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■ Research Paper

The Measurement of Environmental Performance: An Application of Ashby's Law

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Ashby's law of requisite variety is a fundamental law of organizations. An implication of the law for business organizations is that they must develop sufficient information management and decision-making capacity to cope with the complexity in the environment in which they operate.

The law has the major limitation that, for all practical purposes, variety cannot be measured; the number of states of anything other than the simplest 'controller' is a vast, incomputable value. However, it is possible to carry out relative studies—comparing organizations and, in this case, comparing effectiveness in different contexts. To do this, a questionnaire was used to gauge managers' perceptions of business context complexity and organizational capacity.

The paper describes a study of the UK textile industry and, in particular, the response of that industry to environmental (i.e., green) pressures and opportunities. The study was undertaken both at the level of individual companies and of the industry itself. Comparisons of performance are made between the organizations' responsiveness to their natural and commercial environments. Copyright © 2003 John Wiley & Sons, Ltd.

Keywords Ashby's law; textile industry; perceived environmental uncertainty; rationality in strategic decision making; business performance

INTRODUCTION

There is general agreement that the natural environment is of fundamental strategic importance to business. Consequently, one would expect to find clear evidence that the natural environment is being handled by business

organizations at a strategic level. However, a systemic analysis of seven leading¹ blue-chip corporations found an absence of strategic capability in the management of green issues (Lewis, 1997). Other academic research also suggests that corporations are not effectively

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¹Leading' means that the corporations were all regarded as best practice organizations with respect to environmental management in their respective industries.

integrating green issues into their strategic thinking (Hart, 1997; Ketola, 1993), a finding which also receives support in the practitioner press (Environmental Data Services Ltd, 1996). On a more positive note, Banerjee (2001) has reported that managerial perceptions of the natural environment appear to have some associations with environmental strategy. Furthermore, Banerjee (2001) also recommends further research into management decision-making processes in the context of the natural environment.

This paper makes a contribution to the above debate by applying Ashby's law of requisite variety (Ashby, 1956) to explain why business organizations are not effectively integrating the natural environment into business strategy. A contingency approach is used to relate executives' perceived environmental uncertainty (PEU) and their degree of rationality in strategic decision making (RSDM), to their organizations' performance.

ASHBY'S LAW AND CONTINGENCY THEORY

To enable an assessment of organization performance to be made, the open systems concept of Ashby's law of requisite variety has been applied. In essence, Ashby's law states that:

Control can be obtained only if the variety of the controller is at least as great as the variety of the situation to be controlled (Beer, 1981, p. 41).

The application of Ashby's law to organizations means that the organization must generate at least as much variety in order to 'control' the variety in its environment. It is possible to think of the control of variety in terms of two dominant decision techniques, which are algorithms and heuristics (Waelchli, 1989). Algorithms correspond to what Simon (1987) terms rational decision making using analysis. Heuristics correspond to Simon's non-rational decision-making techniques such as judgement and intuition (Janis, 1989).

Thus, the variety in the organization can be represented by the degree to which algorithms

and heuristics are employed in strategic decision making (SDM)—that is, the degree to which rationality plays a role in SDM. We have used here the concept that RSDM offers a measure of 'organized variety' in the organization—other variety will arise from the host of less structured information and decision processes which characterize any practical organization. Variety in the environment is a synonym for complexity in the environment, and complexity is one of two main parameters, along with stability, which are objective measures of uncertainty (Duncan, 1972). Thus, it is possible to compare variety in the organization and variety in its environment by comparing RSDM and uncertainty, respectively. Downey and Slocum (1975) argue that uncertainty is a perceptual quality and thus measures such as environmental volatility, complexity and dynamism would not adequately provide an objective measure of uncertainty. Thus in this research we consider PEU as the appropriate measure of uncertainty in the organization's environment (Lawrence and Lorsch, 1967; Downey and Slocum, 1975; Miles *et al.*, 1974; Anderson and Paine, 1975).

Although these proxy measures have limitations, complexity and the management of complexity are central to strategic decision making; and it is this sense that the use of Ashby's law has validity (Waelchli, 1989). Furthermore, the application of Ashby's law is also consistent with the contingency concept of fit between an organization and its environment (Tushman and Nadler, 1978) and that organization effectiveness (i.e., performance) is dependent on, *inter alia*, the degree of fit achieved (Duncan, 1973).

An important question which the application of Ashby's law raises is 'What if the organization's variety is either too much or too little?' If the organization possesses too much variety then it is wasting resources and financial performance is lower than it should be. If the organization possesses too little variety then it will be exposed to higher levels of risk. For example, the organization is likely to make the wrong decisions because it has not taken account of issues (variables) in its environment. Consequently, the organization's performance will also be lower than it should be. Thus maximum perfor-

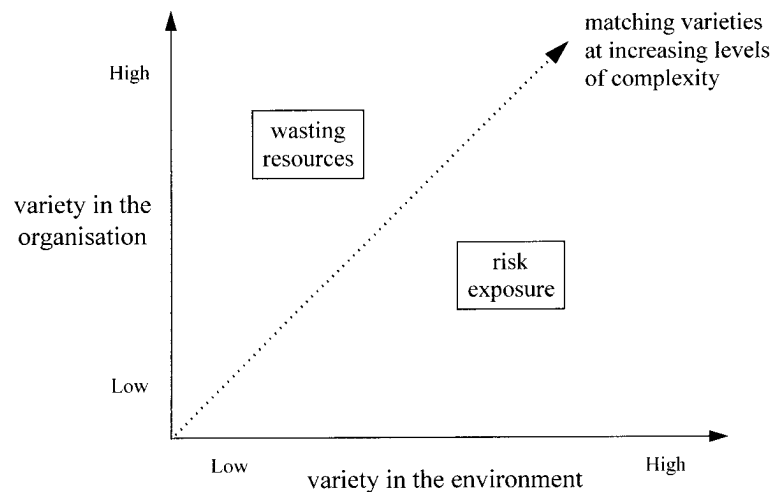


Figure 1. The application of Ashby's law of requisite variety to the measurement of organizational performance

mance requires that the organization's variety should match that of its environment. A diagrammatic form of the above argument is shown in Figure 1.

A typical example of 'variety in the organization' would be the amount of human and financial resources allocated to the environmental scanning function. A typical example of 'variety in the environment' would be the number of environmental laws and regulations and how frequently they are changed and updated.

Finally, a number of scholars have developed the notion of sustainable business practice (Starik and Rands, 1995). The fundamental principle behind this concept is that commercial performance and green performance should be complementary to each other; that is, you cannot have one without the other in a sustainable business. This concept is also examined using Ashby's law.

METHODS

In his comprehensive study of managerial work, Mintzberg (1973) states that the most appropriate use of a questionnaire is in the study of an executive's perception of his job. A self-report questionnaire (see Appendix) was designed which contains four research scales. Two scales measure commercial PEU and green PEU, and

two scales measure commercial RSDM and green RSDM. The commercial PEU and RSDM scales were based on the work of Miller (1993) and Miller (1987), respectively. The green PEU and RSDM scales were developed by one of the authors. All items are answered based on a Likert (1–7) scale. A pilot study was undertaken with a company in the health care industry to test the overall research design, methods and research instruments.

A 'decision-based perspective' to strategic process research was taken. This approach overcomes the problem that not all organizations have formal planning systems (especially SMEs). However, all organizations do make strategic decisions (Fredrickson, 1983). Analysis was undertaken at the senior manager/CEO level. An industry level of analysis was chosen since the nature of both environmental uncertainty and strategic decision making are industry context specific (Hrebiniak and Snow, 1980; Judge and Miller, 1991). The UK textile industry was chosen for a number of practical considerations (e.g., access and support) and its exposure to a number of different green issues (e.g., legislation, natural resource use, waste disposal, fashion driven, global value chains, standard setting). The questionnaire response statistics are shown in Table 1. Tables 2 and 3 give further details of the organizations studied.

Statistical analyses of the data were performed using SPSS[®] and Excel[®] software. The fit bet-

Table 1. Questionnaire response rate statistics

Parameter	N	% of cases
Organizations contacted	332	100.0
Organizations agreeing to participate	293	88.3
Organizations responding to questionnaire	165	49.7
Questionnaires sent out	445	100.0
Questionnaires returned	209	47.0
Questionnaires filled out correctly	206	46.3
Questionnaires filled out correctly by a suitable respondent ^a	198	44.5

^aA suitable respondent is someone who has the appropriate executive status.

Table 2. Respondents by number of employees and turnover (N = 198)

Number of employees	N	% of cases	Turnover (£m)	N	% of cases
1–9 (small)	5	2.52	< 0.5 (small)	5	2.5
10–99 (small)	56	28.28	0.5–5 (small)	59	29.8
100–499 (medium)	47	23.74	6–50 (medium)	62	31.3
500–2499 (large)	28	14.14	51–250 (large)	20	10.1
2500–9999 (large)	24	12.13	251–500 (large)	13	6.6
10k–49,999 (v. large)	7	3.53	501–1000 (v. large)	2	1.0
>50k (very large)	31	15.66	>1000 (very large)	36	18.2
Missing cases	0	0.0	Missing cases	1	0.5
Total	198	100.0	Total	198	100.0

ween the organization's variety and that of its environment was explored using Ashby's (1956) law of requisite variety. Each scale generates average values of PEU and RSDM for the commercial and natural environments. The resulting values are plotted on the Ashby diagrams. Equal values of PEU and RSDM will lie on the Ashby line. Thus by comparing the average values of PEU and RSDM from the questionnaire responses an assessment of fit can be made. Individual measures of fit were made for each organization. In addition, aggregate measures of

fit were made for a number of different contingency variables (Tosi and Slocum, 1984) which are shown in Table 4. By looking at the Likert scale values of PEU (i.e., variety in the environment) and RSDM (i.e., organized variety in the organization) for the different organizations and contingency variables, it is possible to make an assessment of where good and bad fit (i.e., performance) is occurring within the textile industry. Using this approach the problems associated with 'financial' measures (i.e., lack of accurate data) and 'green' measures (i.e., lack of appro-

Table 3. Questionnaire respondents by textile industry sector (N = 198)

Textile industry sectors	N	% of cases
Supply of raw materials	18	9.1
Spinning and twisting of yarns	46	23.23
Weaving and knitting of grey fabrics	35	17.68
Textile dyeing and finishing	47	23.7
Making up into garments and household textiles. Retail/wholesale	25	12.65
Manufacture of textile machinery	27	13.64
Total	198	100.0

Table 4. Contingency variables within the textile industry used for analysis of organization performance

Environmental management system (EMS)	Organization size	Textile industry sector
With EMS	Small	Raw materials
Without EMS	Medium	Spinning
	Large	Weaving
	Very large	Dyeing
		Making up/retail
		Machine manufacture

priate metrics) of performance can be circumvented.

Sustainable business performance has been examined by combining the Ashby scatter plot results from both the commercial and natural environments. This enables us to form a new sustainability performance matrix. The new matrix uses logarithmic scales because reciprocal values have been calculated in order to orient the scales in the desired direction (i.e., low–high). An example of the scatter plot is shown in Figure 2—the diagonal line represents sustainable business performance.

RESULTS

Figure 3 shows the Ashby scatter plot results of performance in the commercial environment for each organization. The majority ($n = 140, 71\%$) of

organizations experience *relatively* low variety in their commercial environments. The majority of organizations ($n = 113, 57\%$) also possess excess organizational variety relative to their commercial environmental variety. Notably, only one organization possesses excessive organizational variety. Conversely, there are no organizations experiencing excessive variety in the commercial environment.

Figure 4 shows the results of performance in the commercial environment at the industry level. Here we can observe that ‘very large’ organizations, organizations that possess an ‘Environmental Management System (EMS)’, and ‘organizations in the ‘raw materials’ sector are all showing below optimal performance in the commercial environment. It is also apparent that ‘medium’-sized organizations outperform other sizes of organization in the commercial environment.

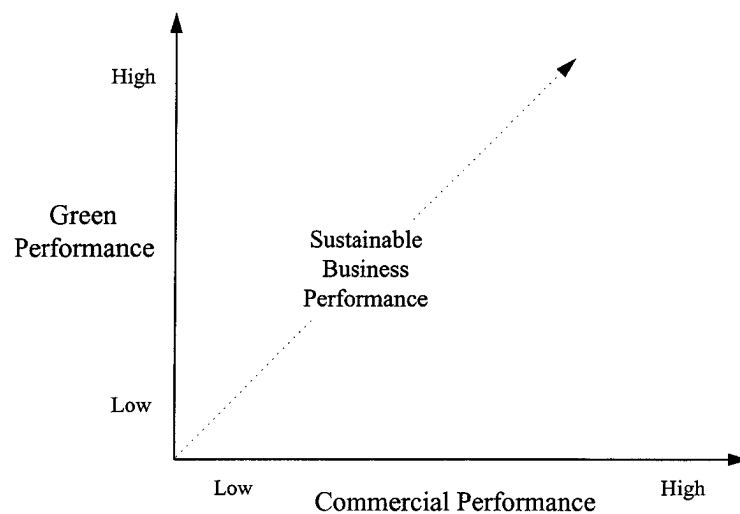


Figure 2. The measurement of sustainable business performance

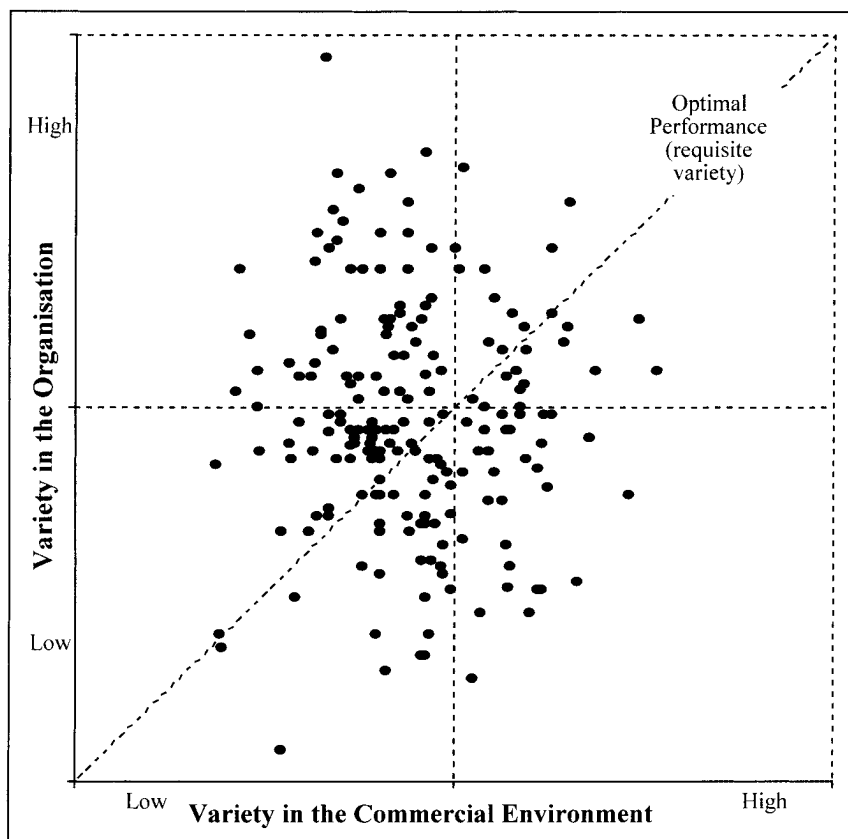


Figure 3. Performance at the organizational level in the commercial environment

Figure 5 shows the Ashby scatter plot results of performance in the natural environment for each organization. The majority ($n = 167$, 84%) of organizations possess relatively low variety. The majority of organizations ($n = 159$, 80%) also experience a higher level of environmental variety relative to their organizational variety. Notably, a small number of organizations are experiencing excessive variety in the natural environment—they perceive themselves to be overwhelmed by natural environmental variety. There are no organizations possessing excessive organizational variety.

Figure 6 shows the results of performance in the natural environment at the industry level. Here we can observe that ‘very large’ organizations, organizations that possess an ‘Environmental Management System (EMS)’, and organizations in the ‘raw materials’ sector are all showing optimal performance in the natural environment.

It is also apparent that organizations in the ‘machinery manufacturing’ and ‘making-up/retail’ sectors possess the worst performance.

Figure 7 shows the scatter plot results of sustainable business performance for each organization. Most of the firms are clustered around a combination of relatively low levels of either ‘commercial’ or ‘green’ performance. Indeed, most points on the scatter plot show organizations to possess superior commercial environmental fit compared to the fit with the natural environment. Although a number of organizations lie along the sustainable business performance line, only one organization demonstrates a level of performance with a relative value exceeding log 10 on both axes.

Figure 8 shows the results of sustainable business performance at the industry level. An interesting observation is that the contingency variables lie along a curve which is asymptotic to



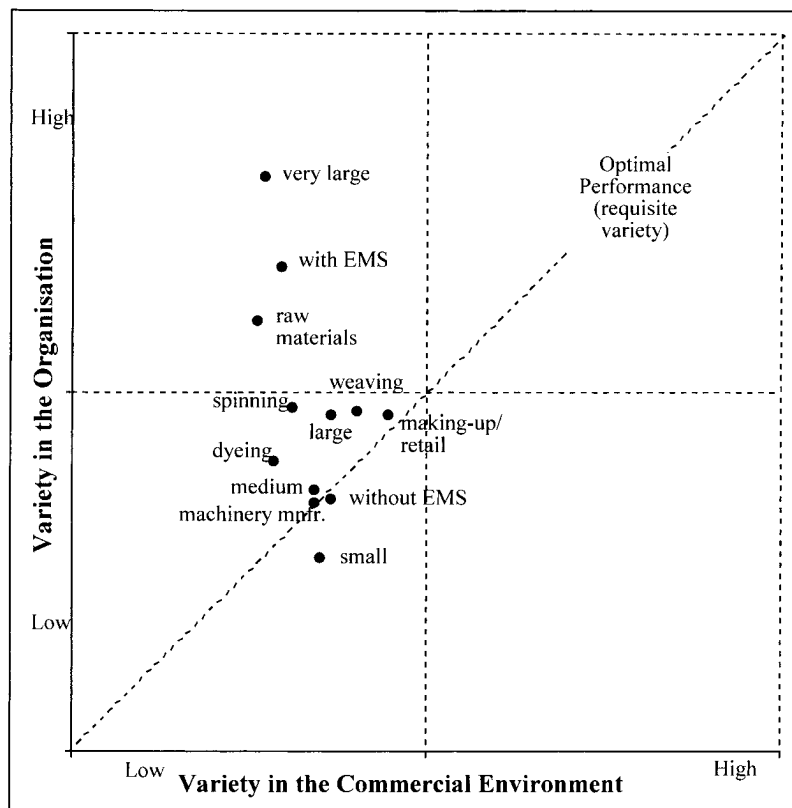


Figure 4. Performance at the industry level in the commercial environment

the axes. Indeed, we observe no sustainable business performance at the industry level of analysis.

DISCUSSION

The Commercial Environment

Figure 3 suggests that the managers' perceptions of their commercial environment is that of relative stability (i.e., most organizations are experiencing relatively low variety). Indeed, compared to many other industries such as banking, telecomms, biotech and e-commerce, the textile industry sees itself as operating in a relatively stable commercial environment—a finding which is supported by Judge and Miller (1991).

The majority of organizations possess too much variety to manage the complexity in their commercial environments; that is, they are inefficient. In itself, this is perhaps a surprising

result given the amount of business process re-engineering (BPR) and de-layering which has taken place in British industry since 1979. However, it may also reflect the continuing relative decline of the British textiles sector and the challenges presented to SME owner/managers to develop a global business in niche markets (Matlay and Fletcher, 2000).

Furthermore, the organizational variety is measured by the Miller (1987) RSDM construct, which does not capture intuition and judgement, that is, the 'non-rational' approaches that executives apply during SDM (Simon, 1987). Intuition and judgement are examples of heuristics that are cognitive decision rules which do not guarantee a solution, but are capable of significantly increasing the situational variety (Waelchli, 1989). As a consequence, the amount of variety organizations possess will be greater than that shown in Figure 3. In other words, the apparent inefficiency increases even further.

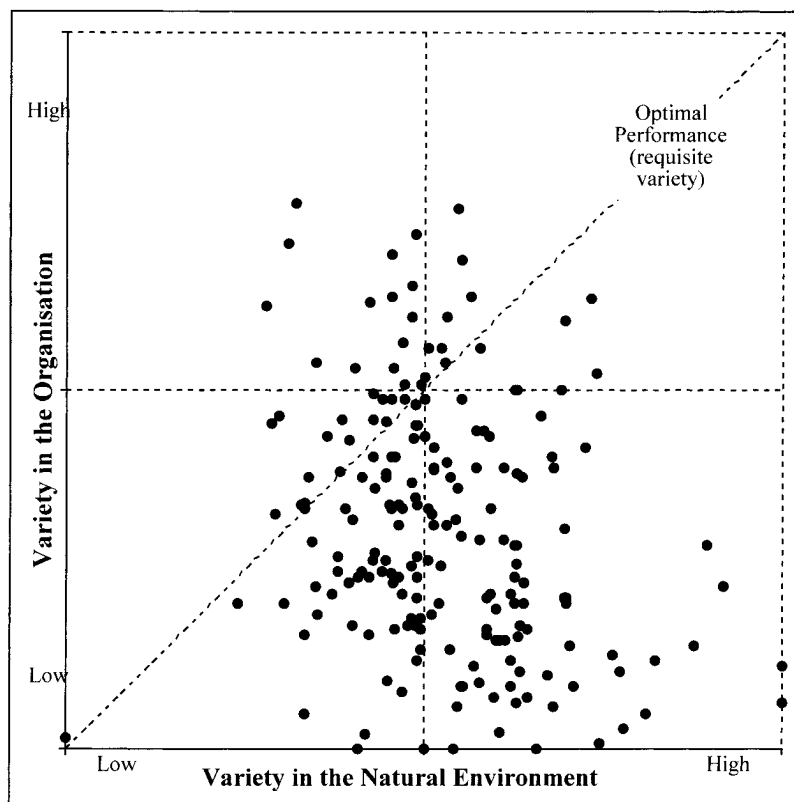


Figure 5. Performance at the organizational level in the natural environment

No organizations are experiencing very high risk. This suggests that the classical strategic tools and management processes used in the commercial environment are generally well established and implemented.

Only one organization is experiencing excessive resource use (and consequently incurring excessive costs). The organization concerned is a Brazilian-based subsidiary of a major UK textile corporation. This result suggests that the perceptions of managers and/or the structure of management systems may differ across different cultural contexts—a finding which is already well established in the literature (e.g., Hofstede, 1980; Trompenaars, 1993).

The analysis at the industry level (Figure 4) reveals that some companies are performing considerably better than others. Those groups of companies wasting resources are either ‘very large’, possess an ‘EMS’ and/or belong to the ‘raw materials’ sector. In fact there is a strong

relationship here, since most companies in the raw materials sector are very large, and very large companies tend to possess an established EMS.

Medium-sized organizations also achieve a superior fit to their commercial environments compared to other sizes of organization. It is well known that ‘small’ organizations have neither the time nor the resources for strategic development. In contrast, ‘large’ and ‘very large’ organizations tend to be bureaucratic and possess excessive organizational inertia and may not respond quickly enough to a declining and changing marketplace.

The Natural Environment

Figure 5 shows clearly that the largest proportion of organizations are taking unnecessary risks, rather than wasting resources. However, this



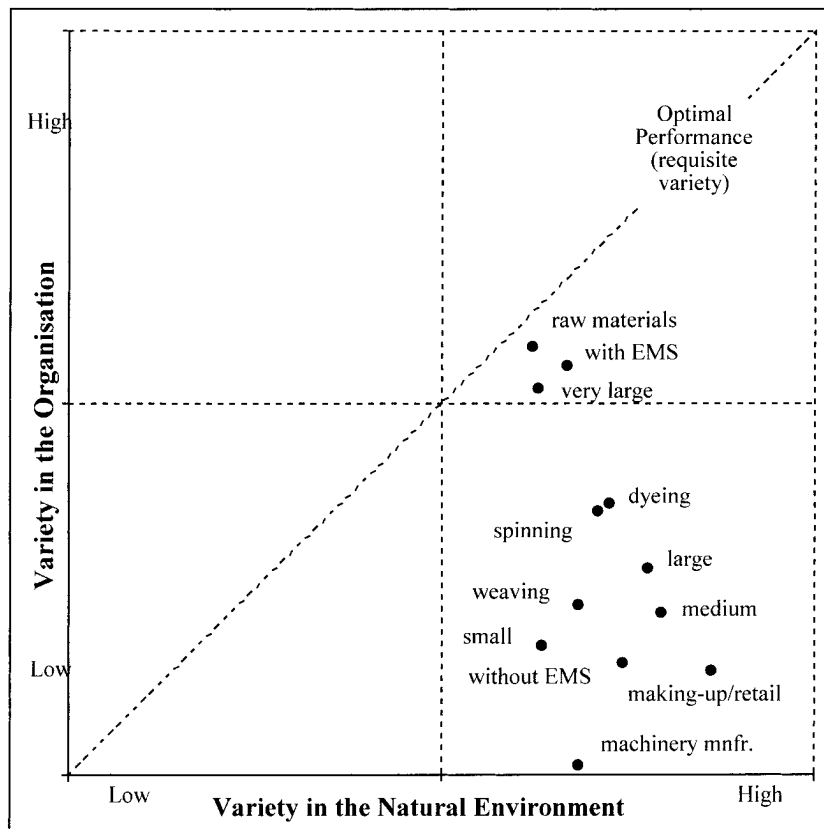


Figure 6. Performance at the industry level in the natural environment

finding is not the result of high variety in the natural environment but low variety in the organization. In other words, they are not fully appreciating or responding to the challenge that pressures from the natural environment create.

This result suggests that the degree of rational-based decision making (i.e., organizational variety) decreases when executives engage in green SDM. However, Ashby's law may still hold in the natural environment, if variety in the organization can be increased by the use of intuition and judgement. Unfortunately, there are two related reasons why this is unlikely to happen:

- (1) Ethically (i.e., green) based SDM is likely to be solely or significantly dependent on heuristics such as intuition and judgement (Goodpaster, 1990; Henderson, 1992; Pauchant and Fortier, 1990). That is, the role of rational-based decision making is significantly reduced.
- (2) Intuitive decision making relies on training and experience (Simon, 1987). Green issues are relatively new, and executives have very little training in, and experience of, SDM involving green issues.

The implication is that until ethically based decision making based on heuristics becomes well established, organizations are unlikely to possess enough variety to make effective strategic decisions when faced with significant levels of variety in the natural environment.

Figure 6 shows clearly that the worst fit to the commercial environment (namely; 'very large', 'with EMS' and 'raw materials') also achieves the best fit to the natural environment. This result suggests that significant resources are required for effective environmental management, currently only affordable by the very largest organizations. Responding to increasing organizational variety in the natural environment is difficult,

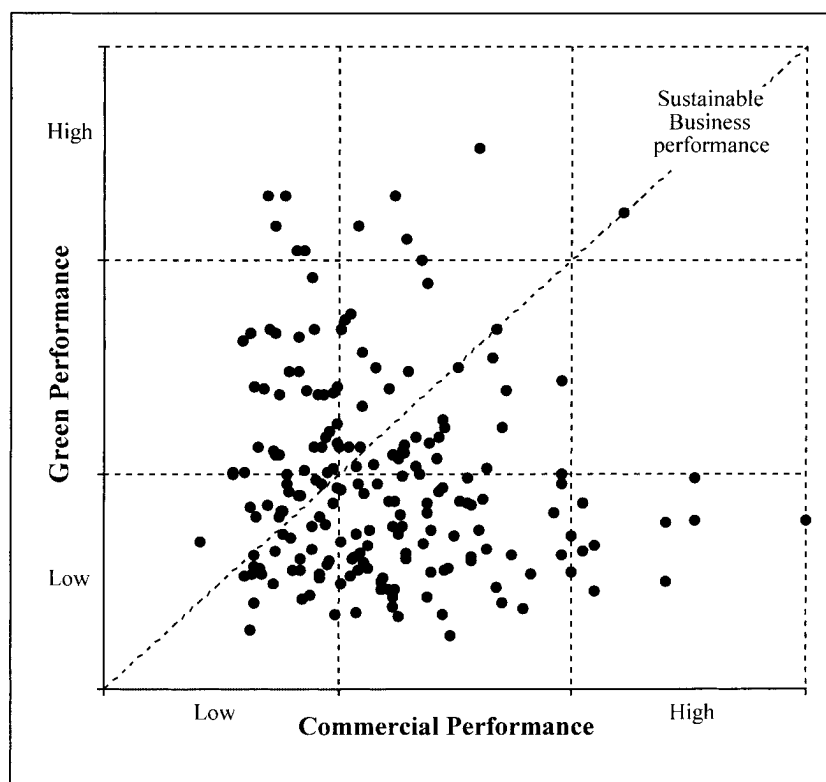


Figure 7. Sustainable business performance at the organizational level

expensive and time consuming. For example, the results shown in Figures 5 and 6 suggest that most organizations do not possess the necessary resources to implement effective EMSs.

Sustainable Business Practice

The performance of individual organizations in the business (i.e., commercial plus natural) environment is illustrated in Figure 7. The logarithmic scatter plot is evidence that organizations are not achieving a balanced commercial and green performance (i.e., sustainable business performance) except at very low levels of both. Only one organization appears to be achieving sustainable business performance at a reasonably high level. This organization has a wide range of high value-added (specialist) textile activities, is a medium-sized company, has undergone a management buy-out and has a top management team who are committed to good environmental practice. The organization has a dedicated enviro-

mental manager (unusual for a medium-sized company), excellent stakeholder dialogue and operates in a sensitive sub-urban/country area. The CEO sits on several environmental committees at EU, national, local and industry level. Clearly this situation is unusual for the top management team. However, this case supports the argument that organizational variety must match variety in the natural environment.

Figure 8 shows the logarithmic scatter plot of sustainable business performance at the industry level. An interesting observation is that a curve drawn through the scatter plot is asymptotic to the axes. This finding places a question mark against previous research which has used combinations of commercial and green criteria in order to develop portfolio approaches to measures of sustainable business performance (e.g., Lee and Green, 1994; Schaltegger and Sturm, 1996).

There are two possible explanations for the asymptotic curve in Figure 8:

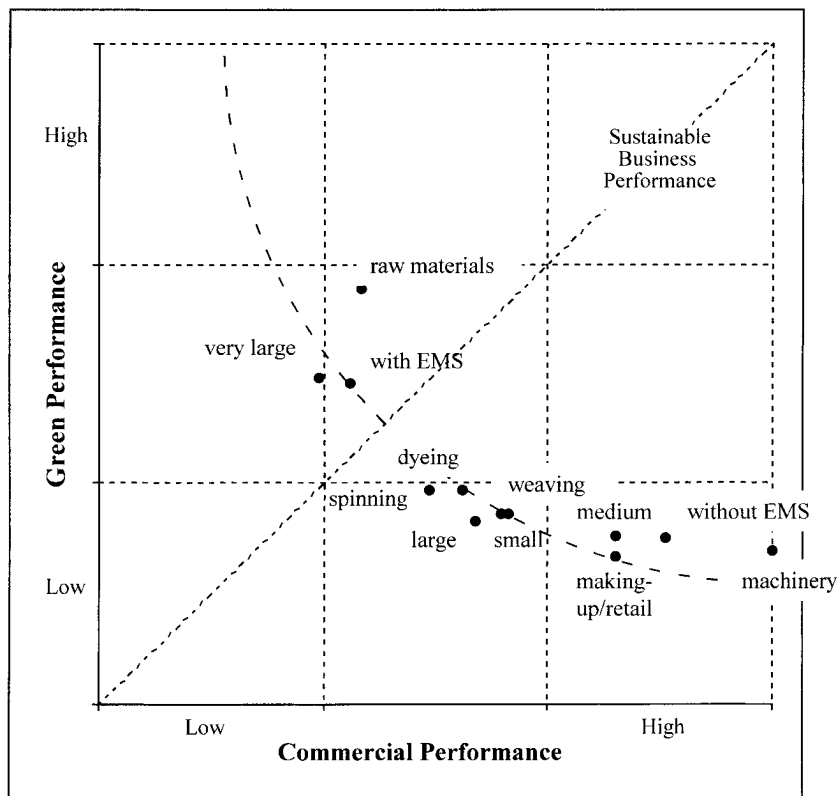


Figure 8. Sustainable business performance at the industry level

- (1) There may exist some underlying societal and structural problems in trying to meet both performance criteria simultaneously. The concept of the business (commercial and natural) environment implies that the number of contingencies increases. Furthermore, many of the ecological contingencies (e.g., resource stewardship) are often in conflict with economic contingencies (e.g., consumer wants); and therefore organizations may give insufficient attention to ecological contingencies (Starik and Rands, 1995).
- (2) Classical management systems and structures are not delivering enough organizational variety, and systems and structures which are capable of providing enough organizational variety are not being used.

The first explanation is related to the paradigm changes in business organizations which have been prescribed by numerous scholars (e.g., Garrod and Chadwick, 1996; Gladwin *et al.*,

1995). Although the case for a new business paradigm is compelling, it is beyond the scope of this paper. The second explanation has practical value for business and addresses a concern of Checkland (1995). That is, our current ideas on management and related practices are not 'up to the task' of environmental management.

This is a view which is also shared by Schwaninger (2000). He argues that many organizations are managed on the basis of traditional models of management which are focused on profitability. Hence, in business contexts which exhibit rapid change, these organizations lack requisite variety (Schwaninger, 2000).

Environmental Management Systems

Checkland's concern is supported if we consider organizations that possess EMSs. Organizations with EMSs possess enough requisite variety for green SDM. Conversely, organizations with no



EMS possess too little variety for green SDM. There is some support for this finding from Guimaraes and Liska (1995), who showed that organizations which engage in environmental management will experience greater benefits than organizations which aim at minimum compliance. Although this appears to be an encouraging finding, EMSs are grounded in classical management procedures, and there is concern that certified EMSs are not suitable for the management of green issues (Moxen and Strachan, 1995), in other words, generating enough organizational variety.

The limitations of EMSs can clearly be seen by comparing Figures 4 and 6. In Figure 4 the organizations with EMSs possess too much variety (more inefficient), and the organizations without EMSs have matched variety. Conversely, in Figure 6 the organizations with EMSs have matched variety, and those without possess too little variety (higher risk). The possession of an EMS moves the organization in a line almost perpendicular to the Ashby line but not along it. This finding suggests that a rational approach to green SDM such as the use of an EMS will be inadequate, when the organization is faced with an increasing number of green decisions which would add to the amount of variety (i.e., uncertainty) in the natural environment. Hence, it is apparent that EMSs do not, *per se*, possess enough variety to enable an organization to match the levels of variety presented by the natural environment.

CONCLUSIONS

We have shown that Ashby's law can be applied to measure organization performance in the commercial, natural and business environments. This is a positive first step since, although research on the development of environmental performance indicators currently occupies a major area of activity in environmental management, it will be some time before suitable criteria and metrics contribute to organizational comparisons and green SDM.

The main conclusions resulting from this research are as follows:

- (1) The majority of organizations in this industry possess too much variety to manage the

complexity in their commercial environments; that is, they are inefficient. *Inter alia*, this may be because the textile industry, the subject of the study, was in decline for most of the decade in which the study took place and had not been able to match organizational and commercial varieties to keep pace with this decline.

- (2) The perceptions of managers and/or the structure of management systems may differ across different cultural contexts.
- (3) Medium-sized organizations achieve a superior performance in the commercial environment compared to other sizes of organization, perhaps because they are more adaptive to change.
- (4) The largest proportion of organizations are taking unnecessary risks in the natural environment due to low variety in the organization.
- (5) Until ethically based decision making based on heuristics becomes well established, organizations are unlikely to possess enough variety to make effective strategic decisions when faced with significant levels of variety in the natural environment.
- (6) Significant resources are required for effective environmental management, currently only affordable by the very largest organizations.
- (7) Organizations are not achieving a balanced commercial and green performance (i.e., sustainable business performance) except at very low levels of both.
- (8) Classical management systems and structures are not delivering enough organizational variety, and systems and structures which are capable of providing enough organizational variety are not being used.
- (9) EMSs do not possess enough variety in themselves to enable an organization to match the levels of variety presented by the natural environment.

The above conclusions raise a number of important policy implications:

- (1) Variety in the organization appears to be excessive for dealing with the commercial environment. There would appear to be potential for further cost savings in this industry, especially in larger organizations.

- (2) Variety in the organization appears to be inadequate for dealing with the natural environment. There would appear to be potential for risk reduction/management, especially in smaller organizations.
- (3) Requisite variety means that the organization minimizes its costs and risks. Given that variety in the natural environment is unlikely to decrease in the foreseeable future, then the key issue is how organizations can effectively increase organizational variety when operating in the natural environment. We believe there are a number of approaches which can be adopted:
- Senge (1990) proposes systems thinking as means to improve the performance of organizations. Systems thinking has also been proposed by a number of academics (e.g., Roome, 1992; Shrivastava and Hart, 1994) as an approach to understanding the natural environment.
 - Applying systems approaches to organization design in order to achieve requisite variety may be another possible way forward. Schwaninger (2000) proposes a combination of the Model for Systemic Control, the Viable System Model, and the Team Syntegrity Model as a framework for designing intelligent organizations with requisite variety.
 - Peak organizations (e.g., trade associations, confederations) should play a key role in providing the necessary organizational and information structure which helps to increase the organization's variety. Peak organizations can act as 'linking pin' organizations in 'action-centred networks' which are capable of matching variety in the natural environment by managing the conflict between organizations through learning and innovation (Carley and Christie, 1992).
 - Supply chain management can also increase variety in the organization. There is a need for cooperation between suppliers and customers in order to develop optimized products for the natural environment (van Someren, 1995) as well as recycling schemes (Roy and Whelan, 1992). Improved awareness and understanding are also

necessary for developing green procurement (Green *et al.*, 1996).

Resulting from this work are also a number of implications for further research:

- (1) The development of ethically (heuristic) based decision routines and management processes is a major area of research which has significant implications for the work presented here.
- (2) This research has relied on the subjective responses of executives in the textile industry. It would be constructive to build on this and develop objective measures of variety in the organization and the environment.
- (3) The theoretical assumption that requisite variety leads to best performance needs to be tested in other contexts.
- (4) The work should be extended to other industries and countries. The ability to compare and contrast will generate many more insights.

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APPENDIX: QUESTIONNAIRE

Your Organization

The name and address of your organization
(please give the organization for which you have
responsibility for making strategic decisions).

The business activity of your organization (if more than one, then
please list the major areas and the approximate percentage of sales
volume attributable to each area).

The Standard Industry Classification (SIC) code(s) for your
organization, if known (if more than one, then please give each SIC
code and the approximate percentage of sales volume attributable to
each code).

Country in which business activity takes place.

Number of employees in your organization/business (please
circle the appropriate range).

1 → 9	10 → 99	100 → 499	500 → 2,499	2,500 → 9,999	10,000 → 49,999	>50,000
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Typical sales turnover in millions of £s per annum for your
organization/business (please circle the appropriate range).

<0.5 m	0.5 m → 5 m	6 m → 50 m	51 m → 250 m	251 m → 500 m	501 m → 1,000 m	>1,000 m
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Does your organization have an environmental management system?

Yes No

If yes, is your system certified?

Yes No

If yes, which certification do you have?

EMAS ISO14001 BS7750

Respondent Details

Name.

Gender (please circle).	Female	Male
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Position/Job Title (please circle the most appropriate).						
Chairman	Chief executive	Director	Senior manager	Managerial	Supervisory	Administrative

Functional Area (please circle the most appropriate)									
Member of the Executive	Procurement and/or shipping and/or logistics	Production and/or operations and/or maintenance and/or quality	Marketing and/or sales and/or public relations	Service and/or repair and/or field support	Health and/or safety and/or environment and/or risk assessment	Research and/or technical development	Human resources management	Finance and/or accounting and/or legal	Other (if 'other' please specify)

Age in years (please circle the appropriate range).						
< 24	25 → 34	35 → 44	45 → 54	55 → 64	65 → 74	>75

The number of years you have been with your organization/business.	No. of years =
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Your Organization's 'Green' Environmental Context

Please consider the factors below and indicate if they are easy or difficult to predict. Simply circle the number which corresponds to your particular experience.

Government environmental policy.	Predictable (easy to predict)			Unpredictable (difficult to predict)			
Environmental tax policies	1	2	3	4	5	6	7
National environmental laws affecting international business	1	2	3	4	5	6	7
Environmental regulations affecting the business sector	1	2	3	4	5	6	7
Enforcement of existing environmental laws	1	2	3	4	5	6	7



Environmental resources and services used by your organization.	Predictable (easy to predict)				Unpredictable (difficult to predict)		
	1	2	3	4	5	6	7
Availability of trained environmental personnel	1	2	3	4	5	6	7
Environmental impact of inputs (e.g. energy, materials, components)	1	2	3	4	5	6	7
Environmental impact of outputs (e.g. waste, effluent, emissions)	1	2	3	4	5	6	7
Availability of disposal capacity for waste, effluent and emissions	1	2	3	4	5	6	7
Prices of disposal capacity for waste, effluent and emissions	1	2	3	4	5	6	7
Environmental impact of natural (renewable) resource use	1	2	3	4	5	6	7
Availability of natural (renewable) resources	1	2	3	4	5	6	7
Prices of natural (renewable) resources	1	2	3	4	5	6	7

Environmental products, markets and demand.	Predictable (easy to predict)				Unpredictable (difficult to predict)		
	1	2	3	4	5	6	7
Customer environmental preferences	1	2	3	4	5	6	7
Environmental product demand	1	2	3	4	5	6	7
Availability of substitute environmental products	1	2	3	4	5	6	7
Availability of complementary environmental products	1	2	3	4	5	6	7

Green competition.	Predictable (easy to predict)				Unpredictable (difficult to predict)		
	1	2	3	4	5	6	7
Changes in the environmental markets served by competitors	1	2	3	4	5	6	7
Changes in the competitors' environmental strategies	1	2	3	4	5	6	7
Entry of new firms into the environmental market	1	2	3	4	5	6	7

Environmental technology in your industry.	Predictable (easy to predict)				Unpredictable (difficult to predict)		
	1	2	3	4	5	6	7
Changes in product environmental attributes	1	2	3	4	5	6	7
Changes in product environmental impact	1	2	3	4	5	6	7
New product introductions with environmental attributes	1	2	3	4	5	6	7
Changes in the production process (e.g. end-of-pipe, clean technology)	1	2	3	4	5	6	7

The behaviour of environmental stakeholders in your organization.	Predictable (easy to predict)				Unpredictable (difficult to predict)		
	1	2	3	4	5	6	7
Investors (e.g. shareholders, banks, financial analysts)	1	2	3	4	5	6	7
Community (e.g. households, schools, welfare groups)	1	2	3	4	5	6	7
Supply chain (including suppliers, customers, retailers, consumers)	1	2	3	4	5	6	7
Industry (e.g. employees, unions, associations, peer companies)	1	2	3	4	5	6	7
Opinion formers (e.g. media, NGOs, pressure groups, scientists)	1	2	3	4	5	6	7
Regulators (e.g. insurers, watchdogs, agencies, government, EU)	1	2	3	4	5	6	7

How major environmental issues are affecting your organization.	Predictable (easy to predict)				Unpredictable (difficult to predict)			
	1	2	3	4	5	6	7	
Climate change (e.g. global warming, ozone depletion)	1	2	3	4	5	6	7	
Pollution of air, water, soil (e.g. by emissions/discharges)	1	2	3	4	5	6	7	
Loss of biodiversity (e.g. extinctions, genetic pool, deforestation)	1	2	3	4	5	6	7	
Eco-efficiency (e.g. reuse, recycle, reduction, minimization)	1	2	3	4	5	6	7	
Resource depletion (e.g. water, energy, metals, forests, landfill)	1	2	3	4	5	6	7	
Social welfare (e.g. population, poverty, urbanization, automobility)	1	2	3	4	5	6	7	
Eco-sufficiency (eg. elimination of toxins, decimation of resource use)	1	2	3	4	5	6	7	

In the following section we would like you to answer some questions about how you make strategic environmental decisions. Please indicate how decisions are actually made in your organization, and not how you think they should be made. Simply circle the number which most closely corresponds to your particular experience in your organization.

In our organization:	Never used				Used extremely frequently			
	1	2	3	4	5	6	7	
the routine gathering of environmental opinions from clients is	1	2	3	4	5	6	7	
the explicit tracking of the environmental policies and tactics of competitors is	1	2	3	4	5	6	7	
the forecasting of sales of environmental products, environmental customer preferences, environmental technology, etc. are	1	2	3	4	5	6	7	
special research studies on environmental markets are	1	2	3	4	5	6	7	

In our organization:	Used rarely				Used frequently			
	1	2	3	4	5	6	7	
the application of operations research techniques, such as linear programming and simulation, to make major environmental decisions are	1	2	3	4	5	6	7	
the periodic brainstorming by senior management groups for novel solutions to environmental problems is	1	2	3	4	5	6	7	
the formalized systematic search for, and evaluation of, environmentally focused opportunities for acquisitions, new investments, new markets, etc. are	1	2	3	4	5	6	7	
the use of specialist environmental staff to investigate and write reports on strategic decisions is	1	2	3	4	5	6	7	
the use of outside environmental specialists/consultants on strategic decisions is	1	2	3	4	5	6	7	



How often and how well does your organization perform:	Very rarely and haphazardly				Very frequently and intensively		
long-term forecasting of sales of environmental products, profits, and the nature of environmental markets?	1	2	3	4	5	6	7
long-term forecasting of the environmental technology relevant to products and services offered by firms?	1	2	3	4	5	6	7
environmental scenario analysis and planning?	1	2	3	4	5	6	7
the planning of long-term environmental investments?	1	2	3	4	5	6	7

In our organization:	Never used			Used extremely frequently			
an active dialogue with environmental stakeholders is	1	2	3	4	5	6	7
the active monitoring of environmental issues is	1	2	3	4	5	6	7
the routine monitoring of environmental legislation is	1	2	3	4	5	6	7
the investigation of changing values in society is	1	2	3	4	5	6	7
the routine monitoring of the availability of resources is	1	2	3	4	5	6	7
the active monitoring of technological developments is	1	2	3	4	5	6	7

For the questions below simply circle the number which most closely corresponds to your particular experience in your organization relative to the statements on the scale.

Choices among strategic environmental alternatives tend very often to be made quickly and without precision, as time pressures are often substantial							Much thought and analysis enter into key environmental decisions
1	2	3	4	5	6	7	

Decisions aimed at the resolution of environmental crises are most common						Decisions aimed at exploiting environmental opportunities are most common
1	2	3	4	5	6	7

There is a 'bird-in-the-hand' emphasis on the immediate future in making environmental management decisions				Medium-term environmental orientation				Long-term (over five years) environmental goals and strategies are emphasized
1	2	3	4	5	6	7		

Administrative and product/market environmental strategies have not been explicitly conceptualized								Environmental strategies are well and precisely conceptualized and guide the modus operandi and decisions
1	2	3	4	5	6	7	7	

Your Organization’s Business Context (Excluding the ‘Green’ Environment)

Please consider the factors below and indicate if they are easy or difficult to predict. Simply circle the number which corresponds to your particular experience.

Government and policies.	Predictable (easy to predict)				Unpredictable (difficult to predict)			
Ability of the party in power to maintain control of the government	1	2	3	4	5	6	7	7
Threat of armed conflict	1	2	3	4	5	6	7	7
Tax policies	1	2	3	4	5	6	7	7
monetary policy	1	2	3	4	5	6	7	7
Prices controlled by the government	1	2	3	4	5	6	7	7
National laws affecting international business	1	2	3	4	5	6	7	7
Legal regulations affecting the business sector	1	2	3	4	5	6	7	7
Tariffs on imported goods	1	2	3	4	5	6	7	7
Enforcement of existing laws	1	2	3	4	5	6	7	7
Public service provision	1	2	3	4	5	6	7	7

Economy.	Predictable (easy to predict)				Unpredictable (difficult to predict)			
Inflation rate	1	2	3	4	5	6	7	7
Exchange rate	1	2	3	4	5	6	7	7
Interest rate	1	2	3	4	5	6	7	7
Results of economic restructuring	1	2	3	4	5	6	7	7

Resources and services used by your organization.	Predictable (easy to predict)				Unpredictable (difficult to predict)			
Availability of trained labour	1	2	3	4	5	6	7	7
Labour and union problems	1	2	3	4	5	6	7	7
Quality of inputs, raw materials, and components	1	2	3	4	5	6	7	7
Availability of inputs, raw materials, and components	1	2	3	4	5	6	7	7
Prices of inputs, raw materials, and components	1	2	3	4	5	6	7	7
Transportation system within the country	1	2	3	4	5	6	7	7
Transportation system to foreign countries	1	2	3	4	5	6	7	7



Products, markets and demand.	Predictable			Unpredictable			
	(easy to predict)			(difficult to predict)			
Customer preferences	1	2	3	4	5	6	7
Product demand	1	2	3	4	5	6	7
Availability of substitute products	1	2	3	4	5	6	7
Availability of complementary products	1	2	3	4	5	6	7

Competition.	Predictable			Unpredictable			
	(easy to predict)			(difficult to predict)			
Changes in competitors' prices	1	2	3	4	5	6	7
Changes in the markets served by competitors	1	2	3	4	5	6	7
Changes in the competitors' strategies	1	2	3	4	5	6	7
Entry of new firms into the market	1	2	3	4	5	6	7
Domestic competitors	1	2	3	4	5	6	7
Foreign competitors	1	2	3	4	5	6	7

Technology in your industry.	Predictable			Unpredictable			
	(easy to predict)			(difficult to predict)			
Product changes	1	2	3	4	5	6	7
Changes in product quality	1	2	3	4	5	6	7
New product introductions	1	2	3	4	5	6	7
Changes in the production process	1	2	3	4	5	6	7

In the following section we would like you to answer some questions about how you make strategic decisions. Please indicate how decisions are actually made in your organization, and not how you think they should be made. Simply circle the number which most closely corresponds to your particular experience in your organization.

In our organization:	Never used			Used extremely frequently			
	1	2	3	4	5	6	7
the routine gathering of opinions from clients is	1	2	3	4	5	6	7
the explicit tracking of the policies and tactics of competitors is	1	2	3	4	5	6	7
the forecasting of sales, customer preferences, technology etc. is	1	2	3	4	5	6	7
special market research studies are	1	2	3	4	5	6	7

In our organization:	Used rarely				Used frequently		
the application of operations research techniques, such as linear programming and simulation, to make major production, marketing and financial decisions are	1	2	3	4	5	6	7
the periodic brainstorming by senior management groups for novel solutions to problems is	1	2	3	4	5	6	7
the formalized systematic search for, and evaluation of, opportunities for acquisitions, new investments, new markets, etc. are	1	2	3	4	5	6	7
the use of staff specialists to investigate and write reports on strategic decisions is	1	2	3	4	5	6	7
the use of outside specialists/consultants on strategic decisions is	1	2	3	4	5	6	7

How often and how well does your organization perform:	Very rarely and haphazardly				Very frequently and intensively		
long-term forecasting of sales, profits, and the nature of markets?	1	2	3	4	5	6	7
long-term forecasting of the technology relevant to products and services offered by firms?	1	2	3	4	5	6	7
scenario analysis and planning?	1	2	3	4	5	6	7
the planning of long-term investments?	1	2	3	4	5	6	7

For the questions below simply circle the number which most closely corresponds to your particular experience in your organization relative to the statements on the scale.

Choices among strategic alternatives tend very often to be made quickly and without precision, as time pressures are often substantial	1	2	3	4	5	6	7
Much thought and analysis enter into key decisions							

Decisions aimed at the resolution of crises are most common	1	2	3	4	5	6	7
Decisions aimed at exploiting opportunities are most common							

There is a 'bird-in-the-hand' emphasis on the immediate future in making management decisions	1	2	3	4	5	6	7
Medium-term orientation							
Long-term (over five years) goals and strategies are emphasized							

Administrative and product/market strategies have not been explicitly conceptualized	1	2	3	4	5	6	7
Strategies are well and precisely conceptualized and guide the modus operandi and decisions							

