

HUMAN CAPITAL, R&D-MANUFACTURING INTEGRATION, AND PERFORMANCE: EVIDENCE FROM TAIWAN TECHNOLOGY-BASED YOUNG FIRMS, 2002–2016

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Abstract

This paper explores the impact of young technology-based firms' human capital and organizational demography on their early-stage performance. The empirical analysis is based on a rich database of Taiwanese government agencies relating to a sample of 152 young firms and 1,049 entrepreneurial team members in technology-based industries. The study provides evidence of the main aspect, namely, human capital and organizational demography. The human capital of team members with advanced professional education, global work experiences, and prior background affiliation helps a firm's performance. Furthermore, our study identified three characteristics of organizational demography, including functional diversity, the combination of chairman and chief executive officer (C.E.O.) positions, and R&D-manufacturing integration, that could explain the impact on young firms' performance. It is noteworthy that Taiwan's semiconductor industry has dominated the global industrial chain for many years, and the significance of this industry is also presented in this study, which simultaneously unravels the mystery of its human capital and organizational demography.

Introduction

Firms are always in complex, dynamic, and volatile external environments [74], especially in this challenging era. However, such depressing circumstances (e.g., political disturbance and the Covid-19 pandemic) require a collaborative approach, and entrepreneurial teams who can demonstrate that their ability when facing growing challenges [44]. For example, the world's largest contract semiconductor manufacturer, TSMC (Taiwan Semiconductor Manufacturing Company), has proven this perspective in demonstrating their ability to develop successful teams. TSMC surpassed global competitors and stayed on top throughout changes in the international supply chain when the Covid-19 ruined economies worldwide [3]. The world realized that an industry giant can emerge on a significant geopolitical

battlefield when controlling a critical technology. This phenomenon has caught our attention, and we are interested in whether or not there is a trajectory to identify the characteristics of technology-based firms' human capital and organizational demography to become the dominant players in the industry.

When it comes to the importance of entrepreneurial teams, Prahalad and Hamel (1990) argue that the most powerful way to win in global competition is the "capabilities" of human capital, which is the core competitiveness of the firm. Therefore, scholars have explored the relationship between human capital and social capital and have even extended the viewpoint of financial capital, such as whether linking to venture capital affects the performance of firms [6]. However, we suggest that there should be further research to explain the relationship between human capital and firm performance, particularly at the organizational level.

From a human capital perspective, new ventures in many fields are created through the startup incubation process of the established enterprise [43][20], and new founders are from existing firms. Experience from former firms often provides the foundation for new entrepreneurs, such as market knowledge and networking opportunities [56]. Barney & Wright (1998) further proposed the "VRIO Framework" to develop human resource functions: Value, Rarity, Inimitability, and Organization. The organizations mentioned above should emphasize that human capital is a scarce and sustainable competitive advantage. Numerous studies have investigated the social function of founders' backgrounds, particularly their past industry fields and work experiences [16][68]. Recent studies highlight the role of founders' educational background [24][30]. In addition, the movement of government policies to support the acquisition of super-advantage is increasingly encouraged through policy formulation to encourage the return of overseas engineers and scientists[50][51]. Some governments believe that the key to a Silicon Valley-like electronics cluster should be the returnees [12][42], and hopefully, they will return for entrepreneurial growth [33][13]. TSMC is an example of the successful entrepreneurship of returned overseas tech experts in the development of Taiwan.

In addition, the position of the entrepreneurial team members in the organization is critical and plays an essential role in the firm's output and profitability from an organizational structure perspective [26]. [67] argues that organizational demography is embedded in the essential technologies and talents of a firm, such as managers, R&D engineers, and researchers, which could influence the performance and policies of a firm through the alignment of organizational positions. For instance, the functional diversity, the combination of the chairman and chief executive officer (C.E.O.) position, and R&D-manufacturing integration, on the firm's performance [39] will be further explored in our study.

When we examine the characteristics of the team at TSMC, founder Morris Chang was invited to Taiwan to operate the first local semiconductor facility with his impressive global work background and Ph.D. in electrical engineering from Stanford University. It is unlikely that we could summarize that TSMC's unprecedented success is due to the presence of an outstanding and experienced founder. We continue to explore not only human capital but also organizational demography to understand the characteristics and structure of the firm's team members and organization. Therefore, this study aims to

determine the entrepreneurial team's characteristics and the organizational position of technology-based firms to achieve better performance results.

To implement the findings of this study, we extend the empirical evidence on firm performance with four new elements. First, young firms are not necessarily startups but must be within five years of the first stage of their life cycle. The second is about the entrepreneurial team's human capital, where we identify the characteristics using various measures of demographics, such as work experience and educational background, Etc. Third, we quantify the characteristics, such as the functional diversity and the combination of chairman and chief executive officer (C.E.O.) positions of the firm's organizational demography. Fourth, we collected a uniquely rich database of Taiwanese government agencies across six different areas of Taiwan's technology-based industry to ensure the broad generalization of this study. If the above factors could influence the performance of firms, our findings will provide evidence for an integrated view. Therefore, this paper explores the characteristics of human capital and organizational demography that help technology firms' performance.

The rest of this article proceeds in the following sequence. Section 2 provides a brief review of the article, including the background of the research analysis presented with the literature on human capital and organizational demography. In section 3, we present the hypothesis building. Section 4 states the results of the empirical study. In Sections 5 and 6, we present the discussion and limitations of the study.

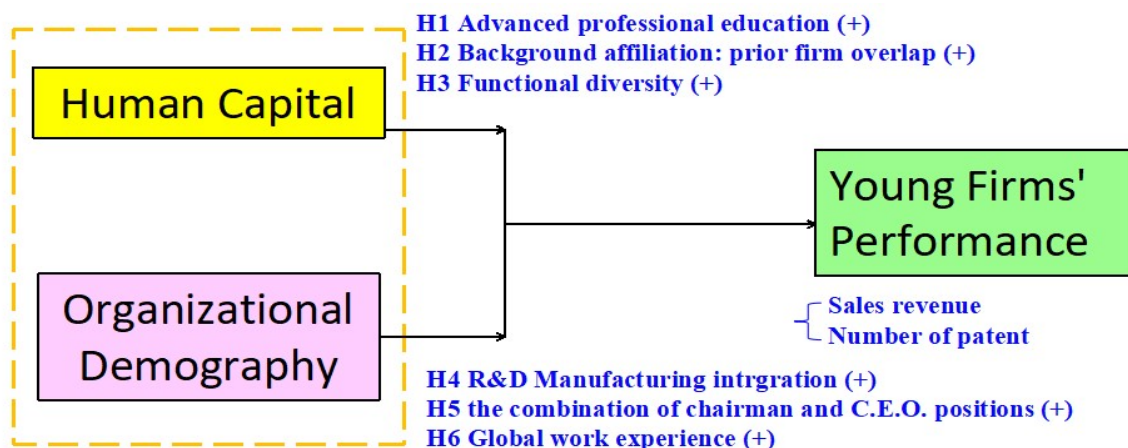


Fig. 1. Research model of the human capital and organizational demography on young firms' performance

Human Capital, organizational demography: A Theoretical Analysis Background

In technology-based industries, the quality of human capital is essential for firms to maintain their competitive advantage. Due to the need for specialized talents to cross technological barriers, shorten product life cycles, invest in R&D expenses, and accelerate knowledge renewal in technology-based industries. In a highly competitive technology industry environment, we elevate our study to the level of teams and organizations because members of entrepreneurial teams have more solution-oriented capabilities in highly uncertain environments [34][64]. Furthermore, they are more likely to acquire the

ability to achieve a balance between technological innovation and operational development than a single founder [25]. In addition, researchers in the entrepreneurial field have shown that team members' work experience helps the development of new firms [19][63][17].

Scholars argue that organizational demography can affect organizational performance [29], which is the formal work arrangement within an organization. An organization can adopt different organizational structures depending on the goals of the organization. The organizational demography can determine how the business operates and works and can express the assignment of tasks to different duties and review different entities, such as branches, departments, work groups, and individuals. The functional diversity [14], the previous experience of team members [6], and the examination of the heterogeneity of the industry experience of team members [24] require all of which can affect the performance of a new firm. In addition, the new product developed combines resources and knowledge across units [52]. In other words, if the R&D and manufacturing departments can work together on new product development activities, it will help the firm's new capability [22]. Thus, there are many benefits for firms to leverage the power of cross-organization, including shortening the development time of new products, reducing development and production costs, improving product quality, and enhancing the company's competitiveness [36]. Accordingly, we consider the presence of R&D-manufacturing integration as a characteristic of organizational structure and further explore the relationship with firm performance.

Scholars are convinced that the characteristics of entrepreneurial teams can be tracked to predict future performance [46]. As new ventures continue to grow, several new occupations and positions arise and therefore require a variety of people with different competencies to join them [2][11]. A functionally diverse team gradually expands its establishment over time, benefiting the firm's performance.

While Taiwan's technology-based industry has demonstrated a relatively high achievement worldwide, it has not received much attention regarding human capital and organizational demography perspectives. We identified firms established in the Hsinchu Science Park in Taiwan after 2002 and studied various technology-based industries (e.g., the semiconductor industry, biotechnology, and information and communication industry). We inspected demographic characteristics, functional heterogeneity, and background affiliation and studied whether startup firms have R&D-manufacturing integration. While there are various aspects to examining the performance of new ventures, we emphasize two specific measures: sales growth and the number of patents [62][73][71] to represent the growth of the firm performance on the operational side as well as on the technical side.

Therefore, according to the resource-based view, we explore the "characteristics" of firms' human capital and organizational demography that explain their positive impact on the performance of young firms.

Hypotheses building

This study proceeds to the hypothesis of the team and organizational level research. Studies on the initial formation of entrepreneurial teams provide an independent perspective for understanding the

team development process [70][46]. We attempt to understand the team's core competencies based on the team member's skills, experience, and resources. From the perspective of human capital, focusing on the attribution of technical background and educational background, Etc.; on the other hand, from the perspective of organizational demography, understanding the characteristics of functional diversity, the combination of chairman and chief executive officer (C.E.O.) positions, and the R&D-manufacturing integration, Etc., to understand whether they contribute to the performance of the firms.

Advanced professional education

Innovative organizations have become a significant indicator of the economic development of global enterprises [65][1]. Notably, the core competitiveness of a startup is the possession of its technology that other competitors cannot surpass in a certain period [57]. The rapid technological changes and high barriers to entry into the technology-based industry have increased the gaps in the entrepreneurial market.

In general, founders with a high level of education shall have more opportunities to enhance their innovative awareness and entrepreneurial ability [66]. Further, high degrees of education and receptiveness to new information could help founders identify innovative possibilities [4].

Most entrepreneurs in the technology-based industry have received academic education and degrees. For some, doctoral degree backgrounds have brought many entrepreneurial ideas and innovative discoveries from their academic research. In this context, we directly correlate the education of human capital with new venture (N.V.) performance. Therefore, we tried to compare the education-specific backgrounds of the team members relative to other experiences. That allows us to explore the capabilities of entrepreneurs closely related to the knowledge and skills based on the resource-based view. We examine the proportion of entrepreneurial teams with doctorate degrees to analyze the effect on new venture performance. Accordingly, we formulate our first hypothesis as follows:

Hypothesis 1. Entrepreneurial team members with a higher proportion of advanced professional education are more likely to affect firm performance positively.

Background affiliation: prior firm overlap

The past work experience and networks of entrepreneurial team members can help new firms to expand [17]. However, the technical background affiliation of entrepreneurial members is still not sufficiently studied [32]. The more technical affiliation of the team, the broader its range of activities and linkages, which should help the firm to be productive and operational. On the contrary, team members from different firms, industries, and backgrounds may have difficulty communicating because of their past experiences, which leads to specific habitual work processes and methods and different orientations toward role responsibilities [15].

Team members who have worked in the same firm (i.e., having overlapping affiliations) are more effective at communicating with each other. They have especially shared the firm culture and related vocabularies [61][32]. Research has proven that one of the developments of firm culture is that team members have a shared work experience and beliefs replicated through interactions [21]. Therefore, we argue that overlapping background affiliations positively impact firms' performance.

Hypothesis 2. Firms whose team members have overlapping background affiliations are more likely to positively affect firm performance than firms whose teams have fewer overlapping background affiliations.

Functional diversity

Research has shown that team-based ventures, where talented people from all sides invest their enthusiasm and time in the desired goal, tend to be more successful than solo firms [60][19]. In contrast to single entrepreneurs, these firms are two or more individuals jointly operated [72]. Furthermore, team firms are better than solo firms in leveraging systems knowledge to overcome the environment's uncertainty and unpredictability [34][47][23][64].

In the literature on founding teams, diverse teams are characterized by their members' different perspectives and backgrounds to obtain information to enhance creativity, flexibility, and unique insights into problems [9][8]. Many studies have suggested that a heterogeneous organization in top teams is more effective for firms' performance than homogeneous teams [45]. Diverse teams can transfer knowledge and improve firm performance by sharing different experiences among team members [41][69]. We decided to examine various dimensions, including technology, finance, operations, and marketing, from the resource-based view to understand whether the diversification of positions within an entrepreneurial team has a positive relationship with the performance of firms.

Hypothesis 3. Entrepreneurial teams with higher levels of functional diversity are more likely to affect firm performance positively.

R&D-manufacturing integration

Crossman and Apaydin (2010) defined innovation as the "production or adoption, assimilation, and exploitation of a value-added novelty in economic and social spheres; renewal and enlargement of products, services, and markets; development of new methods of production; and establishment of new management systems." The innovation novelty also encompasses the development of new production methods, and there are many variations in the manufacturing environment [18][38]. Therefore, we hypothesize that holding R&D-manufacturing linkages is associated with significantly improving a firm's performance.

In new product development and production activities, the firm's manufacturing department shares industry-leading knowledge and accumulates product development capabilities through formal and

informal channels due to confidential, professional, and internal information exchange with suppliers [53]. Therefore, we consider the cross-departmental exchange of information between R&D and manufacturing departments in an organization as a kind of R&D-manufacturing integration and further hypothesize that the firm could benefit from the R&D-manufacturing integration and be ahead of other competitors.

Hypothesis 4. Firms with R&D-manufacturing integration are more likely to affect firm performance positively.

Governance and leadership structures: the combination of chairman and chief executive officer (C.E.O.) positions

Past academic studies have not concluded the impact of the relationship between the Chairman and Chief Executive Officer (C.E.O.) on the firm's performance [39]. In many firms, the C.E.O. holds the highest management position and serves as a chairman of the board at the same time. This situation often occurs in fast-growing firms that retain the founders in these positions. As a result, the chairman and C.E.O. can use their discretion in deciding the firm's strategies [40]. Whether holding both roles would reduce the effectiveness of board management is a hot topic that often draws attention to shareholder meetings. There has been a strong argument for separating the two positions to enhance the overall integrity of the company. The key participants in this situation, direction, and aspirations genuinely shape the business's role and boundaries [55]. Our study also adopts this dual-role framework to understand if there is an impact on the performance of technology-based firms.

Hypothesis 5. Firms with the combination of chairman and chief executive officer (C.E.O.) positions are more likely to affect firm performance positively.

Global work experience

In studying the formation of entrepreneurial teams, we also included members with global work experience as one of the variables. These members are considered to have more successful cross-cultural experiences and adapt to different environments and institutions. They must be aware of and familiar with the local political situation, laws and legal politics, language, history, culture, customs, values, etc., such as they have pre-accepted transnational and cross-cultural training [10][54][37][44][49]. Leaders managing cross-border business activities must face challenges in a technology-based industry embedded in a global network and learn to pursue the optimization of business operations. For HSP firms, the ability of entrepreneur teams to connect with international commerce is an indicative sign requirement that could be developed within a diverse perspective and regarded as a contribution to firm performance.

Hypothesis 6. Entrepreneurial team members with a higher proportion of Global work experience are more likely to affect firm performance positively.

Tables 1 and 2 are shown for descriptive statistics and correlations.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Revenue_CAGR_Annual	1													
2	Number_of_Patents	0.11	1												
3	Founding_team_size	-0.04	0.09	1											
4	Semiconductor_industry	0.207*	0.178*	-0.07	1										
5	Groth_Capital_CAGR_Annual(%)	0.09	-0.09	0.03	-0.07	1									
6	Founders_with_prior_startup_experience	0.195*	-0.04	-0.08	0.08	0.08	1								
7	Founfers_with_executive_experience	0.254**	-0.00	-0.246**	0.14	-0.01	0.411**	1							
8	Founding_team_functional_diversity	-0.165*	0.171*	0.281**	-0.219**	0.10	-0.13	-0.15	1						
9	Founding_Team_overlapping_prior_company_affiliation	0.242**	0.175*	-0.13	0.06	-0.02	0.08	0.178*	-0.04	1					
10	Global_work_experience	0.10	0.233**	-0.13	0.186*	0.04	0.237**	0.204*	0.05	-0.12	1				
11	The combination of the chairman and C.E.O.	-0.08	-0.15	-0.08	0.07	-0.05	-0.12	-0.218**	-0.03	-0.06	0.05	1			
12	R&D_Manufacturing_integration	0.181*	0.02	0.11	-0.188*	0.15	0.14	0.09	0.13	-0.11	0.265**	-0.09	1		
13	Advanced_professional_Education	0.283**	0.03	-0.00	0.12	0.03	0.10	0.14	0.00	-0.15	0.358**	-0.05	0.03	1	

		Mean	SD	Min	Max	N
1	Revenue_CAGR_Annual	0.40	0.66	-0.76	3.91	152
2	Number_of_Patents	10.68	33.48	0.00	361.00	152
3	Founding_team_size	6.90	1.73	3.00	12.00	152
4	Semiconductor_industry	0.36	0.48	0.00	1.00	152
5	Groth_Capital_CAGR(%)	11.69	21.46	-34.00	85.53	152
6	Founders_with_prior_startup_experience	0.07	0.13	0.00	1.00	152
7	Founfers_with_executive_experience	0.09	0.10	0.00	0.40	152
8	Founding_team_functional_diversity	0.60	0.19	0.00	1.00	152
9	Founding_Team_overlapping_prior_company_affiliation	0.45	0.27	0.00	1.00	152
10	Global_work_experience	0.16	0.24	0.00	1.00	152
11	The combination of chairman and C.E.O. positions	0.53	0.50	0.00	1.00	152
12	R&D_Manufacturing_integration	0.44	0.50	0.00	1.00	152
13	Advanced_professional_Education	1.11	1.22	0.00	7.00	152

Sample and method

Firms in this sample are part of longitudinal research of 152 young technology-based firms that have applied for approval to enter Taiwan Hsinchu Science Park (HSP) since 2002. The Hsinchu Science Park (HSP) is the first high technology-based industry development benchmarking model in Taiwan, established in Dec. 1980, and has a good reputation worldwide. During the last 42 years, the contribution of HSP to Taiwan's G.D.P. has exceeded 14%. By Dec. 2021, the HSP had 548 companies with combined annual sales of more than US\$47.2 billion and annual investments of US\$0.9 billion. There are now 165,360 people working inside this park. We try to explore entrepreneurial teams with relevant technology-based backgrounds, global experiences, and doctoral degrees. Numerous founders or foremost technical leaders in HSP are so-called "returnee entrepreneurs." Their overseas study backgrounds, technology knowledge, working experiences, connections, entrepreneurial spirit, etc., interweave the valuable foundation of HSP. Due to their various and close interactions with foreign countries (such as Silicon Valley), they have created new ideas, technologies, products, and applications with Taiwan's local talents, technology policies, and facilities. These returnees created the prosperity and flourishing of Hsinchu Science Park nowadays.

The primary sources we used are the business plan applications for the technology-based industry in the Hsinchu Science Park Bureau Database. It collects the approved business plans through government review procedures and lists the entrepreneurial teams' members and their academic and work experience backgrounds. This study adopts the definition of [7] research. Taking the semiconductor industry as an example, industry analysts and venture capitalists tend to agree that after a new venture has operated for more than about five years, it should no longer be regarded as a new startup firm. Therefore, we screened firms according to four indicators: (1) The firms have operated in the HSP for less than five years; (2) The members of entrepreneurial teams include less than 12 persons (inclusive); and (3) Non-corporate branches. After our screening, 152 startup businesses in HSP were identified as samples that met the indicators.

Estimation procedure

This study used a hierarchical regression analysis approach, which amounts to a separate analysis of the variables in each stratum to identify variability [35]. We used sales growth (annual compound growth rate) and the number of patents as the dependent variables.

We carefully analyzed the problem and avoided the result of reverse causality by differentiating the period at which the variables were calculated. We measured all independent variables in the founding year (t_0). At the same time, at the end of the third year of the young firm's existence (y_3), we calculated all the data for which we could establish variables. All control variables were included in model 1. Model 2 started into the core research items by inserting the main effects for the differentiation and advanced professional education variables; the main effect of differentiation with the variable of background affiliation was inserted in the 3rd model; models 4, 5, 6, and 7 contained the terms: Functional diversity, R&D-manufacturing integration, The combination of chairman and chief executive officer (C.E.O.) positions, and Global work experience.

Results

Tables 3 and 4 reported the results of the hierarchical regression models with sales growth and the number of patents as the dependent variables, respectively.

Table3 Hierarchical regression. Dependent variable: The growth in sales.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Constant	0.07 (0.24)	-0.01 (0.23)	-0.34 (0.25)	-0.15 (0.27)	-0.19 (0.27)	-0.18 (0.28)	-0.17 (0.28)
founding_team_size	0.01 (0.03)	0.01 (0.03)	0.01 (0.03)	0.03 (0.03)	0.02 (0.03)	0.02 (0.03)	0.01 (0.03)
Semiconductor_industry	0.25** (0.11)	0.22** (0.11)	0.20* (0.10)	0.16 (0.11)	0.22** (0.10)	0.22** (0.10)	0.24** (0.11)
Growth_Capital_CAGR	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Founders_with_prior_startup_experience	0.49 (0.44)	0.44 (0.43)	0.41 (0.42)	0.35 (0.42)	0.21 (0.41)	0.21 (0.41)	0.28 (0.42)
Founders_with_executive_experience	1.25** (0.56)	1.08* (0.55)	0.81 (0.54)	0.78 (0.54)	0.61 (0.53)	0.59 (0.54)	0.64 (0.54)
Advanced_professional_Education		0.12*** (0.04)	0.15*** (0.04)	0.15*** (0.04)	0.15*** (0.04)	0.15*** (0.04)	0.17*** (0.04)
Founding_Team_overlapping_prior_company_affiliation			0.61*** (0.18)	0.62*** (0.18)	0.68*** (0.18)	0.68*** (0.18)	0.65*** (0.18)
Founding_team_functional_diversity				-0.46* (0.27)	-0.52* (0.27)	-0.52* (0.27)	-0.48* (0.27)
R&D_Manufacturing_Integration					0.29*** (0.10)	0.29*** (0.10)	0.33*** (0.11)
The combination of chairman and C.E.O. positions						-0.02 (0.10)	0.00 (0.10)
Global_work_experience							-0.27 (0.23)
F	3.79***	4.78***	3.36***	5.96***	6.22***	5.56***	5.19***
R ²	0.11	0.17	0.16	0.22	0.28	0.28	0.29
Adjusted Δ R ²	0.08	0.13	0.11	0.19	0.24	0.23	0.23
df	5,146	6,145	8,143	7,144	9,142	10,141	11,140

Note: Standard errors in parentheses.

*** $\rho < 0.01$

** $\rho < 0.05$

* $\rho < 0.1$

Table4 Hierarchical regression. Dependent variable: The number of patents

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Constant	-7.04 (12.47)	-7.17 (12.60)	-19.89 (13.57)	-35.29 (14.74)	-36.06 (14.78)	-25.97 (15.50)	-27.29* (14.95)
founding_team_size	2.15 (1.62)	2.14 (1.62)	2.47 (1.61)	1.45 (1.63)	1.32 (1.64)	0.91 (1.64)	1.81 (1.60)
Semiconductor_industry	12.60** (5.70)	12.54** (5.75)	11.81** (5.68)	14.56** (5.69)	15.42*** (5.79)	16.49*** (5.75)	12.32** (5.68)
Groth_Capital_CAGR	-0.11 (0.13)	-0.11 (0.13)	-0.11 (0.13)	-0.14 (0.12)	-0.15 (0.12)	-0.16 (0.12)	-0.15 (0.12)
Founders_with_prior_startup_experience	-12.66 (23.18)	-12.74 (23.28)	-13.93 (22.94)	-8.99 (22.63)	-11.23 (22.81)	-12.49 (22.59)	-24.78 (22.07)
Founfers_with_executive_experience	6.81 (29.38)	6.54 (29.65)	-3.73 (29.54)	-1.09 (29.05)	-3.73 (29.25)	-15.73 (29.59)	-22.57 (28.59)
Advanced_professional_Education		0.20 (2.27)	1.19 (2.28)	0.93 (2.24)	0.93 (2.24)	0.77 (2.22)	-1.70 (2.26)
Founding_Team_overlapping_prior_company_affiliation			23.53** (10.12)	22.83** (9.95)	23.75** (10.02)	22.73** (9.93)	26.26*** (9.63)
Founding_team_functional_diversity				36.39** (14.81)	35.42** (14.87)	35.34** (14.72)	28.52** (14.33)
R&D_Manufacturing_Integration					4.74 (5.59)	4.43 (5.54)	-1.08 (5.57)
The combination of chairman and C.E.O. positions						-10.65* (5.42)	-12.66** (5.25)
Global_work_experience							42.23*** (12.31)
F	1.56	1.29	1.91*	2.49**	2.28**	2.48**	3.50***
R ²	0.05	0.05	0.09	0.12	0.13	0.15	0.22
Adjusted Δ R ²	0.02	0.01	0.04	0.07	0.07	0.09	0.15
df	5,146	6,145	7,144	8,143	9,142	10,141	11,140

Note: Standard errors in parentheses.

*** $\rho < 0.01$

** $\rho < 0.05$

* $\rho < 0.1$

Hypothesis 1 shows that team members with a higher proportion of advanced professional education will positively impact performance. In Table 3, we can see that the education level of the entrepreneurial team is related to the firm's performance. We add main effects to Model 2 to make it statistically significant in explaining variance changes (Table 3: F 4.78, R^2 0.17; $p < 0.01$). We then examined the interaction between educational level and performance, starting with models 3 through 7. The more variances a model explains, the better it is close to reality. We confirmed that the role of structural differentiation also obtained statistically significant regression coefficients in all models.

We framed hypothesis 2, that team members with prior overlapping backgrounds are positively associated with firm performance. In the results of the statistical regression model: In model 3, hypothesis 2 is supported by the variables of sales growth and the number of patents obtained (Table 3: F 3.36, R^2 0.16; $p < 0.01$; Table 4: F 1.91, R^2 0.09; $p < 0.05$). We then examined the interaction between work experience and performance in overlapping contexts starting from models 4 to 7, and statistically significant coefficients were shown in each model. That is consistent with previous literature.

We use Hypothesis 3 to respond to the need for a firm's organizational demography to have employees performing functional diversity in order to contribute to the firm's performance growth. In Model 4, the results of the study showed a negative relationship between hypothesis 3 functional diversity and sales growth as a dependent variable (Table 3: F 5.96, R^2 0.22; $p < 0.1$), while the results of the study supported hypothesis 3 in terms of the number of patents obtained as a dependent variable (Table 4: F 2.49, R^2 0.12; $p < 0.05$). That indicates that it is not entirely consistent with the previous research literature that suggested a positive relationship between the diversity of entrepreneurial teams in terms of duties and firm performance.

We used Hypothesis 4 to respond to the variables of R&D-manufacturing integration within the organizational demography to understand whether young firms with R&D-manufacturing integration have a positive relationship with firm performance. Our hypothesis 4 is statistically significant in terms of sales growth (Table 3), supported by the results presented from models 5 to 7 (Table 3: F 6.22, R^2 0.28; $p < 0.01$). Our findings suggest that the increase of R&D-manufacturing integration has the opportunity to help firm performance.

In Hypothesis 5, we noted that in the corporate governance and leadership structure, the combination of chairman and C.E.O.positions is more likely to impact firm performance positively. The study results indicated that models 6 and 7 of the number of patents captured did not support hypothesis 5 (Table 4: F 2.48, R^2 0.15; $p < 0.05$) and a negative correlation in Table 4. That indicates that having the combination of chairman and C.E.O.positions does not help the firm's performance, especially in technical performance.

Finally, our hypothesis 6 is that entrepreneurial team members with more global experience are more likely to impact firm performance positively. The study results indicated that model 7, in terms of the number of patents captured, supported hypothesis 6 (Table 4: F 3.50, R^2 0.22; $p < 0.01$). That indicates

that members with global working experience are more likely to contribute to firm performance, especially in technical performance, because of their overseas knowledge, technology, and experience.

Discussion

We asked the question: what are the characteristics of a well-performing entrepreneurial team? What should their organizational demography look like? We analyzed 152 young firms under the age of 5 and 1,049 technology team members regarding their human capital and organizational structure, respectively. We identified key characteristics that explain the firm's human capital and organizational demography.

First, regarding the human capital of the entrepreneurial team, the results of our hypothesis 1 support that members with advanced professional education are essential in helping and developing the new technology industry. That is because higher education background can be considered the basis of the competitive advantage talents in technology-based industries need, and it is a critical key competency for firms. Advanced professional education (Ph.D.) is a vital resource that influences the entrepreneurial teams of technology-based startups. This finding is consistent with previous related insights [66][4][30][48].

From our sample of 152 new firms, Hypothesis 2 findings present the importance of team members' prior overlapping backgrounds on firm performance (see Tables 3 and 4). Background affiliation has been examined empirically in the literature, but almost no research has been done on the relationships between Taiwan's young firms in the technology-based industry. One of the values of this research is that the most significant and representative industry is the "semiconductor industry" since Taiwan's semiconductor industry has dominated the market for many years. We propose that if team members have background affiliations, they have already experienced a shared company culture and language, e.g., they could bring suitable firm mechanisms or practices learned from prior firms into new ventures. Therefore, prior background affiliations could be regarded as a way to replicate advantages [59], which might be one of the reasons why the Taiwanese technology-based industry, especially the semiconductor industry, has achieved worldwide stained and high thresholds success.

The results of Hypothesis 3 present the significance of the functional diversity of the organization on the firm performance (see Tables 3 and 4) but bring us a difference in the findings. The functional diversity of team members showed a negative correlation with the company sales growth but a positive correlation with the number of I.P. patents. Considering the reasons behind this, it is possible that in the technology-based industry, firms tend to focus on R&D departments based on technological breakthroughs during the first stage of development (3 years), and may not prioritize the firm's revenue growth rate. In addition, with the acceleration of technological change, the more functional diversity in a firm's organization, the greater the impact of disagreements might happen, and the more likely it is to lose market opportunities by not responding rapidly to needs and making the right decisions. However, the functional diversity of team members is positively correlated with the number of IP patents, probably because different departments contribute with different expertise. In general, the advantages of functional diversity outweigh the disadvantages, and the cross-departmental division of labor in the

organizational structure helps to improve its technical performance, and create higher efficiency and knowledge for the firm [58][6].

In Hypothesis 4, we investigated whether 152 young companies had R&D-manufacturing integration in their organizational structure. The study's results proved that cross-departmental linkages in the organizational structure contributed to the firm's operational performance. Probably because young firms could create and accumulate new product development knowledge through R&D and manufacturing departments working together to solve problems and share information during new product development activities. This integration enhances product development capabilities, driving company performance and gaining competitive advantage through close communication and information sharing [28].

In corporate governance, suppose the board of directors chairman is also the C.E.O. and general manager. In that case, it means that the ownership and operation are not separated, and it is easy to lose the function of supervision of the company. However, ownership and management are not all bad. The advantages of having both roles are that they save communication time between the operating level and the owner and make quicker decisions. Second, it can reduce agency problems and costs. The results of hypothesis 5 of this study suggest that the chairman or chief executive officer (C.E.O.) of a high-tech company, if held by the same person, does not enhance the company's performance in the technical performance section. Therefore, our research suggests that a technology-based firm's chairman or chief executive officer (C.E.O.) may be constrained by the rapid changes in the technology industry. That means if the same person serves as both chairman or C.E.O., this may be detrimental to the company's performance.

This study also furthers our knowledge of new ventures by showing how global work experience represents international value for entrepreneurial team performance. Since global work experience appears critical in globalization and internationalization, we explore the link between entrepreneurial teams, returned overseas experts, and N.V. performance. The findings suggest that returned experts from abroad contribute to N.V.'s competitive advantage in the technology-based industry. Our study broadens the focus on global work experiences, demonstrating the diversity of multicultural foreign work experiences and the utility of these career trajectories. Consistent with the past, our findings could indicate that the international perspective and multicultural foreign work experience brought by entrepreneurial team members can contribute to the firm's performance [49][31].

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