The current issue and full text archive of this journal is available at
www.emeraldinsight.com/0025-1747.htm

Knowledge capability, strategic change, and firm performance

The moderating role of the environment

Irene Goll
Kania School of Management, University of Scranton, Scranton, Pennsylvania, USA
Nancy Brown Johnson
School of Management, University of Kentucky, Gatton College of Business and Economics, Lexington, Kentucky, USA, and
Abdul A. Rasheed
Department of Management, College of Business Administration, University of Texas at Arlington, Arlington, Texas, USA

Received 26 July 2005
Revised 22 May 2006
Accepted 6 October 2006

Abstract

Purpose – This paper seeks to examine the relationships between knowledge capability, strategic change, and firm performance in the US airline industry from regulation to deregulation.

Design/methodology/approach – This is a longitudinal study with a cross-sectional time series research design. A theoretical model is tested in which knowledge capability exerts a direct effect on strategic change; strategic change then influences firm performance. The environment moderates the relationship between strategic change and firm performance. The sample of the study includes the major US air carriers from 1972 to 1995. Knowledge capability is operationalized as the education level and functional diversity of top management. Strategic change is measured as change in hub concentration, a key variable for the airlines. The data for the present study come from archival sources.

Findings – Time series statistics with fixed effects are used to examine the relationships between the variables. The results support the theoretical model: knowledge capability influences change in strategy, which, in turn, influences firm performance. The results also indicate that the environment serves as a moderator in the relationship between strategic change and firm performance.

Originality/value – This study examines strategic change in the major US airlines during a period of profound environmental change. It integrates several streams of management research and should be useful to academics and managers who want to understand the performance implications of strategic change.

Keywords Strategic management, Knowledge management, Strategic change, Airlines, United States of America

Paper type Research paper

Introduction

The role of innovation and strategic flexibility in enabling a firm to achieve and sustain competitive advantage is well recognized (Barney, 1991; Zahra and George, 2002).

An earlier version of this paper was presented at the Academy of Management Annual Meeting in August 2006 in Atlanta, Georgia, USA, and a substantially shortened version will appear in the *Best Papers Proceedings*.

Management Decision
Vol. 45 No. 2, 2007
pp. 161-179

0025-1747
DOI 10.1108/00251740710727223

Innovation can come in the form of new products, new processes, or new strategies. An innovation can occur either endogenously or in response to changes in the environment. A key argument in the knowledge management literature is that the ability of a firm to innovate depends on managing, maintaining, and creating knowledge (Smith *et al.*, 2005).

Organizations must anticipate and respond to environmental changes to ensure competitiveness and, ultimately, survival. One of the basic assumptions underlying much of the strategic management literature is that successful firms change their strategies to attain a better fit with the environment (Audia *et al.*, 2000; Sutcliffe, 1994). Decisions and actions of the managers play a key role bringing about this alignment or fit between the firm and its external environment. As such, their knowledge capability is expected to exert a powerful influence on the competitive ability of the firm (Boeker, 1997). Because executive decision making and actions are central to the management of organizations (Waller *et al.*, 1995), it is very important to understand how top managers influence strategic change in response to environmental conditions and what effect this has on firm performance.

This study examines how the knowledge capability of a firm's top management team affects firm performance. Rather than examining the direct relationship between the two, we argue that the relationship is mediated through strategic change. Further, because strategic change is best studied in the context of discontinuous environmental change, we also examine how environment moderates the relationship between strategic change and firm performance. These relationships are examined using a sample of the major US air carriers from 1972 to 1995. We consider the US airline industry to be a particularly appropriate setting for studying the above relationships because the passage of the Airline Deregulation Act in 1978 was a major discontinuous environmental change. Further, the availability of data over a quarter century makes it possible to examine longitudinally the performance consequences of strategic changes.

Theory development

A significant body of research exists on the areas of knowledge capability, top management teams, organization-environment interactions, and organizational performance. Although a review of the literature on each of these areas is beyond the scope of this paper, in this section, we highlight some of the prior research that is relevant to our study.

Knowledge capability

Organizational knowledge refers to the "understanding and beliefs in a firm about the relationship between the firm and its environment" (Smith *et al.*, 2005, p. 347). It includes both explicit and tacit knowledge. An organization's capability for creating knowledge depends on the extent to which managers and other knowledge employees can combine and exchange information. Smith *et al.* (2005) argue that organizational knowledge creation capability depends on three types of resources: individual knowledge, relational contacts, and organizational climate.

This perspective is consistent with Barney's (1991) resource-based view of organizations, which suggests that unique resources contribute to competitive advantage. Barney (1991) argues that resources are valuable when they are rare,

durable, imperfectly imitable, and non-tradable. The resource-based view suggests that a firm's competitive advantage depends on its unique combination of physical, human, and organizational resources. Top management knowledge and skills may serve as a competence that produces competitive advantage (Boeker, 1997).

Theorists recognize intellectual capital as a valuable resource. It represents the knowledge and knowing capability of an organization (Nahapiet and Ghoshal, 1998). The combination and exchange of intellectual capital contributes to the creation of new intellectual capital. Nahapiet and Ghoshal (1998) argue that "the special capabilities of organizations for creating and transferring knowledge are being identified as a central element of organizational advantage " (p. 256).

A firm's level of prior or existing knowledge is likely to influence its ability to innovate by allowing the firm to recognize new information, assimilate, and apply it. Cohen and Levinthal (1990) refer to this as the firm's absorptive capacity. A firm's absorptive capacity depends on the absorptive capacities of its individual members which includes their prior knowledge and background diversity. Through communication and interaction, the diversity of knowledge contributes to the firm's absorptive capacity.

Building on the theory of absorptive capacity, Zahra and George (2002) distinguished between potential and actual capacity which influence a firm's competitive advantage. Potential capacity refers to acquisition and assimilation capabilities whereas realized or actual capacity focuses on knowledge transformation and exploitation. Zahra and George (2002) argue that potential capacity contributes to strategic flexibility and the ability to adapt to environmental change. They define absorptive capacity as the "set of organizational routines and processes by which firms acquire, assimilate, transform, and exploit knowledge to produce a dynamic organizational capability" (Zahra and George, 2002, p. 186). A firm's existing knowledge influences its ability to explore new knowledge. Differences in firm performance within an industry may depend on a firm's ability to use its organizational resources and capabilities.

Top management teams

A fundamental premise of the strategic choice perspective (e.g. Andrews, 1971; Child, 1972) is that managers exert a powerful influence on organizational outcomes. The recent strategic management literature emphasizes the importance of the top management team (TMT). As the dominant coalition, the TMT is responsible for identifying organizational strengths and weaknesses as well as analyzing the opportunities and threats in the external environment. Upper echelon theory (Hambrick and Mason, 1984) suggests that the members of a firm's dominant coalition have a cognitive base and values that influence the field of vision, selective perception, and interpretation of environmental and organizational stimuli. Managerial perceptions then influence strategic choice and firm performance. In most firms, the top management team (TMT) guides the strategic direction of the firm in conjunction with the CEO. This model builds on the work of the Carnegie theorists who argue in favor of considering behavioral factors (Cyert and March, 1963; March and Simon, 1958).

A key premise of the present paper is that an individual manager's knowledge and background are resources that influence future strategic actions and competitive

advantage. A manager's functional expertise is expected to be related to his/her ability to initiate change (Boeker, 1997; Hambrick and Mason, 1984; Miles and Snow, 1978). Boeker's (1997) study of executive migration found that a manager's background and experience play an important role in influencing entry into new product markets.

Strategic change

Strategic change aligns the firm with its external environment. A review of the strategic change literature reflects two schools of thought:

(1) content; and

(2) process (Rajagopalan and Spreitzer, 1997).

The content school focuses on the antecedents and consequences of strategic change using large samples. The process school focuses on managers and the process of strategic change; this school tends to use the case study approach over a longer timeframe. Rajagopalan and Spreitzer (1997) argue that since these schools have evolved separately, they leave us with gaps in our understanding of strategic change. Key questions concern managerial influence on strategic change and its contributions to success or failure in different environmental contexts.

A basic assumption in the literature is that some managers are better able to change strategy than others and that firms that are able to match their information processing needs to environmental change perform better. Environments are characterized according to their attributes, which include stability, munificence, and complexity (Dess and Beard, 1984) and industry characteristics (Sutcliffe, 1994). The greater the environmental turbulence, the greater the difficulty in decision making, and the greater the information-processing requirements (Haleblian and Finkelstein, 1993).

Building on Zahra and George's (2002) distinction between potential and actual capabilities, we believe that the examination of a direct link between a firm's knowledge capability and firm performance leaves out key intermediate linkages. First, potential capability is not always fully translated into realized capability. Second, capabilities themselves are of little value unless they are put to use. Knowledge capability results in organizational performance only when it leads to innovations.

This study focuses on the major US air carriers from 1972 to 1995, a crucial period in the industry's transition from regulation to deregulation that profoundly influenced the environment for the industry. Prior to deregulation, strategic choice in the airlines was limited to service quality as the government controlled route allocation and pricing. Deregulation then afforded airlines the opportunity to freely establish route structures and set their own prices. One significant strategic choice was whether to fly point-to-point or to develop a major hub or hubs. Hubs, by consolidating passengers into a single location and then regrouping them in order to convey them to their destination, have several advantages. Hubs enable airlines to serve less densely populated areas with greater frequency as they can ferry passengers from a relative outpost to a hub city on small planes and then regroup them to fly them to their destination on densely packed planes (Brueckner, 2004). Economies of scale are also gained from staffing major operations such as maintenance (Gittell, 2003). Dominance at a hub also suggests some ability of the airline to extract monopoly rents (Morrison and Winston, 1995). Point-to-point operations tend to have less frequency, lower load factors and less ability to extract

rents (Barla and Constantatos, 2005; Gittell, 2003). Nonetheless, these effects can be offset by focusing on efficiency, as is aptly demonstrated by Southwest Airline's success (Gittell, 2003). Barla and Constantatos (2005) conclude that despite the flexibility provided by hubs, some airlines may choose point-to-point operations for strategic reasons.

New strategies have been crucial for airline success. Hence, we argue that strategic change mediates the relationship between knowledge capability and firm performance. Strategic changes are likely to add most value when the environment is experiencing rapid change. Therefore, we examine the moderating role of the environment in the relationship between strategic change and firm performance. Our theoretical model is presented in Figure 1. We operationalize knowledge capability as the level of formal education and functional diversity of the TMT. Strategic change is measured as change in hub concentration, a key strategic variable in the airline industry. We examine these relationships in the regulated and deregulated environments of the airline industry using a longitudinal sample that covers the periods before and after deregulation.

Hypotheses

The knowledge capability of the TMT plays a crucial role in processing information from the environment and initiating appropriate strategic changes in response (Haleblian and Finkelstein, 1993). Prior research on strategic change has found a relationship between change in corporate diversification strategy and several TMT demographic characteristics (Wiersema and Bantel, 1992). They argue that managers must be proactive when initiating strategic change and that the characteristics of such TMTs include receptivity to change, willingness to take risk, diversity of perspectives, and creativity/innovation in decision making contribute to a momentum toward strategic change (Wiersema and Bantel, 1992).

In their study of knowledge employees in 72 technology firms, Smith *et al.* (2005) found that new product/service introduction was related to the ability to combine and exchange knowledge. Their study operationalized existing knowledge in terms of functional diversity and education level. They found that existing knowledge contributes to the creation of new knowledge, which, in turn, contributes to innovation. The stock of organizational knowledge depends on industry experience, education, and functional diversity of the TMT and other knowledge workers (Smith *et al.*, 2005). Following Smith *et al.* (2005) we selected two key TMT demographic characteristics for the purposes of this study:

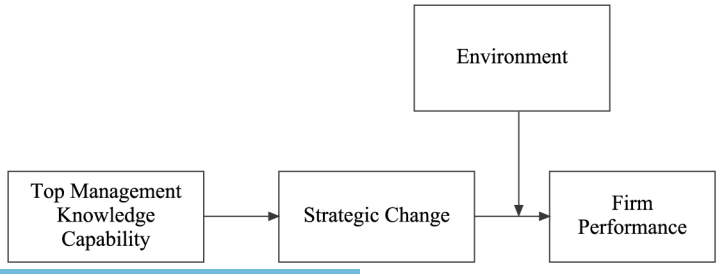

Figure 1.
Theoretical model

(1) education level; and
(2) functional background diversity.

Our hypotheses are developed below.

Education level and strategic change

Education is an indication of the individual's skill and knowledge base (Hambrick and Mason, 1984). Smith *et al.* (2005) expected a positive relationship between education level and knowledge structure as education contributes to explicit knowledge and skill. Likewise, Boeker (1997) argued that greater education contributes to new ideas and change. Greater education is expected to be reflected in more boundary spanning, a greater tolerance for ambiguity, and "integrative complexity" (Dollinger, 1984). Greater education level was also associated with receptivity to innovation (Becker, 1970; Kimberly and Evanisko, 1981; Rogers and Shoemaker, 1971). Bantel and Jackson (1989) found that innovative banks were lead by TMTs with a higher education level.

Education level is expected to influence strategic change as it involves the intellectual capacity to evaluate strengths, weaknesses, opportunity, and threats (Grimm and Smith, 1991). Their study of railroads found that managers with an MBA were more likely to lead firms that changed strategy (Grimm and Smith, 1991). Similarly, Wiersema and Bantel (1992) found that change in corporate strategy was related to TMT education level. In line with the above findings, we hypothesize that:

H1. TMT mean education level has a positive relationship to strategic change.

Functional diversity and strategic change

The variety of knowledge, reflected in a diversity of functional backgrounds in the TMT, is expected to influence the creation of capabilities since it is job related and reflects an individual's social and personal identity and is expected to influence team outcomes (Randel and Jaussi, 2003). A basic assumption of research on TMT functional background is that "team members with backgrounds and experience in different functional areas bring different but complementary knowledge and expertise to their teams " (Bunderson, 2003, p. 458). Functional background is expected to influence TMT problem solving and decision-making, and is a useful measure of work experience (Bunderson, 2003). A greater diversity of knowledge should positively influence new knowledge generation (Boeker, 1997; Cohen and Levinthal, 1990).

Functional background diversity is expected to contribute to a diversity of information collected from the environment (Sutcliffe, 1994). An early study by Dearborn and Simon (1958) reported a relationship between functional background and perceptions. Subsequent studies, however, produced mixed results. Waller *et al.* (1995) reported a relationship between functional background and managers' perceptions about organizational effectiveness. A study by Chattopadhyay *et al.* (1999) found a weak link between functional conditioning and beliefs. Walsh's (1988) study found no significant relationship between functional background and beliefs.

Several prior studies have examined the relationship between functional background and team decision making and outcomes in multiple industry settings (e.g. Bantel and Jackson, 1989; Hambrick *et al.*, 1996; Murray, 1989; Sutcliffe, 1994;

Bunderson, 2003; Knight *et al.*, 1999). Relationships between functional background and strategy type in the tobacco industry (Chaganti and Sambharya, 1987) and functional background and competitive behavior in airlines (e.g. Hambrick *et al.*, 1996) have been reported. Research has also examined the relationship between functional background and firm performance (Michel and Hambrick, 1992; Hambrick and D'Aveni, 1992; Simons *et al.*, 1999).

Our interest is in the relationship between functional background diversity and strategic change. Functional heterogeneity was associated with competitive behavior in a study by Pegels *et al.* (2000). TMTs with diverse skills and orientations may be more creative and nimble with regard to strategic problem solving (Carpenter and Fredrickson, 2001). Carpenter and Fredrickson (2001) reported a negative relationship between functional heterogeneity and a firm's global strategic posture. We hypothesize a positive relationship between functional diversity and strategic change:

H2. TMT functional diversity has a positive relationship to strategic change.

Environment, strategic change, and firm performance

Studies relating deregulation and strategic change have mixed findings. Several studies report a positive relationship between deregulation and change in strategy (e.g. Ginsberg and Buchholtz, 1990; Goodstein and Boeker, 1991; Haveman, 1992; Smith and Grimm, 1987; Zajac and Shortell, 1989). Summarizing these findings, Rajagopalan and Spreitzer (1997) argue that firms that were defender or efficiency-oriented or have less focused strategies change to a prospector, innovator, or a more focused strategy. On the other hand, Kelly and Amburgey (1991) found that deregulation decreases strategic change when they controlled for earlier strategic change. Several studies report that prior strategy has a positive influence on strategic change following deregulation. That is, prior strategy is related to the probability and direction of future changes in business strategy (Haveman, 1992; Kelly and Amburgey, 1991; Zajac and Shortell, 1989).

Although there is lack of consensus on the relationship between deregulation and strategic change, the relationship between strategic change and performance is theoretically less ambiguous and empirically better supported. Inability or unwillingness to change in the face of environmental changes is likely to lead to competitive decline for most companies. Even in relatively stable industries, strategic inertia may lead to imitation by rivals resulting in competitive parity. Therefore, it is theoretically reasonable to assume a positive relationship between strategic change and firm performance. This theoretical relationship has found support in a number of prior studies. For example, in a study of railroads, there was a positive relationship between strategic change and firm performance in response to environmental change (Grimm and Smith, 1991; Smith and Grimm, 1987).

The deregulation of the airline industry was a discontinuous environmental change that profoundly affected the industry's competitive environment (Audia *et al.*, 2000). Prior to deregulation, airlines competed on the basis of adding more flights to existing routes and by emphasizing quality of service. After deregulation, major carriers began to develop extensive hub and spoke networks that collected customers from far reaching locations into a central site where they would then be redistributed to their destination. This structure was designed to increase load factors by concentrating customers through the hub (Audia *et al.*, 2000). The results of a study on the US airline

industry from 1974 to 1978 and 1979 to 1983 by Audia *et al.* (2000) found that strategic persistence resulted in a decline in performance. They also reported that size of air carrier was related to strategic persistence. We hypothesize that:

H3. Strategic change has a positive relationship to firm performance.

The role of the environment as a contingency variable in strategic management is well recognized in the literature (e.g. Prescott, 1986; Venkatraman, 1989). "The concept of fit has served as an important building block for theory construction in [. . .] strategic management" (Venkatraman, 1989, p. 423). In the fit as moderation perspective, the effect that the predictor (strategic change) has on the criterion variable (firm performance) depends on the moderating variable (environment). Thus, we hypothesize that:

H4. The environment moderates the relationship between strategic change and firm performance.

Methods

The sample includes all of the major US air carriers from 1972 to 1995. According to the US Department of Transportation, "majors" are air carriers with annual operating revenues of $1bn or more. This system of classification was also used in previous studies of the US airline industry (e.g. Bailey *et al.*, 1985; Chen and Hambrick, 1995). The present study uses a cross-sectional time series research design. We use fixed effects time-series regressions to examine the relationships between the variables. All the data were collected from archival sources, which are identified in the Appendix.

TMT knowledge capability

Demographic characteristics were collected for all the managers in a firm from CEO down through and including the Vice Presidents. This data was collected from Dun and Bradstreet's *Reference Book of Corporate Managements: America's Corporate Leaders*. Education level and functional diversity are of interest in the present study. The level of education is coded as the following: 1 = high school; 2 = some college; 3 = Bachelor's degree; 4 = some graduate school; 5 = Master's degree; 6 = JD or LLB; 7 = LLM; 8 = doctorate. The mean TMT education level is computed for each air carrier for each year. We also recorded the functional background of each manager as one of the following categories:

- accounting/finance;
- marketing/sales/public relations;
- administration;
- operations; and
- technical.

Blau's (1977) index is then computed for the functional diversity for each air carrier and each year.

Strategic change

As noted in the literature review, hub concentration is a key strategic variable in the US airline industry. It is a measure of the proportion of total passenger enplanements through the air carrier's largest hub and provides us with information on the degree to which an air carrier channels flights through a central geographic hub as opposed to operating flights on a point-to-point basis. Change in hub concentration is computed as the difference between a given year and the previous year, i.e. $\text{time}_n - \text{time}_{n-1}$.

Deregulatory intensity

A key variable in the airline industry is its regulatory/deregulatory environment. The US airline industry was under the control of the Civil Aeronautics Board (CAB) since its inception until 1978 when the Airline Deregulation Act of 1978 was enacted. The Act compelled the CAB to gradually loosen controls over prices and routes until the industry was fully deregulated in 1984 and the CAB was disbanded. We code deregulatory intensity as: 0 = regulated environment (1972-1978); 1 = initial deregulation (1979-1984); 2 = full deregulation (1985-1995). We note that regulation ended in 1984 with the abolition of the CAB.

Firm performance

The present study includes two measures of firm performance:

(1) operating profit per revenue passenger mile (OPRPM); and

(2) operating revenue per revenue passenger mile (ORRPM).

OPRPM was used to measure performance in the airline industry by Chen and Hambrick (1995).

Control variables

Several industry- and firm-level variables are included as controls in the present study. The industry-level variables include total industry revenue, industry wages, the detrended price of fuel, and the total number of air carriers in the industry. The first three variables provide a measure of industry munificence that can influence the dependent variables. The number of carriers gives us a measure of competitive pressures that can influence the dependent variables.

Several firm-level variables are also included as controls. Firm size, measured as assets, is included as it can affect the relationships between the variables of interest. The natural log of assets is taken to normalize the distribution of this variable. Hub concentration is included as a control variable. We reasoned that this variable may influence the level of change in hub concentration and could affect the interpretation of our results. Firms with a high hub concentration may be more or less inclined to change their strategy.

For the financial performance regressions, we include two interaction terms as controls as they may affect financial performance:

(1) the hub concentration × change in hub concentration; and

(2) the deregulatory environment × hub concentration.

Analyses

We use cross-sectional time series statistics with fixed effects modeling to examine the relationships between the variables in the present study. First, we will examine the relationship between TMT knowledge capability and strategic change. If there is a significant relationship, we will conclude that TMT knowledge capability acts as an antecedent to strategic change supporting Figure 1. Next, we examine the relationship between strategic change and environment. We followed Prescott (1986) and Venkatraman (1989) for testing moderators. The lack of a significant relationship between these variables lends support to the role of environment as moderator in the strategic change-firm performance relationship.

Finally, we examine the effects of these variables on firm performance. This involves two steps. In Model 1, we include the main effects and regress firm performance on deregulatory environment, change in strategy, TMT knowledge capability, and controls. We include the TMT demographics to see if they exert a direct effect on firm performance. In Model 2, we include the main effects as well as the hypothesized deregulation × change in strategy interaction as we hypothesized that the environment acts as a moderator in the relationship between change in strategy and firm performance.

Results

Table I shows the means and standard deviations for all the variables in the present study. Table II shows the correlations between the variables. The sources for all the variables are shown in the Appendix.

Table III shows the results of regressing change in strategy on top management knowledge capability and controls. As expected, mean education level is significantly related and functional diversity is (marginally) significantly related to strategic change lending support to *H1* and marginal support to *H2*. In addition, of the controls, fuel price and hub concentration have a significant positive relationship and the number of carriers, a negative relationship to change in hub concentration. With rising fuel prices the major US air carriers increased their change in hub concentration in an effort to economize. The greater the existing hub concentration, the more these air carriers further concentrated flights through hubs. The fewer the number of carriers, the more the majors were able to increase their hub concentration.

Variable	Mean	Standard deviation
1. Deregulatory intensity	1.41	0.73
2. Hub concentration	0.2118	0.0784
3. Change in hub concentration	0.0045	0.0330
4. Mean education level	3.89	0.56
5. Functional diversity	0.695	0.107
6. Total industry revenue	5.19e + 07	2.48e + 07
7. Industry wages	740.06	33.16
8. Fuel price	67.72	26.92
9. Number of carriers	74.22	21.05
10. Firm size (ln assets)	14.84	0.76
11. Operating profit per revenue passenger mile	0.0152	0.0994
12. Operating revenue per revenue passenger mile	0.3596	1.6002

Table I.
Means and standard deviations for all the variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1	1.00											
2	0.39*	1.00										
3	−0.08	0.24*	1.00									
4	0.38*	0.10	0.01	1.00								
5	−0.15*	−0.14*	0.04	−0.37*	1.00							
6	0.87*	0.39*	−0.06	0.38*	−0.17*	1.00						
7	−0.63*	−0.27*	0.07	−0.30*	0.15*	−0.85*	1.00					
8	0.65*	0.33*	0.15*	0.22*	−0.17*	0.63*	−0.35*	1.00				
9	0.64*	0.31*	0.05	0.23*	−0.17*	0.51*	−0.15*	0.80*	1.00			
10	0.48*	0.12	−0.09	0.33*	0.08	0.55*	−0.49*	0.27*	0.19*	1.00		
11	0.11	0.14*	−0.30*	0.03	0.01	0.10	−0.09	0.05	0.00	0.08	1.00	
12	0.12	0.21*	−0.25*	−0.02	0.00	0.13	−0.12	0.09	0.00	0.10	0.95*	1.00

Note: $^{*}p < 0.05$

Table II.
Correlations between all variables

Independent variables	Dependent variable (*t*-values)
Top management knowledge capability	
Mean education level	2.33*
Functional diversity	1.83*t*
Controls	
Total industry revenue	−1.48
Industry wages	−1.13
Fuel price	4.12***
Number of carriers	−3.34***
Firm size (ln assets)	−0.80
Hub concentration	5.28***
F	8.03***
df	(8,166)

Notes: *t*, $p < 0.10$; *$p < 0.05$; **$p < .01$; ***$p < 0.001$

Table III.
Results of regressing change in hub concentration on top management knowledge capability

Next, we examined the relationship between environment and change in business strategy. Table IV shows the results of regressing change in hub concentration on environment, top management knowledge capability, and control variables. There is no significant relationship between deregulatory environment and change in hub concentration. As in the previous table, TMT education level and functional diversity are related to strategic change. Of the control variables, fuel price and hub concentration have a significant positive relationship and the number of carriers a

Independent variables	Dependent variable (*t*-values)
Environment	
Deregulatory intensity	−1.32
Top management knowledge capability	
Mean education level	2.44*
Functional diversity	1.86*t*
Controls	
Total industry revenue	−0.59
Industry wages	−0.89
Fuel price	3.69***
Number of carriers	−2.66**
Firm size (ln assets)	−0.58
Hub concentration	5.45***
F	7.36***
df	(9,165)

Notes: *t*, $p < 0.10$; *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Table IV.
Results of regressing change in hub concentration on deregulatory intensity and top management knowledge capability

negative relationship to change in hub concentration, which is consistent with the findings in Table III.

Finally, we used moderated regression analysis to further explore the relationships between the variables. Table V shows the results of regressing firm performance on environment, change in hub concentration, TMT knowledge capability, and controls. Model 1 shows the results of regressing firm performance on the main effects. Model 2 adds the interaction between environment and change in hub concentration. The interaction term is included to test for the moderating effect of the environment on the strategic change-firm performance relationship.

In Table V, change in hub concentration has a marginally significant relationship to OPRPM and a significant relationship to ORRPM in Model 1. The equations for Model 1 are significant for both measures of performance. In Model 2, change in hub concentration has a marginally significant relationship to OPRPM and a significant relationship to ORRPM. In Model 2, the interaction effect of deregulatory environment and change in hub concentration is significantly and negatively related to ORRPM. Both equations for Model 2 are significant.

Several of the control variables also have a significant relationship to our measures of firm performance. Fuel price has a significant negative relationship to OPRPM in

	Dependent variables (t-values)			
	OPRPM		ORRPM	
Independent variables	Model 1	Model 2	Model 1	Model 2
Environment				
Deregulatory intensity	0.59	0.38	−1.72t	−2.15*
Change in strategy				
Change in hub concentration	1.65t	1.89t	3.33***	4.01***
TMT knowledge capability				
Mean education level	1.25	1.25	−1.31	−1.31
Functional diversity	0.13	0.12	−1.24	−1.27
Controls				
Total industry revenue	0.26	0.34	0.25	0.42
Industry wages	0.17	0.28	−1.00	−0.78
Fuel price	−2.17*	−2.11*	1.13	1.27
Number of carriers	1.36	1.22	−0.08	−0.35
Firm size (ln assets)	0.21	0.22	−0.24	−0.23
Hub concentration	1.57	1.38	0.10	−0.24
Hub concentration × change in hub concentration	−2.80**	−1.95*	−6.14***	−4.27***
Deregulation × hub concentration	−1.34	−1.07	1.39	1.88t
Interaction				
Deregulation × change in hub concentration	–	−0.93	–	−2.19*
F	2.83**	2.68**	8.08***	8.01***
df	(12,154)	(13,153)	(12,158)	(13,157)

Notes: t, $p < 0.10$; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$

Table V.
Results of regressing firm performance measures on environment, change in hub concentration, and TMT knowledge capability

Model 1 and Model 2. Rising fuel prices had a negative effect on firm performance. The interaction effect of hub concentration and change in hub concentration has a significant negative relationship to both measures of firm performance in Models 1 and 2.

In sum, these analyses lend some support to the role of environment as a moderator in the strategic change-firm performance relationship. Thus, both *H3* and *H4* receive some support.

Discussion

The results of our study provide several insights about the relationships among top management knowledge capability, strategic change, and the role of the environment. The study was designed to answer a number of related research questions:

- Does a firm's existing knowledge capability influence strategic change?
- To what extent does strategic change contribute to firm performance?
- Is the relationship between strategic change and firm performance stronger in a deregulated than regulated environments?

Our results support the influence of existing knowledge capability on strategic change as well as the moderating effect of the environment on the strategic change-firm performance relationship.

This study highlights the importance of existing or prior knowledge of a firm and the more dynamic process of strategic change. We showed that the current stock of top management knowledge, measured as level of formal education and functional diversity, influences the ability of a firm to innovate and change its strategy. The results of the present study suggest a strong relationship between education level and strategic change and a weak relationship between functional diversity of the firm's key decision-makers and change in business strategy. Our results provide additional support for the strategic choice perspectives. Further, in line with a number of prior studies following Hambrick and Mason's (1984) upper echelon perspective, our study indicates that observable managerial demographic variables can serve as powerful proxies for underlying traits, cognitions, and capabilities. As expected, TMTs with a greater stock of knowledge (a higher level of education and greater functional background diversity) were found more likely to initiate strategic change as reflected in the airline's change to a more centralized hub.

Our results suggest that a firm's existing knowledge capability can serve as an endogenous source of strategic change. That is, even in the absence of environmental stimuli, higher knowledge levels of managers can lead to strategic change. A high knowledge capability contributes to strategic innovation even when controlling for deregulatory intensity (as shown in Table IV). This suggests that organizations can change their strategies by hiring managers with a greater knowledge capability in terms of education and functional diversity. We also found (from Tables III and IV) that the more a firm had already concentrated its hub, the more likely it was to increase this strategic change. This lends further support to the argument that a firm's prior strategy is related to strategic change and influences the direction of the change.

Our finding lends some insight into another question raised by Smith *et al.* (2005). They argue that hiring high capability knowledge employees is likely to promote the creation of new knowledge. In their study of knowledge workers, Smith *et al.* (2005)

suggest that "[I]t would be interesting to explore if this exchange and combination occur naturally when knowledge stocks are high, or whether this process needs to be induced" (p. 355). As noted above, major air carriers with high knowledge capability contributed to strategic change even when controlling for the regulatory environment. They also responded to environmental changes and competitive pressures such as fuel price (see Table IV). Higher fuel prices were associated with a positive change in hub concentration. We reasoned that the majors responded to higher fuel price by relying even more on moving passengers through their largest hub. This finding suggests that competitive pressures contributed to strategic change (Table IV).

This led us to further examine the environment as moderator argument in Table V. In Model 1 we note that the more the major air carriers increased their passenger traffic through their largest hub, the greater the operating profit per revenue passenger mile and operating revenue per revenue passenger mile. We reason that although the majors traditionally competed on the basis of service they increased their hub concentration in an effort to become more efficient. In the next step of the analysis (Model 2, Table V), the interaction of deregulatory intensity and change in hub concentration was added to the main effects and proved to have a negative relationship to one measure of firm performance. Thus, in sum, these findings lend some support to the role of environment as moderator in the strategic change-firm performance relationship.

The findings of this study have implications for both theory and practice in the strategic management area. At the theoretical level, our results suggest that the knowledge capability of an organization, in the final analysis, resides in the individuals within the organization. Further, the results also suggest that the study of strategy in general and strategic change in particular can greatly benefit from studying the decision makers themselves. From a methodological standpoint, an important implication of the study is that, collectively, specific individual demographic characteristics of TMT members can constitute an effective proxy measure for organizational level constructs such as knowledge capability, From the perspective of the practice of strategic management, our results have two important implications. First, it suggests that the performance consequences of a strategic change cannot be studied in isolation without taking into account the environmental context. Second, the results also suggest that knowledge capability of TMT members is a precondition for initiating successful strategic change.

While interpreting the results of our study, it is important to bear in mind some of its limitations. Because our study focused on a single industry that underwent a discrete and radical environmental change (Audia *et al.*, 2000), it is not clear whether these findings are generalizable to other industries that experience environmental change. Although this may limit the generalizability of the findings to other contexts, it provides us with data that is rich and deep.

Our study also points to the need for further research in the area of knowledge capability. The present study focused on the existing or current knowledge stock of managers and its effect on strategic change and firm performance in the airline industry. Studies are needed to examine the influence of current knowledge on the ability to create new knowledge. Research is needed to further refine our understanding of how the knowledge capability of the firm contributes to its efforts to respond to the environment.

References

Andrews, K.R. (1971), *The Concept of Corporate Strategy*, Dow-Jones Irwin, Homewood, IL.

Audia, P.G., Locke, E.A. and Smith, K.G. (2000), "The paradox of success: an archival and a laboratory study of strategic persistence following radical environmental change", *Academy of Management Journal*, Vol. 43 No. 5, pp. 837-53.

Bailey, E., Graham, D.R. and Kaplan, D.P. (1985), *Airline Deregulation*, MIT Press, Cambridge, MA.

Bantel, K.A. and Jackson, S.E. (1989), "Top management and innovations in banking: does the composition of the top management team make a difference?", *Strategic Management Journal*, Vol. 10, pp. 107-24.

Barla, P. and Constantatos, C. (2005), "Strategic interactions and airline network morphology under demand uncertainty", *European Economic Review*, Vol. 49, pp. 703-16.

Barney, J. (1991), "Firm resources and sustained competitive advantage", *Journal of Management*, Vol. 17, pp. 771-92.

Becker, M.H. (1970), "Sociometric location and innovativeness: reformulation and extension of the diffusion model", *American Sociological Review*, Vol. 35, pp. 267-82.

Blau, P.M. (1977), *Inequality and Heterogeneity*, The Free Press, New York, NY.

Boeker, W. (1997), "Strategic change: the influence of managerial characteristics and organizational growth", *Academy of Management Journal*, Vol. 40, pp. 152-70.

Brueckner, J.K. (2004), "Network structure and airline scheduling", *The Journal of Industrial Economics*, Vol. LII, pp. 291-312.

Bunderson, J.S. (2003), "Team member functional background and involvement in management teams: direct effects and the moderating role of power centralization", *Academy of Management Journal*, Vol. 46 No. 4, pp. 458-74.

Carpenter, M.A. and Fredrickson, J.W. (2001), "Top management teams, global strategic posture, and the moderating role of uncertainty", *Academy of Management Journal*, Vol. 44 No. 3, pp. 533-45.

Chaganti, R. and Sambharya, R. (1987), "Strategic orientation and characteristics of upper management", *Strategic Management Journal*, Vol. 8, pp. 393-401.

Chattopadhyay, P., Glick, W.H., Miller, C.C. and Huber, G.P. (1999), "Determinants of executive beliefs: comparing functional conditioning and social influence", *Strategic Management Journal*, Vol. 20 No. 8, pp. 763-88.

Chen, M.-J. and Hambrick, D.C. (1995), "Speed, stealth, and selective attack: how small firms differ from large firms in competitive behavior", *Academy of Management Journal*, Vol. 38, pp. 453-82.

Child, J. (1972), "Organizational structure, environment and performance: the role of strategic choice", *Sociology*, Vol. 6, pp. 2-22.

Cohen, W.M. and Levinthal, D.A. (1990), "Absorptive capacity: a new perspective on learning and innovation", *Administrative Science Quarterly*, Vol. 35 No. 1, pp. 128-52.

Cyert, R.M. and March, J.G. (1963), *A Behavioral Theory of the Firm*, Prentice-Hall, Englewood Cliffs, NJ.

Dearborn, D. and Simon, H.A. (1958), "Selective perceptions: a note on the departmental identification of executives", *Sociometry*, Vol. 38, pp. 140-4.

Dess, G.G. and Beard, D. (1984), "Dimensions of organizational environments", *Administrative Science Quarterly*, Vol. 28, pp. 52-73.

Dollinger, M.J. (1984), "Environmental boundary spanning and information processing effects on organizational performance", *Academy of Management Journal*, Vol. 27, pp. 351-68.

Dun & Bradstreet (various years), *Reference Book of Corporate Managements: America's Corporate Leaders*, Dun & Bradstreet Corporation, Parsippany, NJ.

Ginsberg, A. and Buchholtz, A. (1990), "Converting to for-profit status: corporate responsiveness to radical change", *Academy of Management Journal*, Vol. 33, pp. 445-77.

Gittell, J.H. (2003), *The Southwest Airlines Way*, McGraw-Hill, New York, NY.

Goodstein, J. and Boeker, W. (1991), "Turbulence at the top: a new perspective on governance structure changes and strategic change", *Academy of Management Journal*, Vol. 34, pp. 306-30.

Grimm, C.M. and Smith, K.G. (1991), "Management and organizational change: a note on the railroad industry", *Strategic Management Journal*, Vol. 12 No. 7, pp. 557-62.

Haleblian, J. and Finkelstein, S. (1993), "Top management team size, CEO dominance, and firm performance: the moderating roles of environmental turbulence and discretion", *Academy of Management Journal*, Vol. 36 No. 4, pp. 844-63.

Hambrick, D.C. and D'Aveni, R.A. (1992), "Top team deterioration as part of the downward spiral of large corporate bankruptcies", *Management Science*, Vol. 38, pp. 1445-66.

Hambrick, D.C. and Mason, P.A. (1984), "Upper echelons: the organization as a reflection of its top managers", *Academy of Management Review*, Vol. 9, pp. 193-206.

Hambrick, D.C., Cho, T.S. and Chen, M.-J. (1996), "The influence of top management team heterogeneity on firms' competitive moves", *Administrative Science Quarterly*, Vol. 41, pp. 659-84.

Haveman, H.A. (1992), "Between a rock and a hard place: organizational change and performance under conditions of fundamental environmental transformation", *Administrative Science Quarterly*, Vol. 37, pp. 48-75.

Kelly, D. and Amburgey, T.L. (1991), "Organizational inertia and momentum: a dynamic model of strategic change", *Academy of Management Journal*, Vol. 34, pp. 591-612.

Kimberly, J.R. and Evanisko, M.J. (1981), "Organizational innovation: the influence of individual, organizational, and contextual factors on hospital adoption of technological and administrative innovations", *Academy of Management Journal*, Vol. 24, pp. 689-713.

Knight, D., Pearce, C.L., Smith, K.G., Olian, J.D., Sims, H.P., Smith, K.A. and Flood, P. (1999), "Top management team diversity, group process, and strategic consensus", *Strategic Management Journal*, Vol. 20 No. 5, pp. 445-65.

March, J.G. and Simon, H.A. (1958), *Organizations*, Wiley, New York, NY.

Michel, J. and Hambrick, D. (1992), "Diversification posture and top management team characteristics", *Academy of Management Journal*, Vol. 35, pp. 9-37.

Miles, R.E. and Snow, C.C. (1978), *Organizational Strategy, Structure, and Process*, McGraw-Hill, New York, NY.

Morrison, S.A. and Winston, C. (1995), *Evolution of the Airline Industry*, Brookings, Washington, DC.

Murray, A.I. (1989), "Top management group heterogeneity and firm performance", *Strategic Management Journal*, Vol. 10, pp. 125-41.

Nahapiet, J. and Ghoshal, S. (1998), "Social capital, intellectual capital, and the organizational advantage", *Academy of Management Review*, Vol. 23 No. 2, pp. 242-66.

Pegels, C.C., Song, Y.I. and Yang, B. (2000), "Management heterogeneity, competitive interaction groups, and firm performance", *Strategic Management Journal*, Vol. 21 No. 9, pp. 911-24.

Prescott, J.E. (1986), "Environments as moderators of the relationship between strategy and performance", *Academy of Management Journal*, Vol. 29 No. 2, pp. 329-46.

Rajagopalan, N. and Spreitzer, G. (1997), "Toward a theory of strategic change: a multi-lens perspective and integrative framework", *Academy of Management Review*, Vol. 22 No. 1, pp. 48-79.

Randel, A.E. and Jaussi, K.S. (2003), "Functional background identity, diversity, and individual performance in cross-functional teams", *Academy of Management Journal*, Vol. 46 No. 6, pp. 763-74.

Rogers, E. and Shoemaker, F. (1971), *Communication of Innovation*, The Free Press, New York, NY.

Simons, T., Pelled, L.H. and Smith, K.A. (1999), "Making use of difference: diversity, debate, and decision comprehensiveness in top management teams", *Academy of Management Journal*, Vol. 42 No. 6, pp. 662-73.

Smith, K.G. and Grimm, C.M. (1987), "Environmental variation, strategic change and firm performance: a study of railroad deregulation", *Strategic Management Journal*, Vol. 8, pp. 363-76.

Smith, K.G., Collins, C.J. and Clark, K.D. (2005), "Existing knowledge, knowledge creation capability, and the rate of new product introduction in high-technology firms", *Academy of Management Journal*, Vol. 48 No. 2, pp. 346-57.

Sutcliffe, K.M. (1994), "What executives notice: accurate perceptions in top management teams", *Academy of Management Journal*, Vol. 37 No. 5, pp. 1360-78.

US Department of Commerce (various years), *Bureau of Economic Analysis – Survey of Current Business*, Government Printing Office, Washington, DC.

US Department of Energy (various years), *Annual Energy Review*, Government Printing Office, Washington, DC.

US Department of Transportation (1960, 1970, 1980, 1990, 1993, 1994, 1995), *NTS Appendix A – Modal Profiles*, Government Printing Office, Washington, DC.

US Department of Transportation (various years a), *Air Carrier Financial Statistics*, Government Printing Office, Washington, DC.

US Department of Transportation (various years b), *Air Carrier Traffic Statistics*, Government Printing Office, Washington, DC.

US Department of Transportation (various years c), *Transportation Sector Establishments, Employment, Revenues, and Productivity*, Government Printing Office, Washington, DC.

Venkatraman, N. (1989), "The concept of fit in strategy research: toward verbal and statistical correspondence", *Academy of Management Review*, Vol. 14 No. 3, pp. 423-44.

Waller, M.J., Huber, G.P. and Glick, W.H. (1995), "Functional background as a determinant of executives' selective perception", *Academy of Management Journal*, Vol. 38 No. 4, pp. 943-74.

Walsh, J. (1988), "Selectivity and selective perception: an investigation of managers' belief structures and information processing", *Academy of Management Journal*, Vol. 31, pp. 873-96.

Wiersema, M.F. and Bantel, K.A. (1992), "Top management team demography and corporate strategic change", *Academy of Management Journal*, Vol. 25, pp. 91-121.

Zahra, S.A. and George, G. (2002), "Absorptive capacity: a review, reconceptualization, and extension", *Academy of Management Review*, Vol. 27 No. 2, pp. 185-203.

Zajac, E.J. and Shortell, S.M. (1989), "Changing generic strategies: likelihood, direction, and performance implications", *Strategic Management Journal*, Vol. 10, pp. 413-30.

Appendix

Variable	Source
Education level	Dun & Bradstreet's *Reference Book of Corporate Management*
Functional background	Dun & Bradstreet's *Reference Book of Corporate Management*
Hub concentration	US Department of Transportation, *Air Carrier Industry Scheduled Service Traffic Statistics*
Industry – total operating revenues	US Department of Transportation, *Transportation Sector Establishments, Employment, Revenues, and Productivity*
Industry – total wages and salaries	US Department of Commerce, *Bureau of Economic Analysis – Survey of Current Business*
Industry – average price of fuel	US Department of Energy, *Annual Energy Review*
Industry – total number of carriers	US Department of Transportation, *NTS Appendix A – Modal Profiles*
Firm – total assets	US Department of Transportation, CAB, *Air Carrier Financial Statistics*
Operating profit	US Department of Transportation, CAB, *Air Carrier Financial Statistics*
Revenue passenger mile	US Department of Transportation, CAB, *Air Carrier Traffic Statistics*
Operating revenue	US Department of Transportation, CAB, *Air Carrier Financial Statistics*

Table AI.
Sources of variables

Corresponding author
Irene Goll can be contacted at: golli2@scranton.edu