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# Interrelationships Among Strategy, Environment and Controls - An Empirical Analysis of Singaporean Industrial Firms

H. Y. Teoh

*University of Wollongong*

Ah Ba Sim

*University of Wollongong, absim@uow.edu.au*

G. Thong

*Nanyang Technological University*

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EMPIRICAL ANALYSIS OF SINGAPOREAN  
INDUSTRIAL FIRMS

by

Hai Yap Teoh,  
Department of Accountancy  
University of Wollongong  
Wollongong N.S.W. 2500, Australia

A B Sim  
Department of Management  
University of Wollongong  
Wollongong N.S.W. 2500, Australia

&  
Gregory Thong  
School of Accountancy & Business  
Nanyang Technological University  
Singapore

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**INTERRELATIONSHIPS AMONG STRATEGY, ENVIRONMENT AND  
CONTROLS --- AN EMPIRICAL ANALYSIS OF SINGAPOREAN  
INDUSTRIAL FIRMS**

Hai Yap Teoh  
Department of Accountancy  
University of Wollongong  
P.O.Box 1144 Wollongong  
New South Wales 2525  
Australia

A. B. Sim  
Department of Management  
University of Wollongong  
P.O.Box 1144 Wollongong  
New South Wales 2525  
Australia

and

Gregory Thong  
School of Accountancy & Business  
Nanyang Technological University  
Singapore

**ABSTRACT**

A profile of environmental, control system and performance characteristics was investigated for their interrelationships with Defender, Prospector and Analyzer strategy types in a sample of 69 industrial firms in Singapore. A multiple discriminant analysis revealed systematic differences in selected environmental and control system characteristics among the three strategy groups. The relationships with performance measures however were either absent or weak. Areas for further research were also suggested.

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The globalisation of business has brought about intense competition among business firms that is threatening their very survival. It is this phenomenon that has motivated a renewed interest in the issues of strategy and the choice of strategy orientations for improving a firm's competitiveness. Conceptualizations of strategy have been mostly concerned with an organization seeking to achieve a fit between itself and the external environment, and among its internal structures and management processes (Nightingale & Toulouse, 1977; Miller & Friesen, 1978; Miller, 1981; Venkatraman & Camillus, 1984). Mainly through the seminal work of Johnson & Kaplan [1987] who criticized extant management accounting practices for failing to respond to the need to create competitive advantage, there has also been widespread acceptance of integrating the strategic dimension into the management accounting paradigm. Dent [1990] believed that research at the interface between accounting and strategy is, as yet, underdeveloped and he identified three possibilities for research where further inquiry might contribute to the body of knowledge. Accordingly, this study reported an empirical analysis of the interrelationships among strategy, environment and controls in Singaporean industrial firms, providing further empirical evidence from a newly industrialised country context.

## LITERATURE REVIEW

While an organization's strategic behavior might be too complex to be fully captured in a single paradigm, the typology by Miles & Snow [1978] has attracted much interest in the management and accounting literature.

### **Miles & Snow Strategy Typology**

The Miles & Snow typology adopted a descriptive perspective for empirically investigating business-level strategies. Four distinct strategies were identified: Defenders, Prospectors, Analyzers and Reactors. Defender firms operate in relatively stable product areas, competing through cost efficiency, quality and service. Prospector firms, on the other hand, constantly seek new market opportunities, competing largely through new product/market development. Analyzer firms represent a hybrid, incorporating the features of both Defender and Prospector strategies. Reactor firms are characterized by the absence of a consistent strategy and, therefore, have been excluded from most analyses, including in this study.

### **Strategy and Environment**

The relationship between strategy and environment has been extensively investigated focussing on different strategic themes and using different conceptualizations of environment (Miles & Snow, 1978; Porter, 1980; Hambrick, 1981; Boulton, et.al., 1982; Gordon & Narayanan, 1984;

Miller, 1987). The Miles & Snow typology postulated that Defender firms perceived their environment as relatively stable, Prospector firms as dynamic and Analyzer firms anywhere between these two extremes. Further, Miles & Snow believed that firms in a particular environment might follow different strategies. Hambrick [1983] however found that Prospectors outperformed Defenders in industries that were innovative and dynamic. Similar findings were reported by Simons [1987] and Miller [1987; 1988]. In the Miller study [1987] strategic and environmental variables were significantly correlated: strategies of innovation associated with a dynamic environment, market differentiation with a hostile environment, cost control with a stable environment, and breadth strategy with a heterogeneous environment. Simons [1987] included only the dynamism variable in his analysis, however. In this study it was felt that the inclusion of additional environmental variables (heterogeneity and hostility) might enrich the analysis.

#### **Strategy and Control System Attributes**

Research into the conceptual linkage between strategy and management control systems was a more recent phenomenon. Simons [1987] pointed out that an understanding of this relationship should be a prerequisite to the development of general theories concerning accounting control systems in complex organizations. In the context of the Miles & Snow typology a Defender firm with its emphasis on cost efficiency would need a tight cost control system

achieved via formal accounting procedures. To facilitate search for new market opportunities and innovation, a Prospector firm would need a more flexible structure in which accounting controls would be de-emphasized. An Analyzer firm would have a cost control system displaying attributes of both Defenders and Prospectors.

The few studies that investigated the relationship between firm strategies and control systems have found some systematic differences in management control systems among firms adopting different strategic postures (Miller & Friesen, 1982; Govindarajan & Gupta, 1985; Simons, 1987). Simons was the first to examine from an accounting perspective which specific attributes of control system design differ with a firm's strategy.

Despite the general findings of a systematic relationship the results were not as hypothesized. In the Miller & Friesen [1982] study control and innovation were positively correlated for conservative firms ("Defenders" using Miles & Snow terminology) and the converse was true for entrepreneurial firms ("Prospectors"). These results were at variance with Miles & Snow's contention that Prospectors would tend to de-emphasize control systems. Miller [1988] in another study did not find any significant relationship between control and innovation, but found a significant relationship between cost leadership strategy and controls. Simons [1987] reported that Prospectors relied on their financial control systems more intensively than Defenders, with tighter

budget goals and more frequent reporting, and placing greater emphasis on forecasts and output goals.

Dent [1990] offered some explanations for the apparent contradictions of Simon's findings with Miles & Snow's proposition. Prospectors might actually rely more, not less, on their control systems in order to constrain a tendency toward innovative excess and excessive risk taking. Moreover, the greater uncertainty faced by Prospectors might demand more frequent performance monitoring to facilitate organizational learning. With Defenders, which exhibit greater stability, cost control imposed through rigorous budgetary systems would inhibit, rather than promote, efficiency. Manufacturing efficiency would be better achieved via the monitoring of quality and inventory levels, instead of relying on existing financial control procedures (Kaplan, 1983).

The lack of any conclusive empirical evidence from these studies has partly prompted this research. The inclusion of additional environmental variables and the use as subjects firms in a newly industrialised country should provide further insight into the relationships among strategy, environment and control systems.



## METHODOLOGY

### Sample Selection

Using four digit Standard Industry Classification Codes (SIC), a list was prepared of 260 Singapore manufacturing firms across a diverse group of industries. Each firm represents a strategic business unit as defined by the SIC industry code since this is the unit of analysis. All the firms selected accordingly are operating as distinct legal entities.

### Data Collection

Data were collected using a questionnaire which was mailed to the Chief Executive Officer of each firm for completion, or by someone in a senior management position familiar with the research issues investigated in this study. Pre-questionnaire and follow-up interviews were also conducted with selected firms from the sample to explain the background to this study and to assess whether the objective of the research has been fully understood. This feedback showed that the questionnaire was completed largely by Chief Executive Officers and that no difficulty was encountered in responding to the questionnaire. Of the 260 questionnaires distributed, a total of 69 questionnaires were returned and usable, giving a response rate of 26.5 percent. Twenty-six (37.7%) of the responding firms identified themselves as best fitting the description of Prospectors, 23 (33.3%) as Analyzers and 20 (29%) as Defenders.

## **Operational Measures**

The operational measures in the questionnaire were: (1) strategy types (2) environment (3) control system variables and (4) performance. A brief description of each operational variable is provided below.

### **1. Strategy Types**

In this research strategy types were operationalised based on an adaptation of the Miles & Snow typology. This typology was chosen for several reasons. First, it has been widely adopted in other studies (see, for example, Hambrick, 1981; Simons, 1987). Secondly, it is representative of the current literature dealing with content of strategy research. Thirdly, empirical validity of the Miles & Snow typology has been reported in various studies (Hambrick, 1983; Shortell & Zajac, 1990). Finally, comparability of the research findings would also be facilitated.

Three strategy types were adopted for this study, viz., Prospectors, Analyzers and Defenders. The questionnaire instrument contained brief descriptions of three firms, one typifying a Defender strategy and is identified only as Type 1, another a Prospector strategy which is identified as Type 2, and the third one an Analyzer strategy and identified as Type 3. Respondents were asked to indicate which of the descriptions most closely fitted the firm compared to other firms in the industry, thus yielding nominally scaled data. There were no specific

references made to Defenders, Prospectors and Analyzers, in order to overcome respondents' potential reactivity effects. Moreover, the instructions explicitly stated that no one strategy type is inherently good or bad. It might also be argued that this self-typing approach to classifying business strategy could pose a methodological weakness. On the other hand, Snow & Hambrick [1980] have indicated some advantages of using this approach: (1) top managers' perceptions and opinions largely determine the organization's strategy, and (2) relatively large data bases can be generated for hypothesis testing. More recent empirical evidence was provided by Shortell & Zajac [1990] who examined the Miles & Snow typology using both perceptual self-typing and archival data from multiple sources. Their findings provided strong support for the measurement validity of Miles & Snow's strategy types.

## **(2) Environmental Variables**

Environment was measured using scales developed by Khandwalla [1977], Miller & Friesen [1984] and Miller [1987]. The environmental variables used in this study were dynamism, heterogeneity and hostility. Dynamism is defined as the amount of change and unpredictability in the technical and economic dimensions of the industry environment. It is measured as the mean of a four-item 7-point Likert-type scale with verbally anchored end points. Heterogeneity is defined as the differences in competitive tactics across a firm's respective markets.

It is scored on a one-item 7-point scale. Hostility is defined as the extent of competition from key competitors, and of the legal and political constraints faced by a firm. It is also measured as the mean of a four-item 7-point Likert-type scale with descriptive anchors. Cronbach alphas were computed to test the reliability of these environmental constructs.

### (3) Control System Variables

Ten control system variables, which are related to accounting and control attributes, were derived by Simons [1987] using factor analysis of an original set of thirty-three anchored 7-point Likert-type scales. These control system variables were adopted for this research. A brief explanation of each variable is provided in Table 1.

Table 1

	<u>Control System Variables</u>	<u>Explanation</u>
F <sub>1</sub>	Tight budget goals	Extent to which meeting tight budget targets is emphasized.
F <sub>2</sub>	External scanning	Extent to which data on external events are included in control information.
F <sub>3</sub>	Results monitoring	Extent to which managers monitor interperiod budget and performance results.
F <sub>4</sub>	Cost control	Extent to which cost analysis techniques and controls are used.

F <sub>5</sub>	Forecast data	Extent to which forecast data included in control reports.
F <sub>6</sub>	Goals related to output effectiveness	Knowledge and importance of factors related to product output.
F <sub>7</sub>	Reporting frequency	Frequency of issuing control reports.
F <sub>8</sub>	Formula-based bonus remuneration	Extent to which bonus remuneration is established by formula based on achieving budget targets rather than discretionary.
F <sub>9</sub>	Tailored control systems	Extent to which control systems are tailored to departmental circumstances and needs.
F <sub>10</sub>	Control system changeability	Frequency of change in control systems and importance of employing informal communications to transmit control information.

#### **(4) Performance Measures**

Performance is a multifaceted phenomenon, hence it was operationalized by two measures: ROI and annual sales growth (each computed as the mean for the last three years). A perceived overall performance compared to the industry measure was also included as a reliability check against the first two measure. The overall performance measure was scored on a 7-point scale.

### Statistical Analysis

In order to identify the profile of environmental, control system and performance characteristics that would best explain the categorization of firms by strategic types, a stepwise multiple discriminant analysis was employed.

A general form of the final discriminant function is as follows:

$$Z_i = b_0 + b_1X_1 + b_2X_2 + \dots + b_nX_n$$

where the discriminant score  $Z_i$  is a linear function of the discriminating variables,  $X_1 \dots X_n$ .

The environmental, control system and performance variables were input to the SPSS-X discriminant analysis program. Three discriminant analysis runs were performed, one for each performance measure used.

A split sample approach was employed with 40 randomly selected firms from the original data base of 69 used to construct the discriminant function. The remaining 29 firms representing the hold-out sample was used to test the predictive ability of the model. Although this procedure was followed the primary concern here was with descriptive rather than predictive relevance (see Frank, Massy & Morrison, 1965).

## RESULTS AND DISCUSSION

The classification rules derived from applying discriminant analysis make two parametric assumptions about the data. These are multivariate normality in distribution and homogeneous variance-covariances across groups. Inspection of the data showed that normality could be assumed. However, discriminant analysis is not particularly sensitive to minor violations of the normality assumption (Klecka, 1980). The results of a preliminary Box's M test of the equality of the within-group covariance matrices yielded Box's  $M=32.831$ ,  $p<0.669$  which is not significant. This indicates that the variance-covariance matrices can be assumed to be equal across the three groups.

Table 2  
Results of Discriminant Analysis

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Canonical Discriminant Functions				
Function	Eigenvalue	% of Variance	Cumulative	Canonical Correlation
-----				
1	3.05	94.01	94.01	0.8679
2	0.19	5.99	100.00	0.4036
-----				
-----				
After				
Function	Wilk's Lamda	Chi-Square	D.F.	Significance
-----				
0	0.2066	55.19	10	0.0000
1	0.8371	6.22	4	0.1832
-----				

The results of a stepwise multiple discriminant analysis were summarized in Table 2 which showed the results of

significance tests, the eigenvalues and their proportions of between-group variances, the canonical correlations, Wilk's lamda, and chi-square statistics with their associated probability levels. Function 1 was highly significant ( $p < 0.000$ ) and explained 94 percent of the common variance. This was indicated when the group centroids were calculated which showed how far apart the various groups were in terms of the discriminant space reflected by each function. The analysis thus discriminated among the groups: Defenders (group centroid = -2.53), Prospectors (group centroid = 1.72) and Analyzers (group centroid = 0.25). Function 2 however did not add any discriminating power in the analysis. The canonical correlation of 0.8679 indicated the strength of the relationship of the discriminating variables in the function and the predictive value. In addition, the square of the coefficient indicated that 75.3 per cent of the variance associated with group membership was related to the set of discriminating variables identified.

An examination of the correlation matrix for the set of discriminant function variables revealed some evidence of multicollinearity in the data, which could affect the discriminant weights derived from the analysis. Consequently, a more meaningful interpretation of the discriminant function was based on the structure coefficients since these coefficients would not be affected by relationships with other variables (Klecka, 1980). The structure coefficients are simple bivariate



correlations between each discriminating variable and the discriminant function, and they can be used to determine the relative importance of the individual variables.

Table 3 showed the standardized canonical discriminant weights and the structural coefficients.

Table 3  
Standardized Canonical Weights and Structure Coefficients

<u>Variables</u>	<u>Function 1</u>	
	<u>Standardized Weights</u>	<u>Structure Coefficients</u>
Dynamism	0.3822	0.3314
Results monitoring	-1.2705	0.0992
Forecast data	0.9739	0.3251
Reporting frequency	0.8371	0.3391
Control system changeability	0.7927	0.5033

Four of the five variables have high structure coefficients in association with the the first function. The control system changeability factor loaded most heavily to the discriminating function in this set of variables. The other three variables combining with control system changeability, in order of importance, were: (1) reporting frequency; (2) dynamism; and (3) forecast data. Results monitoring was the least important discriminator. All performance measures did not appear to be discriminators at all. Analysis showed that Prospectors, faced with a more dynamic environment, would need greater control system changeability, increased reporting frequency, and more forecast data to facilitate a quick response to changing market conditions. These results supported the alternative

thesis that Prospectors tended to use their financial control systems more intensively.

Table 4a  
Classification Results - Analysis Sample

Actual Group Membership	No. of Cases	Predicted Group Membership		
		1	2	3
Group 1	11	11 100.0%	0 0.0%	0 0.0%
Group 2	14	0 0.0%	11 78.6%	3 21.4%
Group 3	15	2 13.3%	2 13.3%	11 73.3%

Percent of "grouped" cases correctly classified: 82.50%

Group 1: Defenders  
Group 2: Prospectors  
Group 3: Analyzers

As a final test of the relationship between strategy types and the discriminating variables, the probable group membership of each strategy type was predicted on the basis of the strategy types' values on the discriminating variables. Table 4a presented the results on the analysis sample. Entries on the main diagonal of the matrix denote correct classifications, while those on the off-diagonal are misclassifications.

When interpreting the model's classificatory accuracy the groupings should contain an equal number of respondents (Morrison, 1969). If not, the evaluation should be compared against a proportional chance classification model (Joy & Tollefson, 1975; Pinches, 1980). This involved

the use of proportional probabilities of group membership as the prior probabilities, calculated as follows. The actual priors from the preliminary sample of 69 firms consisted of 29.0 percent Defenders, 33.3 percent Analyzers and 37.7 percent Prospectors. The analysis sample used to construct the model consisted of 27.5 percent Defenders, 37.5 percent Analyzers and 35.0 percent Prospectors. Using these data the proportional chance model correctly classified 33.7 percent  $[(.290)(.275) + (.377)(.350) + (.333)(.375)]$  of the firms in the sample. The overall percentage of strategy types correctly classified was 82.5 percent, indicating that the discriminant model was significantly more accurate than the corresponding chance model.

The model at this stage is essentially descriptive or explanatory in that it merely shows that firms in the three groups can be differentiated on the basis of dynamism and selected control system characteristics.

Table 4b  
Classification Results - Hold-out Sample

Actual Group Membership	No. of Cases	Predicted Group Membership		
		1	2	3
Group 1	9	6 66.7%	0 0.0%	3 33.3%
Group 2	12	1 8.3%	9 75.0%	2 16.7%
Group 3	8	1 12.5%	4 50.0%	3 37.5%

Percent of "grouped" cases correctly classified: 62.07%

Group 1: Defenders  
Group 2: Prospectors  
Group 3: Analyzers

Table 4b showed the results of classification analysis on the hold-out sample which is used for validation purposes. The percentage of firms grouped correctly into the three groups (Defenders, Prospectors and Analyzers) was 62 percent, which was higher than the proportional chance model of 33.8 percent (calculated in the same way as before). As shown in Table 4b, most of the diagonal percentages were substantially higher than the prior probabilities. The discriminant model was more successful in classifying Prospectors (75.0%) and Defenders (66.7%) than in classifying Analyzers (37.5%).

The results of the hold-out sample should not pose a serious concern because the primary interest was not to predict the firms' group membership on the basis of values on the discriminating variables. Rather, the

primary interest was to determine using inductive inference analysis, variables that were systematically associated with the three strategy types (Selcuk, et.al.1990) and, for this purpose, classification accuracy has been adequately demonstrated in the analysis sample (Table 4a).

### CONCLUSION

Based on the results of the discriminant analysis it can be concluded that dynamism and selected control system characteristics (control system changeability, reporting frequency, forecast data and results monitoring) relate to groupings by Miles & Snow's typology of strategy orientations. The lack of evidence of a relationship with performance measures suggested that further research would be warranted in this area.

The use of a perceptual self-typing approach exclusively to characterise firms into their strategic types could pose problems of validity and reliability. Shortell & Zajac [1990] suggested that ideally researchers should employ self-typing data in conjunction with archival data to obtain a reasonably complete description of a given firm's strategy. Another limitation might have been the use of Simon's ten control factors rather than the original questions from the Simon study to arrive at control system attributes using factor analysis. The current study is cross-sectional. Future work could involve longitudinal investigations to ascertain whether

there have been changes in a firm's strategic orientation, and how such changes relate to environmental and control system factors. Future research might also consider the impact of culture on the choice of strategy.

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