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MANAGEMENT HETEROGENEITY, COMPETITIVE INTERACTION GROUPS, AND FIRM PERFORMANCE

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One of the fundamental problems in strategic management is to map a heterogeneous set of firms in an industry into subsets of firms within which firms are homogeneous in their conduct and performance. The strategic group concept provides an answer to this intriguing question. Researchers in strategic group theory argue that firms within the same strategic group are behaviorally similar and thus tend to compete more fiercely within the group than across groups. In this paper, we focus on the question whether firms within the same group show similar decision-making characteristics. Strategic-choice theorists argue that top management teams in firms have substantial discretion in determining the future strategic contour of firms. Upper-echelon theorists also argue that top managers are the strategists who set the direction of firms and the pace of competition in the industry. Further, they argue that top management team characteristics are an important element that determines the market niche in which a firm competes and the strategic direction a firm follows. Based on these arguments, we expect that there will be a significant link between grouping of firms by the patterns of competitive interactions and grouping of firms by top management team heterogeneity. Moreover, we argue that the closer the TMT heterogeneity of a firm is to the dominant heterogeneity in the competitive interaction group, the better it performs.

INTRODUCTION

Strategic group theorists argue that firms within the same strategic group are similar in their behavior and in their performance as they manage their efforts to maximize the level of joint profit of the group members (Porter, 1979; Oster, 1994). Implicit in this theory is that strategists (top managers) within a strategic group must share commonalities in determining strategic direction of their firms and in nurturing and deploying resources to realize chosen strategies. Under these conditions, top managers may possess substantial discretion in determining strategic direction of their firm, and thus the formation of strategic groups are largely the result of strategic choices by top managers rather than by environmental choices (Finkelstein and Hambrick, 1990). However, the current stream in strategic group research has rarely recognized the roles of the top management team in forming and developing strategic groups. The cognitive approach to group theory provides some evidence that cognitive mapping of top managers on competition in an industry matches the actual competitive patterns in the industry (Reger and Huff, 1993; Porac and Thomas, 1990). However, while the cognitive approach to group formation validates the role of the top management team in forming groups, the researchers do not investigate the characteristics of the top management team per se as driving

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forces that make possible the link between cognitive mapping and actual grouping.

Based on previous work of the cognitive approach to strategic groups, we combine the arguments of upper-echelon theory (Hambrick and Mason, 1984) with those of strategic group theory and focus especially on how the characteristics of the top management team are associated with the development of strategic groups. Rooted in strategic choice theory (Child, 1972), upper-echelon theorists (Hambrick and Mason, 1984; Hambrick and Finkelstein, 1987; Finkelstein and Hambrick, 1990) argue that top managers have a powerful influence over forming and developing the strategic contour of firms and that demographic and societal characteristics of top managers influence strategy-making activities of the top management team. We explore these arguments in the context of group formation in an industry.

Since we do not want to claim that our approach in this paper is a replacement or alternative to strategic group formation, we will refer to the proposed approach as the formation of competitive interaction or industry groups to avoid confusion with past research on strategic groups. The term strategic group will be used when referring to past research.

REVIEW ON INDUSTRY GROUP RESEARCH

Researchers in strategic management recognize that one of the fundamental problems in the discipline is to draw a meaningful demarcation line between heterogeneous sets of firms within which firms are homogeneous in their conduct and performance (Hatten and Hatten, 1987; Porter, 1985). The strategic group concept lies in between two extreme views: one being the traditional industrial organization view in which all the firms in an industry are homogeneous except for size (Bain, 1956), and the other being the traditional strategic management view in which each firm is idiosyncratic in their behavior so that firms are heterogeneous in a strategically unique manner (Henderson, 1979).

Although there is substantial variation in defining strategic groups, researchers on strategic groups tend to agree that the following elements are the basic building blocks of the strategic group concept (Cool and Schendel, 1987, 1988):

1. A strategic group consists of firms that compete against each other on the basis of similar combinations of strategic (resource and scope) commitments (Dess and Davis, 1984; Oster, 1994; Porter, 1980).
2. Different groups are distinguished by mobility barriers (Porter, 1980; Oster, 1994).
3. Intraindustry difference in performance level can be basically explained by the group membership, especially through the height of the mobility barriers surrounding each group (Oster, 1994; Porter, 1980; Dess and Davis, 1984).

Although researchers in strategic group theory emphasize the similarities in the patterns of resource deployment and scope commitment among the firms in the same strategic group, the focus of previous research has been placed on the identification methods of strategic groups (Fiegenbaum and Thomas, 1993; Mascarenhas, 1989; Harrigan, 1985) and the implications of group membership on firm performance and industry structure (Oster, 1994; Porter, 1979; Dranove, Peteraf, and Shanley, 1998).

The primary implication of the above reasoning is that firms should carefully consider the group structure in the industry when they make decisions on entry, expansion, and any other strategic moves. Second, researchers propose a theoretical model that mobility barriers significantly affect the patterns of intergroup dynamics (Fiegenbaum, McGee, and Thomas, 1987; Oster, 1982 Porter, 1979). Specifically, they argue that the ease, frequency, and predictability of changes in group membership over time ultimately affect the profitability of different strategic groups.

RESEARCH OF TOP MANAGEMENT TEAMS

According to upper-echelon theory (Hambrick and Mason, 1984; Boeker, 1997; Knight *et al.*, 1999), top management team (TMT) characteristics have important impacts on organizational outcomes because top executives are empowered to make strategic decisions for organizations. Since top executives make decisions consistent with their

cognition, which is in part a function of the values and the experiences they commonly share, their experiences and values may be associated with organizational outcomes and their firm's performance. Based on this logic, researchers have investigated the link between TMT characteristics and the behavior of firms such as organizational innovation (Bantel and Jackson, 1989), strategic planning (Finkelstein and Hambrick, 1990; Grimm and Smith, 1991; Michel and Hambrick, 1992; Wiersema and Bantel, 1992), and firm performance (Finkelstein and Hambrick, 1990, Thomas, Litschert, and Ramaswamy, 1991; Michel and Hambrick, 1992; Hambrick and D'Aveni, 1992; Boeker, 1997). These studies commonly articulate that TMT heterogeneity in social and demographic characteristics do matter in determining activity patterns of firms. Other researchers also find links of specific TMT characteristics to the heterogeneity of firms in strategic orientation (Wiersema and Bantel, 1992), risk-taking propensity (Bantel and Jackson, 1989), consensus building (Priem, 1990; Knight *et al.*, 1999), and industry experiences (Eisenhardt and Schoonhoven, 1990).

Given a plethora of research and significant findings, upper-echelon theorists have successfully established that TMT heterogeneity (particularly in demographic characteristics) is an important driving force for the organizational processes and outcomes. Lacking in this research stream, however, is how TMT heterogeneity of firms affects the course of competitive dynamics in an industry. Since competitive dynamics of firms in an industry is the process through which profit potential of firm activities is realized, the link between TMT heterogeneity and organizational outcomes is contingent at least partially upon how other firms in the industry respond to the actions taken by the focal firm. Although we do not establish that link in this paper, we do solidify the link between TMT heterogeneity and organizational performance.

In this paper, we combine the upper-echelon perspective and the competitive interaction group concept to address three important issues in management research, namely; (1) use of fine-grained competitive information to achieve competitive interaction group formation; (2) determination of how TMT heterogeneity of firms compares with other industry group members; (3) identification of how firms with TMT heterogeneity similar to their respective industry group show better firm performance.

TOP MANAGEMENT TEAM HETEROGENEITY AND COMPETITIVE INTERACTION GROUPS

The influence of top managers on shaping the future strategic contour of firms has gathered ongoing attention from researchers. Strategic choice theorists (Child, 1972) argue that top management in a firm has substantial discretion in determining the future strategic contour of the firm. Top managers can choose decision-making environments that are conducive to realizing the organizational potential. Top managers can also influence external and internal environments by constructing, eliminating, or defining characteristic elements of an environment (Child, 1972; Weick, 1979). In this way, top managers can create their own domain of reality and decision-making boundary.

In a similar vein, upper-echelon theorists (e.g., Hambrick and Mason, 1984) argue that top managers are the strategists in the industry who set the direction of firms and the pace of competition. Further, they argue that top management team characteristics are important elements that determine the market niche in which a firm competes and the strategic direction a firm follows (Finkelstein and Hambrick, 1990; Hambrick and Finkelstein, 1987). For example, Michel and Hambrick (1992) used the concept of social integration to explain links between average team tenure and diversification strategy and performance. They proposed that the length of team tenure is a surrogate for the level of team cohesion (homogeneity) and that cohesion in turn affects performance. Similarly, others (Wiersema and Bantel, 1992; Boeker, 1997; Knight *et al.*, 1999) argued that top management team traits such as age, organizational tenure, educational level, and technical specification influence the firm's decision-making process in terms of receptivity to change and willingness to take risk, which in turn affect the degree of corporate strategic changes. Also, Waller, Huber, and Gluck (1995) found that functional background of executives has an effect on which changes they perceive in their organization's effectiveness.

Previous studies show that team demography influences team processes, such as social integration and communication, and these processes in turn affect organizational strategy and outcome. Specifically, the profiles of the TMT influence the selection of competitive fields and the patterns of actions and responses in the chosen fields. For example, firms with high TMT heterogeneity in social and demographic characteristics are likely to compete in a dynamic environment where diverse capabilities of top managers are required to outperform competitors (Michel and Hambrick, 1992; Murray, 1989). Similarly, firms with low TMT heterogeneity may show dominant presence in stable environments where group cohesion produces better results. Therefore, TMT heterogeneity provides vital information on a firm's preference for environmental niches to compete and on the likelihood of success in the chosen market niches.

The connection between TMT heterogeneity and a firm's positioning in the market, in turn, provides implications on the competitive mapping in the industry. That observation implies that each environmental niche is likely to be packed with firms with similar TMT characteristics. Such a grouping of firms is strengthened as the cumulation of competitive interactions combined with social and institutional processes proceeds (Tang and Thomas, 1992). As long as the niche structure is stable, these processes produce a tightly coupled cognitive mapping shared by TMTs within the group, which governs competitive rules and institutional norms within the group (Porac and Thomas, 1990; Reger and Huff, 1993). Moreover, once established, the similarity in TMT characteristics may persist as firms recognize a particular combination of managerial resources as dominant and socially desirable in the environmental niches in which they compete (DiMaggio and Powell, 1983; Tang and Thomas, 1992).

The above arguments imply that the heterogeneity of firms' TMT profiles may be associated with the formation of competitive interaction groups within the industry. Based on the argument, we posit that member firms in a competitive interaction group are likely to have a similar profile of TMT heterogeneity. This leads to the following hypothesis:

Hypothesis 1: Firms in the same competitive interaction group have similar TMT heterogeneity, compared to the TMT heterogeneity of firms across groups.

TMT CHARACTERISTICS AND FIRM PERFORMANCE

From the discussion above, it follows that a firm may be successful in a particular competitive interaction group to the degree that the firm's managerial characteristics, as represented by TMT heterogeneity, are consistent with the group characteristics. First of all, to the extent that the use of managerial resources governs the strategic outcomes of firms, combinations of TMT heterogeneity used in a group become a source of performance pressure. As performance pressure builds up, firms using less efficient combinations of managerial resources are forced to change their combinations or they will be driven out of the group (Harrigan, 1985).

Researchers in TMT also support the mediating roles of group structure between TMT characteristics and organizational performance. A firm's prospective profitability, growth, and competitiveness are arguably a function of psychological predispositions of top executives (Finkelstein and Hambrick, 1990; Wiersema and Bantel, 1992). For example, Eisenhardt and Schoonhoven (1990), and Hambrick and D'Aveni (1992) have attributed these findings to the links between team demography, organizational performance and social and psychological predispositions of top executives such as TMT age, TMT tenure, and TMT heterogeneity. Murray (1989) used social integration and communication patterns to predict the form of the relationship between team heterogeneity and organizational performance. He argued that high team heterogeneity may lower performance in stable environments because the TMT would be less cohesive and require more formal communication.

Therefore, the organizational performance of firms is contingent at least partly upon the fit between demographic TMT traits and environmental characteristics, especially the characteristics and the structure of the competitive interaction group in which they compete. We argue that the proximity of a firm's TMT characteristics to the dominant TMT characteristics in the competitive interaction group in which it competes is an important predictor of the firm's performance.

The above argument leads to the following hypothesis:

Hypothesis 2: Firms showing TMT heterogeneity similar to the mean of their respective competitive interaction group show higher performance levels.

COMPETITIVE INTERACTION APPROACH TO GROUP FORMATION

In order to identify strategic groups, researchers have used size (Caves and Pugel, 1980; Porter, 1985), degree of vertical integration (Newman, 1978), product strategy (Oster, 1982), manufacturing and marketing variables (Hatten and Hatten, 1987; Hatten and Schendel, 1978; Dess and Davis, 1984) as the strategic variables and employed various statistical methods including cluster analysis (Dess and Davis, 1984), factor analysis (Baird and Sudharsan, 1983), and arbitrary classification using only one or two classificatory variables (e.g., Caves and Pugel, 1980; Newman, 1978; Porter, 1979).

While classification of firms in terms of resource profiles or scope commitments provides information on the configuration of strategic commitments of firms, it does not directly address the patterns of interdependence of firms in an industry, the fundamental building block on which strategic group theory is based. Without directly investigating the patterns of competitive interactions, one would never be sure that grouping of firms by strategic profiles is the correct reflection of interdependence patterns of firms in the industry.

Responding to the above, we use the patterns of competitive interaction of firms, defined here as the exchange of competitive or cooperative moves (actions and responses) among firms in a market (Chen, Smith, and Grimm, 1992), to classify firms into groups. The existence of distinctive patterns of competitive interaction implies that firms recognize some competitors' actions as more important than others and thus respond to them in a differential manner. Firms that are strategically interdependent on each other are the ones that are most likely to respond to one another, building up frequent interaction patterns. On the other hand, if there are no discernible interdependence patterns in the industry, firms face enormous uncertainty and unpredictability and tend to respond to almost every action taken by any competitor in the market (Porter, 1980). Competitive interaction captures the actual competitive, or cooperative, moves and antimoves of firms in an effort to occupy preferable positions in the 'strategic space' (Fiegenbaum, Sudharsan, and Thomas, 1990). In this sense, the competitive interaction view provides rich information on the evolutionary paths of industry groups.

In the proposed model, the emphasis is given to the role of competitive interaction patterns mapped onto competitive interaction groups. To form the competitive interaction groups, we first identified action–response dyads, events, over the observation period from 1990 through 1995. An event is defined as a market move (either an initial action or a response) taken by a firm which is followed by at least one response or preceded by an initial action. As noted in the previous sections, a key word search method was used to identify all the responses and link them to the matching initial actions. Some examples of the key words that have been used for this study are:

- 'match,' 'matched,' 'matching,'
- 'in responding to,' 'in response,' 'respond,'
- 'following,' 'followed by,' 'follow,'
- 'compare with,' 'oppose,' 'equivalent to,' 'dispute,' 'counter,'
- 'industry reaction,' 'competitive reaction,' 'other airlines,' 'several airlines,' etc.

The number of competitive interactions among firms over the observation period are then organized into matched pairs between firms; based on this information the competitive interaction (action–response) matrix is constructed. The rows in the matrix represent initial actions while the columns represent responses to the initial actions. The action–response matrix consists of ($n \times n$) cells with the rows representing initial actors and the columns responders. Each cell represents the frequency of the action–response events between the nth responder over the observation period.

We use cluster analysis on the action–response matrix to cluster firms into competitive interaction groups (Woelfel and Fink, 1980). The particular form of cluster analysis used in this study is the clique partitioning method (Borgatti, Everett, and Freeman, 1992). Given a partition of an action–

response matrix of similarities (meaning that larger values represent stronger ties) into *n* groups, the method uses the average similarity values within each group to provide a measure of the extent to which the groups form clique-like structures. The method uses a tabu search procedure in the optimization process (Glover, 1989, 1990). The routine attempts to optimize these measures to find the best fit for a given number of groups.

RESEARCH SAMPLE

After consideration of several alternative industries, the major and national airlines in the U.S. domestic airline industry were selected for this study. The domestic airline industry has been a popular subject for studying the impact of deregulation from the economic perspective (Levine, 1987) and for investigating competitive events among competitors (Smith *et al.*, 1989, 1991; Baum and Korn, 1996). Chen *et al.* (1992) have used domestic airline industry data collected over the 1979–86 period, focusing on dyadic competitive relationships among the industry participants. We used *Aviation Daily* to collect data and information on strategic moves (actions and responses) over a 5-year period from 1990 to 1994. *Aviation Daily* is the most comprehensive trade journal in the airline industry, reporting all the important news items such as competitive events, changes in environmental conditions, legal issues, changes in government regulation, etc.

The competitive interaction groups were derived from 424 events taken by 33 competitors. We used all the interaction data to identify competitive interaction groups, but only 22 airlines were useable for analysis owing to missing observation problems. Using the identified events, an action–response matrix is constructed to identify competitive interaction groups. The action–response matrix shows the number of matched pairs between an initial actor and all the responders and carries the basic information for applying the clique partitioning method. Starting with the four-clique method, the three-clique and the five-clique methods were also evaluated. The fit scores showed that the four-clique solutions provided the best-fit score for the sample. The results are reported in Table 1.

Table 1. Clique partitioning results for competitive interactions

Group	Assignments
1.	Alaska, American, America West, Continental, Delta, Eastern, Northwest, PanAm, Southwest, TWA, United, USAir
2.	Midway, ValuJet
3.	Air Wisconsin, Airtran, Atlantic Coast, Atlantic South-East, Horizon, West Air
4.	Aloha, ComAir, Metro, AirMidwest, Skywest

Fit score: -1.838 (small value indicates better fit).

As can be observed from the table, group 1 consists of the large, major airlines either serving most of the United States or large regions of the United States. Clique partitioning positioned them in group 1 because they are in direct competition in regions where their services overlap. Any competitive action, such as a fare change or a service frequency change, would elicit a response from those competitors directly affected by the initial action.

The three remaining groups consist of smaller airlines, usually either low-cost carriers or supplemental carriers to the major airlines. As such they also are likely to compete with each other but at a different level than the major airlines. For instance, Midway and ValueJet compete on several mid-West to Florida routes. The group 3 and 4 airlines are largely supplemental airlines, and as such have a natural grouping with competitive interactions but at a much lower intensity level than that found for the group of large, major airlines.

Finally, data on the TMT during the observed period (1988–91) were obtained from the *Dunn and Bradstreet Reference Book of Corporate Management* (D&B), company proxy statement, and 10 K reports. Each TMT is defined as consisting of those executives above the vice president level (sometimes secretary, controller, and treasurer depending on the firm's structure), as well as any other officers who served as directors of the company, e.g., senior vice president, vice chairman, CEO, and any other officers who were on the board of directors. This definition yielded a mean TMT size of 20.7, with a range of 5–59. Coding the D&B entries is relatively straightforward. We followed a previously accepted coding scheme (e.g., Michel and Ham-

brick, 1992; Wiersema and Bantel, 1992).

VARIABLES AND MEASUREMENT

TMT age

This variable measured the average age of the firm's TMT members for each year analyzed.

TMT tenure

Tenure was measured as the mean number of years the members of a TMT had spent with a firm. Basically three sets of tenure variables have been coded, consisting of total number of years spent in the current company, total number of years spent in the current company as a member of TMT, and total number of years spent in the current company at the current position.

TMT education level

Years of education completed, source of education, and educational focus were obtained from bibliographical data found in D&B. The assessment of education level was accomplished using a coding scheme whereby each member was assigned a value 1–8, depending on the level of education attained by the individual. Coded values are listed in Table 2.

Table 2. Codes for education level and function

Education levels	
1.	Secondary school only
2.	Some college
3.	Associate's degree
4.	Bachelor's degree
5.	More than one bachelor's degree
6.	Master's degree or professional certification (CPA, CPCM, etc.)
7.	More than one master's degree or master's plus a professional certification
8.	Doctorate degree or professional certification (PhD, DBA, JJD, JD, etc.)
Functional classifications	
1.	Flight operations, Engineering, Technical Service, and Maintenance
2.	Personnel, Human Resources, Industrial Relations, and Communications
3.	Finance, Budgeting, Financial Planning
4.	Accounting, Data Processing, MIS, and Audit/Reservations
5.	Advertising, Marketing, Customer Service, and Public Relations
6.	Law, General Counsel, and Government Affairs
7.	Scheduling, Development, Marketing Research, and Purchasing and Inventory
8.	General Management, Administration
9.	Traffic and Stations

TMT functional background

Functional background was measured as the percent of team members whose primary career had been in any functional area in airline operations. The functional background is based on a review of the individual's career background. Only the coded functional classifications as shown in Table 2 were used to determine functional background heterogeneity.

In some cases it was difficult to decide on the functional background of senior executives. They were generally coded as general managers. If senior executives were in charge of a large group they were assigned as general managers unless there was some function associated with their title such as senior VP finance, when they were assigned to finance rather than general management. Individuals who are assistants to a senior executive were assigned to the same functional background as the person they were assisting.

TMT group heterogeneity

Group heterogeneity refers to the amount of diversity found within the TMT. It is measured in four ways: (1) functional heterogeneity, (2) educational heterogeneity, (3) company tenure heterogeneity, and (4) age heterogeneity (Michel and Hambrick, 1992; Wiersema and Bantel, 1992). To avoid multicollinearity, both the standard deviation and the Herfindahl index methods have been used.

TMT functional background heterogeneity

Functional background heterogeneity is measured by the Herfindahl index (Blau, 1977; Michel and Hambrick, 1992). The formula is:

$$H = 1 - \sum_{i=1}^{10} p_i^2$$

where H is the heterogeneity measure and p is the percentage of TMT's members in each of the nine functional background categories. H can take on values from 0 to 1, with high values indicating that a TMT is heterogeneous, with typically one or two functional areas being dominant.

TMT education level heterogeneity

To determine the team's diversity (heterogeneity) the standard deviation for educational background was calculated. The larger the standard deviation or the coefficient of variation, defined as the standard deviation divided by the mean, the greater the diversity of the team on the education level.

TMT age heterogeneity

To determine the team's diversity (heterogeneity) on the age variable, the standard deviation for age was calculated. The larger the standard deviation or the coefficient of variation, the greater the diversity of the age of the TMT.

TMT company tenure heterogeneity

Three types of tenure measures, i.e., the number of years the executives on the TMT had spent in the firm, total number of years spent in the current company as a member of TMT, and total number of years spent in the current company at current positions are used to represent the company tenure heterogeneity. The coefficient of variation as well as standard deviation have been used to denote the heterogeneity.

Firm performance

Performance of each airline was measured by each firm's load factor. Load factor is defined as the proportion of an aircraft's seating capacity that is actually sold or used, determined by dividing revenue passenger miles by available seat miles. Load factor is conventionally used as an efficiency measure directly associated with firm profitability.

To test Hypothesis 1, we used the one-way ANOVA test. If there is a significant difference in heterogeneity measures across competitive interaction groups, Hypothesis 1 will be supported. To test Hypothesis 2, we developed Euclidean distance measures that identify the deviations of each firm's TMT characteristics from the dominant TMT characteristics for the competitive interaction group to which each firm belongs. The Euclidean distance measure is defined as follows:

$$d_k = \sqrt{(M_i - X_{ik})i^2}$$

where d_k = a Euclidean distance measure for airline k, M_i = mean score for heterogeneity variable X_i for group i, and X_{ik} = the value of heterogeneity variable X_i for airline k.

The centroid of each group for heterogeneity variables, the mean vector, was used as the representative point of the group to calculate the distance. The Euclidean distance scores for all the heterogeneity measures were then factor-analyzed to form two distinctive factors with Eigen values of 1.7123 and 1.0564 respectively. The first factor, named *experience heterogeneity*, was composed of current tenure heterogeneity (factor loading = 0.8022), age heterogeneity (0.7382), and education heterogeneity (0.6309). All the variables were positively loaded on the first factor, indicating the degree of experience heterogeneity. The second factor consisted of a single variable, *functional background heterogeneity*. We then used multiple regression model to test Hypothesis 2. The model is specified as follows:

$$Y = b_0 + b_1.X_1 + b_2.X_2 + b_3.X_3 + b_4.X_4 + b_5.X_5 + b_6.X_6$$

where Y = performance level (load factor) of each airline, X_1 = experience heterogeneity factor, X_2 = functional background heterogeneity factor, X_3 = TMT size of each airline, X_4 = dummy variable for Year 1, X_5 = dummy variable for Year 2, and X_6 = dummy variable for Year 3.

To estimate the effect of the deviation of TMT characteristics of an airline from the mean TMT characteristics in the group on the future performance, we specified two models by time-lagging the dependent variable, the load factor, by 1 year and 2 years respectively. Since we used time-series cross-sectional data for the analysis, serial correlation may be problematic. Following the suggestions of Kmenta (1986), we include dummy variables for the observation years to eliminate serial correlation. Since both the experience heterogeneity factor and the functional back-

ground heterogeneity factor are measured on deviation scores from the means, Hypothesis 2 will be supported if the results show a negative relationship between the Euclidean distance measure and the performance of each airline. In the regression model, TMT size is used as a control variable.

STATISTICAL ANALYSIS

We next assembled the descriptive statistics that included the TMT characteristics variables, control variable, and performance measures. Correlations, standard deviations, and means for the variables are reported in Table 3.

Among TMT means statistics we observe that strong statistical significance was found for TMT average education level, which is inversely related to average age and functional background, which is positively related to average age. Among TMT heterogeneity statistics we observe that strong statistical significance was found for tenure heterogeneity, which is positively related to both age heterogeneity and education heterogeneity. The control variable top management team size showed strong statistically significant correlation with mean functional background and mean education level. The two performance variables, the load factors, showed strong statistical significance with tenure mean (negative), mean education (positive), functional background heterogeneity (negative), tenure heterogeneity (negative), age heterogeneity (negative), education heterogeneity (negative), and top management team size (positive).

Hypothesis 1, which tests the existence of systematic differences across the groups in terms of TMT heterogeneity characteristics, is strongly supported as shown in Table 4. ANOVA tests supported Hypothesis 1 for all the indicators of TMT heterogeneity measures except functional background heterogeneity, which was statistically significant at the marginal level.

Hypothesis 2 posited that the closer the TMT characteristics of an airline are to the dominant TMT characteristics in the group to which it belongs, the higher the future performance level will be. The multiple regression results testing Hypothesis 2 are reported in Table 5. For both regression models, the heterogeneity factors for experience and functional background are statistically significant in a negative direction, strongly supporting the hypothesis. The results indicate that, as airlines deviate from the dominant TMT characteristics of the competitive interaction groups to which they belong, their future performance potential declines.

IMPLICATIONS OF TMT CHARACTERISTICS AND COMPETITIVE INTERACTION GROUPS

This study examined how the heterogeneity of the functional and demographic characteristics of decision-makers (the top management team) is associated with the competitive market behavior of firms and the profit potential of such behavior in a competitive interaction group. The central idea of industry group theory is that firms within the same group are homogeneous in terms of resource/scope combination and their use of such resources in the market place. In this paper, we investigated this notion by focusing on how firms mobilize and use managerial resources to compete in a particular domain in the industry identified by competitive interaction grouping.

Our analysis centered around one particular aspect of managerial resources, top management team heterogeneity, in terms of functional and demographic characteristics. TMT heterogeneity has been recognized as one of the central upper-echelon constructs which affects significantly the process of decision making and strategic behavior of firms (Hambrick and Finkelstein, 1987). By focusing exclusively on TMT heterogeneity, this paper pinpoints the association of the construct with competitive interaction groups and the performance implication of this relationship for each firm.

Prior industry group theory used resource and scope variables to identify industry groups, and then used the resultant group structure to investigate the profit implication of group membership and competitive implications of such grouping. This paper presents a reverse logic by using market competition information to classify firms into competitive interaction groups. We then proceeded to investigate the TMT heterogeneity characteristics of firms within the same competitive interaction groups. The verification of Hypotheses 1 and 2 proves to be useful. While

Table 3. Descriptive statistics and correlations of TMT demographic and functional characteristics and firm performance

Variables	Means	S.D.	1	2	3	4	5	6	7	8	9	10
TMT: means												
1. Tenure	5.64	2.08										
2. Age	50.03	3.36	-0.02									
3. Education	4.94	0.87	-0.06	-0.39***								
4. Functional background	0.80	0.04	-0.13	0.39***	-0.13							
TMT: heterogeneity												
5. Functional background	0.03	0.01	0.13	-0.39***	0.11	-0.04						
6. Tenure	0.007	0.01	0.15	-0.21*	-0.11	-0.23*	0.16					
7. Age	0.029	0.029	-0.00	-0.15	-0.14	0.05	0.21*	0.38***				
8. Education	0.229	0.07	0.26**	0.12	-0.37***	-0.03	0.05	0.37***	0.23*			
Control variable												
9. Top management team size	20.65	12.37	-0.31	0.14	0.31**	0.38***	-0.12	-0.14	-0.04	-0.19		
Load factors												
10. 1-year lead time (%)	58.8	6.95	-0.40***	0.09	0.31**	0.02	-0.26**	-0.30**	-0.37***	-0.39***	0.45***	
11. 2-year lead time (%)	58.7	7.21	-0.42***	0.02	0.28**	0.09	-0.29**	-0.24*	-0.38***	-0.32**	0.43***	0.96***

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$, two tailed

Table 4. One-way ANOVA test of differences in top management team's heterogeneity characteristics across four competitive interaction groups

Independent variables	Degrees of freedom	*F*-statistic	*p*
Total tenure at the current company	3	3.76	0.041
Total tenure as a member of top Management team	3	3.43	0.052
Total tenure at the current position	3	3.71	0.042
Education level	3	3.06	0.039
Age	3	3.21	0.061
H index of functional background	3	3.51	0.108

Table 5. Regression results of top management team's heterogeneity and control variable on performance (load factor)

Independent variables	Load factor: 1-year lead time	Load factor: 2-year lead time
Constant	55.02*** (2.04)[a]	56.16*** (1.88)
Experience heterogeneity[b]	-2.55*** (0.94)	-2.37*** (0.87)
Functional background heterogeneity[b]	-1.65** (0.81)	-1.69** (0.76)
Top management team size	0.21*** (0.07)	0.21*** (0.07)
Year 1 dummy	-2.19 (2.29)	-2.67 (2.14)
Year 2 dummy	-0.31 (2.29)	-2.73 (2.14)
Year 3 dummy	-0.18 (2.33)	-1.69 (0.44)
Adjusted R^2	0.28	0.32
Number of observations	59	60

[a]Numbers inside parenthesis are standard errors.
[b]These two variables measure the deviation of each firm's heterogeneity characteristics from the respective group's mean heterogeneity characteristics.
*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$, two tailed

limited only to top management heterogeneity, the current study provides strong support to the notion that firms within the same competitive interaction groups that have similar TMT heterogeneity represent a close competitive relationship.

The current study also provides implications on TMT research. Upper-echelon theorists argued that the demographic and social characteristics of the TMT affect the future strategic contour of firms and thus performance levels to the degree that top managers have managerial discretion. They further argued that managerial discretion is constrained to the extent that external environments penetrate organizational boundaries and internal environments restrict managerial power. This implies that different types of TMTs may excel in different environmental space. Therefore, according to their view, the characteristics of TMTs should be consistent with the environmental characteristics for a firm to be profitable. Hypothesis 2 shows that the characteristics of the TMT in a firm should be aligned with those of the competitive environment, rendering strong support to the argument of previous research.

Our findings render support to the cognitive view of strategic group research. Reger and Huff argued that group membership is a matter of degree: 'a strategic group might be best conceptualized as a core group of firms that define the group position and secondary firms that are aligned with core firms in many essential ways' (Reger and Huff, 1993: 116). The results of the current study confirm the above.

CONCLUSIONS

This paper inquired into the dynamic implications of TMT heterogeneity on the patterns of competitive interactions reflected in the competitive interaction group mapping in the airline industry. The strategic leadership literature, especially the literature applying upper-echelon theory, has flourished recently and produced important managerial implications. Firmly rooted in this research tradition, this paper represents an attempt to link TMT characteristics with a firm's competitive interactions. The results shed light on new directions for future research. Both the hypotheses are verified with statistical support. First, we found that TMT characteristics defined as experience heterogeneity and functional background heterogeneity are shown to be homogeneous within a specific competitive interaction group. Second, the firm's performance inside a competitive interaction group has a high association with the TMT profile.

The current research bears significant implications for practicing managers who are in the position of controlling the TMT composition. At the same time, this paper serves as a reference point for studying the implications of a firm's strategic leadership upon competitive interactions and grouping, which govern directly and indirectly the profit generation processes of firms.

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