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Linking Organizational Ambidexterity and Performance: The Drivers of Sustainability in High-Tech Firms

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Abstract: To strengthen national competitiveness and sustainability, the high-tech industry has been developed as the center of gravity of industrial development in each country, covering the development of new products and the expansion to new customers and markets. Although both aspects are indispensable to high-tech firms' growth momentum and competitive advantages, it is difficult to develop them at the same time. In recent years, scholars have been paying an increasing amount of attention to the significance of organizational ambidexterity in different management fields. Importantly, transformed high-tech firms are obliged to manage the tensions and conflicts that arise from the exploration of new knowledge and the exploitation of existing knowledge to find an appropriate balance between the two to yield synergistic effects. In this study, an original method was used to measure differences in the degree of ambidexterity. The method establishes a multiplicative term of exploration and exploitation to represent the degree of effect of ambidexterity. The higher the exploration and exploitation are, the higher the degree of ambidexterity will be. This study takes as its objects electronics manufacturing firms in Taiwan that engage in the development of new high-tech products. We issued a total of 1000 questionnaires to electronics manufacturing firms in Taiwan and received 228 valid ones. The results indicate that exploitation has a positive effect on performance, and there is an inverse U-shaped correlation between exploration/exploitation and performance. Ambidexterity and its interaction with the market orientation were found to have a positive influence on organizational performance. We also investigated the extent to which an organization places emphasis on resources and the influence of resource allocation on organizational performance. We suggest that the co-existence of exploration and exploitation is important to organizational performance. Accordingly, developing the two capabilities at the same time conforms to the concept of ambidexterity.

Keywords: ambidexterity; exploration; exploitation; market orientation

1. Introduction

The high-tech (computer hardware and software, telecommunications, electronics, semiconductors, medicines and pharmaceuticals, biotechnology, etc.) industry in Taiwan has dominated the market for the past two decades by virtue of its cutting-edge R&D and innovation. The high-tech industry in Taiwan maintains its competitive position with a large amount of investment in R&D and advanced manufacturing techniques. To sustain organizational and economic development, many firms have abandoned their original equipment manufacturing (OEM) model and turned to original design or brand manufacturing (ODM or OBM, respectively). The successful transition of the high-tech

industry in Taiwan from an OEM model to an ODM or OBM model is a result of intensive R&D and well-defined innovation, which enable firms to update their production technology and knowledge to sustain their competitive edge [1,2]. For example, High Tech Computer (HTC) stopped serving as a contract manufacturer for major brands, entered markets through a partnership with telecom, and encouraged customers to use services in whose design telecom had participated to increase telecom's profits. HTC has introduced new types of cell phones every year and made its products different from Apple's iPhone through its self-contained smart phone line. This example shows that Taiwanese high-tech firms are devoted to product and marketing innovation, which will help us to understand the research context based on Taiwanese high-tech industries. However, many subsequent studies consider this case study to be an intellectual base in the field of the strategic management of high-tech firms [3–5]. Few studies have attempted to explore how these transformed high-tech firms translate resources/capabilities into competitive advantages and performance (exploration). In addition, many studies ignore the importance of understanding how these high-tech firms use their existing abilities, which affect their performance (exploitation). Therefore, the object of this study is to adequately analyze the dynamic capabilities of transformed high-tech firms.

Organizational ambidexterity is a new issue in organization management [6]. Duncan [7] pointed out that firms need to consider a dual structure (exploration and exploitation) to be successful in the long term and as the difference between the results in the execution of innovative ideas and concepts. Tushman and O'Reilly [8] pointed out that firms, in the process of developing new products and services, need to face complexity and a high speed of environmental change, and ambidexterity implies that exploration and exploitation need to move concurrently [9]. As with other companies, high-tech firms need to have the ability to acquire, develop, and/or upgrade capabilities dynamically [10,11]. This ability requires the proper adaptation, integration, and reconfiguration of the enterprise strategy, as well as internal and external skills and resources that are in tune with environmental changes. Organizational ambidexterity can be viewed as a dynamic adjustment between exploration and exploitation [12]. Many previous studies have emphasized the combined effects of exploration and exploitation on firm performance [4]; however, few studies have examined the combined or ambidextrous effects of both on transformed high-tech firms. Therefore, the second objective of this study is to explore the impact of ambidexterity on transformed high-tech firms' performance.

Due to a lack of resources and the restricted scope of management, exploration and exploitation are often viewed as a trade-off [13]. However, the two must be considered as being complementary. A trade-off means that firms either enhance their management ability or focus on the acquisition of new abilities [14]. Unrest intensifies in a market environment and tends toward a precarious state; hence, exercising a single capability cannot satisfy the growth demand. However, developing an ability to manage contradictions and conflicts is difficult. This lack of consistency in the research findings can be partly attributed to an insufficient precision when specifying the relationship between dynamic capabilities and performance in transformed firms. In other words, exploration/exploitation and performance in a general setting are typically assumed to have a positive linear relationship [1,15,16], and little attention has been paid to the nonlinear relationships between them. If the relationship between exploration/exploitation and performance is quadratic, and performance declines with excessive exploration/exploitation, inconsistencies in the latter results may be caused by a failure to simulate exploration/exploitation's association with performance when testing for ambidexterity. Therefore, based on a dynamic capability, this study explores ambidexterity's key role in the nonlinear relationship between exploration/exploitation and performance for transformed high-tech firms.

Most previous studies confirm that an ambidextrous strategy has a positive effect on organizational performance; however, a few scholars have indicated that ambidexterity has a negative correlation with performance [16]. Tushman and O'Reilly [8] indicated that ambidexterity is more likely to be successful if there is strong social control and a common culture that combines exploration and exploitation in an organization [17]. Studies in the marketing literature have shown that market orientation is a critical form of culture that potentially provides firms with a positioning advantage and facilitates

the development of their exploration and exploitation. Menguc and Auh [16] argue that market orientation is a complete organizational culture in which exploration and exploitation coalesce and form a complementary relationship instead of a trade-off. This study also explored whether exploration and exploitation can be integrated to yield a superior organizational performance using the promotion of market orientation, particularly in transformed high-tech firms.

To develop a clearer nomological network of dynamic capabilities, it is necessary to resolve these critical issues from a managerial perspective. Our model identifies possible situations where an increase in exploration/exploitation may be inappropriate or may even harm a firm's performance, and our results validate our model. We also provide insights into how transformed high-tech firms should manage their exploration and exploitation as they increase their profitability, growth, and sustainability.

2. Literature Review

2.1. Theoretical Foundation

In the fiercely competitive industry environment, firms face many challenges to their survival. How do they deal with these continuous difficulties? They mainly deal with these by adaptive processes—firms have the ability to apply their existing assets, status, and capacity to explore new technologies and markets to construct and reconstruct organizational resources to pursue existing and new opportunities [18–21]. As elaborated on by some scholars engaging in organizational learning theory research, and based on the research of Yamakawa et al. [21], exploration creates something other than the existing knowledge of an organization (e.g., new knowledge) by using new methods to experiment with technologies, business processes, or markets and to search for new organizational practices, norms, and systems [22–24]. This theory assumes that exploitation builds trust in certain of the firm's activities, such as the refining of existing knowledge [21], the use and improvement of existing capabilities, and a focus on technologies, processes, and products within existing markets [5]. Using variation–selection–retention from the traditional evolutionary paradigm, Zollo and Winter [25] divided the process of the evolution of knowledge and capability into the stages of generative variation, internal selection, replication, and retention. Some scholars have also added exploration and exploitation as evolutionary stages of knowledge and capability building [13,26]. Exploration puts emphasis on finding growth opportunities and enhancing innovation in a competitive environment with limited resources. Exploration urges the organization to create an appropriate organizational structure, adapt to the changes brought about by the market environment, create new products and services, and develop new markets [27]. Conversely, exploitation is a dynamic capability that involves path-dependent learning and knowledge accumulation. Firms tend to develop existing markets until they develop the capability to expand to new markets [2,28].

Studies [11,29–31] have found that an enterprise's competitive advantages can be established or strengthened through exploration and exploitation in an insecure economy. Time is needed for the development of capabilities, and the learning process often ends with a high degree of idiosyncrasy, so a manager must determine the capabilities to be developed and invested in, and must then take actions to achieve these goals [32]. Consequently, management decisions on one capability to be developed or several different capabilities to be developed concurrently are also strategic decisions. This section explains the trade-off between exploration and exploitation, and the effect of such a relationship on organizational performance from the perspective of dynamic capability, and then proposes hypotheses.

2.2. Direct Effect of Exploration and Exploitation on Organizational Performance

In this study, we assume that a firm pursues two distinct and conflicting capabilities that benefit it: exploration and exploitation. When an organization performs exploration and exploitation actions, it not only improves its operational efficiency (profitability, productivity, and market share), but also promotes innovative performance (environmental adjustment, new market development, new product

development, and flexibility). In accordance with studies on organizational ambidexterity, this study divides organizational performance into three categories: growth/share (sales level, target market share, and growth rate); organizational effectiveness (customer retention, new product success, and relative product quality); and profitability (return on investment (ROI), gross margin, and return on equity (ROE)) [33–37].

The examination of new alternatives [26], a type of innovation, and a source of new knowledge [34], is the essence of exploration. Exploration is the basis of organizational growth. Firms in a competitive context with limited resources and industrial development will devote themselves to seeking opportunities for growth and promoting innovation [1,38]. In the process of the internationalization of enterprises, Prange and Verdier [28] show that exploration reflects firms that dynamically make use of their disruptive or value-adding capability to obtain new and innovative competitive advantages; all in all, a capability for disruption can increase the tendency of organizations to facilitate structure–deconstructed changes, letting them overcome path-dependence and inertia to expedite organizational growth. Accordingly, in addition to creating new products and services and to developing new markets [39], exploration also enables firms to identify appropriate organizational structures. Firms coordinate changes in the market environment and future customer demands via structural changes (organizational re-integration and organizational restructuring) [4,40]. According to the organizational learning theory, exploration refers to learning activities beyond the current product–market knowledge base for the creation of new alternatives [4,26]. These learning activities help firms to internalize more new knowledge, such as potential customer demand, new technology, and new market information, which enables firms to enhance their innovation [15,26].

However, stubbornly pursuing exploration is not the right way to develop an organization. Firms that are engaged in an exploration process take advantage of expenditures or resources that originally belonged to an exploitive process. This will lead to a substantial experimental cost for the firm, which may even fail to make a profit [26]. Failure often impels organizations to adopt exploration strategies, as the dynamics of failure will sink an organization into “crazy experiments, change, and innovation” [13]. When financial resources are invested in rapid expansion, new routines, and/or adaptation, firms engaged in exploration fail to garner direct profits from continuous profit sources. The establishment of exploration and the performance of its activities often require more time than exploitation and its activities. Furthermore, the former involve risk and cost uncertainties [41]; e.g., firms develop new products to satisfy customer demand and to direct them at new markets, siphoning capital, resources, and manpower. Additionally, the cost of too much exploration learning tends to integrate more new knowledge, which reduces the development efficiency of new products [13]. The development of new products often belongs to a long-term orientation, since after a new product appears it will experience the initial stages of its life cycle, and the new product’s operational performance cannot defray the operating cost.

Therefore, exploration enables firms to realize ongoing market growth through overcoming path-dependencies and inertia. The exploration of new resources and capabilities through the development of new products can improve proximity [4,22–24] and the response to local customers, and can increase the speed to market [5,42]. However, if firms seldom engage in exploitation or activities related to organizational survival (threshold capabilities, consolidated capabilities, the refining or expansion of existing capabilities, technologies, and models), this may reduce their chance of survival [28]. Therefore, we hypothesize:

H1. *Exploration has an inverse U-shaped relationship with organizational performance.*

Exploitation refers to the learning activities in the neighborhood of a firm’s current product–market knowledge base for the refinement and extension of existing customers, technologies, and routines [4,26]. From the organizational learning theory, a high degree of exploitation can act as a learning absorptive capacity and, thus, improve firms’ effectiveness in exploring new knowledge to consolidate existing customers and markets, as well as renew products. Before developing adequate capabilities, firms

tend to place emphasis on the development of existing customers and markets, and do not develop new ones. In addition to reducing uncertainties in exploration and experiments, their survivability will also be improved [28]. Slater and Narver [33] demonstrate that firms will tend to track and respond to consumer demands with continuous learning. Firms seek and capture market opportunities through the provision of appropriate target products to facilitate customer retention, sales growth, and profitability. Experience and a lot of learned lessons enable enterprises to know how to reduce production and transaction costs, avoid repeating mistakes, improve their capacity to understand each other, and coordinate to solve problems [43]. If an organization merely engages in exploitation and excludes exploration, its performance may decline or it might become outdated due to advances in technology or customer preference changes [13]. An organization often shifts its attention from explorative to exploitive activities when it succeeds, because firms in a well-defined field need to further enhance their specified competence; however, the opportunity cost of exploration will simultaneously increase. In other words, existing routines within an organization are extracted and implemented over time, and organizations that are based on strong subjective learning and who constantly engage in old routines will not be able to adapt to a new situation or environment and will thus head in the wrong direction [13].

According to the preceding arguments, a firm is competent in realizing the desired synergy by relying on its exploitation, which requires the ability to leverage, deploy, and utilize resource complementarity to maximize profits in the short term [4,5,42]. As pointed out by Prange and Verdier [28], firms place emphasis on exploitation for organizational survival, earning survival in the short term by effectively exploiting existing knowledge, resources, and routines within an organization. Still, in long-term organizational development, a failure to satisfy the conditions for organizational growth will more likely heighten the risk of a decline in performance. Therefore, we hypothesize:

H2. *Exploitation has an inverse U-shaped relationship with organizational performance.*

2.3. *Effect of Combining Exploration and Exploitation on Organizational Performance*

An organization that faces basic problems will devote itself to the use of an adequate amount of exploitation to confirm its current viability. Meanwhile, organizational energy should concentrate on exploration to confirm future viability [26]. Exploitation-related activities can enhance the reliability and productivity of various organizational fields, whereas exploration-related activities enhance an organization's ability to add new knowledge to its existing knowledge base, allowing for the organization to create new products and services to meet new market demand [13]. Although Ebben and Johnson [44] found, in a study of 300 small enterprises, that those enterprises who pursued efficiency and flexibility had a lower performance than those who used a single and concentrated strategy, some scholars believe that, in this situation, a single effective strategy should be used in the short term until one can no longer make progress. This strategy, however, should not be used for long-term adaptation [45]. The study of March has, as its initial premise, that organizational growth requires both exploitation and exploration to achieve persistent success. On this basis, some studies have concluded that "ambidexterity" is the answer [2,3,12,17,43]. Ambidexterity means the pursuit of both exploitation and exploration via loosely coupled and differentiated subunits or individuals [42], each of which specializes either in cost efficiency or in the development of new products/services [4,41].

Although the trade-off between exploration and exploitation is essential [41], March (2003) represents the appropriate balance between exploration and exploitation not in terms of competition and trade-off, but in terms of an inter-relation among complementary deficiencies [43]. As to competition, two views with different orientations not only have a competitive relationship, but also prove to be mutually supportive, helping each other leverage the use of resources; this is called combined ambidexterity [2,4,15]. Regarding the influence of exploration and exploitation, by the repeated use of existing knowledge and resources, managers are able to identify relevant knowledge and resources within firms more easily and understand it more thoroughly, causing a reconfiguration of existing resources and knowledge while promoting the capability to explore new products and

markets. Burgelman [46] illustrates how Intel's managers are able to identify and sense sustainable competitive advantages in the microprocessor industry due to their knowledge of the capabilities and engineering aspects of existing memory chips, as well as their understanding of market trends. In other words, more exploitation can improve firms' efficiency when exploring new knowledge and resources for their new products and markets [15]. On the other hand, mastering an exploration process can enhance firms' capacity for exploitation. When firms internalize external knowledge and resources by exploration, they mean to extend their own competence so that effective routines and processes can be utilized in larger economies of scale. We stress that ambidexterity can leverage the synergy between new opportunities and the limitations in existing routines and knowledge. As a form of improvisation, as described by Miner, Bassoff, and Moorman [47], it restructures existing elements in new ways to contribute to connecting an appropriate idea to the proper demand at the right time.

Firms that are adept in exploitation but not exploration will see their competitive advantages be impaired over time, while firms that are adept in exploration but not exploitation will see their new competences perform poorly [42]. According to Katila and Ahuja [40], a firm needs to exploit existing capabilities to explore new capabilities, and the exploration of new capabilities also expands a firm's knowledge base [2,3]. High-tech firms cannot lack either aspect if they are to remain competitive [4]. We hypothesize:

H3. *A combination of exploration and exploitation (ambidexterity) is positively correlated with organizational performance.*

2.4. Moderating Effect of Market Orientation

Kohli and Jaworski [48], and Narver and Slater [32], suggest that the actions, decisions, and attitudes of senior managers "trickle down" organizational levels to employees who implement a strategy. A market-oriented culture [49] features the generality and consistency of shared (customer-satisfaction-focused) values. It tends to foster frequent contact with customers, shared efforts to solve problems, enquiries about customer problems, and open functional communication. This study adopts Narver and Slater's perspective on market orientation, which has been widely quoted. They believe that market orientation consists of competitor orientation, customer orientation, and inter-functional coordination. As far as most authors are concerned, all three components are vital, and they provide a holistic view of firms' ability to collect and use market information effectively [32,34].

While previous studies suggest that management synergy, in terms of exploration and exploitation, requires different strategies, structures, and cultures [4], this study emphasizes the importance of the role of culture. Successful exploration and exploitation are imperative but challenging because they are associated with paradoxical values [4,13,15,16]. Tushman and O'Reilly [12] indicate that ambidexterity is more likely to be successful with a strong social control and a common culture that combines exploration and exploitation in an organization [17]. Menguc and Auh [16] postulate that market orientation is an organizational culture wherein exploration and exploitation coalesce to create a complementary versus trade-off relationship. Besides the cultural perspective, much empirical research discusses the implications of an organizational culture and strategic behavior from an integrated perspective [50], indicating that market orientation promotes effective behavior through the sharing, accumulation, and evaluation of relevant information from customers and competitors. On the other hand, by fostering cultures among diverse departments and using valuable resources in harmony with one another, firms can improve their production efficiency with interdepartmental communication, collaboration, and coordination [32]. Based on the extant literature, it seems reasonable to infer that an organization that relies on the contradictory values of efficiency and flexibility (related to hierarchy and market cultures) can operate at superior levels and improve its performance. The marketing strategy literature highlights how exploration focuses on advances in efficiency, while exploitation focuses on efficiency. Market orientation strikes a balance between exploration and exploitation while fostering an organizational culture, and enables exploration and exploitation to create and deliver superior customer values [16]. We hypothesize:

H4. *The positive effect of organizational ambidexterity on performance will be stronger when organizations are characterized by a market orientation culture.*

Based on the above hypotheses, this study proposes the following Figure 1:

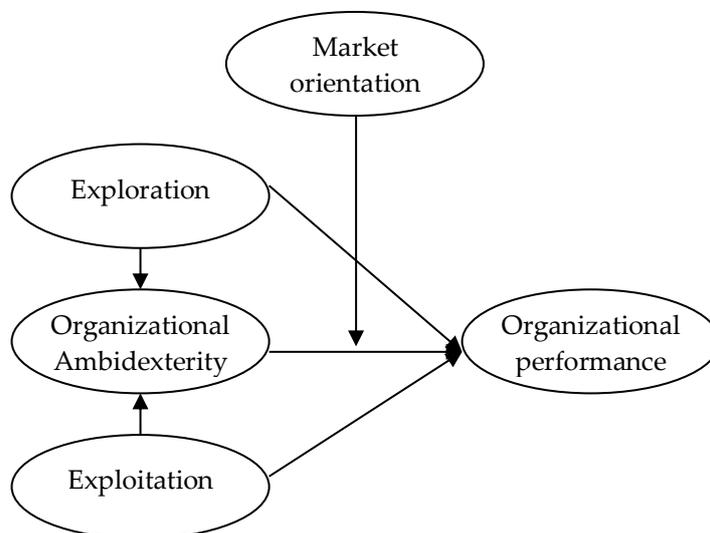


Figure 1. The research framework.

3. Methodology

3.1. Data Sources

We first modified scales from the literature to suit our research objectives. Thirty managers of Taiwanese firms were selected to participate in a questionnaire pretest. The results of the pretest show that potential respondents have a positive attitude toward university-sponsored research, which can greatly improve trust and response rates (critical concerns when collecting data on product development and organizational performance). In this study, a stratified random sampling method was adopted for brand selections to rank transformed firms within each high-tech product category. In the second stage, we surveyed the knowledge and responsibilities of respondents, including CEOs, vice presidents, and senior managers. We selected top managers to be the main information providers, because they know about most businesses and are familiar with the internationalization, capability development, and operations of their companies. The recovered survey instruments confirmed the appropriateness of the wording, as well as the test's reliability and validity. The questionnaire was finalized after inappropriate items were deleted. The database of the Taiwan Association of Industries in Science Parks was used to create a sample list of 1200 high-tech firms. The samples were collected from March 2018 to May 2018. Each survey package contained a covering letter explaining the survey's purpose, a postage-paid envelope, and a survey instrument. We issued a total of 1000 survey instruments and received 234 completed ones (a response rate of 23.4%). The elimination of 6 invalid survey instruments left 228 valid ones, representing an effective response rate of 22.8%. A total of 228 high-tech firms were selected for inclusion in the study.

Tests for nonresponse bias were carried out based on a comparison between the 110 early and the 118 late respondents in terms of the mean values of construct items and descriptive statistics. These tests yielded no significant differences (exploration, $t = 0.894$, $p > 0.1$; exploitation, $t = 1.126$, $p > 0.1$; market orientation, $t = 0.675$, $p > 0.1$; organizational performance, $t = 0.744$, $p > 0.1$), suggesting that nonresponse bias played a minor role in this study. When self-report questionnaires are used to collect data at the same time from the same participants, common method variance (CMV) may be a concern. A post hoc Harman one-factor analysis was used to test for CMV [51]. The factor analyses produced neither a single factor nor one general factor that accounted for the majority of the variance. The results show that the tests did not identify CMV as a problem.

Most respondent firms (88.6%) were from the electronics, electrical appliance, semiconductor, metal, control system/design, engineering, and high-end exclusive gift manufacturing industries. Eleven percent (11%) of them had been established for 3–10 years, 34.3% for 11–20 years, 34.8% for 21–30 years, and 19.9% for over 31 years. Most of the firms exported their products, with 23.2% employing less than 300 employees, 34.4% employing 301–500 employees, 20.4% employing 501–700 employees, and 22% employing over 700 employees. Their major international markets include China, Japan, North America, South America, Europe, and Southeast Asia. Additionally, most of the respondent firms (70.3%) had engaged in a transformed business operation for 5–10 years; 29.7% had engaged in a transformed business operation for over 11 years.

3.2. Assessment of Variables

To measure the variables, we chiefly adopted scales from previous studies. Four items on the exploration scale and four on the exploitation scale were taken from He and Wong [4], Lubatkin et al. [35], Menguc and Auh [16], and Cao et al. [15]. We asked informants to state the extent to which these eight items were true regarding product development in their firm over the past three years. These items were designed to measure how important it was for a firm to exercise its capabilities to enter into product–market domains or to improve existing product–market efficiency. Following Gibson and Birkinshaw’s study [17], the representation of ambidexterity as a multiplicative term (interactive term) of exploration and exploitation concurs with the theoretical conceptualization of ambidexterity [12]. Since we measured ambidexterity as a multiple (interactive term) of exploration and exploitation, we acknowledged that it may suffer from multicollinearity. To minimize this concern, we mean-centered the variables of exploration and exploitation before deriving ambidexterity [52].

Firm performance is a construct with multiple elements, and we used perceived measures to assess the firm performance in terms of the organizational effectiveness (three items), growth/share (three items), and profitability (three items), based on an established reflective scale [32–36]. Senior managers were asked to evaluate their firms’ performance relative to their competitors’ performance for the past three years.

Consistent with previous studies in marketing [16,32,48], we operationalized market orientation as a higher-order construct of customer orientation (six items), competitor orientation (four items), and inter-functional coordination (five items).

We also controlled for two other variables that might affect the model: firm size and age. Following Lubatkin et al. [35], the firm size and age were transformed by their square root because their distributions departed from normality. Except for the firm size, age, and ambidexterity, all scale items were answered using a seven-point Likert scale. All items are shown in Table 1.

Table 1. Variables and scales.

Variables	Items	Source
Exploration	Introduce a new generation of products	He and Wong [4], Lubatkin et al. [32], Menguc and Auh [16], and Cao et al. [15]
	Extend the product range	
	Open up new markets	
	Enter into new technology fields	
Exploitation	Innovations in marketing techniques	
	Improve existing product quality	
	Improve production flexibility	
	Reduce production cost	
Customer orientation	Improve yield or reduce material consumption	
	Our business objectives are driven by customer satisfaction	
	We closely monitor and assess our level of commitment to serving customers' needs	
	Our competitive advantage is based on understanding customers' needs	
	Business strategies are driven by the goal of increasing customer value	
We frequently measure customer satisfaction		
Competitor orientation	We pay close attention to after-sale service	
	In our organization, our salespeople share information about competitors	
	We respond rapidly to competitive actions	
	We regularly discuss competitors' strengths and weaknesses	
Inter-functional coordination	Customers are targeted when we have an opportunity for a competitive advantage	
	We share resources with other business units	
	Our managers understand how employees can contribute to customer value	
	Our top managers from each business function regularly visit customers	
Organizational effectiveness	Business strategies are driven by the goal of increasing the customer value	
	Business functions are integrated to serve the target market's needs	
	Product quality	
Growth/share	New product success rate	Narver and Slater [32,33], Jaworski and Kohl [34], Lubatkin et al. [35], and Han and Celly [36]
	Customer retention rate	
	Sales	
Profitability	Growth rate	
	Targeted market share	
	Return on Equity (ROE)	
	Gross margin	
	Return on Investment (ROI)	

4. Results

4.1. Measurement

The descriptive statistics for the scales are summarized in Table 2. A confirmatory factor analysis (CFA) and AMOS 23.0 were used to measure the reliability and validity of the scale. The validity was verified in terms of the convergent and discriminant validity. According to the evaluation standards of Hair, Black, Babin, Anderson, and Tatham [53], the results in Table 2 show that the average variance extracted (AVE) for all variables is higher than the threshold of 0.5, and that the composite reliability (CR) values are all greater than 0.7. All three criteria for the convergent validity were satisfied, and the correlation coefficients were all less than the square root of the AVE within one dimension, suggesting that each dimension in this study had a good discriminant validity.

Table 2. The results of the confirmatory factor analysis.

Measure	1	2	3	4	5	6	7
1. Exploration	(0.831)						
2. Exploitation	0.449 ***	(0.728)					
3. Market orientation	0.443 ***	0.283 ***	(0.741)				
4. Organizational performance	0.281 ***	0.569 ***	0.376 ***	(0.755)			
5. Ambidexterity	0.895 ***	0.776 ***	0.401 ***	0.482 ***	-		
6. Firm size (square root)	-0.129	-0.038	0.027	0.027	-0.117	-	
7. Firm age (square root)	0.130	0.063	0.046	-0.064	0.104	0.458 ***	-
Means	4.93	4.93	5.15	4.74	0.68	2.57	3.32
Standard Deviation	1.15	1.11	0.92	0.93	1.35	1.45	1.11
α	0.933	0.857	0.803	0.908	-	-	-
AVE	0.69	0.53	0.55	0.57	-	-	-
CR	0.93	0.85	0.81	0.92	-	-	-

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

4.2. Regression Results

Table 3 presents the regression results for the organizational performance. The addition of squared terms for both exploration and exploitation in Model 2 raises the R^2 by 6%. Aiken and West [52] suggest that a positive (negative) and significant coefficient of a squared term indicates an inverted U-shaped relationship. According to H1 and H2, exploration and exploitation have an inverse U-shaped relationship with performance, meaning that the squared term of exploration and exploitation is negatively correlated with performance. Model 2 shows that the coefficients for the squared term of the exploration ($\beta = -0.984, p < 0.1$) and exploitation ($\beta = -0.836, p < 0.1$) capabilities are negative and significant, in support of H1b and H2b.

In H3, we argued that organizational ambidexterity has a positive effect on organizational performance. Model 3 shows that the interaction between capabilities and organizational performance is positive and significant ($\beta = 1.207, p < 0.05$); this confirms H3. With regard to H4, which posits that the effect of the interaction between organizational ambidexterity and market orientation on organizational performance is strong, Model 4 shows that the moderating effect of the interaction between ambidexterity and market orientation is positively correlated with organizational performance ($\beta = 0.181, p < 0.05$); this supports H4. When we impute the ambidexterity of the two capabilities and the moderating effect of market orientation into Models 3 and 4, compared with Models 1 and 2, the positive contribution of exploration to a firm's operation is stronger than that of exploitation, especially when exploitation is insignificant in Models 2, 3, and 4.

Table 3. Regression results.

Variables	Organizational Performance			
	Model 1	Model 2	Model 3	Model 4
<i>Control variables</i>				
Firm size	0.135 ⁺	0.128 ⁺	0.139 ⁺	0.094
Firm age	−0.170 [*]	−0.179 [*]	−0.170 [*]	−0.158 [*]
<i>Independent variables</i>				
Exploration	0.072	1.059 [*]	0.236	0.120
Exploitation	0.552 ^{***}	−0.482	−0.142	−0.598
Explorative ²		−0.984 ⁺	−0.999 [*]	−1.615 ^{**}
Exploitative ²		−0.836 ⁺	0.128	0.184
MO				0.336 ^{***}
<i>Interaction</i>				
Ambidexterity			1.207 [*]	1.915 ^{**}
Ambidexterity * MO				0.181 [*]
F-value	19.695 ^{***}	14.193 ^{***}	13.115 ^{***}	15.362 ^{***}
R ²	0.349	0.370	0.389	0.493
Adj-R ²	0.331	0.344	0.360	0.461
Max VIF	1.832	1.984	2.132	2.323

Note: ⁺ $p < 0.1$; ^{*} $p < 0.05$; ^{**} $p < 0.01$; ^{***} $p < 0.001$.

4.3. Post Hoc Examination of Findings

Other than providing information on the hypothesized relationships, the results reveal two pieces of information regarding the relationship between the capabilities and organizational performance. First, Figure 2 shows that the optimal value of exploration and exploitation changes with ambidexterity and market orientation. Figure 2, Panel A, shows that, all else being equal, a firm operating under general conditions with the exploration level e1 has an optimal exploration level, and its performance (p1) is maximized. However, if this firm becomes more ambidextrous, the curvilinear relationship (i.e., the inverse U-shape relationship) between exploitation and performance turns into a positive linear relationship; we might expect the performance p2 to be the same as p1. Similarly, if a firm operates with more ambidexterity and market orientation, and with the exploitation level e3, we might expect the firm's performance to rise from p2 to p3.

A second finding shows that the optimal value of exploration increases with ambidexterity and market orientation (Figure 2, Panel B). As ambidexterity increases, additional exploration is required to attain an optimal sales performance. The implication here is that firms that become more ambidextrous while maintaining the same exploration level spread the same amount of activity across new customers and markets. All else being equal, a firm operating under original conditions and having the optimal exploration level of e1 achieves the performance level p1. If this firm increases its degree of ambidexterity but maintains the same level of exploration, the spreading of exploration across additional new customers and markets will dilute exploration and reduce its performance impact. At exploration level e2, this more ambidextrous firm will reap performance benefits and rise to the level of p2. Similarly, if a firm operates with more ambidexterity, more market orientation, and the exploration level e3, we might expect the firm's performance to rise from p2 to p3.

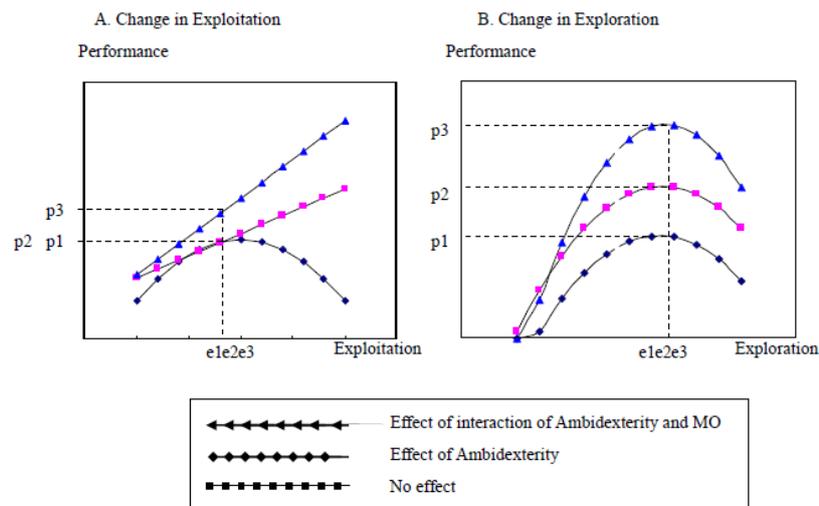


Figure 2. The moderating effect of ambidexterity and MO.

4.4. Analysis of Variance

To explore patterns in less ambidextrous firms with respect to their pursuit of an exploration or exploitation orientation, we performed a post hoc cluster analysis. Following the K-means algorithm, a four-group model addresses the best fit. The following groups were constructed, based on firms' exploitation and exploration (as rated above): low exploitation/exploration; low exploitation/high exploration; high exploitation/low exploration; and high exploitation/exploration. Table 4 plots the exploration and exploitation levels for each of the four cluster centers and reports univariate F-statistics. By examining the level of exploration, exploitation orientation, firm size, age, and performance of each group of high-tech firms, we found that Group 4, which contained the most ambidextrous firms, reported the highest levels of subsequent performance. Some scholars have termed this "dual orientation ambidextrous" [54], which facilitates the dynamic balancing of the exploration and exploitation orientations, as firms become aware of opportunities to improve their working efficiency and innovation [15]. At the other extreme, Group 1 contained the least ambidextrous and lowest-performing firms. As the firms in Group 1 (lacking an orientation) have no clear strategic orientation and tend to "muddle through" [52], they fail to connect problems and opportunities for their resolution. While the ANOVA showed that exploration orientation, exploitation orientation, and firm performance ($F = 19.30, p < 0.001$) varied significantly across groups, a post hoc Student–Newman–Keuls procedure indicated statistically insignificant differences between Groups 2 and 3. In other words, the firms in Groups 2 and 3, which were moderately ambidextrous but tended to favor either the exploration orientation or the exploitation orientation, had moderate levels of exploration orientation, exploitation orientation, and firm performance. Firms in Group 2 (exploitation orientation firms) possess well-developed routines that leverage clearly identified core strengths and focus on efficiency-driven rents [45]. In addition, firms in Group 3 (exploratory orientation firms) seek opportunities to obtain access to new technologies, new products, and new markets as well as to pursue new capabilities for adapting to the dynamic market environment [45]; however, they lack a successful commercialization and profit efficiency [13]. Firms in Groups 2 and 3 are similar to each other, yet they are significantly different from firms in Groups 1 and 4. These results, therefore, provide additional empirical evidence for the theory that underlies our hypotheses: ambidextrous Taiwanese high-tech firms can better pursue both exploration and exploitation and can thereby attain a higher level of relative subsequent performance.

Table 4. Results of the post hoc cluster analysis.

Firms	<i>n</i>	Exploration	Exploitation	Firm Size	Firm Age	Firm Performance
Group 1	36	3.73	3.51	2.50	3.22	4.26
Group 2	22	3.78	4.95	2.82	3.55	4.50
Group 3	10	5.80	4.10	2.20	2.80	4.38
Group 4	84	5.63	5.63	2.57	3.36	5.15
F	152	91.837 ***	94.208 ***	0.455	1.169	13.081 ***

*** $p < 0.001$.

5. Conclusions

5.1. Discussion and Implications

This study investigated the degree to which organizational performance is affected by the organizational emphasis on and the allocation of resources to exploration and exploitation. It also suggests that the incorporation of both exploration and exploitation is important [10,12,54]. Accordingly, the concept of ambidexterity was found to fit well with the simultaneous development of the two capabilities. Our results show that, in Model 1, exploitation, but not exploration, has a positive impact on organizational performance. We note that Taiwan's high-tech firms tend to emphasize the exploitation items of efficiency and compatibility, which have consistently been the advantages for such firms, although they place a roughly equal emphasis on and devote equal resources to both capabilities. Our findings show that both types of capabilities have a curvilinear (inverse U-shaped) relationship with organizational performance, implying positive returns from exploration and/or exploitation; however, beyond a certain level, these were found to be harmful to organizational performance. These findings support the organizational learning theory's [13] proposition that too much exploration of new knowledge and emerging market opportunities may be associated with higher risks and costs of new knowledge integration [55], thereby harming organizational performance. Furthermore, too much exploitation of a firm's knowledge base and routines may hinder or neglect the exploration of new knowledge or market domains that could afford useful solutions. These capabilities or activities may produce the risk of an inability to respond to radical shifts in market conditions and customer preferences.

Moreover, our results support two hypotheses about ambidexterity. The positive interaction between the two capabilities and organizational performance establishes the "fit as moderating" assumption [4]. This indicates that a trade-off of exploitation and exploration can achieve a synergistic or reinforcing effect on a high-tech firm's performance [12], while the absence of either capability may impair the synergistic effect. Although these imbalances can never be completely removed, most successful organizations reconcile them to a large extent, expecting to enhance their long-term competitiveness [17]. This study provides direct empirical evidence that transformed high-tech firms in Taiwan pursuing an ambidextrous strategy on the simultaneous development of both capabilities are able to strike an optimal balance in organizational growth. It is recommended that managers place a balanced emphasis on the two capabilities and that enterprises build a set of systems, processes, or contexts that enable and encourage employees to make their own decisions on the time to be allocated to the conflicting demands [17,35,56]. One key finding of our study is the positive joint effect of exploration and exploitation on organizational performance when a high level of one capability is coupled with a high level of another. The explanation for this finding concurs with He and Wong's [4] reasoning that exploration and exploitation augment each other when combined with high-high matching. In addition to the hierarchical regression analysis and verification of the role of ambidexterity in the relationship between the capabilities and organizational performance, we also verified the significance of ambidexterity in the competitive advantages of firms by ANOVA. For the technology-intensive and export-intensive high-tech manufacturing industry in Taiwan, the market competition they are confronted with has become increasingly tense and has shifted from a single-market

competition to a multi-market competition. Firms in this industry must make every effort to learn, adapt, and develop new capabilities, such as branding, innovation, distribution, human capital, and social capital [42].

Recently, scholars have paid attention to activities and capabilities for organizational ambidexterity. We examined the cultural role of market orientation in aligning ambidextrous activities. The findings suggest that a market-oriented culture can avoid both the dilemma of continually developing disruptive innovations and “failure traps” in order to advance existing experiences for established markets. Firm managers should recognize the level at which the market orientation will “kick in” and lead to positive effects from ambidexterity [16]. Moreover, a higher market orientation pays off because ambidexterity was found to benefit these firms. This will obviously differ for each firm, and managers will reap advantages by exploring methods that align exploration and exploitation and that identify their respective threshold levels.

5.2. Future Research and Limitations

This study is not without its limitations. First, due to the cross-sectional nature of the study, we failed to test whether firms follow any sequential strategy to cascade their exploration into exploitation, or vice versa. Additional studies may employ longitudinal data and a unit of analysis at the project level to conduct such tests. To measure the performance variables, this study used a self-assessed estimate of sales in the short term; therefore, we cannot rule out to what extent erosion may have occurred. Only a longitudinal study will be able to determine whether a higher performance is sustainable under conditions of competitive challenges, limited resources, and the inherent difficulty in reconciling competencies, risk preferences, and repertoires within the same firm [31].

Second, the sample frames used in this study were selected from high-technology industries. This industry covers a diverse range of products with great differences among them in terms of production scale and resource investment. For example, independent software vendors and semiconductor firms will have different demands for capabilities and resources. In addition, this study adopted the firm size as the control variable. Lubatkin et al. [35] suggest that executives of large firms should consider creating units that focus on either exploitation or exploration, instead of units that are competent to pursue both. Therefore, future studies may test for differences in specific products from the high-tech industry and control for the effect of the firm type and firm location.

Third, the high-tech industry is well-recognized for its innovative intensity, and these firms are leaders in terms of profits and awards. The issues of whether their lessons can be applied elsewhere, and, if so, how this can be done have raised pivotal questions. We suggest that future studies extend our work to other industries and more conventional manufacturing. Studies have obtained similar results for new product development (NPD) industries [41], product development groups, and cultural industries within the more traditional industries. However, the question of whether linking integration and differentiation tactics enables ambidexterity in such contexts requires further investigation.

Finally, we failed to soundly consider how to avoid common method variance when issuing questionnaires. Future studies should design the research and experiments to avoid occurrences of common method variance. Problems arising from it will affect not only the results of the statistical analysis, but also the results from the methods and verification. Therefore, relevant issues on, and the verification of, common method variance should be further studied.

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