Marquette University
e-Publications@Marquette

Management Faculty Research and Publications | Business Administration, College of

3-1-2008

Performance Implications of Firm Resource Interactions in the Acquisition of R&D-Intensive Firms

David King
Marquette University, drking@iastate.edu

Rebecca J. Slotegraaf
Indiana University - Bloomington

Idalene Kesner
Indiana University - Bloomington

Published version. *Organization Science*, Volume 19, No. 2 (March-April 2008), DOI: 10.1287/orsc.1070.0313. Used with permission.

Organization Science
Vol. 19, No. 2, March–April 2008, pp. 327–340
ISSN 1047-7039 | EISSN 1526-5455 | 08 | 1902 | 0327

informs®
DOI 10.1287/orsc.1070.0313
© 2008 INFORMS

Performance Implications of Firm Resource Interactions in the Acquisition of R&D-Intensive Firms

David R. King
U.S. Air Force, Wright-Patterson AFB, Ohio 45433, david.king.2@us.af.mil

Rebecca J. Slotegraaf, Idalene Kesner
Kelley School of Business, Indiana University, Bloomington, Indiana 47405
{rslotegr@indiana.edu, ikesner@indiana.edu}

We explore the role of resource interactions in explaining firm performance in the context of acquisitions. Although we confirm that acquisitions do not lead to higher performance on average, we do find that complementary resource profiles in target and acquiring firms are associated with abnormal returns. Specifically, we find that acquiring firm marketing resources and target firm technology resources positively reinforce (complement) each other; meanwhile, acquiring and target firm technology resources negatively reinforce (substitute) one another. Implications for management theory and practice are identified.

Key words: merger and acquisition; resource-based view; high technology
History: Published online in *Articles in Advance* January 7, 2008.

Introduction

The value of worldwide merger and acquisition (M&A) activity set a new record in 2006 with $3.79 trillion worth of transactions—a 38% increase over 2005 (Berman 2007a).[1] The dominant rationale used to explain acquisition activity is that acquiring firms seek higher performance (Bergh 1997, Hoskisson and Hitt 1990, Sirower 1997). However, existing M&A research has not consistently identified variables that impact acquisition performance (King et al. 2004). These mixed signals represent an apparent inconsistency or unsolved puzzle (Agrawal and Jaffe 2000), because firms continue to use acquisitions as a strategic tool with no evidence establishing that acquisitions improve firm performance. Consequently, there is a recognized need for research to identify a theoretical framework that helps to explain acquisition performance (Hitt et al. 1998, Hoskisson et al. 1994, Sirower 1997).

Research on resource interdependence may offer such a framework (Barney 1988, Capron et al. 1998, Capron and Mitchell 1998, Capron and Pistre 2002, King et al. 2004). Using resource-based theory (RBT) as a theoretical lens, research in this area suggests that, in general, acquisition performance will be higher when acquiring and target firm resources complement one another (Capron and Pistre 2002; Hitt et al. 1998, 2001; King et al. 2003; Puranam et al. 2006). Most extant research on resource interconnectedness (Dierickx and Cool 1989) has focused on positive reinforcement (Milgrom and Roberts 1995, Tanriverdi and Venkatraman 2005, Teece 1986) or on complements, where the marginal benefit from higher levels of one resource increases from the level of another resource (Sigglekow 2002). However, firm resource transfers may also serve as substitutes (Capron and Mitchell 1998, King et al. 2003, Miller 2003) or display negative interactions (Sigglekow 2002). We examine resource interactions involving both substitutes and complements between acquiring and target firm resources.

Although an acquiring firm's ability to achieve improved performance is likely to depend on interdependence between its resources and those of the target firm, there is limited research that empirically examines target and acquiring firm resource interactions on firm performance (Song et al. 2005). For example, in three different studies, Capron and her colleagues use a methodology largely reliant on survey data, showing that substantial resource integration occurs following acquisitions and that this plays a key role in a firm's potential adaptation and value creation (Capron and Mitchell 1998, Capron and Hulland 1999, Capron and Pistre 2002). Additionally, Larsson and Finkelstein (1999), relying on a case survey method, show that the complementary interaction between acquiring and target firm resources can produce synergy realization. Finally, Uhlenbruck et al. (2006) examine a subgroup of acquisitions involving online firms to demonstrate the potential for resource transfers. Although these studies have significantly influenced our understanding of the value of interconnectedness between acquirer and target firm resources, examination of resource interactions remains an issue deserving of additional research (King et al. 2004, Song et al. 2005, Uhlenbruck et al. 2006). In response to this need, we

contribute to the literature by using archival data to reinforce existing research through triangulation (Jick 1979) with continuous, nonreactive measures that demonstrate temporal precedence and the potential to advance theory and confidence in prior research (Singh et al. 2003).

We also contribute to existing research by using RBT to explore heterogeneity in firm performance through an examination of target and acquiring firm resource interactions. This advances several identified research needs by: (1) examining the reliance on another firm's resources to achieve competitive advantage (Dyer and Singh 1998), (2) modeling interactions in M&A research (Hoskisson and Hitt 1990), (3) empirically testing hypotheses developed from RBT (Priem and Butler 2001), (4) examining whether acquisitions can be used to gain access to technology (Uhlenbruck et al. 2006), (5) helping to resolve the debate on whether acquired research and development (R&D) acts as a complement (Veugelers 1997) or substitute (Hitt et al. 1990), and (6) exploring resource substitutability (Peteraf and Bergen 2003). Importantly, we also outline conditions where acquisitions may contribute to improved firm performance (King et al. 2004). Thus, our study directly builds on and extends existing management research.

Theoretical Background and Hypotheses

We use RBT to explore heterogeneity in firm performance following an acquisition. The foundation of RBT identifies resources as the drivers of firm heterogeneity (Penrose 1959). Barney (1991, p. 101) defines firm resources as "all assets, capabilities, organizational processes, firm attributes, information, knowledge, etc. controlled by a firm that enable the firm to conceive of and implement strategies that improve its efficiency and effectiveness." The conditions needed to identify a "valuable" resource were further developed by Peteraf (1993, p. 180), and we base our research on two of her four conditions—resource heterogeneity and imperfect resource mobility.

Resource heterogeneity reflects the assumption that resources are unevenly distributed across firms (Barney 1991) because of either resource scarcity or information asymmetry. Scarcity of a preferred resource means that only some firms will possess a resource that enables improved efficiency and effectiveness, driving others to use inferior resources with higher costs to meet demand. The shortage of the preferred resource results in imperfect substitution that allows firms with the preferred resource to enjoy higher performance. When transferring resources, a search involving some degree of irreducible uncertainty must occur (Szulanski 2000). This uncertainty is a result of an information asymmetry, where one party may be better informed or causal ambiguity exists toward the development, refinement, use, or interconnectedness of resources. Imbalanced information is even greater when knowledge is the primary asset of a target firm (Coff 2003). Increasing a recipient's familiarity with information from the source of a transfer (Szulanski 2000) and bringing resources under a hierarchy (King 2006) are approaches to reducing this ambiguity.

We focus on technology resources because technology innovation is central to many industries and innovative capability is scarce (Berry and Taggart 1994). Technology resources also exhibit information asymmetries that make these specialized resources valuable (Zahra 1996). Resource information asymmetry also contributes to imperfect resource mobility. An acquiring firm's R&D intensity builds an absorptive capacity (Cohen and Levinthal 1989, 1990) that can mitigate the difficulty of valuing specialized technology resources that are difficult to appraise and sell (Zahra 1996). An implication is that firms may not represent an equal threat to one another (Chen 1996) or have the same ability to create value from acquiring a given target firm's resources (Barney 1988).

We further develop RBT explanations for competitive advantage (Barney 1991, Peteraf 1993) by examining the interaction of resources between a target and acquirer to include exploring resource substitutability. The extent to which rivals can compete on the basis of resource substitution influences a firm's a competitive advantage (Peteraf and Bergen 2003). In general, the ability of rival firms to substitute similar resources reduces competitive advantage (Barney 1991, Peteraf 1993). However, the impact of substitutes on competitive advantage can be mitigated by time compression, economies of scale, resource interactions and erosion, and causal ambiguity (Dierickx and Cool 1989, p. 1507) through rivals applying imperfect resource substitutes. We hold that the interaction of target and acquiring firm resources should influence an acquiring firm's subsequent performance. In the following sections, we develop and empirically test hypotheses where target and acquiring firm resource relationships can be defined as substitutes or complements. Resource substitution occurs when a negative interaction exists or the marginal benefit of each resource decreases in the level of the other resource (Sigglekow 2002, p. 901). For our purposes, resource substitution occurs when increases in levels of "Resource A" decrease the marginal impact on performance of "Resource B."[2] Considering resource substitution is an important change from M&A research that has traditionally focused on firm relatedness (Hitt et al. 2001).

Resource Substitution

Acquisitions allow for the purchase of resources, such as target firm R&D, that are imperfectly mobile (Capron and Mitchell 1998). So target firm R&D investments represent a primary motivation for acquisition activity (Ahuja and Katila 2001; Bresman et al. 1999; Ranft

and Lord 2000, 2002; Heeley et al. 2006). Acquisitions are often explored because an acquiring firm seeks a firm with requisite capabilities that it lacks (Hoskisson and Busenitz 2002, Heeley et al. 2006), with innovative resources subsequently redeployed between acquiring and target firms (Capron and Mitchell 1998). One expectation is that the larger a target firm's R&D resources, the greater the number of possible resource combinations in a combined firm. An increased number of possible R&D combinations, for example, may increase the chances that a firm will develop a technological innovation (Henderson and Cockburn 1996, Nelson and Winter 1978, Zahra 1996). Meanwhile, recent research indicates that acquired R&D substitutes for internal R&D (Blonigen and Taylor 2000, Heeley et al. 2006)—a position best explained by considering the nature of R&D.

R&D investment creates technology resources (Dierickx and Cool 1989, Grabowski and Vernon 1990) with the uncertain promise of future innovation, but it also requires limiting the funding of clear current needs. Because firms that fail to take advantage of investment opportunities risk being unable to make comparable investments later (Hill and Rotharmel 2003), the result is a dilemma where firms can either risk obsolescence and loss of market share (King et al. 2003) or invest in R&D, where it is estimated that between 46% and 75% of spending goes toward products that ultimately fail (Christensen and Raynor 2003, Hudson 1994).

A real options (McGrath 1999, McGrath and MacMillan 2000) perspective offers a potential way out of this dilemma, with the implication that firms only need to sustain a level of investment to maintain the option to acquire proven technology. However, limited investment may simply reserve firms the right to lose their investment later, if it proves insufficient (Courtney et al. 1997). If true, this suggests that firms may deliberately exceed perceived thresholds to protect their investments.

As acquiring firms consider potential targets, their search is generally limited to firms with similar R&D allocation patterns (Harrison et al. 1991, Stewart et al. 1984, Wolpert 2002). In particular, the ability to effectively appraise (Zahra 1996) and create value (Barney 1988) from target firm technology resources requires that an acquirer look in areas in which it is already performing some level of research. For example, Higgins and Rodriguez (2006) found that the returns associated with acquiring biotechnology firms are positively related to the information accumulated by the acquirer prior to the acquisition. Indeed, integration of a target firm's resources requires a minimum understanding of those resources (Chatterjee and Wernerfelt 1991, Szulanski 2000, Teece 1977); thus an acquiring firm's "absorptive capacity," or its ability to recognize, assimilate, and convert new information to commercial ends (Cohen and Levinthal 1989, 1990), is critical.

The capacity to recognize and exploit external technology is a function of a firm's R&D intensity that enables an acquiring firm to integrate a target firm's technology resources (Cohen and Levinthal 1989, 1990; Nelson and Winter 1978). This frequently limits the search for acquisition targets to areas related to an acquiring firm's existing technological capabilities (Christensen and Rosenbloom 1995, Stuart and Podolny 1996) because of industry-level paradigms that define technology trajectories (Puranam et al. 2006). In particular, technology resources develop in a path-dependent manner (Kogut and Zander 1996), with sustained investments contributing to the depth of firm capabilities (Berry and Taggart 1994, Helfat and Peteraf 2003).

The need for an acquirer to have absorptive capacity further implies that it must perform R&D in the same general areas as a target firm to overcome information asymmetries that hinder integration of technology resources. Thus, there may be significant resource redundancy between target and acquiring firms (Zollo and Singh 2004) or diminishing returns for acquirer R&D.[3] We therefore expect that the acquisition of technology resources will fill specific resource needs of an acquiring firm (King et al. 2003) or that external R&D (at least) serves as a partial substitute for internal development (Barkema and Vermeulen 1998; Blonigen and Taylor 2000; Hitt et al. 1990, 1991). In particular, R&D resources are imperfectly immobile, and acquirers not only seek but will retain such resources to keep such specialized knowledge from rival firms (Capron and Pistre 2002). Thus, the more R&D resources an acquirer holds, the greater the possibility of redundant resources following the acquisition of an R&D-intensive target. As a result, lower returns can be expected from prior investments in those resources.[4]

The effect of a target firm's technology resources substituting for internal development can be anticipated for two reasons. First, there will be resource redundancy resulting from an acquirer needing an absorptive capacity, or a means of valuing and redeploying target firm technology resources. External sourcing of R&D investments represents a rational means of coping with uncertainty (Heeley et al. 2006), assuming that after uncertainty is reduced (McGrath 1999), firms can access needed technology resources through acquisition (Dixit 1992). Second, the likelihood of any resource redundancy in a combined firm will increase with the size of a target firm's R&D investments. As R&D investments increase or exceed the specific technology needs of an acquirer, a target's technology resources become less beneficial (Uhlenbruck et al. 2006) and potentially counterproductive. This meets Sigglekow's (2002) condition for an interaction of substitutes. Therefore, the following is hypothesized:

Hypothesis 1 (H1). *The interaction between target technology resources and acquirer absorptive capacity*

in explaining post-acquisition firm performance involves resource substitution (*i.e., negative interaction*).

Resource Complements

Resource complements represent a valuable source of asymmetry (Miller 2003) and involve a situation where the marginal benefit of each resource increases with the level of the other resource. Research on complementary resources stresses the importance of having specific interconnected resources (Christman 2000, Moorman and Slotegraaf 1999, Tanriverdi and Venkatraman 2005). For our purposes, a complementary relationship exists when different resources positively reinforce one another or exhibit a positive interaction (Sigglekow 2002). In the context of M&A activity, Williamson (1975) argues that an efficient approach to innovation is having technology development or initial products acquired by firms able to commercialize them.

Target firms are often sought for their strong technology resources (Ahuja and Katila 2001, Puranam et al. 2006, Schweizer 2005), which are redeployed within an acquiring firm (Capron and Mitchell 1998). However, innovation and product development research supports the position that effective integration of R&D and marketing contributes to successful outcomes (King et al. 2003, Moorman and Slotegraaf 1999, Song et al. 2005), with effective communication between marketing and R&D functions proving critical to success (Dougherty 1990, Griffin and Hauser 1992). Although both target and acquirer may exhibit similar marketing resource allocation patterns (Stewart et al. 1984), this is less likely to occur among high-technology acquisitions. Firms with relative strengths in marketing typically enter markets *after* technological uncertainty is resolved (Lieberman and Montgomery 1998). R&D-intensive firms typically focus limited financial resources on technology investments over marketing, a resource these firms often lack (King et al. 2003).

The interaction between acquirer marketing and target R&D resources results from bilateral benefits of marketing and R&D resources. Marketing resources increase the value of R&D in at least two ways. First, marketing enables the successful commercialization of innovations. For example, marketing capabilities can improve the success of innovation by increasing a firm's ability to recognize customer needs, improving the position of a firm relative to competitors, and offering a strong sales force for targeting specific customer segments (Moorman and Slotegraaf 1999, Teece 1988). Marketing resources and advertising expenditures, in particular, are a means of appropriating value for a firm's technological resources (Mizik and Jacobson 2003). Second, acquisition by a firm with an established brand may enhance the legitimacy of a target firm's product or technology (Wernerfelt 1988). Firms with brand recognition, for example, have the potential for reputation spillovers that can be applied to other products or markets (Teece 1986, Wernerfelt 1988) without diminishing the underlying value of a firm's brand (Peteraf 1993, Slotegraaf et al. 2003). Consistent with this relationship, Capron and Hulland (1999) found that redeploying marketing resources has a positive impact on acquisition performance. At the same time, technology resources resulting from R&D also enhance the value of marketing resources (Moorman and Slotegraaf 1999). In particular, a firm's technological resources can enhance customer relationships. For example, certain technologies can facilitate frequent product updates that enable a firm to more quickly respond to customer demands (Milgrom and Roberts 1990). Further, a firm's technological resources facilitate its ability to absorb external information (Cohen and Levinthal 1990).

Given a positive reinforcement between marketing and R&D resources to enhance innovation and performance (Dutta et al. 1999, Moorman and Slotegraaf 1999, Teece 1988), acquirer performance will benefit when it has robust marketing resources to commercialize acquired technology resources. This suggests that marketing and R&D positively reinforce one another or that marketing and R&D represent resource complements. As such, we expect firm performance will be higher when an acquirer's marketing resources and a target firm's technology resources are both strong. Therefore, we hypothesize the following:

Hypothesis 2 (H2). *The interaction between target technology resources and acquirer marketing resources in explaining post-acquisition firm performance involves resource complements* (*i.e., positive interaction*).[5]

Method

Sample

Our focus on the acquisition of R&D-intensive or high-technology targets was theory driven. In particular, high-technology acquisitions involve the exchange of R&D resources that meet conditions of resource value through heterogeneity or imperfect mobility (Peteraf 1993). Technology resources resulting from R&D are also consistent with relationships of resource substitution or complements observed in M&A activity (Capron and Mitchell 1998, Capron and Pistre 2002, Heeley et al. 2006, King et al. 2003, Teece 1988). Avoiding a wide cross section of firms also limits the introduction of extraneous effects identified as a concern with existing M&A research (Haspeslagh and Jemison 1991; King et al. 2004; Ranft and Lord 2000, 2002).

We identified high-technology targets as firms operating in two-digit manufacturing and service industries commonly recognized as high-technology that displayed moderate R&D intensity prior to being acquired. Existing literature commonly recognizes seven two-digit

industry sectors as high-technology industries: chemicals (28), computer equipment (35), electronics (36), aerospace (transportation: 37), instruments (38), communications (48), and software (business services: 73) (Certo et al. 2001, Ranft and Lord 2000). Moderate R&D intensity was operationally defined as R&D-to-sales of 2% or greater. This value was based on rounding up from what has been reported as the overall industry average R&D-to-sales figure of 1.5% (Cohen and Klepper 1992, Ravenscraft and Scherer 1987). This enabled us to conservatively and objectively identify target firms as reasonably R&D intensive without unduly restricting our sample. An advantage of including an R&D intensity screen was the elimination of firms in industries such as woodworking machinery (Standard Industry Classification (SIC) 3533) that otherwise may be included in a sample based only on two-digit industry membership.

We examined publicly traded, high-technology firms that were acquired between January 1, 1994, and December 31, 1997. This time frame offered control over known impacts of the business cycle on acquisition activity (Lubatkin et al. 1997, Ramanujam and Varadarajan 1989) by ensuring that all measurement was limited to a period of similar economic conditions. Additionally, we restricted our sample to target firms with a market capitalization of at least $10 million. Imposing such a restriction is consistent with the lower bound observed in prior acquisition research (Ranft and Lord 2002, Ravenscraft and Scherer 1987). After applying these screens, a census of 312 high-technology firms was identified.

To identify the final sample, however, two additional restrictions were applied. First, acquisitions were eliminated if target and acquiring firms' were not identified in COMPUSTAT with non-zero four-digit SIC codes.[6] This enabled controlling for industry effects by focusing on firms operating primarily in a single industry. It also offered the benefit of controlling for potential confounding effects of diversified firms (Berger and Ofek 1995). This restriction also enabled us to use a categorical measure of target and acquiring firm relatedness as a control variable for diversification (Hoskisson et al. 1993). For example, Larsson et al. (2004) suggest that more closely related acquisition targets offer more strategic potential. The second restriction was that acquiring firms had to be present in the Center for Research on Security Prices (CRSP) database to allow calculation of our dependent measures. The final sample included 133 firms, or 42% of the firms meeting our initial screening criteria.

Measures

Dependent Variable. We rely on Jensen's alpha to measure an acquiring firm's abnormal return. Jensen's alpha has been used previously in diversification research (Farjoun 1998; Hoskisson et al. 1993, 1994). It measures the average difference or abnormal return between competing investments (Alexander and Francis 1986, Jensen 1968). (See appendix for discussion of Jensen's alpha). Once calculated for each firm, Jensen's alpha was used as the dependent variable in a cross-sectional regression model to test our hypothesized effects (Campbell et al. 1997).

Independent Variables. Target firm R&D resources were measured using a firm's stock of R&D investments.[7] The use of R&D expenditures as a proxy to measure R&D resources is consistent with existing research (Ahuja and Katila 2001, Ahuja and Lampert 2001, Dutta et al. 2005, Veugelers 1997). R&D is a recognized part of developing technology resources that are built over time through cumulative investments (Cohen and Levinthal 1989, Ethiraj et al. 2005, Henderson and Cockburn 1996, Zahra 1996). Similar to Griliches and Mairesse (1984) and Heeley et al. (2006), we measured a firm's R&D stock using a cumulative R&D measure of a firm's R&D investments depreciated by 15% per year for three years to account for the possibility that more recent R&D is more valuable (Dierickx and Cool 1989).[8] Data on a firm's R&D expenditures were obtained from COMPUSTAT (data code 46).

Similar to Cohen and Levinthal (1989, 1990), we measured acquiring firm absorptive capacity using R&D intensity. Specifically, the measure used was a firm's R&D intensity minus the average R&D intensity of firms in its industry to control for industry effects (Dess et al. 1990). Industry R&D intensity, obtained from COMPUSTAT, was calculated using the average R&D intensity for all firms with the same four-digit SIC code. The resulting relative R&D intensity measure was averaged for the prior three years to represent a firm's level of commitment (Dierickx and Cool 1989) to R&D, while controlling for annual variation. Firm and industry R&D intensity were calculated using data available from COMPUSTAT (R&D expenditures (data code 46) divided by sales (data code 12)).[9]

Acquiring firm marketing resources were measured using a firm's cumulative advertising investments, depreciated by 15% per year for three years. We relied on advertising investments because they represent a key component of a firm's marketing resources (Dutta et al. 1999). A firm's advertising investments are highly related to its marketing know-how (Reuer 2001) and its ability to build and differentiate brands (Langlois 2003). Thus, marketing resources can play a critical role in a firm's ability to recognize and target customer needs and position products relative to competitors (Day 1994). Data on a firm's advertising expenditures were obtained from COMPUSTAT (data code 45).

Control Variables. We also controlled for extraneous effects that could influence the ease of integration and signal or impact acquisition performance. First, we controlled for an acquisition's "announcement effect" using a binary variable based on Sirower's (1997) observation that short-term stock market reactions may serve as a signal for long-term acquisition performance. (See appendix for a description of this control.) Second, we controlled for the relative size of firms using a ratio of target firm market capitalization to acquiring firm market capitalization (Sirower 1997) four weeks prior to an acquisition announcement. We use market capitalization, as it helps signal the value of a target firm's resources and also represents the starting price for which target shareholders would be willing to sell their ownership interest to an acquiring firm.[10] Additionally, this variable helps account for research suggesting that smaller firms are easier to integrate (Alvarez and Barney 2001).

Third, firm profitability prior to an acquisition could impact post-acquisition performance (Kusewitt 1985, Vermeulen and Barkema 2001). Therefore, for the year preceding the acquisition, a ratio of acquiring firm industry-adjusted return-on-sales (ROS) to target firm industry-adjusted ROS was calculated and included in the model.[11] Fourth, an acquiring firm's debt capacity, measured using its current ratio (current assets/current liabilities) in the year prior to an acquisition, was included because it provides information about a firm's leverage and financial burden. Fifth, the relatedness of an acquisition was included and measured using a categorical entropy measure (Hoskisson et al. 1993) to control for the higher potential for related targets (Larsson et al. 2004).

Sixth, we control for target industry type. Our sample includes both service and manufacturing firms, although existing M&A research largely relies on samples of manufacturing firms (Empson 2000). Seventh, we control for an acquiring firm's acquisition experience, measured similar to Hayward (2002) as the sum of the number of acquisitions that the firm completed in the previous three years. Finally, we controlled for the year, or time impact, of an acquisition using dummy variables, with 1994 serving as the reference year. All variables were calculated from data available in COMPUSTAT, CRSP, or Security Data Corporation databases.

Analysis. Moderated multiple regression was used to test our hypothesized relationships because it is recommended for detecting interactions (Sharma et al. 1981). Further, the incremental contributions of the explanatory variable main and interaction effects were analyzed in a forward stepwise fashion. Finally, all predictor variable coefficients were standardized to facilitate interpretation of results (Aiken and West 1991).

Results

The means, standard deviations, and correlations for the research variables are shown in Table 1. Before continuing with our regression analysis, a few results are worth highlighting. First, all correlations are well under the recommended 0.8 threshold that would indicate problems with multicollinearity (Gujarati 1995, p. 355). Second, consistent with existing research (King et al. 2004), the Jensen's alpha in our sample of acquiring firms exhibited a mean abnormal return of zero, indicating that the acquisitions, on average, did not result in abnormal returns. Third, the average relative R&D intensity for acquiring firms was −2.96, a R&D intensity level significantly less than zero ($p < 0.001$). Recall that our measure of R&D intensity is industry adjusted, so an R&D intensity significantly less than zero means that an acquirer is spending significantly less on R&D than other firms in the industry.[12] This suggests that acquiring firms use the acquisition of technology resources as a substitute for internal R&D.

Table 2 shows results from the multiple regression analysis. The independent effect for relative size in both models is significant ($p < 0.05$). Normally, this would

Table 1 Variable Means, Standard Deviations, and Correlations[a]

Variable	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Jensen's alpha	0.00	0.02	1												
2. Acquirer R&D	−2.96	5.83	0.00	1											
3. Target R&D	0.50	1.41	0.00	−0.14	1										
4. Acquirer marketing	−0.11	0.46	−0.01	−0.05	0.01	1									
5. Relative profitability	0.04	0.47	0.04	0.04	0.01	0.00	1								
6. Relative size	0.10	0.21	0.26**	−0.08	0.04	0.03	−0.03	1							
7. Acquirer debt	−1.70	3.47	0.12	0.24**	−0.13	−0.07	−0.02	0.01	1						
8. Relatedness	1.82	1.29	0.16	−0.10	0.18*	−0.04	0.01	0.06	0.13	1					
9. Acquirer experience	1.12	1.56	0.00	−0.03	0.05	0.06	−0.01	−0.02	−0.11	−0.19*	1				
10. Target firm type	0.30	0.46	−0.01	0.29**	−0.12	−0.027**	0.13	0.01	0.16	0.14	−0.02	1			
11. Announcement	0.35	0.48	0.12	−0.04	−0.01	−0.11	−0.05	0.07	−0.13	−0.16	0.07	0.01	1		
12. 1994	0.31	0.46	−0.21*	0.03	0.03	−0.09	−0.07	−0.02	0.05	−0.01	−0.01	0.02	−0.07	1	
13. 1995	0.26	0.44	0.06	0.01	0.00	0.07	−0.06	−0.04	0.17*	−0.10	0.24**	0.05	0.07	−0.39**	1
14. 1996	0.21	0.41	0.08	0.03	0.05	0.08	−0.05	0.07	−0.07	0.03	0.00	−0.06	0.09	−0.35**	−0.31**

[a] $n = 133$; $^{*}p \leq 0.05$; $^{**}p \leq 0.01$.

Table 2 Multiple Regression Results[a]

Variable	Model 1	Model 2
Relative profitability	0.04	0.05
Relative size	0.23*	0.24*
Acquirer debt	0.13	0.14
Relatedness	0.16†	0.20*
1995	−0.25*	−0.29*
1996	−0.06	−0.07
1997	−0.05	−0.06
Acquirer experience	0.06	0.08
Target firm type	−0.07	−0.10
Announcement effect	0.13	0.15†
Acquirer marketing	−0.02	0.03
Acquirer R&D	0.03	0.06
Target R&D	−0.02	−0.30*
Resource substitution		
Interaction of target and acquirer R&D (H1)		−0.21*
Resource complements		
Interaction of acquirer marketing and target R&D (H2)		0.23*
Overall model		
F statistic	1.84*	2.06*
Model R^2	0.17	0.21
Adjusted R^2	0.08	0.11
Incremental F		3.11**

[a] $n = 133$. Standardized coefficients, and one-tailed tests of significance for hypotheses since they connote direction.
† $p \leq 0.10$; * $p \leq 0.05$; ** $p \leq 0.01$.

be interpreted as larger target firms positively impacting performance. However, target firms are typically smaller than their acquirer. In our sample, relative size has a mean value of 0.10, with a standard deviation of 0.21, suggesting that target firms up to half the size of their acquirer are associated with higher performance. Next, the relatedness of an acquisition is positively associated with acquisition performance (Model 2; $p < 0.05$), confirming the admonition of Larsson et al. (2004) that more related acquisitions have higher potential.

Another interesting finding is that the announcement effect is partially significant (Model 2; $p < 0.10$), suggesting the stock market's short-term reaction has a tendency to signal long-term acquisition performance. The results also indicate that acquisitions completed for 1995 experienced significantly lower returns than the reference year 1994. Therefore, a potential concern for interpreting the regression results involves whether pooling acquisition activity from different years violates the regression assumption of homoskedasticity, or equal variance. Supplementary analysis using the Goldfeld-Quandt F-test (Griffiths et al. 1993) showed that none of the year pairings or full model combinations are significant. This suggests that variance across the different years is homoskedastic and regression analysis is appropriate. Finally, the insignificance of target firm type suggests that our results can be generalized across service and manufacturing industries.

The incremental F-statistic for Model 2 is significant ($p < 0.01$), indicating that adding interactions improves the model's explanatory power. Specifically, the interaction of target and acquirer R&D is significant and has a negative impact on firm performance ($p < 0.05$). This supports the notion that target technology resources involve resource substitution with an acquiring firm's technology resources (Hypothesis 1). Also consistent with the hypothesis is the negative effect of target R&D (Model 2; $p < 0.05$), which suggests surplus target technology resources can be counterproductive. We also find the interaction of an acquiring firm's marketing resources and a target firm's technology resources is positive and significantly impacts firm performance ($p < 0.05$). This supports Hypothesis 2, which says that target firm technology resources complement acquiring firm marketing resources. Our research findings are consistent with prior research that shows acquisitions do not lead to higher performance on average (King et al. 2004), but we find resource interactions play a significant role in explaining the performance of acquiring firms. In fact, we explain approximately twice the variance in firm performance from existing M&A research that typically only examines direct effects (Sirower 1997, p. 158). The importance of considering interactions is further emphasized by the lack of significance for the main effects of acquirer resources.

Discussion

Our study offers new insights for RBT by showing that acquiring and target firm resource profiles can be used to predict acquiring firm performance. In answering the need for empirical research examining RBT (Priem and Butler 2001), we demonstrate that acquiring firms can leverage external resources with substitution and complementary relationships to create competitive advantage. Consistent with RBT (Barney 1991, Peteraf 1993), we find evidence that firms can overcome resource heterogeneity and immobility using acquisitions. By developing and testing interactions of acquirer and target resources, we shed light on previously unexplained variance in M&A performance (King et al. 2004) and reinforce the need to examine interactions in M&A research (Hitt et al. 1998, Hoskisson and Hitt 1990). Identifying observable measures associated with abnormal acquiring firm performance, as we have done here, represents an important advancement in explaining observed acquisition activity.

Theoretical Discussion and Implications

Our findings suggest that acquisitions can be profitably used to gain access to technology resources. Our results support research that suggests acquisition activity is one method firms use to manage their resource profiles (Ahuja and Katila 2001, Capron and Mitchell

1998, Capron and Pistre 2002) and overcome problems in the exchange of resources (Anand and Delios 2002, Williamson 1975). Although our sample of firms exhibits an acquisition performance of zero, we identify significant factors that relate to both higher and lower acquisition performance.

The significant negative interaction in our model supports the view that target R&D substitutes for an acquirer's R&D, or that a target firm with substantial R&D investments will produce greater value for an acquiring firm with lower-than-average R&D intensity. Yet the difficulty of valuing and exchanging R&D resources (Zahra 1996) drives acquiring firms to perform R&D, so that they have the requisite absorptive capacity (Cohen and Levinthal 1989, 1990). We are unable to answer how much absorptive capacity or acquirer R&D spending is enough to perform these functions—an important question for future research.[13] Nevertheless, we can conclude that different firm resource profiles, resulting from different investment levels, suggest that the ability to create value from a given target is heterogeneous across potential acquirers.

This is consistent with arguments that acquirers may still earn abnormal returns if inimitable assets or skills are leveraged or exchanged in an acquisition because other potential bidders cannot achieve the same benefit (Barney 1988). Moreover, our results do not indicate that when high-technology firms acquire high-technology targets such an acquisition will necessarily result in lower performance. Instead, our results illustrate that the nature of technological resources between the acquiring and target firms generates substitution effects. Our results—that a target firm's technology resources act as a substitute for an acquirer's technology resources—fill an identified research need (Peteraf and Bergen 2003) and help to resolve an ongoing debate about whether acquired technology serves as a substitute for (Hitt et al. 1990, 1991) or a complement to (Cohen and Levinthal 1989, 1990; Veugelers 1997) internal development.

As a result, our research also illustrates the value of understanding the underlying, complex relationships between an acquiring firm's resources and those of the target firm. A firm that lacks specific technological resources, for example, is likely to seek a target firm that possesses such resources. However, achieving abnormal returns may also depend on an acquiring firm's resources. Thus, an acquiring firm must begin with a good understanding of its own resources if it hopes to take advantage of interactions with the resources of a target firm. Although the potential for value creation is unlocked in the process of integration, an acquisition's potential value may be limited from the start by acquirer and target firm resource profiles. This reiterates the importance of considering the impact of target firm resources on acquisition success (Capron and Mitchell 1998, Saxton and Dollinger 2004) and offers insight for further development of theory relating to the prediction of acquisition performance. Importantly, we find that resource interactions can involve both resource complements and substitutes. For technology resources, both positive and negative marginal benefits can exist for an acquiring firm.

Managerial Discussion and Implications

This research also offers clear implications for practitioners. First, the model presented in our study provides a useful framework for managers of acquiring firms to use to evaluate the fit between the resources of targets and their own firms. It may also serve as a guide to target selection and may offer an initial prediction of acquisition performance.

Second, our results reiterate the importance of managerial decision making on acquisition performance. We rely on measures that are visible to managers and often under their control. Specifically, the value creation potential and, therefore, the price that different acquirers may be willing to pay for a target will be different because of differences in each firm's prior investments to develop unique resources that will interact with a target firm's resources. There is unlikely to be a universal value from acquiring a given target, so understanding the value creation potential of a target for a firm will improve the odds of avoiding the "winner's curse" when managers bid for target firms (Varaiya and Ferris 1987).

A third practitioner implication is that acquisitions offer a viable means for obtaining needed external technology. A firm that lacks specific technology resources, for example, may require an absorptive capacity to identify, value, and integrate target firm technology. As such, the ultimate success of an acquisition may depend on prior discretionary investments that build acquiring firm resources as much as the resources held by a target. Specifically, acquirers should seek targets with technology resources in areas where an acquiring firm is short and (at the same time) ensure they have established the necessary resource stocks to complement acquired technology resources.

Limitations and Opportunities for Future Research

Our intention was to perform an exploratory study of resource interactions on the performance of acquiring firms. Our theory development and results highlight the importance of understanding resource interactions and, by extension, the potential impact of resource redeployment on acquisition success. Overall, there is a need for continued research on resource interactions using other methods and measures to extend our understanding of the impact of resources on M&A performance, as well as in other contexts. We address three main limitations of our study that present opportunities for future research.

First, future research exploring additional aspects of resources and other resource interactions between an

acquirer and target firm will offer additional insight. Our measures of technology and marketing resources relied on observable information and prior practice in extant research. R&D investments are recognized as the foundation of a firm's technological resources and absorptive capacity, but other measures may provide further insight. For example, patent content may offer an alternate measure of technology resources for target firms in the same or similar industries that could isolate the redundant components of technology between a target and acquirer. Moreover, other measures of marketing resources, such as brand reputation or established supplier or customer relationships, could be used. Future research aimed at understanding the process of resource development would improve our understanding and ability to measure these concepts and relationships.

Another opportunity relates to whether threshold levels of absorptive capacity are needed to successfully acquire and integrate R&D intensive targets. For example, King and Driessnack (2003, p. 266) observe that "firms may only need to perform enough R&D to remain aware of external technology and maintain the ability to absorb needed technological developments." Our data suggest the minimum level of R&D intensity required to evaluate and assimilate new technological resources is below an industry's average R&D intensity.[14] Still, inadequate investments can put potential returns (Courtney et al. 1997), as well as the success of subsequent acquisitions, at risk.

Second, we did not examine the impact of implementation or acquisition integration. However, acquiring firms are likely to recognize the importance of integrating the R&D stock from target firms because of interactions with acquiring firm resources (Thompson 1967), with the implication that there is likely to be less variance regarding the degree of integration in the context that we examine. In addition, we controlled for multiple potential issues associated with resource coordination and integration.

Still, a continuing need remains to examine the impacts of acquisition implementation (Ramanujam and Varadarajan 1989) for additional insight into achieving acquisition success. It would be interesting to explore whether the process of selecting a target firm influences integration, and whether an acquirer adjusts its processes or resource redeployment (i.e., integration depth) based on information disclosed through the integration process. A related question involves the commercialization of technology. Future research could build on Puranam et al. (2006) to examine the prevalence of resources in target and acquiring firms that facilitate turning technology into products.

Third, we examined R&D-intensive target firms in the United States, where data are publicly available. Although 90% of all high-technology acquisitions involve U.S. firms (Inkpen et al. 2000), enhancing the generalizability of the resource interactions we observed requires research in other contexts. Our focus on technology target firms facilitated the identification and measurement of known resource exchanges (Capron and Mitchell 1998); however, research examining additional resource interactions and strategies is warranted. For example, examining the impact of acquisitions on firms outside the United States is an additional opportunity for research. The examination of resource interactions in M&A subgroups and other settings, such as alliances, would also be worthwhile.

In closing, the dollar value of acquisition activity remains high, and the expectation is for increased acquisition activity as firms in technology industries continue to consolidate (Berman 2007b, Schonfeld and Malik 2003). Our focus on resource interactions supports existing theory that the resource profiles of both acquiring and target firms impact acquisition performance (Barney 1988, Capron et al. 1998, Capron and Pistre 2002, King et al. 2003). Identifying a role for both resource substitution and resource complements in acquisitions also offers new insights into target firm selection, the source of value from firm resources, and acquirer performance.

Acknowledgments

The authors thank Jeff Covin, Tom Lenz, Margaret Cording, and two anonymous reviewers for their contributions in developing their research. Any remaining errors in the research are the responsibility of the authors. The views expressed in this research are those of the authors and do not reflect the official policy or position of the United States Air Force, Department of Defense, or the U.S. government.

Appendix. Performance Measurement

Strategic management literature in general (Daily 1994, Daily et al. 2002) and acquisition research specifically (Javidan et al. 2004) do not provide a consensus for measuring firm performance. Generally, M&A research focuses on financial performance using either accounting or stock market measures. We elected to avoid using accounting measures of performance because they tend to have a historical focus (Chakravarthy 1986) and, in the case of return on assets, can be biased by the method of accounting for an acquisition (Ravenscraft and Scherer 1987, Sirower 1997). This left a choice between short- or long-term stock market measures of performance.

The primary difference between short- and long-term measures of stock performance is that they relate to "expected" or "realized" returns, respectively. A criticism of short-term stock market measures in M&A research is that they may downwardly bias abnormal returns because of the implicit assumption that all the information needed to accurately price the impact of an acquisition, when it is announced, is available to the market (Loderer and Martin 1992, Lubatkin and Shrieves 1986). The need for longitudinal measures in M&A research (Puranam et al. 2006) shows that acquisitions represent complex events where information is revealed over time (Lubatkin 1987). Several researchers suggest three years as a sufficient amount of time to observe changes in firm post-acquisition performance (Ingham et al. 1992, Lubatkin et al.

2001). Time frames of even two years may be too short to discover how acquisitions contribute to an acquiring firm's performance (Saxton and Dollinger 2004).

Therefore, we selected a long-term stock measure. Jensen's alpha (Jensen 1968), a variation of the two-parameter market model previously used (Farjoun 1998; Hoskisson et al. 1993, 1994), was our primary performance measure. An advantage of Jensen's alpha is that it compares the return of an acquiring firm with a benchmark from a common starting point. We use the Standard and Poor (S&P) 500 as our benchmark for calculating abnormal returns, as acquiring firms had an average market capitalization of \$6.05 billion and represented a diverse set of industries. (Note: Only target firms were limited to high-technology industries.) Further, the S&P 500 provides a recognized stock market benchmark of large firms and represents a reasonable rate of return that an acquisition should exceed if it is expected to contribute to a firm's competitive advantage. Additionally, Jensen's alpha measures the average difference between the market benchmark's return and the return of the firm for the time unit (i.e., month) used (Alexander and Francis 1986), rather than the return over the entire window (i.e., three years). The return for the time unit should be less susceptible to changes in event window than buy and hold returns that simply calculate the return between two points in time.

For each month after an acquisition ($t = 1$ to 36) the following regression model was used to calculate Jensen's alpha:

$$R_{it} = \alpha_i + \beta_i(R_{mt}) + \varepsilon_{it},$$

where

- R_{it} is the monthly rate of return of firm i during month t
- α_i is Jensen's alpha for firm i
- β_i is firm i's stock price variance relative to the variance of the market benchmark (m)
- R_{mt} is the monthly rate of return of the market benchmark (m) during month t
- ε_{it} is the random error term.

Positive values of Jensen's alpha indicate that an acquiring firm outperformed the market benchmark or S&P 500. Comparing a firm's stock performance with a benchmark portfolio offers several benefits, including: (1) comparing an acquirer with a benchmark of multiple firms that eliminates matching firms to calculate abnormal returns, and (2) calculating the average abnormal return of investing in a firm against a benchmark over the same time period. This eliminates a pre-announcement estimation period needed for the capital asset pricing model to estimate a firm's normal return. However, long-term stock market measures of firm performance are also subject to criticism because of the potential for confounding events (Williams and Siegel 1997).

Because all our measures are observable on the day an acquisition is announced, the stock market may be able to accurately classify whether an acquisition can be expected to create value (Sirower 1997, p. 123). Therefore, we added a control for an acquisition's "announcement effect" using a short-term stock market measure of an acquirer's cumulative abnormal returns. We calculated cumulative abnormal returns for each acquirer one day before announcement to one day after announcement (three-day window), using the CRSP equally weighted market index for benchmark portfolio. The market model first estimates α_j and β_j from returns earned during the estimation period

$$R_{jt} = \alpha_j + \beta_j R_{mt} + \epsilon_{jt},$$

where R_{jt} is the rate of return on the common stock of the jth firm on day t; R_{mt} is the rate of return of a market index on day t; ϵ_{jt} is the random error term. β_j is a parameter that measures the sensitivity of R_{jt} to the market index. The abnormal return for firm j on day t is defined as:

$$AR_{jt} = R_{jt} - (\alpha_j + \beta_j R_{mt}),$$

where t now corresponds to the event window. The variable used in our models—cumulative abnormal returns—is the sum of the abnormal returns for the three-day event window. The resulting announcement effects were then transformed into a categorical variable, with "0" assigned to acquisitions with a negative announcement effect and a "1" assigned to acquisitions with a positive announcement effect. The resulting variable was used as a control in our regression model.

Endnotes

[1]Our focus on R&D-intensive firms is driven by theory and the level of observed activity, as it is estimated that technology firms represent over one-fifth the number and two-fifths the value of acquisitions (Inkpen et al. 2000).

[2]We would like to thank an anonymous reviewer for this succinct description.

[3]The impact of nonredundant R&D between target and acquiring firms should be conservative, as nonredundant R&D would suggest a positive impact from new resource combinations.

[4]We would like to thank an anonymous reviewer for helping to make this link to our dependent variable explicit.

[5]We would like to thank an anonymous reviewer for pointing out that the reverse relationship (i.e., target marketing and acquirer R&D) could also exist. In our sample, 68% of target firms reported no marketing expenditures for the three-years prior to their being acquired. This is consistent with acquiring firms having marketing resources that can be extended to other markets and products (Peteraf 1993, Wernerfelt 1988).

[6]COMPUSTAT assigns an SIC code that best describes a firm's business. If a firm is involved in more than one industry, it may be assigned a more general code indicated by a zero entered for the third and fourth digits (Kahle and Walkling 1996). A four-digit code is only used when a firm's primary focus is in a single industry. Additionally, Kahle and Walkling (1996) compare samples matched on COMPUSTAT and CRSP SIC codes and conclude that the use of SIC codes assigned by COMPUSTAT is more powerful in detecting abnormal performance.

[7]While patents were considered a measure, they were not used for two key reasons: (1) Patents were not consistently reported for our sample of target firms (i.e., only approximately 40% of sampled firms held patents), and (2) Acquiring firms in our sample operated in multiple industries, where patent publication was not consistently valued across the industries (Ahuja and Katila 2001, Brusoni et al. 2001).

[8]Although we follow available guidance on depreciating R&D, we thank an anonymous reviewer for recognizing that the depreciation rate of R&D may vary across industries.

[9]Comparing target firm R&D stock to acquirer R&D intensity compensates for large differences in target and acquiring firm size, while capturing the extent of potential resource redundancies from a target firm's R&D investments.
[10]Sensitivity analysis using a sales measure of relative size provided similar results.
[11]Because research suggests that prior performance may impact the performance of acquiring firms, we control for it as a potential extraneous effect. A positive coefficient on our profitability variable could be interpreted as contributing to acquirer performance by either: (1) a more profitable acquirer, keeping target ROS constant, continuing to outperform, or (2) a less profitable target, keeping acquirer ROS constant, leading to higher performance through a disciplinary function of target firm management. We thank an anonymous reviewer for prompting this explanation.
[12]Note that acquirers still spent significant sums on R&D; average R&D expenditures for the three years prior to an acquisition for our sample of acquiring firms are $502 million per firm.
[13]We thank an anonymous reviewer for raising this point.
[14]We would like to thank an anonymous reviewer for this insight.

References

Agrawal, A., J. Jaffe. 2000. The post-merger performance puzzle. C. Cooper, A. Gregory, eds. *Advances in Mergers and Acquisitions.* Elsevier Science, New York, 7–42.

Ahuja, G., R. Katila. 2001. Technological acquisitions and the innovation performance of acquiring firm: A longitudinal study. *Strategic Management J.* **22** 197–220.

Ahuja, G., C. Lampert. 2001. Entrepreneurship in the large corporation: A longitudinal study of how established firms create breakthrough inventions. *Strategic Management J.* **22** 521–543.

Aiken, L., S. West. 1991. *Multiple Regression*: *Testing and Interpreting Interactions*. Sage Publications, London.

Alexander, G., J. Francis. 1986. *Portfolio Analysis*, 3rd ed. Prentice Hall, Englewood Cliffs, NJ.

Alvarez, S., J. Barney. 2001. How entrepreneurial firms can benefit from alliances with large partners. *Acad. Management Executive* **15** 139–148.

Anand, J., A. Delios. 2002. Absolute and relative resources as determinants of international acquisitions. *Strategic Management J.* **23** 119–134.

Barkema, H., F. Vermeulen. 1998. International expansion through start-up or acquisition: A learning perspective. *Acad. Management J.* **41** 7–26.

Barney, J. 1988. Returns to bidding firms in mergers and acquisitions: Reconsidering the relatedness hypothesis. *Strategic Management J.* **9** 71–78.

Barney, J. 1991. Firm resources and sustained competitive advantage. *J. Management* **17** 99–120.

Berger, P., E. Ofek. 1995. Diversification's effect on firm value. *J. Financial Econom.* **37** 39–65.

Bergh, D. 1997. Predicting divestiture of unrelated acquisitions: An integrative model of ex ante conditions. *Strategic Management J.* **18** 715–731.

Berman, D. 2007a. Can M&A's "best of times" get better? *Wall Street J.* (January 2) R5.

Berman, D. 2007b. The game: Handicapping deal hype and hubris. *Wall Street J.* (January 16) C1.

Berry, M., J. Taggart. 1994. Managing technology and innovation: A review. *R&D Management* **24** 341–353.

Blonigen, B., C. Taylor. 2000. R&D intensity and acquisitions in high-technology industries: Evidence from the US electronic and electrical equipment industries. *J. Indust. Econom.* **48** 47–70.

Bresman, H., J. Birkinshaw, R. Nobel. 1999. Knowledge transfer in international acquisitions. *J. Internat. Bus. Stud.* **30** 439–462.

Brusoni, S., A. Prencipe, K. Pavitt. 2001. Knowledge specialization, organizational coupling, and the boundaries of the firm: Why do firms know more than they make? *Admin. Sci. Quart.* **46** 597–621.

Campbell, J., A. Lo, A. MacKinlay. 1997. *The Econometrics of Financial Markets*. Princeton University Press, Princeton, NJ.

Capron, L., J. Hulland. 1999. Redeployment of brands, sales forces, and general marketing management expertise following horizontal acquisitions: A resource-based view. *J. Marketing* **63** 41–54.

Capron, L., W. Mitchell. 1998. Bilateral resource redeployment and capabilities improvement following horizontal acquisitions. *Indust. Corporate Change* **7** 453–484.

Capron, L., N. Pistre. 2002. When do acquirers earn abnormal returns? *Strategic Management J.* **23** 781–794.

Capron, L., P. Dussauge, W. Mitchell. 1998. Resource redeployment following horizontal acquisitions in Europe and North America, 1988–1992. *Strategic Management J.* **19** 631–661.

Certo, S., J. Covin, C. Daily, D. Dalton. 2001. Wealth and the effects of founder management among IPO-stage new ventures. *Strategic Management J.* **22** 641–658.

Chakravarthy, B. 1986. Measuring strategic performance. *Strategic Management J.* **7** 437–458.

Chatterjee, S., B. Wernerfelt. 1991. The link between resources and type of diversification: Theory and evidence. *Strategic Management J.* **12** 33–48.

Chen, M. 1996. Competitor analysis and interfirm rivalry: Toward a theoretical integration. *Acad. Management Rev.* **21** 100–134.

Christensen, C., M. Raynor. 2003. *The Innovator's Solution: Creating and Sustaining Successful Growth*. Harvard Business School Press, Boston, MA.

Christensen, C., R. Rosenbloom. 1995. Explaining the attacker's advantage: Technological paradigms, organizational dynamics, and the value network. *Res. Policy* **24** 233–257.

Christman, P. 2000. Effects of "best practices" of environmental management on cost advantage: The role of complementary assets. *Acad. Management J.* **43** 663–680.

Coff, R. 2003. Bidding wars over R&D intensive firms: Knowledge, opportunism and the market for corporate control. *Acad. Management J.* **46** 74–85.

Cohen, W., S. Klepper. 1992. The anatomy of industry R&D intensity distributions. *Amer. Econom. Rev.* **82** 773–799.

Cohen, W., D. Levinthal. 1989. Innovation and learning: The two faces of R&D. *Econom. J.* **99** 569–596.

Cohen, W., D. Levinthal. 1990. Absorptive capacity: A new perspective on learning and innovation. *Admin. Sci. Quart.* **35** 128–152.

Courtney, H., J. Kirkland, P. Viguerie. 1997. Strategy under uncertainty. *Harvard Bus. Rev.* **75**(6) 66–79.

Daily, C. 1994. Bankruptcy in strategic studies: Past and promise. *J. Management* **20** 263–295.

Daily, C., P. McDougall, J. Covin, D. Dalton. 2002. Governance and strategic leadership in entrepreneurial firms. *J. Management* **28** 387–412.

Day, G. 1994. The capabilities of market-driven organizations. *J. Marketing* **58**(4) 37–52.

Dess, G., R. Ireland, M. Hitt. 1990. Industry effects and strategic management literature. *J. Management* **16** 7–27.

Dierickx, I., K. Cool. 1989. Asset stock accumulation and sustainability of competitive advantage. *Management Sci.* **35** 1504–1513.

Dixit, A. 1992. Investment and hysteresis. *J. Econom. Perspectives* **6** 107–132.

Dougherty, D. 1990. Understanding new markets for new products. *Strategic Management J.* **11** 59–78.

Dutta, S., O. Narasimhan, S. Rajiv. 1999. Success in high-technology markets: Is marketing capability critical? *Marketing Sci.* **18** 547–568.

Dutta, S., O. Narasimhan, S. Rajiv. 2005. Conceptualizing and measuring capabilities: Methodology and empirical application. *Strategic Management J.* **26** 277–285.

Dyer, J., H. Singh. 1998. The relational view: Cooperative strategy and sources of interorganizational competitive advantage. *Acad. Management Rev.* **23** 660–679.

Empson, L. 2000. Mergers between professional service firms: Exploring an undirected process of integration. C. Cooper, A. Gregory, eds. *Advances in Mergers and Acquisitions*. Elsevier Science, New York, 205–238.

Ethiraj, S., P. Kale, M. Krishnan, J. Singh. 2005. Where do capabilities come from and how do they matter? A study in the software services industry. *Strategic Management J.* **26** 25–45.

Farjoun, M. 1998. The independent and joint effects of the skill and physical bases of relatedness in diversification. *Strategic Management J.* **19** 611–630.

Grabowski, H., J. Vernon. 1990. A new look at the risks and returns to pharmaceutical R&D. *Management Sci.* **36** 804–821.

Griffin, A., J. Hauser. 1992. Patterns of communication among marketing, engineering and manufacturing—A comparison between two new product teams. *Management Sci.* **38** 360–373.

Griffiths, W., R. Hill, G. Judge. 1993. *Learning and Practicing Econometrics*. John Wiley and Sons, New York.

Griliches, Z., J. Mairesse. 1984. Productivity and R&D at the firm level. Z. Griliches, ed. *R&D, Patents, and Productivity*. University of Chicago Press, Chicago, IL, 339–374.

Gujarati, D. 1995. *Basic Econometrics*, 3rd ed. McGraw-Hill, New York.

Harrison, J., M. Hitt, R. Hoskisson, R. Ireland. 1991. Synergies and post-acquisition performance: Differences versus similarities in resource allocations. *J. Management* **17** 173–190.

Haspeslagh, P., D. Jemison. 1991. *Managing Acquisitions*: *Creating Value Through Corporate Renewal*. The Free Press, New York.

Hayward, M. L. A. 2002. When do firms learn from their acquisition experience? Evidence from 1990–1995. *Strategic Management J.* **23** 21–39

Heeley, M., D. King, J. Covin. 2006. R&D investment level and environment as predictors of firm acquisition. *J. Management Stud.* **43** 1513–1536.

Helfat, C., M. Peteraf. 2003. The dynamic resource-based view: Capability lifecycles. *Strategic Management J.* **24** 997–1010.

Henderson, R., L. Cockburn. 1996. Scale, scope, and spillovers: The determinants of research productivity in drug discovery. *RAND J. Econom.* **27**(1) 32–59.

Higgins, M., D. Rodriguez. 2006. The outsourcing of R&D through acquisitions in the pharmaceutical industry. *J. Financial Econom.* **80** 351–383.

Hill, C., F. Rotharmel. 2003. The performance of incumbent firms in the face of radical technological innovation. *Acad. Management Rev.* **28** 257–274.

Hitt, M., J. Harrison, R. Ireland. 2001. *Mergers and Acquisitions*: *A Guide to Creating Value for Stakeholders*. Oxford University Press, Oxford, UK.

Hitt, M., R. Hoskisson, R. Ireland. 1990. Mergers and acquisitions and managerial commitment to innovation in M-form firms. *Strategic Management J.* **11** 29–47.

Hitt, M., J. Harrison, R. Ireland, A. Best. 1998. Attributes of successful and unsuccessful acquisition of U.S. firms. *British J. Management* **9** 91–114.

Hitt, M. A., R. Hoskisson, R. Ireland, J. Harrison. 1991. Effects of acquisitions on R&D inputs and outputs. *Acad. Management J.* **34** 693–706.

Hoskisson, R., L. Busenitz. 2002. Market uncertainty and learning distance in corporate entrepreneurship entry mode choice. M. A. Hitt, R. D. Ireland, S. M. Camp, D. L. Sexton, eds. *Strategic Entrepreneurship*: *Creating a New Mindset*. Blackwell, Oxford, UK, 151–172.

Hoskisson, R., M. Hitt. 1990. Antecedents and performance outcomes of diversification: A review and critique of theoretical perspectives. *J. Management* **16** 461–509.

Hoskisson, R., R. Johnson, D. Moesel. 1994. Corporate divestiture intensity of restructuring firms: Effects of governance, strategy, and performance. *Acad. Management J.* **37** 1207–1251.

Hoskisson, R., M. Hitt, R. Johnson, D. Moesel. 1993. Construct validity of an objective (entropy) categorical measure of diversification strategy. *Strategic Management J.* **14** 215–235.

Hudson, B. 1994. Innovation through acquisition. *Cornell HRA Quart.* **34** 82–87.

Ingham, H., I. Kran, A. Lovestam. 1992. Mergers and profitability: A managerial success story. *J. Management Stud.* **29**(2) 195–208.

Inkpen, C., A. Sundaram, K. Rockwood. 2000. Cross-border acquisitions of U.S. technology assets. *California Management Rev.* **42**(3) 50–71.

Javidan, M., A. Pablo, H. Singh, M. Hitt, D. Jemison. 2004. Where we've been and where we're going. A. Pablo, M. Javidan, eds. *Mergers and Acquisitions*: *Creating Integrative Knowledge*. Blackwell Publishing, Malden, MA, 245–261.

Jensen, M. 1968. The performance of mutual funds in the period 1945–1964. *J. Finance* **23** 389–416.

Jick, T. 1979. Mixing qualitative and quantitative methods: Triangulation in action. *Admin. Sci. Quart.* **24** 602–611.

Kahle, K., R. Walkling. 1996. The impact of industry classifications on financial research. *J. Financial Quant. Anal.* **31** 309–335.

King, D. 2006. Implications of technological uncertainty on firm outsourcing decisions. *Human Systems Management* **25** 115–125.

King, D., J. Driessnack. 2003. Investigating the integration of acquired firms in high-technology industries: Implications for industrial policy. *Acquisition Rev. Quart.* **10**(Summer) 260–283.

King, D., J. Covin, W. Hegarty. 2003. Complementary resources and the exploitation of technological innovations. *J. Management* **29** 589–606.

King, D., D. Dalton, C. Daily, J. Covin. 2004. Meta-analyses of post-acquisition performance: Indications of unidentified moderators. *Strategic Management J.* **25** 187–200.

Kogut, B., U. Zander. 1996. What firms do: Coordination, identity, and learning. *Organ. Sci.* **7** 577–590.

Kusewitt, J. 1985. An exploratory study of strategic acquisition factors relating to performance. *Strategic Management J.* **6** 151–169.

Langlois, R. 2003. The vanishing hand: The changing dynamics of industrial capitalism. *Indust. Corporate Change* **12** 351–385.

Larsson, R., S. Finkelstein. 1999. Integrating strategic, organizational, and human resource perspectives on mergers and acquisitions: A case survey of synergy realization. *Organ. Sci.* **10** 1–26.

Larsson, R., K. Brousseau, M. Driver, P. Sweet. 2004. The secrets of merger and acquisition success: A co-competence and motivational approach to synergy realization. A. Pablo, M. Javidan, eds. *Mergers and Acquisitions*: *Creating Integrative Knowledge*. Blackwell Publishing, Malden, MA, 3–19.

Lieberman, M., D. Montgomery. 1998. First-mover (dis)advantages: Retrospective and link with the resource-based view. *Strategic Management J.* **19** 1111–1125.

Loderer, C., K. Martin. 1992. Postacquistion performance of acquiring firms. *Financial Management* **21**(3) 69–80.

Lubatkin, M. 1987. Merger strategies and stockholder value. *Strategic Management J.* **8** 39–53.

Lubatkin, M., R. Shrieves. 1986. Towards reconciliation of market performance measures to strategic management research. *Acad. Management Rev.* **11** 497–512.

Lubatkin, M., N. Srinivasan, H. Merchant. 1997. Merger strategies and shareholder value during times of relaxed antitrust enforcement: The case of large mergers during the 1980s. *J. Management* **23** 59–81.

Lubatkin, M., W. Schulze, A. Mainkar, R. Cotterill. 2001. Ecological investigation of firm effects in horizontal mergers. *Strategic Management J.* **22** 335–357.

McGrath, R. 1999. Falling forward: Real options reasoning and entrepreneurial failure. *Acad. Management Rev.* **24** 13–30.

McGrath, R., I. MacMillan. 2000. Assessing technology projects using real options reasoning. *Res. Tech. Management* **43**(4) 35–49.

Milgrom, P., J. Roberts. 1990. Rationalizability, learning, and equilibrium in games with strategic complementarities. *Econometrica* **58** 1255–1277.

Milgrom, P., J. Roberts. 1995. Complementarities and fit: Strategy, structure, and organizational change in manufacturing. *J. Accounting Econom.* **19** 179–208.

Miller, D. 2003. An asymmetry-based view of advantage: Towards an attainable sustainability. *Strategic Management J.* **24** 961–976.

Mizik, N., R. Jacobson. 2003. Trading off between value creation and value appropriation: The financial implications of shifts in strategic emphasis. *J. Marketing* **67** 63–76.

Moorman, C., R. Slotegraaf. 1999. The contingency value of complementary capabilities in product development. *J. Marketing Res.* **36** 239–257.

Nelson, R., S. Winter. 1978. Forces generating and limiting concentration under Schumpeterian competition. *Bell J. Econom.* **9** 524–548.

Penrose, E. 1959. *The Theory of the Growth of the Firm*. John Wiley, New York.

Peteraf, M. 1993. The cornerstones of competitive advantage: A resource-based perspective. *Strategic Management J.* **14** 179–191.

Peteraf, M., M. Bergen. 2003. Scanning dynamic competitive landscapes: A market-based and resource-based framework. *Strategic Management J.* **24** 1027–1041.

Priem, R., J. Butler. 2001. Is the resource-based "view" a useful perspective for strategic management research? *Acad. Management Rev.* **26** 22–40.

Puranam, P., H. Singh, M. Zollo. 2006. Organizing for innovation: Managing the coordination-autonomy dilemma in technology acquisitions. *Acad. Management J.* **49** 263–280.

Ramanujam, V., P. Varadarajan. 1989. Research on corporate diversification: A synthesis. *Strategic Management J.* **10** 510–551.

Ranft, A., M. Lord. 2000. Acquiring new knowledge: The role of retaining human capital in acquisitions of high-tech firms. *J. High Tech. Management Res.* **11** 295–319.

Ranft, A., M. Lord. 2002. Acquiring new technologies and capabilities: A grounded model of acquisition implementation. *Organ. Sci.* **13** 420–441.

Ravenscraft, D., F. Scherer. 1987. *Mergers, Sell-Offs, and Economic Efficiency*. The Brookings Institution, Washington, D.C.

Reuer, J. 2001. From hybrids to hierarchies: Shareholder wealth effects of joint venture partner buyouts. *Strategic Management J.* **22** 27–44.

Saxton, T., M. Dollinger. 2004. Target reputation and appropriability: Picking and deploying resources in acquisitions. *J. Management* **30** 123–147.

Schonfeld, E., O. Malik. 2003. Gulp! Mergers are back with a vengeance. *Business 2.0* **4**(7) 88–95.

Schweizer, L. 2005. Organizational integration of acquired biotechnology companies into pharmaceutical companies: The need for a hybrid approach. *Acad. Management J.* **48** 1051–1074.

Sharma, S., R. Durand, O. Gur-Arie. 1981. Identification and analysis of moderator variables. *J. Marketing Res.* **18** 291–300.

Sigglekow, N. 2002. Misperceiving interactions among complements and substitutes: Organizational consequences. *Management Sci.* **48** 900–916.

Singh, K., S. Ang, S. Leong. 2003. Increasing replication for knowledge accumulation in strategy research. *J. Management* **29** 533–549.

Sirower, M. 1997. *The Synergy Trap*: *How Companies Lose the Acquisition Game*. The Free Press, New York.

Slotegraaf, R., C. Moorman, J. Inman. 2003. The role of firm resources in returns to market deployment. *J. Marketing Res.* **40** 295–309.

Song, M., C. Droge, S. Hanvanich, R. Calantone. 2005. Marketing and technology resource complementarity: An analysis of their interaction effect in two environmental contexts. *Strategic Management J.* **26** 259–276.

Stewart, J., R. Harris, W. Carleton. 1984. The role of market structure in merger behavior. *J. Indust. Econom.* **32** 293–312.

Stuart, T., J. Podolny. 1996. Local search and the evolution of technological capabilities. *Strategic Management J.* **17** 21–38.

Szulanski, G. 2000. The process of knowledge transfer: A diachronic analysis of stickiness. *Organ. Behav. Human Decision Processes* **82** 9–27.

Tanriverdi, H., N. Venkatraman. 2005. Knowledge relatedness and the performance of multibusiness firms. *Strategic Management J.* **26** 97–119.

Teece, D. 1977. Technology transfer by multinational firms: The resource cost of transferring technological know-how. *Econom. J.* **87** 242–261.

Teece, D. 1986. Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. *Res. Policy* **15** 285–305.

Teece, D. 1988. Capturing value from technological innovation: Integration, strategic partnering, and licensing decisions. *Interfaces* **18**(3) 46–58.

Thompson, J. D. 1967. *Organizations in Action*. McGraw Hill, New York.

Uhlenbruck, K., M. Hitt, M. Semadeni. 2006. Market value effects of acquisitions involving Internet firms: A resource-based analysis. *Strategic Management J.* **27** 899–913.

Varaiya, N., K. Ferris. 1987. Overpaying in corporate takeovers: The winner's curse. *Financial Analysts J.* **43** 64–73.

Vermeulen, F., H. Barkema. 2001. Learning through acquisitions. *Acad. Management J.* **44** 457–476.

Veugelers, R. 1997. Internal R&D expenditures and external technology sourcing. *Res. Policy* **26** 303–315.

Wernerfelt, B. 1988. Umbrella branding as a signal of new product quality: An example of signaling by posting a bond. *RAND J. Econom.* **19** 458–466.

Williams, A., D. Siegel. 1997. Event studies in management research: Theoretical and empirical issues. *Acad. Management J.* **40** 626–657.

Williamson, O. 1975. *Markets and Hierarchies: Analysis and Antitrust Implications. A Study of the Economics of Internal Organization*. The Free Press, New York.

Wolpert, J. 2002. Breaking out of the innovation box. *Harvard Bus. Rev.* **80**(8) 76–83.

Zahra, S. 1996. Technology strategy and performance: Examining the moderating role of a firm's competitive environment. *J. Bus. Venturing* **11** 189–219.

Zollo, M., H. Singh. 2004. Deliberate learning in corporate acquisitions: Post-acquisition strategies and integration capability in U.S. bank mergers. *Strategic Management J.* **25** 1233–1256.