PERFORMANCE IMPACT OF TECHNOLOGICAL ASSETS AND RECONFIGURATION CAPABILITIES: THE CASE OF SMALL MANUFACTURING FIRMS IN JAPAN

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ABSTRACT

The purpose of this study is to investigate the relationships between firm resources and performance. We divide firm resources into two types: *primary resources* and *support resources*. Primary resources include technological assets and reconfiguration capabilities, which directly contribute to a firm's competitive advantage. Support resources include internal human capital, interfirm collaboration, and managerial vision, which contribute to the development of primary resources. Using a sample of 302 small-and-medium manufacturing firms in Japan, our analysis revealed that both technological assets and reconfiguration capabilities significantly enhanced firm performance, that the firms with superior technological assets tended to possess superior reconfiguration capabilities, and that most of the support resources significantly contributed to the development of both technological assets and reconfiguration capabilities.

INTRODUCTION

The resource-based view of the firm (RBV) sees a firm as a bundle of resources (Penrose, 1959; Wernerfelt, 1984; Peteraf, 1993; Conner, 1991; Barney, 1991) and suggests that a firm's distinctive resources are direct sources of its sustainable competitive advantage. The general premise of the RBV is that firms that own distinctive resources are more likely to achieve superior performance than those that do not own such resources. A related but different perspective, the dynamic capability perspective, highlights the importance of a firm's capability to reconfigure the asset structure as the key source of its sustainable competitive advantage (Teece, 1984; Teece, *et al.*, 1997). The general premise of the dynamic capability perspective is that firms that reconfigure their resources faster than rivals to capture newly emerging market opportunities are more likely to achieve superior performance.

These two perspectives suggest that "ownership" of proprietary assets and "reconfiguration" of the asset structure are the critical sources of a firm's competitive advantage. However, firms with limited available resources may not be able to afford to simultaneously "own (acquire)" new assets and "reconfigure" the existing asset structure. Therefore, the choice between these two orientations has a critical strategic implication. Specifically, managers confronted with uncertainty face two critical strategic issues: should they focus on *owning* more proprietary assets than their rivals so as to build a stronger competitive position in the existing market, or should they focus on *reconfiguring* the existing asset structure faster than their rivals so as to capture new market opportunities? While a growing number of studies have investigated the impact of firm resources on performance, few have clearly differentiated between the effect of ownership and that of reconfiguration of assets, and almost no studies have simultaneously examined their impacts on performance. The purpose of the present study is to fill this gap.

In developing conceptual discussions for hypotheses, we divided firm resources into two types: *primary resources* and *support resources*. Primary resources are defined as firm-specific resources directly involved in value creation and the sustainable competitive advantage of the firm. Primary resources include technological assets and reconfiguration capabilities. Technological assets represent the "stock" of technological knowhow and skills accumulated within a firm that are used to develop differentiated or low cost products. In contrast, reconfiguration capabilities represent a firm's ability to facilitate "flow" in commercial application of technological assets (Eisenhardt and Martin, 2000; Amit and Schoemaker, 1993; Henderson and Cockburn, 1994; Foss *et al.*, 1995).[1]

Support resources are defined as firm-specific resources that contribute to the development of primary resources. They include *internal human capital*, which involves a team of employees and managers that works as a carrier of technological assets and reconfiguration capabilities; *interfirm collaboration*, which involves a firm's network with individuals or organizations external to the firm through which the firm can gain access to new technological assets and reconfiguration capabilities; and *managerial vision*, which provides impetus and direction in the development of technological assets and reconfiguration capabilities. We consider that primary resources are direct sources of a firm's competitive advantage, and hence, directly influence firm performance. Support resources contribute to the development of primary resources, which indirectly influence firm performance.

The main purpose of this study is to simultaneously examine the relationships between support resources, primary resources, and firm performance. Specifically, we address two important questions: how two types of primary resources – technological assets and reconfiguration capabilities – influence firm performance, and how three types of support

[1] An example of technological assets and reconfiguration capabilities can be observed in the product diversification of Canon, one of the most advanced companies in "electrophotography" technology. Building on its optics technologies and combining them with microelectronics, Canon has successfully commercialized the electrophotography process and entered into the personal printer, fax, and copying markets. In this case, the advanced electrophotography technology represents Canon's core technological asset, and the commercialized electrophotography process represents its reconfiguration capability.

resources – internal human capital, interfirm collaboration, and managerial vision – contribute to the development of the primary resources.

THEORY AND HYPOTHESES

Primary Resources

Technological assets. The RBV assumes that firms can be viewed as a bundle of resources, that such resources are distributed heterogeneously across firms, and that they cannot readily be transferred among firms (Penrose, 1959; Wernerfelt, 1984; Barney, 1991; Conner, 1991; Mahoney and Pandian, 1992; Teece *et al*., 1997). Barney (1991) proposed that such resources must be valuable, rare, inimitable, and non-substitutable (the so-called VRIN characteristics), and must be able to produce competitive advantage when integrated into strategy formulation and implementation processes. Amit and Schoemaker (1993) proposed that the primary determinants of rent-creating resources include the following eight characteristics: complementarity, scarcity, low tradability, overlaps with strategic industry factors, inimitability, durability, appropriability, and limited sustainability. Grant (1991) listed four conditions: durability, transparency, transferability, and replicability. Peteraf (1993) argued that four conditions underlying sustained competitive advantage must be met simultaneously: heterogeneity, ex post limits to competition, imperfect mobility, and ex ante limits to competition.

Dierickx and Cool (1989: 1506-1507) suggested that resources should be differentiated as either "asset flows" or "asset stocks." In their words, "a key dimension of strategy formulation may be identified as the task of making appropriate choices about strategic expenditure (advertising spending, R&D outlays, etc.) with a view to accumulating required resources and skills (brand loyalty, technological expertise, etc.). Thus, the level of a firm's asset stocks is a primary determinant of sustainable competitive advantage and hence of its potential profitability" (Dierickx and Cool, 1989: 1510). The notion of "feedback effects," which amplify the heterogeneity among organizations (Levinthal and Myatt, 1994), has similar implications. Underlying this notion is the idea that, in a stable market, the more resources a firm possesses, the more likely it is that the firm can acquire and accumulate greater knowledge than its rivals can, and at a faster rate. The feedback effects have naturally self-reinforcing characteristics: a firm can acquire more resources because it has a large pool of resources. Wernerfelt (1984) also argued that technological assets would allow a firm to gain higher returns because such assets enable the firm to keep better employees in a more stimulating setting. As a result, a firm can develop more advanced technologies and ideas than can its rivals.

A substantial body of theoretical works suggests that idiosyncratic technological competencies are likely to be a significant advantage for engineering- and science-driven industries (Dierickx and Cool, 1989; Nelson, 1991; Dierickx and Cool, 1989; Nelson, 1991; Teece *et al*., 1997). Previous studies have confirmed the positive associations between technological assets and competitive advantage in different industries, such as the pharmaceutical (Henderson and Cockburn, 1994; Yoeh and Roth, 1999), automobile (Clark and Fujimoto, 1991), and film industries (Miller and Shamsie, 1996). Henderson and Cockburn (1994) found that a firm's previous or cumulative success increased the likelihood of its future success and explained a substantial portion of the variance in heterogeneity across firms. In the case of international market entry, Isobe, *et al*. (2000) found that Japanese firms' tendency to transfer more high-level technological assets to their subsidiaries in China generally allowed them to attain superior market performance in China. In sum, previous studies have tended to suggest a positive association between ownership of technological assets and firm performance. Consistent with the evidence of previous studies, we expect that the more technological assets a firm possesses and the higher level those assets are, the more likely it is that the firm will attain superior performance.

Hypothesis 1: The level of technological assets is positively associated with firm *performance.*

Reconfiguration capabilities. In a competitive environment, a firm should change its combination or pattern of asset structure so as to create new opportunities (Karim and Mitchell, 2000) because existing organizational practices and routines may reduce the firm's flexibility in adapting to new changes (Levitt and March, 1988; Weick, 1979). An extension of this idea is that a firm may achieve competitive advantage not only because it owns proprietary assets, but also because it possesses a superior ability to make better use of those assets (Penrose, 1959). Penrose argued that:

> The services yielded by resources are a function of the way in which they are used. … Resources consist of a bundle of potential services, and in combination with different types of resources a firm can create different types of services. …It is the heterogeneity … of the productive services available or potentially available from its resources that give each firm its unique character. (1959: 75)

Penrose's notion of services is akin to "combinative capabilities" (Kogut and Zander, 1992). Combinative capabilities involve "the intersection of the capability of the firm to exploit its knowledge and the unexplored potential of the technology" (Kogut and Zander, 1992: 391). In support of this view, research suggests that the ability of a firm to effectively utilize accumulated resources is the key indicator of its competitive advantage (Rumelt, 1984; Majumdar, 1998).

In addition, a firm does not use resources independently, but as teams or combinations of resources. In an innovative firm, its procurement, production, marketing, and organizational structures and control systems are built to support and complement the R&D activities (Nelson, 1991; Teece, 1986). RBV researchers typically view resources and capabilities as independent sources of competitive advantage and tend to ignore how resources are reconfigured with one another and how the nature of relationships among them would influence a firm's sustainable competitive advantage (Black and Boal, 1994). Henderson and Cockburn (1994) studied the sources of competitive advantage in the pharmaceutical industry. They differentiated between "component competence," which involves local activities and knowledge for day-to-day problem solving, and "architectural competence," which involves a firm's ability to use component competencies, integrate them effectively, and develop new ones. They found that architectural competencies appeared to explain a significant portion of the variance in research productivity across firms.

Recently, management scholars have proposed the dynamic capability perspective. This perspective is an extension of the RBV and emphasizes the importance of reconfiguration as the key building block for competitive advantage (Teece *et al*., 1997; Eisenhardt and Martin, 2000; Henderson and Cockburn, 1994; Nelson 1991). Wernerfelt (1984: 172) argued that strategy should involve "a balance between the exploitation of existing resources and the development of new ones." Eisenhardt and Martin (2000: 1107) defined dynamic capabilities as "the firm's processes that use resources – especially the processes to integrate, reconfigure, gain and release resources – to match and even create market change." The commonality of such definitions is that dynamic capabilities are the natural processes whereby a firm creates a preferable circular system, or routine, through which it can: (1) identify and accumulate firm-specific assets; (2) deploy them into attractive product markets in which such resources are most effectively utilized; and (3) develop new distinctive competencies or integrate internal and external resources (Teece *et al*., 1997).

Building on the notions of combinative capability, architectural competence, and dynamic capability, we define "reconfiguration capability" as a firm's ability to redeploy or recombine the structure of technological assets by integrating internal and external sources of technologies to capture new market opportunities in changing environments. We expect that a firm's reconfiguration capabilities will function as a building block for its sustainable competitive advantage.

Building on previous theoretical and empirical studies, we expect that a firm's reconfiguration capabilities will lead to superior firm performance.

Hypothesis 2: The strength of a firm's reconfiguration capabilities is positively associated with firm performance.

Some authors have suggested that a firm's technological assets will evolve in a path-dependent manner (Teece *et al*., 1997). Path dependence describes the situation in which a firm builds on what it already knows, and what it chooses to do (or know) in the future depends on what it chose to do (or knew) in the past (Langlois, 1995: 91). A firm accumulates its technological assets as the result of path-dependent processes of investments, learning, and decision-making that it adopts over time (Dierickx and Cool, 1989). As a result, firms tend to confine themselves to a limited set of technological domains and lose flexibility in responding to environmental changes (Levitt and March, 1988; Tushman and Anderson, 1986).

Cohen and Levinthal (1990) suggested that a firm's existing knowledge base (or prior related knowledge) plays a key role in its innovative activities. Such a knowledge base is referred to as "absorptive capacity," which is defined as "the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends." (Cohen and Levinthal, 1990: 128). The notion of absorptive capacity suggests that a firm's reconfiguration capabilities depend on the existing level of technological assets. Some firms can respond flexibly to technological change because they successfully seek out, in advance, new technological opportunities to exploit and develop their technological capabilities (Cohen and Levinthal, 1990: 138). Thus, a firm's capabilities simultaneously enhance and inhibit technological innovation (Leonard-Barton, 1992). Studying market entry strategies in the U.S. medical equipment industry, Mitchell (1989) observed that the level of a firm's industry-specific capabilities was significantly associated with the likelihood of the firm being able to effectively utilize its existing resources and exploit new technology within the present industry. In sum, we expect that a firm's existing technological assets will enhance its development of reconfiguration capabilities.

Hypothesis 3: The level of a firm's technological assets is positively associated with the strength of its reconfiguration capabilities.

Support Resources

We define "support resources" as those resources that are owned by a firm and contribute to the development of its primary resources. Previous studies have identified different types of support resources, such as human resources (Lado and Wilson, 1994), organizational culture (Fiol, 1991), information technology (Powell, 1997), and organizational learning (Prahalad and Hamel, 1990), which have notable properties at individual, group, organization, and network levels (Kogut and Zander, 1992). Unlike primary resources, support resources do not directly influence a firm's competitive advantage. They can, however, indirectly influence performance by supporting the development of the firm's technological competencies (DeCarolis and Deeds, 1999). In this study, we focus on three types of support resources, internal human capital, interfirm collaboration, and managerial vision, and discuss how they contribute to the development of a firm's primary resources.

Internal human capital. Internal human capital can be a source of sustainable competitive advantage because tacit knowledge resides in the minds of individuals (Barney, 1991; Amit and Schoemaker, 1993). For example, Karnoe (1995) argued that technological competencies are likely to stem from culturally shaped and embedded organizational routines and behavioral norms of engineers and workers. However, unlike physical or financial assets, employees as carriers of tacit knowledge have the option of leaving the company for better opportunities elsewhere (Coff, 1997). Thus, keeping more talented people within an organization than its rivals is a key to sustainable competitive advantage.

One critical issue is whether a firm should develop employees internally or outsource them from other organizations. Lepak and Snell (1999) developed four employment modes along with the value of uniqueness of human capital. When human capital is both valuable and unique, firms are likely to internalize employment and build employee skills through training and development inside their organizations. Specific knowledge and skills need to be developed internally because internal employment can enhance socialization and decrease bureaucratic costs (Chiesa and Barbeschi, 1994).

Additionally, Hannan and Freeman (1989: 72-73) suggested that well-established firms have two advantages: *reliability*, or capacities to "produce collective products of a given quality repeatedly," and *accountability*, or capacities to "account rationally for their actions." Firms that exhibit reliability and accountability will enjoy sustainable competitive advantage in stable environments. These two advantages are likely to be established through the long-term development of internal human capital. Thus, we set forth the following hypothesis:

Hypothesis 4: The development of internal human capital is likely to enhance the level of a firm's existing technological assets.

Interfirm collaboration. Interfirm collaboration embedded in a firm's relationships with suppliers, customers, and particular institutions often brings new resources and opportunities to the firm, so that such collaboration is thought of as a significant source of competitive advantage (McEvily and Zaheer, 1999; Gulati, 1999; Powell *et al.*, 1996). Many empirical studies have found positive relationships between interfirm linkage, technological development, and firm performance (Powell *et al*., 1996; Henderson and Cockburn, 1994; Baum *et al*., 2000). Powell *et al*. (1996: 119) suggested that "interorganizational collaborations are not simply a means to compensate for the lack of internal skills, nor should they be viewed as a series of discrete transactions." In fact, a firm can further develop and strengthen internal competence through collaboration. They found that a knowledge creation process in external linkages in the form of interfirm collaboration led to superior technological performance.

In addition, since collaboration makes firms more aware of outside opportunities, it is expected that it will also make them more flexible and innovative in dynamic environments (Tushman, 1977). Consequently, the main inducements of reconfiguration capabilities come from external firms or individuals, rather than from inside the firm. For example, von Hippel (1988) demonstrated that requests or suggestions from leading-edge customers are likely to expose a firm to opportunities in terms of new products and advances in technology. Thus, we set forth the following hypotheses:

Hypothesis 5: Interfirm collaboration is likely to enhance the level of a firm's existing technological assets.

Hypothesis 6: Interfirm collaboration is likely to enhance the strength of a firm's reconfiguration capabilities.

Managerial vision. In changing environments, existing firms face considerable uncertainties and complexities stemming from the emergence of new technologies, changes in consumer preferences, and intense competition. Under such conditions, it is difficult for managers to make successful decisions regarding what market to enter, what customers to serve, or what products and technologies to develop. Shared managerial vision is therefore critical for a firm's development of competitive advantage because an organizational rent is likely to stem from imperfect decisions made by rational managers under highly uncertain conditions (Amit and Schoemaker, 1993).

Levinthal and Myatt (1994) proposed the concept of "feed forward effects" that emphasize the significance of the roles of top managerial vision in strategic decision making under conditions of uncertainty. They argued that: "[T]he firm is, or should be, not only concerned about its current capability to compete within that domain, but also with how participating in that particular industry or subfields will affect the firm's future capabilities" (Levinthal and Myatt, 1994: 48). Managers who can provide a clear managerial vision regarding the direction of the firm's capability building are therefore thought of as potent sources of competitive advantage (Hambrick and Mason, 1984; Tushman and Romanelli, 1985; Castanias and Helfat, 1991; Prahalad and Bettis, 1986). Westley and Mintzberg (1989) also proposed the notion of a visionary leader whose managerial vision penetrates into organizations, who facilitates organizational change, and who commits to certain domains of competence in the future. We therefore expect that the managerial vision of a firm will play a critical role in the firm's development of reconfiguration capabilities. Thus, we set forth the following hypothesis:

Hypothesis 7: The extent to which managerial vision is articulated by top management is positively associated with the strength of a firm's reconfiguration capabilities.

DATA AND METHODS

Sample

The data used in this study were collected by a mail survey sent to the member firms of the Osaka Industrial Association. A questionnaire was separately mailed to each of the executives of 917 small-to-medium-sized manufacturing firms in the association; 317 responded and returned the questionnaire among which 302 were suitable for analysis. The response rate was 32.5 percent. The reason we focused on small firms is that they tend to have a relatively more limited number of core products or technologies so that managers may have a good understanding of the key technologies and their impact on the firms' core competencies.

Following the non-response bias detection method (Armstrong and Overton, 1977), comparisons between several key variables for the earlier and later respondents in our sample were made. We considered those respondents who responded within two weeks after the questionnaire was sent to them to be "early respondents" (183) and the rest to be "late respondents" (119). The t-tests showed no significant differences for all variables between the early and late respondent groups. In addition, we examined the potential response bias stemming from the differences in firm size (number of employees) and industrial sector. Since the Spearman's correlation and variance analysis showed that there was no significant association with primary activities and firm performance, we concluded that both industry differences and firm size effects would probably not bias the findings of this study.

We sent the same questionnaire to the technology or manufacturing managers, who were not the first respondents, in each of the 164 responding firms. Seventy-one questionnaires were returned. They were compared with those returned by their firm's first respondents in terms of eight variables representing primary resources and firm performance. All the variables were positively and significantly correlated, and the data collected from the first respondents were used in this analysis.

In addition, to test a possible self-report bias in the performance measurement, we examined whether the profitability and sales growth of the selected firms in our sample were significantly correlated with those of the same firms (67 in total) reported in the *Nikkei Mijoujou Kigyo Soran 2000* (Directory of Non-listed Companies). There was a significant correlation (profitability $r = .402$, $p < 0.01$) between the two performance measures obtained from the two different sources of information, indicating reasonable validity for the performance measures.

Measurement

The overall measurement model employed 14 items to measure both the three exogenous and the three endogenous constructs. The exogenous constructs represented three aspects of support resources: internal human capital, interfirm collaboration, and managerial vision. The endogenous constructs represented two types of primary resources, technological assets and reconfiguration capabilities, as well as a performance construct. Table 1 provides details of the individual items used to measure each construct.

Insert Table 1 about here

The respondents were asked to report their responses to all items on a five-point Likert-type scale with codes ranging from 1 (very unlikely, very low, very slow, or very easy) to 5 (very likely, very high, very fast, or very difficult). To assess internal reliability, we calculated Cronbach's alphas for each construct and found that all of them exceeded the 0.7 level recommended by Nunnally (1978). Table 2 shows the descriptive statistics and internal reliability.

Insert Table 2 about here

The hypotheses were tested using a complementary factor analysis known as structural equation modeling. This method allowed us to identify the effects of support resources on primary resources (technological assets and reconfiguration capabilities) and the effects of primary resources on firm performance. The model used in the analysis is described in Figure 1. The proposed model was recursive and thus satisfied the rank conditions for identification (Bollen, 1989). We used LISREL 8 to estimate the proposed model.

Insert Figure 1 about here

RESULTS

The overall fit of the model was excellent, as indicated in Table 3. The p value of the chi square indicating deviations of the variance-covariance matrix from the model was insignificant at $p = 0.33$, while the other indicators of fit (AGFI = 0.95, CFI = 1.00, RFI = 0.96, RMR = 0.033, and RMSEA = 0.010) were all in the range considered to be indicative of excellent overall model fit to the data.

Insert Table 3 about here

For the structural equations of the endogenous variables, the fit ranged from adequate to excellent for cross-sectional data. The new construct of reconfiguration capabilities was particularly well fitted, with $R^2 = 0.50$, so the model seemed to capture this proposed phenomenon very well. The $R^2 = 0.29$ for Technological Assets, which was also very good for cross-sectional data. As would be expected given that performance was likely to be impacted by many factors outside the scope of our model, the $R^2 = 0.13$ is adequate, if unspectacular, for performance. All variables were statistically significant at well beyond the 0.01 level.

Hypotheses 1-7 all posit positive coefficients in the structural equations. The maximum likelihood estimates of these coefficients, their estimated standard errors, and their t ratios are presented in Table 3. All seven of the hypotheses were supported at the 0.05 level or beyond based upon a one-tailed t-test. Six of the seven received support at well beyond the 0.01 level. Thus, the posited positive relations between the model variables were all well supported by the data.

The standardized coefficients for direct, indirect, and total effects, and their associated t ratios are presented in Table 4. It should be recalled that the standardized coefficients reflect a relative importance measure of each predictor variable on the endogenous variables (Goldberger, 1964). That is, the standardized coefficients indicate the “typical” variation in an endogenous variable which is associated with a “typical” variation in an independent variable, where “typical” is calibrated by the sample standard deviations of all the variables in turn. It should be noted that all direct, indirect, and total effects were significant at the 0.05 level, with 23 of the 24 coefficients being significant at beyond the 0.01 level. Again, the results were very supportive of the model.

Insert Table 4 about here

For Performance, Reconfiguration Capability was the most important construct (0.28), followed by Technological Assets (0.20) and Interfirm Collaboration (0.19). Internalization of Human Capital (0.08) and Managerial Vision (0.05) were substantially less important for Performance; however, their effects were not trivial and were statistically supported. On balance, these results emphasized, both for theory and practice, the importance of reconfiguration capabilities, technological assets, and interfirm collaboration to performance.

For Reconfiguration Capabilities, by far the most important link was Interfirm Collaboration (0.55), with Technological Assets (0.24) and Managerial Vision (0.19) being less than half as important. Internalization of Human Capital (0.09) was important and statistically significant, but much less so than the other factors. These results emphasized the vital role of interfirm collaboration in achieving reconfiguration capabilities, which, in turn, was the most important factor in performance.

For Technological Assets, Internalization of Human Capital was the most important construct (0.38), while Interfirm Collaboration was also important (0.28). Interestingly, the internal aspect was most important for Technological Assets.

One might think that the existence of a causal arrow from Reconfiguration Capabilities to Technological Assets would be a reasonable additional hypothesis. That is, one might hypothesize that technological assets can be built up over time through the development of reconfiguration capabilities (Dierickx and Cool, 1989; Grant, 1991; Black and Boal, 1994). Thus, one might hypothesize that firms with stronger reconfiguration capabilities would be likely to establish higher levels of technological assets. This conjecture, however, was not supported by our data. While the overall fit statistics for a model adding this relationship were virtually identical to those of our original model, the R^2's for the structural equations were lower. For Technological Assets, the drop was over 25 percent, from 0.29 to 0.20; for Reconfiguration Capabilities there was a more modest drop from 0.50 to 0.48; while the R^2 for Performance remained unchanged. Furthermore, the added direct link from Reconfiguration Capabilities to Technological Assets was statistically insignificant ($t < 1.0$) and had the wrong sign (negative). In addition, the inclusion of this additional direct linkage induced nine additional indirect effects, none of which was statistically significant (t's < 1.0). In summary, the inclusion of a direct linkage from Reconfiguration Capabilities to Technological Assets added nothing to the results and was harmful to the fits at the margin.

To examine the potential of the direct effects of support resources (internal human capital, interfirm collaboration, and managerial vision) on performance, we estimated another model which excluded the primary resources of technological assets and reconfiguration capabilities (see Figure 2). The LISREL results are presented in Table 5 and show that for the support resources, neither internal human capital (γ_{31} = 0.061, t = 0.77) nor managerial vision (γ_{32} = 0.044, t = 0.68) had a significant direct effect on performance, which contrasts with the significant indirect effects discussed earlier and with the results of some previous studies (e.g., DeCarolis and Deeds, 1999). Only interfirm collaboration (γ_{33} = 0.32, t = 2.45) was found to have a significant direct effect on performance, but the R^2 of the Performance equation was reduced from 0.13 to 0.77. Thus, it appeared that the proposed model was empirically preferable.

Insert Figure 2 about here

Insert Table 5 about here

DISCUSSION AND CONCLUSIONS

This study investigated how two types of primary resources, technological assets and reconfiguration capabilities, influence firm performance, and how support resources (internal human capital, interfirm collaboration, and managerial vision) influence the development of primary resources.

Our findings provide strong empirical support for almost all of our hypotheses. The findings suggest that both the level of technological assets (H1) and the strength of a firm's reconfiguration capabilities (H2) are strongly associated with firm performance. The level of technological assets significantly enhanced the strength of a firm's reconfiguration capabilities (H3). Specifically, our findings suggest that reconfiguration capabilities have a larger impact on firm performance than do technological assets. This evidence has three important implications. First, reconfiguration capabilities and technological assets both have a significant and positive impact on firm performance. Second, reconfiguration capabilities have a greater impact on firm performance than do technological assets. Third, the development of reconfiguration capabilities is facilitated by technological assets.

With regard to support resources, our findings suggest that internal human capital (H4) and interfirm collaboration (H5) significantly enhance a firm's level of technological assets, and that interfirm collaboration (H6) and managerial vision (H7) have a significant and positive impact on the strength of reconfiguration capabilities. There is a message in these results relating to managerial priorities among these variables. Interestingly, as Table 4 shows, interfirm collaboration has by far the most important impact on reconfiguration capabilities (0.55) – more than double the relative importance of technological assets (0.24) and nearly three times that of managerial vision (0.19).

The findings also suggest that both internal learning through the development of human capital (0.38) and external learning through interfirm collaboration (0.28) make important contributions to the development of technological assets, and that interfirm collaboration (0.55) has a far stronger impact on reconfiguration capabilities than do other support resources such as managerial vision (0.19) and internal human capital (0.09). This latter evidence suggests that firms acquire reconfiguration capabilities more effectively from other firms (via interfirm collaboration) than through internal development.

To supplement the above findings, we conducted in-depth interviews with 36 executives of the selected small-to-medium-sized manufacturing firms in our sample, all of which possessed the leading-edge technologies and dominant market shares in their respective fields. These firms have aggressively developed the original technologies and products, collaborated with other firms or universities, absorbed external technologies and knowledge, and successfully commercialized them into the markets.

One of the respondent firms, a manufacturer of precious metal galvanizing for titanium, recently developed new technology to provide conductivity to ceramic powder and special parts for DNA multiplying equipment and DNA chips. Originally, this firm specialized in traditional galvanizing for accessories such as earrings, necklaces, and brooches. In developing new technology, this firm has aggressively recruited engineers from several large electronics firms and started collaborative R&D activities with biotechnology and information technology specialists in other firms and universities.

Another example concerns a firm that manufactures the key parts of high-pressure hydraulic piston pumps for excavators, cranes, and tractors. The core technologies used by this firm include spherical processing and special welding. These core technologies have been developed though technological collaboration with engineering experts at MIT. The firm established a subsidiary in the U.S. to manufacture piston pump equipment for diesel engine fuel jet pumps, collaborating with several established firms including Caterpillar, VOLVO, and General Motors. With this equipment, the fuel pump is used to inject fuel at high pressure to improve combustion efficiency and reduce CO_2 emission. The equipment has greatly helped users, especially local truck engine manufacturers, to satisfy engine emission requirements.

Most of the executives we interviewed believed that the most critical source of competitive advantage is a firm’s ability to integrate internal and external technologies and speedily commercialize them in the markets. This idea is consonant with our finding that both technological assets and reconfiguration capabilities are the key sources of superior firm performance. The executives also emphasized the importance of their alliances in the development of technological assets and reconfiguration capabilities. An interesting remark made by one senior manager is that a firm develops an advanced technology through interfirm collaboration, not only because the firm can physically gain access to the partner’s pool of technological assets, but also because the firm is expected or even “forced” by the collaborating partner to make a significant commitment to the development of advanced technology. In the words of one of the executives: “Collaborating with other firms requires us to be a leader in a specific area of key technology. Our partners continue supporting us by giving us a significant number of orders and ideas for further innovation. In order to maintain a good alliance with our partners, we continually have to do something beneficial for their business.”

Implications for the Literature

The present study makes several contributions to the RBV literature. First, we conceptually distinguished between technological assets and reconfiguration capabilities and empirically examined their impact on performance. Most studies of RBV used these concepts interchangeably (Priem and Butler, 2001). However, given the fact that a firm’s financial performance is largely a consequence of successful or unsuccessful application of technological assets to new product development and commercialization, mere ownership of technological assets by itself will not always guarantee commercial success of the firm. In conducting analyses, therefore, researchers should make a clear distinction between a firm’s decisions regarding “what assets they should own” and those decisions regarding “how to use (reconfigure) the assets they own” to achieve superior performance. Our study clearly suggests that the “using” decision, which is embodied in our reconfiguration capabilities variable, was even more important than the “owning” decision, which is embodied in our technological assets variable, in improving firm performance. The existing RBV literature tends to focus on discussion of what assets to own, and says little about how to use them to build competitive advantage in newly emerging markets. Future work should treat the concepts of “ownership” and “reconfiguration” of assets separately and conduct more research on their independent and interaction effects on performance.

Second, we examined the systematic relationships between support resources and primary resources (i.e., technological assets and reconfiguration capabilities). Makadok (2001: 391) suggested that understanding the relationship between "resource-picking" and "capability-building" mechanisms is one of the most important issues in strategy research. Our study partly addressed this issue. Our evidence suggests that the level of a firm's technological assets significantly enhances the strength of its reconfiguration capabilities, and interfirm collaboration significantly enhances reconfiguration capabilities**.** These findings suggest that interfirm collaboration, reconfiguration capabilities, and technological assets work dynamically in a complementary manner to develop a firm's competitive advantage. One interesting and important extension of the study is to investigate how firms use interfirm collaboration to manage the dynamic process of co-evolution between technological assets and reconfiguration capabilities, and how they resolve the potential problems of expropriation (Hamel, 1991), the competency trap (Levitt and March, 1991), or core rigidities (Leonard-Barton, 1992) in this process. This kind of research, however, requires more in-depth, longitudinal case studies.

Third, another contribution of our study lies in the use of survey data. Previous studies of the RBV were mostly conceptual. Although an increasing number of researchers have identified the source of competitive advantage and investigated the relationships between resources and firm performance, most research used publicly available data such as R&D expenditure, the number of patents, or the development of new products as proxies for technological competencies (e.g., Hitt and Ireland, 1985; Hitt *et al*., 1990). Our study contributes to the literature of the RBV by empirically measuring technological assets and reconfiguration capabilities, and conducting a systematic empirical test incorporating the effect of support resources such as internal human capital, managerial vision, and interfirm collaboration in the model.

Finally, this study is one of the few that have adopted a causal modeling method in RBV research. This method helps us understand systematic associations between the antecedents and consequences of competitive advantage.

Implications for Practitioners

The study has two implications for practitioners. First, our evidence suggests that the impact of reconfiguration capabilities on performance is even greater than that of technological assets; although both had substantial positive performance effects. In other words, our study suggests that both "using" and "owning" decisions were critical in achieving superior performance. Although capability-building is not an easy task as it involves organization wide commitment, managers should recognize that, as our study suggests, the mere accumulation of technological assets is of little use unless they are successfully converted into distinctive products and services (Penrose, 1959; Henderson and Cockburn, 1994). Our evidence clearly shows that much of the variation in performance of firms comes from the variation in both technological assets and reconfiguration capabilities among firms.

Second, our evidence suggests that interfirm collaboration is a very effective means of developing reconfiguration capabilities, and is substantially superior to internal development. This further suggests that even small firms with limited resources would be able to develop competitive advantages comparable to resource-rich large enterprises by forming collaborative relationships with other firms, and thereby enhancing their reconfiguration capabilities. While some firms may be reluctant to form alliances or any other forms of collaboration with other firms due to the expropriation risks of proprietary knowhow, they should recognize that the key issue in interfirm collaboration is not about how to avoid the expropriation risks of proprietary knowhow but about how to develop a good partnership with partners to explore new competitive opportunities.

Limitations

Despite the contributions discussed above, this study has potential limitations. First, we focused only on technological assets and reconfiguration capabilities as the key elements of primary resources. Other potential sources such as organizational culture, leadership, marketing competence, and other functional skills were ignored in this study. Since superior performance is often based on a complex mix of interrelated and organizationally embedded resources (Black and Boal, 1994), more in-depth investigations are necessary for further understanding of the linkages among different sets of resources and their impact on performance. The moderate R^2 for Performance is consistent with the notion that further development of the performance model might be helpful.

Secondly, this study is cross sectional in nature and says little about the dynamic process of competitive strategy (Porter, 1991; Priem and Butler, 2001; Foss *et al.*, 1995). Scholars have recently proposed the perspective that emphasizes the dynamic and evolutionary nature of technological competencies (Teece *et al*., 1997; Eisenhardt and Martin, 2000; Amit and Schoemaker, 1993). This perspective views a firm's distinctive competence as "process" rather than substance, and explains how the firm articulates necessary resources for innovative outcomes over time, how it deploys the existing resources, and where it explores new resources. Our study, being cross sectional, does not capture the process aspect of competitive strategy.

REFERENCES

Amit R, Schoemaker PJH. 1993. Strategic assets and organizational rent. *Strategic Management Journal* **14**: 33-46.

Armstrong JS, Overton TS. 1977. Estimating nonresponse bias in mail surveys. *Journal of Marketing Research* August: 396-402.

Barney JB. 1986. Strategic factor markets: Expectations, luck, and business strategy. *Management Science* **32**: 1231-1241.

Barney JB 1991. Firm resources and sustained competitive advantage. *Journal of Management* **17**: 99-120.

Baum JAC, Calabrese T, Silverman BS. 2000. Don't go it alone: Alliance network composition and startups' performance in Canadian biotechnology. *Strategic Management Journal*, Special Issue **21**: 267-294.

Black JA, Boal KB. 1994. Strategic resources: Traits, configurations and paths to sustainable competitive advantage. *Strategic Management Journal*, Summer Special Issue **15**: 131-148.

Bollen KA. 1989. Structural Equations with Latent Variables. Wiley: New York.

Castanias RP, Helfat CE. 1991. Managerial resources and rents. *Journal of Management* **17**: 155-171.

Chiesa V, Barbeschi M. 1994. Technology strategy in competence-based competition. In *Competence-based Competition*, Hamel G Heene A (eds). Wiley: New York; 213-234.

Clark KB, Fujimoto T. 1991. *Product Development Performance: Strategy, Organization, and Management in the World Auto Industry*. Harvard Business School Press: Boston, MA.

Cohen WM, Levinthal DA. 1990. Absorptive capacity: a new perspective on learning and innovation. *Administrative Science Quarterly* **35**: 128-152.

Coff RW. 1997. Human assets and managerial dilemmas: Coping with hazards on the road to resource-based theory. *Academy of Management Review* **22**: 374-402.

Conner DJ. 1991. A historical comparison of resource-based theory and five schools of thought within industrial organization economics: Do we have a new theory of the firm. *Journal of Management* **17**: 121-154.

DeCarolis DM, Deeds DL. 1999. The impact of stocks and flows of organizational knowledge on firm performance: An empirical investigation of the biotechnology industry. *Strategic Management Journal* **20**: 953-968.

Dierickx I, Cool K. 1989. Asset stock accumulation and sustainability of competitive advantage. *Management Science* **35**: 1504-1510.

Eisenhardt KM, Martin JA. 2000. Dynamic capabilities: What are they? *Strategic Management Journal*, Special Issue **21**: 1105-1121.

Fiol CM. 1991. Managing culture as a competitive resource: An identity-based view of sustainable competitive advantage. *Journal of Management* **17**: 191-211.

Foss NJ, Knudsen C, Montgomery CA. 1995. An exploration of common ground: Integrating evolutionary and strategic theories of the firm. In *Resource-based and Evolutionary Theories of the Firm: Towards a Synthesis*, Montgomery CA (eds). Kluwer: MA; 1-17.

Fujimoto T. 1998. Reinterpreting the resource-capability view of the firm: A case of the development-production systems of the Japanese auto-makers. *The Dynamic Firm: The Role of Technology, Strategy, Organization, and Regions*, Chandler Jr. AD Hagstrom P Solvell O (eds). Oxford University Press: New York: 16-44.

Goldberger AS. 1964. *Economic Theory*. Wiley: New York.

Grant RM. 1991. The resource-based theory of competitive advantage: implication for strategy formulation. *California Management Review* **33**: 114-135.

Grant RM. 1996. Towards a knowledge-based theory of the firm. *Strategic Management Journal,* Winter Special Issue **17**: 109-122.

Gulati R. 1999. Network location and learning: the influence of network resources and firm capabilities on alliance formation. *Strategic Management Journal* **20**: 397-420.

Hambrick DC, Mason PA. 1984. Upper echelons: The organization as a reflection of its top managers. *Academy of Management Review* **9**: 193-206.

Hamel G. 1991. Competition for competence and inter-partner learning within international strategic alliances. *Strategic Management Journal* **12**: 83-103.

Hannan MT, Freeman J. 1977. The population ecology of organizations. *American Journal of Sociology* **82**: 929-964.

Hannan MT, Freeman J. 1989. *Organizational Ecology*. Harvard University Press: Cambridge, MA.

Henderson R, Cockburn I. 1994. Measuring competence? Exploring firm effects in pharmaceutical research. *Strategic Management Journal*, Winter Special Issue **15**: 63-84.

Hitt MA, Ireland RD. 1985. Corporate distinctive competence, strategy, industry and performance. *Strategic Management Journal* **6**: 273-294.

Hitt MA, Hoskisson RE, Ireland RD. 1990. Mergers and acquisitions and managerial commitment to innovation in M-form firms. *Strategic Management Journal*, Special Issue **11**: 29-47.

Isobe T, Makino S, Montgomery DB. 2000. Resource commitment, entry timing, and market performance of foreign direct investments in emerging economies: the case of Japanese international joint ventures in China. *Academy of Management Journal* **43**: 468-484.

Karim S, Mitchell W. 2000. Path-dependent and path-breaking changes: configuring business resources following acquisitions in the U.S. Medical sector, 1978-1995. *Strategic Management Journal*, Special Issue **21**: 1061-1081.

Karnoe P. 1995. Competence as process and the social embeddedness of competence building. *Academy of Management Journal* **38**: 427-431.

Keats BW, Hitt MA. 1988. A causal model of linkages among environmental dimensions. *Academy of Management Journal* **31**: 570-598.

Kogut B, Zander U. 1992. Knowledge of the firm, combinative capacities, and the replication of technology. *Organization Science* **3**: 383-397.

Lado AA, Wilson MC. 1994. Human resource systems and sustained competitive advantage: a competency-based perspective. *Academy of Management Review* **19**: 699-727.

Langlois RN. 1995. Capabilities and coherence in firms and markets. In *Resource-based and Evolutionary Theories of the Firm: Towards a Synthesis*, Montgomery CA (eds). Kluwer: Boston, MA; 71-100.

Leonard-Barton D. 1992. Core capabilities and core rigidities: a paradox in managing new product development. *Strategic Management Journal*, Summer Special Issue **13**: 42-62.

Lepak DP, Snell SA. 1999. The human resource architecture: toward a theory of human capital allocation and development. *Academy of Management Review* **19**: 31-48.

Levinthal DA, Myatt J. 1994. Co-evolution of capabilities and industry: the evolution of mutual fund processing. *Strategic Management Journal*, Winter Special Issue **15**: 63-84.

Levitt B, March JG. 1988. Organizational learning. *Annual Review of Sociology* **14**: 319-340.

Mahoney JT, Pandian JR. 1992. The resource-based view within the conversation of strategic management. *Strategic Management Journal* **13**: 363-380.

Majumdar SK. 1998. On the utilization of resources: perspectives from the U.S. telecommunications industry. *Strategic Management Journal* **19**: 809-831.

Makadok R. 1999. Interfirm differences in scale economies and the evolution of market shares. *Strategic Management Journal* **20**: 935-952.

Makadok R. 2001. Towards a synthesis of the resource-based and dynamic-capability views of rent creation. *Strategic Management Journal* **22**: 387-401.

McEvily B, Zaheer A. 1999. Bridging ties: a source of firm heterogeneity in competitive capabilities. *Strategic Management Journal* **20**: 1133-1156.

Miller D, Shamsie J. 1996. The resource-based view of the firm in two environments: the

Hollywood film studios from 1936 to 1965. *Academy of Management Journal* **39**: 519-543.

Mitchell WR. 1989. Whether and when? probability and timing of incumbents' entry into emerging industrial subfields. *Administrative Science Quarterly* **34**: 208-230.

Nelson RR. 1991. Why do firms differ, and how does it matter? *Strategic Management Journal*, Winter Special Issue **12**: 61-74.

Nelson RR, Winter S. 1982. *An Evolutionary Theory of Economic Change*. Harvard University Press: Cambridge, MA.

Nunnally JC. 1978. *Psychometric Theory* (2nd ed). McGraw-Hill: New York.

Penrose ET. 1959. *The Theory of the Growth of the Firm*. Wiley: New York.

Peteraf MA. 1993. The cornerstones of competitive advantage: a resource-based view. *Strategic Management Journal* **14**: 179-191.

Porter ME. 1991. Towards a dynamic theory of strategy. *Strategic Management Journal* **12**: 95-117.

Powell TC. 1997. Information technology as competitive advantage: the role of human, business, and technology resources. *Strategic Management Journal* **18**: 375-405.

Powell WW, Koput KW, Smith-Doerr L. 1996. Interorganizational collaboration and the locus of innovation. *Administrative Science Quarterly* **41**: 116-145.

Prahalad CK, Bettis RA. 1986. The dominant logic: a new linkage between diversity and performance. *Strategic Management Journal* **7**: 485-501.

Prahalad CK, Hamel G. 1990. The core competencies of the corporation. *Harvard Business Review* **68**: 79-91.

Priem RL, Butler JE. 2001. Is the resource-based 'view' a useful perspective for strategic management research? *Academy of Management Review* **26**: 22-40.

Rumelt RP. 1984. Towards a strategic theory of the firm. In *Competitive Strategic Management*, Lamb B (eds). Prentice-Hall: Englewood Cliffs, NJ; 556-570.

Teece DJ. 1984. Economic analysis and strategic management. *California Management Review* **26**: 87-110.

Teece DJ. 1986. Profiting from technological innovation: implications for integration, collaboration, licensing, and public policy. *Research Policy* **15**: 285-305.

Teece DJ, Pisano G., Shuen A. 1997. Dynamic capabilities and strategic management. *Strategic Management Journal* **18**: 509-533.

Tushman ML. 1977. Special boundary roles in the innovation process. *Administrative Science Quarterly* **22**: 568-586.

Tushman ML, Anderson P. 1986. Technological discontinuities and organizational environments. *Administrative Science Quarterly* **31**: 439-465.

Tushman ML, Romanelli E. 1985. Organizational evolution: a metamorphosis model of convergence and reorientation. In *Research in Organizational Behavior*, Cummings LL Staw BM (eds). Vol.7: JAI Press: Greenwich, CT; 171-222.

von Hippel E. 1988. *The Source of Innovation*. Oxford University Press: New York.

Weick KE. 1979. *The Social Psychology of organizing* (2nd ed.). Reading, MA: Addison-Wesley.

Wernerfelt B. 1984. A resource-based view of the firm. *Strategic Management Journal* **5**: 171-180.

Westley FR, Mintzberg H. 1989. Visionary leadership and strategic management. *Strategic Management Journal* **10**: 17-32.

Yoeh PL, Roth K. 1999. An empirical analysis of sustained competitive advantage in the U.S. pharmaceutical industry: impact of firm resources and capabilities. *Strategic Management Journal* **20**: 637-653.

TABLE 1

Measurement Instruments

Measurement items		
Support Resources		
Internal human capital		
	x1	We train and develop our employees through in-house training programs (very unlikely-very likely).
Interfirm collaboration		
	x2	We aggressively participate in technological alliances (very unlikely-very likely).
	x3	We obtain important product / market information from external sources (suppliers, customers, and alliance partners) rather than from internal sources (internal search) (very unlikely-very likely).
	x4	We frequently develop new products or services with customers (very unlikely-very likely).
Managerial vision		
	x5	Senior executives articulate the direction of our organization (very unlikely-very likely).
	x6	Senior executives' visions are shared among employees in our organization (very unlikely-very likely).
Primary Resources		
Technological assets		
	y1	Our technological level is much higher than competitors' (very low-very high).
	y2	We acquire new technologies much faster than competitors (very slow-very fast).
	y3	Our technologies can not be easily imitated by competitors (very easy-very difficult).
Reconfiguration capabilities		
	y4	We integrate internal and external technologies more successfully than competitors (very unlikely-very likely).
	y5	We are more successful than competitors in commercial application of technologies to end market (very unlikely-very likely).
	y6	We are more successful than competitors in diversifying into new markets by deploying the existing technologies. (very unlikely-very likely).
Performance		
	y7	Our three-year average sales growth is higher than our major competitors' (very low-very high).
	y8	Our three-year average profitability is higher than our major competitors' (very low-very high).

Items with verbal anchors in parentheses had 1-5 response scale.

TABLE 2
Descriptive Statistics: Means, Correlation Coefficients, and Cronbach's Alphas

	Constructs	Mean	S.D.	1	2	3	4	5	6	Items	Cronbach's alphas
1	Internal human capital	3.40	0.90	1.00						1	1.00
2	Interfirm collaboration	3.91	1.09	0.34**	1.00					3	0.79
3	Managerial vision	2.95	1.07	0.09	0.34**	1.00				2	0.82
4	Technological assets	3.48	1.15	0.43**	0.31**	0.11*	1.00			3	0.76
5	Reconfiguration capabilities	3.15	1.30	0.34**	0.61**	0.38**	0.34**	1.00		3	0.75
6	Performance	2.38	1.01	0.16**	0.19**	0.12*	0.25**	0.32**	1.00	2	0.86

** $p < 0.01$, * $p < 0.05$.

TABLE 3
LISREL Maximum Likelihood Results

Constructs	Technological Assets η_1	Reconfiguration Capabilities η_2	Performance η_3
Internal human capital ξ_1	γ_{11} **0.29** (0.048) 6.02		
Interfirm collaboration ξ_2	γ_{12} **0.34** (0.081) 4.12	γ_{22} **0.66** (0.088) 7.56	
Managerial vision ξ_3		γ_{23} **0.20** (0.058) 3.39	
Technological assets η_1		β_{21} **0.27** (0.070) 3.86	β_{31} **0.15** (0.085) 1.72
Reconfiguration capabilities η_2			β_{32} **0.27** (0.076) 3.57
Adjusted R^2	0.29	0.50	0.13

n = 302; χ^2 = 54.98, df = 51, p = 0.33; adjusted goodness of fit index (AGFI) = 0.95; Comparative fit index (CFI) = 1.00; relative fit index (RFI) = 0.96; root mean square residual (RMR) = 0.033; root mean square error of approximation (RMSEA) = 0.010.
Values in upper rows are maximum likelihood estimators. Values in middle rows are estimated standard deviations. Values in bottom rows are *t* ratios.

TABLE 4
Standardized Efects of Exogenous and Prior Endogenous Constructs

Variables	Technological assets η_1			Reconfiguration capabilities η_2			Performance η_3		
	direct effect	indirect effect	total effect	direct effect	indirect effect	total effect	direct effect	indirect effect	total effect
Internal human capital	0.38		0.38		0.09	0.09		0.08	0.08
ξ_1	6.02		6.02		3.28	3.28		2.48	2.48
Interfirm collaboration	0.28		0.28	0.49	0.07	0.55		0.19	0.19
ξ_2	4.12		4.12	7.56	2.94	8.85		4.40	4.40
Managerial vision				0.19		0.19		0.05	0.05
ξ_3				3.39		3.39		2.47	2.47
Technological assets				0.24		0.24	0.14	0.07	0.20
η_1				3.86		3.86	1.72	2.64	2.73
Reconfiguration capabilities							0.28		0.28
η_2							3.57		3.57

Variables in upper rows are standardized effects. Variables in lower rows are *t*'s.

TABLE 5
LISREL Results: Relationships between Support Resources and Performance

Constructs	Performance $\eta 3$
Internal human	$\gamma 31$
capital	**0.061**
$\xi 1$	(0.080)
	0.77
Interfirm	$\gamma 32$
collaboration	**0.32**
$\xi 2$	(0.130)
	2.45
Managerial vision	$\gamma 33$
$\xi 3$	**0.044**
	(0.065)
	0.68
Ajusted R^2	0.077

n = 302; χ^2 = 12.60, *df* = 10, p = .25; adjusted good-of-fit index (AGFI) = .95; comparative fit index (CFI) = .99; relative fit index (RFI) = 0.94; root-mean-square residual (RMR) = .035; root-mean-square error of approximation (RMSEA) = .013. Values in upper rows are maximum likelihood estimators. Values in middle rows are estimated standard deviations. Values in bottom rows are t ratios.

FIGURE 1
Paths between Latent Variables

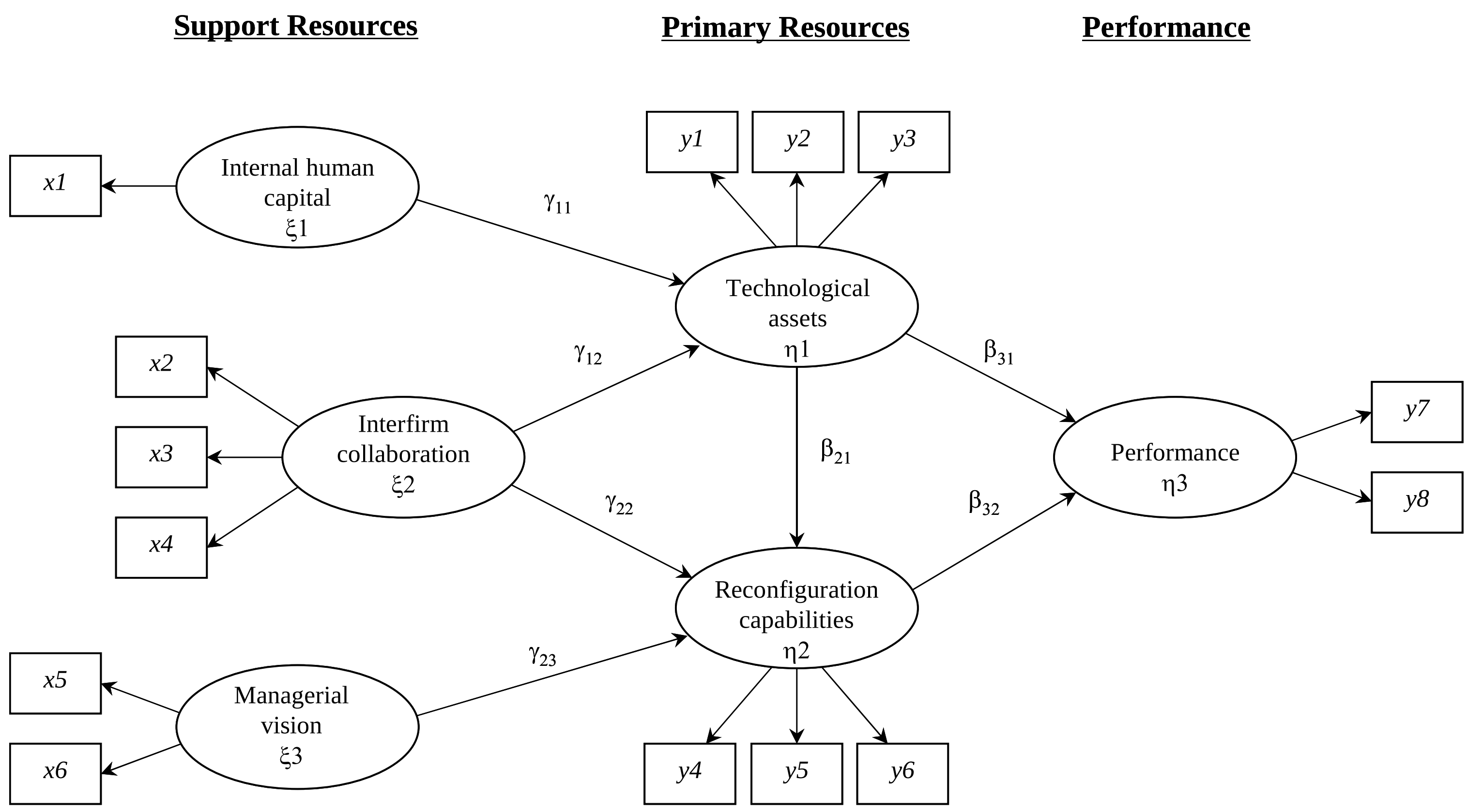

FIGURE 2
Direct Paths of Support Resources to Performance