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Entrepreneurial resources, dynamic capabilities and start-up performance of Taiwan's high-tech firms

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Abstract

This study addresses the resources and performance of start-ups in a rapidly changing market. Using data from Taiwanese high-tech firms, this investigation demonstrated that dynamic capabilities were significantly helping to leverage entrepreneurial resources to benefit start-up performance, and moreover demonstrated that dynamic capabilities mediated between entrepreneurial resources and performance. This study mainly focused on enhancing comprehension of start-up dynamic capabilities, and thus improving the resource-based view in high-tech start-ups.
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Keywords: Entrepreneurial resources; Dynamic capabilities; Performance; Start-up; High-tech

1. Introduction

This study elucidates the start-up resources and performance in a rapidly evolving market, especially with a particular focus on high-tech start-ups. According to the concept of the resource-based view (hereafter RBV), firms gain and sustain competitive advantage by deploying valuable resources (Barney, 1986; Dierickx and Cool, 1989; Grant, 1991; Ray et al., 2004; Wernerfelt, 1984). Undoubtedly, resources accumulation is crucial in determining start-up success. However, in a rapidly evolving market, the straightforward application of the RBV in predicting firm success is too simplistic (Eisenhardt and Martin, 2000). Restated, in dynamic environments, simply examining relationships between start-up resources and performance can produce misleading conclusions when using RBV.

Dynamic capabilities, or the ability to integrate, build and reconfigure internal and external resources and competences as a means of addressing rapid change in business environments, are essential in determining firm performance (Teece et al., 1997). Deeds et al. (1999), Eisenhardt and Martin (2000), Zollo and Winter (2000), Makadok (2001), and Zott (2003) have conducted conceptual investigations on dynamic capabilities, building upon the work of Teece et al. (1997). Without dynamic capabilities, firms which are initially resource rich can rapidly deplete their endowments and be eliminated. This study thus proposed a preliminary method of assessing resource-based logic based on the use of a class of mediating *dynamic capabilities* to address start-ups in a dynamic environment.

The high-tech sector was selected because of having short product life cycles and high demand for customized products such as personal computing, network, and communication devices (Liu et al., 2005; Moitra and Ganesh, 2005). These were identified by Teece et al. (1997) as those that stand to benefit from dynamic capabilities in a dynamic environment. Thus, the results of surveys involving Taiwanese high-tech firms provide a rich data set of information regarding dynamic capability behaviors in unstable environments.

This study proposes that an intermediate variable, dynamic capability, existed between start-up performance and resources. Moreover, in actual operations, this study demonstrated that dynamic capabilities were significant, transforming entrepreneurial resources into performance, and that dynamic capabilities were the mediating variable between entrepreneurial resources and performance. Without dynamic capabilities to convert resources into advantage, entrepreneurial resources do not translate into performance (cf., Zollo and Winter, 2000;

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Zott, 2003). Consequently, this work mainly focused on improving comprehension of start-up dynamic capabilities, and thus improving RBV in high-tech start-ups.

The structure of this paper is as follows: after the Introduction, Section 2 reviews the literature and develops research hypotheses, Section 3 describes the research methodology, Section 4 discusses the empirical results, and Section 5 concludes the paper.

2. Literature review and hypotheses

Numerous researches indicate that the work history and experiences of the entrepreneur are crucial for entrepreneurial success (Bruno and Tyebjee, 1985; Hisrich and Peters, 2002; Roberts, 1991; Sandberg and Hofer, 1987; Starr and MacMillan, 1990). These views endorse the resource-based view on firm performance; namely, entrepreneurial resources (such as human and financial capital or access to networks through which these capitals can be acquired) determine entrepreneurial successes.

Often, a start-up cannot thrive on the entrepreneur's human and financial capital alone. Significant other resources must also be in place to produce success (Deeds and Hill, 1996; Teece, 1986). Therefore, the entrepreneur's networks (whether personal and relation-based networks or strategic alliances) are crucial for acquiring the requisite complementary resources and capabilities (Bantham et al., 2003; Deeds and Hill, 1996; Johnson and Sohi, 2003; Shan et al., 1994). Since start-ups are often small in size initially and tend to fail at a very high rate as compared to established companies, cooperative relationships with these entities are often conditioned on their likelihood to survive and thrive. Laumann (1982) believes that balanced reciprocity would entice cooperative firms to supply resources to a start-up so long as the start-up has an appreciable probability of succeeding. Hite (2000) finds that cooperative partners use the abundance of the entrepreneur's resources to assess the likelihood of future reciprocity from the start-up. Following the rational evaluation of cooperation, economic benefits can be acquired and that this is an important factor in a partner's considering cooperation. In conclusion, the more abundant the entrepreneur's own resources are, the greater the willingness of the external partners to cooperate.

Hypothesis 1. The more abundant the entrepreneur's resources, the greater the willingness for external partners to cooperate.

Dynamic capabilities are especially important to technology-based ventures. One unique feature of technology is its speed of development. For example new technologies in information industries have greater memory requirements, faster data processing speed, sharper and brighter visual effects, and so on. As new technology progresses at a fast speed, information product manufactures face enormous pressure to catch up in terms of R&D to prevent their product from immediately becoming obsolete, and out-of-date products have the potential to create a serious inventory problem. Furthermore, sometimes technological breakthrough may completely substitute for existing technologies, for example the document processing function of personal computer created a substitute for typewriters, causing the entire industry to disappear. Similar examples include the digital camera replacing Polaroid, and mobile phones replacing pagers. Zhang (2005), for example, proposed that strategic flexibility enhance firm performance. Thus, for technology-based ventures, dynamic capability, or the capability to adjust to rapid environmental change, is particularly important to survival.

Start-up resources include the core resources of the entrepreneur involved (including human capital, namely professional know-how and operational and managerial knowledge, as well as financial and physical capital, namely money, land, buildings and equipment), and complementary resources provided by cooperating entities. Following Teece et al. (1997), this study defines dynamic capability as start-up ability to integrate, learn, reconfigure and transform. Specifically, dynamic capabilities indicate the ability of ventures to combine and coordinate internal and external resources, to gain and internalize new knowledge from other organizations, and to transform and reconfigure the resource base of their start-up into new processes or routines.

According to the absorptive capacity that Cohen and Levinthal (1990) propose, prior knowledge influences the absorptive capacity of firms to obtain new knowledge. Furthermore, Heeley (1997) and Liao et al. (2003) stated that absorptive capability comprises two major components: external knowledge acquisition and intrafirm knowledge dissemination. Meanwhile, the dynamic capability of start-ups comprises two main components: complementary resources from external partners and internal resources from the entrepreneur themselves. Consequently, one precondition (or component) for being able to combine, coordinate, transform and reallocate existing start-up resources, including start-up internal and external resources, is that these resources are abundant. Thus, the integration, reconfiguration and learning of resources only become meaningful when the resources themselves are abundant.

Hypothesis 2. The more abundant the entrepreneur's resources, the greater the start-up's dynamic capabilities.

Firm resources are limited, and thus firms seek to obtain resources from their environment (Pfeffer and Salancik, 1978). Examples include start-ups relying on upstream suppliers to supply raw materials, downstream channels to deliver goods, and research institutions to provide new technologies. These support firms or organizations provide resources that are necessary to the start-up and moreover that complement its existing resources.

Bantham et al. (2003), Johnson and Sohi (2003), and Danilovic and Winroth (2005) observed that firms which lack sufficient resources to thrive frequently use cooperative methods such as strategic alliances to gain complementary resources and capabilities from support firms. Network studies (such as Gulati, 1999) also indicate the importance of the cooperation of associated support firms in obtaining access to the requisite complementary resources. Following the logic underpinning Hypothesis 2, start-ups will gain more available resources with increasing willingness of support firms to

cooperate, thus increasing the dynamic capabilities of the start-up.

Hypothesis 3. The higher the external partners' willingness to cooperate, the greater the start-up's dynamic capabilities.

Teece et al. (1997) points out that a firm's ability to integrate and reconfigure its resources positively impacts its operational performance. Dynamic capabilities are the antecedent organizational and strategic routines by which managers transform their resource base to create new value-creating strategies (Grant, 1996; Pisano, 1994). They also lie behind the creation, evolution, and recombination of other resources into a competitive advantage. For example, Toyota has employed its superior product development skills to achieve competitive advantage in the automotive industry (Clark and Fujimoto, 1991). Iansiti and Clark (1994) examine integration capability in the automobile and computer industries and discovered that knowledge integration capability in product development correlated positively with firm performance and performance improvements over time.

High-tech start-ups, particularly, face rapidly changing environments in which life cycle of technology is continually shortened, product development is increasingly accelerated, and competing technologies appear frequently. Even if a start-up has the ability to accumulate large resources and to continue to replenish its resources, success is not guaranteed (Eisenhardt and Martin, 2000). In a volatile environment, competitive advantages are not constant but fleeting. Without dynamic capabilities to transform entrepreneurial resources into future advantages, entrepreneurial resources do not translate into start-up performance.

Hypothesis 4. The greater the start-up's dynamic capabilities, the better the start-up's performance.

The relationships among the variables included in the four research hypotheses are presented as in Fig. 1.

3. Method

3.1. Sources of data

This study is a retrospective study with high-tech entrepreneurs as the primary research subjects. Firms in the sample are chosen from Taiwan's Hsinchu High Technology Industrial Park Council's Science Industry Association Registry and the Taiwan Manufacturers Registry published by the China Credit Information Service. The sample is sub-divided into six categories: "integrated circuits", "computer and peripheries", "communications", "optoelectronics", "precision machinery", and "biotechnology".

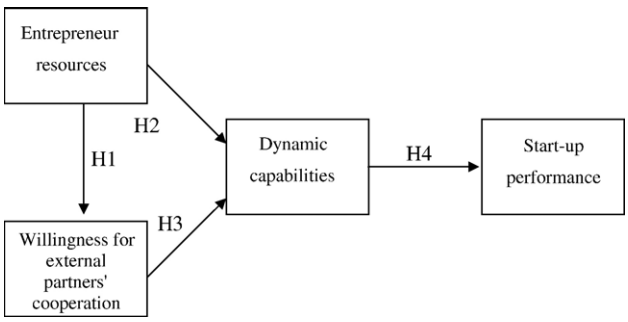

Fig. 1. Hypothesized relationships.

As many of the questionnaire question items involve the circumstances and details during the starting of the firm as well as questions on firm strategies, it is necessary that the firms' executive officers complete the questionnaire themselves (Bowman and Ambrosini, 1997; Phillips, 1981). Specifically, a respondent must either be the entrepreneur or a member of the firm's start-up team, who is privy to the details and circumstances of the firm during its inception. An important step in the data collection process is gaining direct access to the firm's original entrepreneur(s) or executive officer(s). This allows me to conduct personal interviews in addition to the standard paper survey, which collected the more basic information regarding the firm and its history. The personal interview also helps improve the reliability level of the survey answers.

This study first confirms by phone that a potential respondent on contact list did indeed find the firm. After confirmation, this potential respondent is contacted, and I solicited his help in filling out research questionnaire. Questionnaires are mailed out to those respondents who indicated a willingness to complete the survey. The personal phone interviews are then conducted after the paper surveys have been returned by the respondents.

3.2. Measures

Given the exploratory nature of this study, construct operationalization and measurement were achieved in two ways: (1) for those variables employed in previous studies, the measures were adopted as long as they could provide acceptable measurement quality with minor modifications in wording to increase their applicability to the Taiwanese context; (2) for variables that were not measured in previous studies, this study developed operational measures based on previous conceptual studies and assessed content validity via interviews with five hi-tech entrepreneurs and three scholars. Entrepreneurs and scholars were convenience-sampled (Churchill and Brown, 2004) and are EMBA students and faculty members of National Chengchi University, Taiwan.

To assess the content validity of the survey items, survey questions were pre-tested and refined through application to convenience-sampled 20 CEOs (who were also entrepreneurs) chosen from among EMBA students of National Chengchi University (NCCU), Taiwan, to assess both the questionnaire and the administrating process. The respondents were given 1 month to respond, and 16 complete responses were obtained. Ambiguities in the wording were identified and clarified based on these responses. Overall the respondents exhibited no difficulty in understanding the items or the instructions on completing and returning the questionnaire.

Self-administrated questions are used for all variables and established scales are used to measure the latent constructs in this study. The measurements are carried out with Likert and semantic-differential scales. The start-up stage (or early stage) is defined as the period spanning from the establishment of the start-up to the mass production of its first product. Following the approach of Block and MacMillan (1985) and Starr et al. (1993), this study uses new product R&D success, new product exhibition, formal mass production, and the involvement of institutional investors to indicate the beginning of the start-up early stage. In-depth interviews with three high-tech firms and two entrepreneurs found agreement that "formal mass production" is the most important milestone. Furthermore, the average length of time in this study of high-tech firms was 1.83 years. Four constructs exist in this study: entrepreneur resources, willingness for external partners' cooperation, dynamic capability, and start-up performance.

3.2.1. Entrepreneur resources

Entrepreneur resources include an entrepreneur's own resources and abilities. Similar to other studies, this study adopted the following three variables to measure entrepreneur resources: specialized know-how (Amit and Schoemaker, 1993; Leonard-Barton, 1992); financial capital (Brush et al., 1997; Tsai and Ghoshal, 1998); and managerial ability (Collis, 1991; Lippman and Rumelt, 1982). Semantic-differential scales are used for these questions (see Table 1 for details).

3.2.2. Willingness for external partners' cooperation

This study asks the respondent to assess, on a Likert scale (from strongly agree to strongly disagree), external entities' willingness to cooperate with the start-up in its early stage. The respondent is first asked to identify one of its most important external partners in its early stage (whether it be an entity which supplied materials, production capacity, or an individual that supplied technological or managerial know-how). All subsequent questions relating to external partners then focus on this specific entity.

Table 1
Measurements and scales

Constructs	Scale	Type	Measurement item
Entrepreneur resources	1–7	SD	1. In the early stage, your own specialized know-how was (Outdated–Cutting edge) 2. In the early stage, your own capital was (Scant–Abundant) 3. In the early stage, your own managerial capacity was (Scarce–Excellent)
Willingness for external partners' cooperation	1–5	Lkt	1. The cooperative partners are willing to provide resources with priority 2. The cooperative partners are not willing to lightly severe cooperative relations with the company 3. The cooperative partners will not seek to take advantage of the company
Dynamic capabilities	1–7	SD	1. Resource integration capability (Insufficient–Sufficient) 2. Resource reconfiguration capability (Insufficient–Sufficient) 3. Learning capability (Slow–Fast) 4. Ability to respond to the rapidly changing environment (Slow–Fast)
Start-up performance			1. Average Return on Investment (ROI) of the fist 2 years

Note: SD=Semantic-differential scale; Lkt=Likert scale.

3.2.3. Dynamic capabilities

This study's measurement of dynamic capabilities conforms to Teece et al.'s (1997) definition. The entrepreneur is asked to recall the circumstances during the inception of the firm in a free response (which helps the researcher prepare for the subsequent interview); then questions based on semantic differential scales are employed to provide additional assessments. The respondents are asked to respond to the following: during the initial stage of the firm, the firm's: (1) resource integration capability was: insufficient–sufficient; (2) resource reconfiguration capability was: insufficient–sufficient; (3) learning capability was: slow–fast; and (4) ability to respond to changes was: slow–fast.

3.2.4. Start-up performance

This study adopted Return on Investment (ROI) as an indicator of financial performance. Respondents were asked to state their average ROI for the first 2 years.

3.3. Analytical techniques

This study applies the item-to-total correlation and used Cronbach's alpha to establish the adequacy of the measurement model. This study then performed path analysis in LISREL for hypotheses testing (Hair et al., 2006; Nunnally, 1978). The path analysis procedure is common in studies in which a small sample size restricts the use of full structural equation models (cf., Li and Calantone, 1998; Chaudhuri and Holbrook, 2001).

4. Results and discussions

4.1. Sample and data collection

This study's questionnaire data collection includes paper questionnaire and personnel interviews. A total of 450 questionnaires are mailed and 130 valid questionnaires are returned with a rate-of-return of 28.89%. A total of 78 valid questionnaires were returned from the personnel interview portion, which adopts a convenience-sample from NCCU EMBA students of National Chengchi University, Taiwan. The final sample contained 200 firms.

This paper takes additional steps of testing against the efficacy of combining samples collected using different methods in this way. Responses returned by mail were classified as group 1 ($n=130$), while those received by personnel interviews were classified as group 2 ($n=70$). ANOVAs were conducted for annual sales and employee numbers across group 1 and group 2. Analytical results demonstrated no significant difference between these two groups in any of the two measures (for annual sales: $p=0.846$; for number of employees: $p=0.891$).

4.2. Reliability

First, the construct measurements were assessed by calculating the item-to-total correlation coefficients. A coefficient exceeding 0.5 was adopted as the acceptable level of construct measurement. The item-to-total correlation coefficients of all the items revealed that they all exceeded 0.5, indicating acceptable measurements (Hair et al., 2006). Second, measurement reliability was assessed by calculating the Cronbach's alpha coefficient. A coefficient exceeding 0.7 was adopted as the acceptable level of construct measurement. The Cronbach's alpha of all constructs revealed that they all exceeded 0.7, indicating acceptable reliability (Hair et al., 2006; Nunnally, 1978). These results supported the unidimensionality of the scales.

4.3. Hypothesis testing

To best capture the theoretical interdependencies between entrepreneurial resources, dynamic capabilities, and start-up performance, this study analyzed the data using structural equation modeling (LISREL 8.54 statistical package). This procedure allows for a fine-grained analysis of the hypothesized relationships within the context of the entire model. Structural equation modeling is an especially attractive choice when testing mediating variables since all of the relevant paths are directly tested and complications, such as measurement error and feedback, are incorporated directly into the model (Edelman et al., 2005; Venkataraman, 1989). Consequently, path analysis in LISREL was performed for hypotheses testing.

Table 2 presents the overall model fit and the test of each hypothesis. As shown, the results of path analysis indicated an adequate fit: $\chi^2_{(2)}=0.82$, $p=0.66$, GFI=1.00, AGFI=0.99, RMSEA=0.00, NFI=1.00, and CFI=1.00. All four hypotheses gained support (see Table 2 for details). H1 (the more abundant the entrepreneur's resources, the greater the willingness for external partners' cooperation) ($\beta=0.14$, t-value=3.02); H2 (the more abundant the entrepreneur's resources, the greater the start-up's dynamic capabilities) ($\beta=0.53$, t-value=10.31); H3 (the higher the external partners' willingness to cooperate, the greater the start-up's dynamic capabilities) ($\beta=0.27$, t-value=2.68) and H4 (the greater the start-up's dynamic capabilities, the better the start-up performance) ($\beta=0.88$, t-value=13.46).

Table 2
Testing results

Causal path	Hypothesis	Expected sign	Path coefficient	t-Value
Entrepreneur resources→ Willingness for external partners' cooperation	H1	+	0.14*	2.68
Entrepreneur resources→ Dynamic capabilities	H2	+	0.53*	10.31
Willingness for external partners' cooperation→ Dynamic capabilities	H3	+	0.27*	2.68
Dynamic capabilities→ Start-up performance	H4	+	0.88*	13.46

*p<0.05.

4.4. Discussions

Competing models strategy compares the proposed model with a number of alternative models in an attempt to demonstrate that no better fitting model exists. This approach is particularly relevant in structural equation modeling because a model can be shown only to have acceptable fit (Hair et al., 2006). This paper takes additional steps of testing against other competing models to provide validity of my model (Anderson and Gerbing, 1998; Hair et al., 2006; Steenkamp and van Trijp, 1991). First, an additional research hypothesis – the entrepreneur's resources influence directly the start-up performance – is added to the study to form competing model one (Compmod1). This hypothesis forms a natural competing model to my model where resources must be mediated by dynamic capabilities to affect performance. A comparison of Compmod1 with the Estimated Model (my original model) reveals a $\chi^2_{(1)}=0.81$ with a Chi-squared variation value of 0.01, which is insignificant, suggesting that Compmod1 is less desirable. This paper also examines the additional hypothesis that greater external partners' willingness to cooperate leads to better firm performance; this hypothesis is also natural in light of Hypotheses 2 and 3 and is consistent with the observations of Bantham et al. (2003), Dyer and Singh (1998), Harrigan (1985), and Johnson and Sohi (2003). Competing model two (Compmod2) is contrasted with the Estimated Model. Again, model comparison test finds the alternative model unattractive with a $\chi^2_{(1)}=0.017$ with a Chi-squared variation value of 0.803.

The model comparison tests therefore showed that dynamic capabilities were significant, transforming entrepreneurial resources in place into performance, and that the mediating variable between entrepreneur resources and performance was dynamic capabilities. Without dynamic capabilities to convert resources into advantage, entrepreneurial resources do not translate into performance (cf., Zollo and Winter, 2000; Zott, 2003).

5. Conclusions

RBV conceives a firm as a bundle of resources and suggests that resources markedly influence firm performance (Barney, 1986; Dierickx and Cool, 1989; Grant, 1991; Ray et al., 2004; Wernerfelt, 1984). Recent studies have found that RBV has not reached dynamic markets, because alteration is nonlinear and unpredictable (Teece et al., 1997; Eisenhardt and Martin, 2000). Consequently, this study improves understanding of start-up resources and performance in a rapidly evolving market, with a particular focus on high-tech start-ups. This study proposed the existence of an intermediate variable, *dynamic capability*, between start-up performance and resources. Furthermore, in actual operations, this study demonstrated that start-ups with dynamic capabilities can manage resources so as to outperform rivals. Restated, in an unstable environment, start-up resources, including both internal and external, do not directly influence start-up performance. Instead start-up resources influence performance via dynamic capabilities. Consequently, this study improved comprehension of start-up dynamic capabilities, and

thus enhanced RBV in high-tech start-ups. Other ancillary results, which are also interesting, indicate that (1) abundant entrepreneurial resources tend to increase the willingness of outside entities to enter into cooperative networks with the start-up company and (2) the effectiveness of firm cooperative network tends to enhance start-up dynamic capabilities.

5.1. Implications

This study has clearly demonstrated that, for start-ups facing a rapidly changing environment, developing and enhancing dynamic capabilities are crucial. Naturally, improving the resource base is also extremely important since dynamic capabilities must act on the resources in place to ensure firm performance. Start-ups can gain access to complementary or crucial resources via strategic alliances, thus enhancing performance via dynamic capabilities.

This study also provides valuable recommendations on how to assess the quality of start-up companies by assessing their dynamic capabilities. Specifically, one should focus the start-up's resource integration capability, resource reconfiguration capability and learning capability.

5.2. Further research

This study mainly extends Teece et al.'s (1997) definition of dynamic capabilities. Subsequent research can continue by consulting other scholars' interpretations of dynamic capabilities as well as pursue the development of dynamic capability measurement indices using the method of Churchill (1979). Moreover, it would be beneficial to use LISREL second order factor analysis to conduct verification. Furthermore, it is likely that different industries have different dynamic capabilities. This is also a subject that is worthy of further investigation.

The majority of prior studies investigate network formation and firm strategies in static environments. However, networks are not static (Powell, 1990). Consequently, future research can extend the theoretical structure proposed here by injecting dynamic capabilities in a multi-period cooperative network model to investigate the multi-period start-up networks with dynamic capabilities.

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