting to a new technology (Mitchell, 1992). Insights into the importance of inter-firm collaboration for research are provided based on extensive empirical analyses of Taiwan's biotech new ventures. Establishing inter-firm collaborative relationships is considered to be vital as commercial biotechnology research becomes more independent from academic research.

Although Taiwan's biotechnology still lags behind the USA, Europe, or Japan, the Taiwanese have been carrying out an extremely well coordinated effort to excel in this field. Taiwan's biotech firms will intensify their successful approaches, learned from other alliances partners, to advance the development of biotechnology, as well as to build strong international networks, improve strategic alliances efficiencies, and maximize global competitiveness.

In contrast to research institutes and universities focusing on basic research, biotech firms tend to specialize in particular research areas. Thus, specialization within the industry creates incentives for biotech firms to enter into alliances with other firms to gain access to complementary technological know-how. Likewise, specialization motivates pharmaceutical companies to gain access to financial resources, as well as technological, market and manufacturing know-how (Mitchell and Singh, 1996). This is also the reason why Taiwan's biotech SMEs enter alliances with biotechnology companies, rather than develop their own biotechnology operations.

A large body of research on inter-organizational linkages examines the benefits and costs that these linkages confer on incumbents (Baum and Oliver, 1991; Powell, Koput and Smith-Doerr, 1996). Baum et al. (2000) find that new ventures integrating potential competitors' innovative capacity may perform more successfully than ventures relying on individual effort. Powell et al. (1996) indicate that an innovative unit was a network rather than simply a specific firm in the biotech industry. If a firm is unable to develop a learning network, it will be at a competitive disadvantage. Strategic alliances provide an essential knowledge platform. In general, large biotech companies do not readily transfer their technology or know-how to other (potentially rival) firms. While SMEs are acquiring new technological knowledge, strategic alliances provide a good choice.

5.3. Limitations

Interpret these results with caution because of the study's limitations. While several important benefits occur for single industry studies, the fact that this research's focus on the biotechnology industry may limit the generalizability of the findings. The current results reflect the nature of the measures used, especially those related to new ventures success. This study uses "firm size" as a control variable. However, factors of patents held and R&D intensity are also measures of the observed variable "scientific knowledge". Future studies might benefit from exploring other indicators of new ventures success. For instance, patents held, R&D intensity, partner size, and the origin of the partner's home country could be used as control variables. The use of alternative control variables should help to establish the robustness of the current findings.

5.4. Future research directions

Taiwan's biotech firms are much smaller, and often refrain from providing access to internal scientific resources, as well as frequently regard joint government-sponsored R&D as unavoidable. As a consequence, it is necessary to overcome SMEs' weakness in basic R&D using international alliances as a strategy. However, clinical studies are currently being conducted in collaboration with universities and hospitals. In Taiwan's case, biotech SMEs sometime ally with hospitals such as the National Taiwan University Hospital and Veterans General Hospital in Taipei. Several joint research programs are also in progress with international institutes in the United States, Canada, Australia and other regions.

This study has focused on inter-firm collaborative method. Yet the general outline of this research could be applied to other forms of strategic alliances. For example, this research could be extended to examine inter-organization alliances such as governmental research institutes, universities, and non-profit organizations (e.g. hospitals). As a second suggestion, if biotech SMEs become to larger firms or multinational enterprises, they may use a merger and acquisition (M&A) method to exploit partners' technical capacity. Much could be learned from the formulation of M&A know-how construct and its antecedents and effects on firm performance in light of previous researches (Pennings et al., 1994; Simonin, 1997).

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