Dimensions of Uncertainty and its Impact on Performance

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Abstract : Business uncertainty has long been recognized as one of the important measure in the explanation of organization design and performance. Exhaustive research, both theoretical and empirical, has been made to conceptualize and measure the volatility of the market. A research gap exists in the area of establishing an objective measure of environmental uncertainty of an organization and their impact on organizational performance. To address this complex issue of environment-performance relationship in which organization design parameters has played a pivotal role, the present research study was taken in the context of liberalized Indian economy focusing on some selected organizations of the agrichem sector. An attempt has been made in this paper to estimate the objective measures of uncertainty that can be used to determine to what extent the environment of the select firms of agrichem sector is volatile. Objective uncertainty measures on different operational verticals would be of significant value in helping both practitioners and researchers to understand the volatility of each organization. And, ultimately, the impact of volatility of the environment has been assessed. The significant part of the research outcomes is the estimation of uncertainty index (UI) which is a resultant effect of the volatility present in the sub-environment i.e. marketing, materials, research & development and within organization. The researchers have also established the level of influence of the environmental uncertainty reflected in the uncertainty index (UI), on the performance of the organizations.

Keywords : *Uncertainty measure, Market Volatility, Supply Chain Volatility, Technological Volatility, Internal Volatility, Performance, Agrichem Sector, India*

INTRODUCTION

Uncertainty refers to a sense of doubt arising from potentially unpredictable variation (Priem et al., 2002). Environmental uncertainty refers to the doubts managers experience when faced with the difficulty of forecasting future competitive conditions (McMullen and Shepherd, 2006). A significant amount of theoretical and empirical effort has been made to understanding the nature of effects of environmental uncertainty on organizations (Jauce & Kraft, 1986 and Milliken, 1987). The measures of uncertainty of the environment are of the great challenge for the mangers to formulating the strategy for superior performance.

The relationship between organization and environment is completely dynamic and the dynamism depends on the context of the study, more specifically, country and time specific. Within a business structures, environment-performance relationship is also different from one organization to another organization, one sector to another sector etc. Organizations may change their strategy depending of their flexibility but has very little to do to resist the environmental change. The change is obvious and to adapt with changed environment is the main issue of research, innovation or anything creative.

To address this complex issue of environment-performance relationship in which organization design parameters has played a pivotal role, this research study was taken in the context of liberalized Indian economy focusing on some selected organizations of the agrichem sector.

LITERATURE SURVEY

Uncertainty has been a central concept in the organization theory literature, particularly in theories which seek to explain the nature of the relationship between organizations and their environments (Dill, 1958; Lawerence & Lorsch, 1967; Thompson, 1967; Duncan, 1972). The concept of uncertainty is a central point of discussions of the organization-environment interface, particularly in theories of organizational design (Burns &Stalker, 1961; Lawerence & Lorsch, 1967; Thompson, 1967).

Three kinds of uncertainty may be distinguished (Milliken, 1987): state uncertainty (difficulty knowing in which direction the environment may change), uncertainty of effect (difficulty assessing the possible impact of these changes on a particular company) and response uncertainty (difficulty knowing which type of response may prove successful).

In a review of the environmental uncertainty literature, Jauch and Kraft (1986) stated three views in the study of uncertainty:

(1) The classical view (for example, Burns & Stalker 1961; Cyert and March 1963; Emery and Trist 1965) Business environment was the root cause of uncertainty and it had great influences on the structures, decisions and performance of the organizations. The recommended strategy was the change in internal structure to establish the "system equilibrium".

(2) The transition view (for example, Thompson 1967; Perrow 1970; Child 1972; Galbraith 1973)

The researchers have indicated that external and internal sources were responsible for the uncertainty and decisions makers could choose the strategies for changing the internal structure to mitigate the uncertainty issues and

(3) The process view (for example, Lawrence and Lorsch 1967; Duncan 1972; Downey, Hellriegel, and Slocum 1975)

Significant theorizing and research have focused on the nature of the relationship between an organization and its environment, and the construct of environmental uncertainty has been central to most of these inquiries (Emery and Trist 1965; Thompson 1967; Duncan, 1972; Downey and Slocum 1975; Pfeffer and Salancik 1978; Aldrich 1979; Boulton et al. 1982; Hambrick 1982; Jauch and Kraft 1986; Smircich and Stubbard 1985). The basic problem is associated with the measuring the construct of environmental uncertainty. Two uncertainty instruments and conceptualizations have received widespread attention. They are those of Lawrence and Lorsch (1967) and Duncan (1972).

Lawrence and Lorsch (1967) have identified the uncertainty parameters related with research department, manufacturing department and marketing department and evaluate the degree of uncertainty of three different organization subsystems. Duncan's (1972) instrument seeks to measure uncertainty on the basis of three characteristics: (1) the lack of information regarding environmental factors associated with decision making situations (2) the lack of knowledge about the organizational consequences of a decision if the decision is incorrect and (3) the ability or inability to assign probabilities as to the effect of environmental factors on the success or failure of the organization in performing its function.

Despite the fact that the field has attributed great theoretical significance to the construct of uncertainty, research generally has yielded inconsistent results (Duncan, 1972; Downey, Hellriegel &Slocum, 1975). Problems range from findings from poor reliability and validity evidence for measurement instruments (Tosi, Aldag &Storey, 1973; Downey et al., 1975) to a failure to find clear evidence of a relationship between "objective" characteristics of the organizational environment and perceptions of environmental uncertainty (Duncan, 1972; Tosi, Aldag &Storey, 1973; Downey et al., 1975; Pennings, 1975; Pfeffer, 1978). Bourgeois (1978) criticized Tosi et al.'s volatility measure and develop a more systemic and predictable model of measuring industry volatility. Snyder and Glueck (1982) used Tosi et al's (1973) measures for scaling the volatility of the industry environments and established a positive correlation of the perceptual uncertainty with Tosi et al's objective measures for six industries. Kundu (2011) measures the volatility of the two dairy firms taking the three sub environment of their operations, namely, demand of the produce, supply of the inputs and the internal factors operating strictly within the organization.

It is also worth noting that uncertainty shows two sides in the literature: uncertainty as a perceptual phenomenon (referring to the uncertainty perceived by the managers making business decisions) and the uncertainty describing the business environment (linked to analysts' assessment on the basis of certain

indicators. The latter kind of uncertainty is often referred to as objective uncertainty as these indicators are measured on quantitative variables through statistical procedures which may be easily generalized (Dess and Beard, 1984).

These two sides of uncertainty are therefore founded on the basis of complexity and the variability of the external conditions surrounding the business activity but from quite different perspectives. Still there are no definitive answers to the questions of whether objective or subjective measures are most appropriate.

Khandwalla(1976) and Miles and Snow (1978) indicated that strategic managers in more uncertain environment tend to become more proactive and innovative. Bourgeois III, L. J. (1984) emphasized to incorporate the creative activity in strategy making to curve the challenges of the market instead of linear thinking. Eisenhardt, K. M., & Martin, J. A. (2000) also supported the same in their research and mentioned that in high velocity markets, dynamic capabilities must rely more on new knowledge creations.More researches in this field have also argued that strategic decisions based on environment constraints coupled with internal structures have an impact on performance.Child (1973), in the first phase of work, established that managerial and organizational attributes have an impact on the organizational performance irrespective of the nature of the organization and its operating conditions. Child (1974) examined the relationship in between the degree of variability in company's environments in heterogeneous sectors with organizational design and performance. Khandwalla(1973) raised the stimulating research issue stating that there may be several rather than one effective design and the appropriates of the design depends on the context in which the organization operates. Prescott (1986) has developed a model to examine joint impact of environment and strategy on the organizational performance. Rumelt(1982) identified that diversification strategy of the organizations in response to market conditions have an impact on performance. Bhattacharya and Kundu(2013) has also made a study to find out the impact of volatility of the business environment along with differentiation and integration, on the performance of the selected Indian organizations.

Hambrick (1983) indicated that environmental uncertainty had main impacts on three performance measures such as return on investment, cash flow and market share. An exhaustive study of Ray (2004, 2007) on Indian Firms after economic reforms empirically proved that firms having better environment-strategy 'fit' achieved superior performance. The effect of environment on firm performance was moderated by firm strategies. Khandwalla (2001) has prescribed creative restructuring of Indian firms in the post liberalization era by carrying out an exhaustive diagnostic study for their sustenance in the context of an increasingly competitive and technologically turbulent operating environment. The works of Som(2008) has also indicated that the synergy between innovative HRM practices

was not significant in enhancing corporate performance during the liberalization process of India. Kundu (2014) has developed the Linear Programming model to estimate the impact of design parameters namely, uncertainty reduction, differentiation and integration on the performance of the organizations.Kundu & Bhattacharya (2015) has established the strong relationship between two measures, namely, subjective and objective measures of uncertainty and the strong impact subjective measure of uncertainty on the performance of the organization has also ascertained.

CONTEXT OF THE STUDY

Liberalization of the Indian Economy

Indian firms recognized significant changes in the business environment during economic liberalization. Overall, economic liberalization in India has led to a more munificent environment characterized by opportunities for higher growth and return, resources availability increases, and easier access to the international market. It has provided improved infrastructure, better institutional support, and lower regulatory interference and hurdles. It has also resulted in an intensely competitive market with increased foreign and domestic competition and sophisticated and demanding customers (Manimala, 1996 and Ray, 1998). It has also been observed that in response to these emerging opportunities and threats, a large majority of firms aimed for higher growth and return; increased the scale of operation; diversified into new products and business lines; expanded the geographical base in domestic and international markets; offered a variety and value added products to satisfy the diverse customer segments to their customers; introduced foreign technology and emphasized modernization of plants and equipment, and increased the sharing of resources across departments, divisions, and business units within the firm (Ray and Dixit, 2000).

A new dynamism has emerged after liberalization of the economy and that has been observed more or less in every sector mainly information technology, automobile sector, real estate, electronics and also in service sectors such as communication, banking and insurance. The new technologies have provided the best opportunities for economic and social development. The vision has also changed in the R& D intensive sectors such as pharmaceuticals, biotechnologies, chemical and agro-chemicals related sector and a huge investments has observed by both of the national and multinationals. They have identified the change in demographic trends such as a rising number of people of working age, affluent middle income group, increasing numbers of quality conscious consumers.

The total global Agrichemical market is expected to be worth $196 billion by 2014, and the Asian market will account for nearly 43.1 percent of the total revenues where India will have a major share. The global Agrichemical market is expected to grow at a CAGR of 10.4 percent from 2009 to 2014(Frost & Sullivan, 2010).

The Agrichemical sector comprises of fertilizers and crop protection chemicals. India is the third-largest fertilizer producer and consumer in the world with installed production capacities of over 18 million tons per annum. Currently, there are over 64 large fertilizer units in the country, manufacturing a wide range of nitrogenous and phosphate complex fertilizers.

India is one of the most dynamic generic pesticide manufacturers in the world with more than 60 technical grade pesticides being manufactured indigenously by 125producers consisting of large and medium-scale enterprises (including about 10 multinational companies) and more than 500 pesticide formulators spread over the country.

OBJECTIVES OF THE PRESENT STUDY

An attempt has been made in this paper to estimate the objective measures of uncertainty that can be used to determine to what extent the environment of the select firms of agrichem sector is volatile. Objective uncertainty measures on different operational verticals would be of significant value in helping both practitioners and researchers to understand the volatility of each organization. And, ultimately, the impact of volatility of the environment has been assessed.

The objectives of the paper are as follows:

1. To suggest the different measures which are indicative of different dimensions of uncertainty

2. To construct an uncertainty index with the dimensions mentioned above

3. To indicate the relative importance attached to different dimensions of uncertainty

4. To estimate the extent of variation the performance of the organizations explained by the uncertainty index

RESEARCH DESIGN

Sources of Data

The unit of observation for this study is the organizations belonging to the sectors, namely agricultural related chemical industry (agrichem sector), more specifically, fertilizer sector. The selection of the firms of the specified sector are basically made by the exhaustive study of the Print version of Economic Intelligence Service named Industry Market Size & Shares published by Centre for Monitoring Indian Economy Private Limited (CMIE). The database of CMIE of the detailed performance report of Indian firms in the form of software PROWESS 4 are used as the source of data of the respective organizations.

Attempt has been made to consider the top most organizations belonging to the agrichem sector. These sources generated a sample size of 10 organizations in the specified sector that include private, public and cooperative firms.

Methodology

Tosi et al (1973) has used objective measures of uncertainty to measure the market volatility. Lawrence and Lorsch (1967) and Duncan (1972) instrument have completely relied on the perceptions of the managers. Downey, Hellriegel &Slocum (1975) found that individual differences regarding the environment moderate the relationship. However, Gifford, Bobbitt, and Slocum (1979) differed from these findings. Snyder and Glueck (1982) also raised certain doubts regarding perceptual measures of uncertainty.Bourgeois (1978) also used more refined way of objective volatility measures in comparison to Tosi et al (1973). Snyder and Glueck (1982) established the validity of Tosi et al's (1973) measures and determined the indices that can be used to calculate industry volatility. These works have provided the motivation for the present researchers to undertake the objective measures of environmental uncertainty considering the different dimensions of organizational operations.

Uncertainty can have different dimensions, each dimension taking care of the sub-environment of organizations. In this paper, the following dimensions have been suggested to measure industry volatility :

1. Market Volatility- Volatility in respect of demand of the produce.

2. Supply Chain Volatility -Volatility in respect of supply of inputs.

3. Technological Volatility- Volatility in respect of product obsolescence

4.   Internal Volatility- Volatility in respect of factors operating strictly within the organization.

The time period 2009 through 2014 was selected for study the environmental uncertainty of the select 10 firms in the mentioned sector.

The data related for the above dimensions, are as follows:

1.   Sales – sales data for the 6 years are used as the basis to measure the volatility present in the market i.e., in the demand side

2.   Raw materials cost– raw materials cost data for the 6 years are used as the basis to measure the volatility present in the supply of inputs.

3.   R & D Cost- investment in research and development (R & D cost) for the 6 years are used as the basis to measure the volatility present in the product obsolescence

4.   Employee cost –employee cost data for the 6 years are used as an indicative measure of uncertainty within the organization.

Standard error of the estimate in regression analysis, while regressing each of above variables on time is used to indicate the market volatility, supply chain volatility, technological volatility and volatility within the organization. Lower value of standard error indicates more stability in respect of the concerned variables, less fluctuation within the defined time period and a certain level of consistency. On the other hand, higher value of standard error indicates less stability in respect of the concerned variables and high level of fluctuation within the defined time period which indicates a greater degree of inconsistency.

Discriminant scores have been estimated on the basis of objective measures of the uncertainty based on four dimensions for the each organization. Discriminant scores are reflection of the level of uncertainty of individual firm in the existing environment. The average value of sales turnover of each organization for the time period 2009-2014 is taken as performance indicator.

Now, regression analysis has been performed taking the Performance indicator (average sales turnover), as dependent variable and discriminant scores (reflection of environmental uncertainty) as independent variables to ascertain the level of influence of uncertainty on the performance of the organization.

RESULTS

Analysis –Stage I

Based on yearly data on the different dimensions of uncertainty, namely sales, raw materials cost, R& D cost and employees cost, time series analysis has been performed using regression method with time being the only independent variable for 10 selected firms of the mentioned sector. The time series data taken

for study was from 2009-2014. Here, the time dimension is highly significant as the dynamism of the task environment is completely time specific. As we have suggested earlier, standard error of the estimate is taken as measure of uncertainty in respect of the variables because it shows the degree of volatility of the respective sub-environment. Table 1 indicates the different dimensions of volatility of the sub-environment and corresponding measures to construct an uncertainty index (UI) as a whole for that specific sector.

Table 1: Dimensions & measures of Uncertainty Index

	Uncertainty Dimensions	Time	Period
1.	Market Volatility (MV)	standard error of the estimate of sales	2009-2014
2.	Supply Chain Volatility(SCV)	standard error of the estimate of raw materials cost	2009-2014
3.	Technological Volatility (TV)	standard error of the estimate of R & D Cost	2009-2014
4.	Internal Volatility (IV)	standard error of the estimate of employee cost	2009-2014

Analysis –Stage II

The organizations of the specified sector are sorted on ascending order on the basis of their sales turnover. The objective is to form two relatively homogeneous groups. Then, on the basis of these two groups, discriminant analysis has been performed.

Before that, normality test for four parameters related to Uncertainty Measures such as market volatility (MV), supply chain volatility (SCV), technological volatility (TV) and internal volatility (IV) has been performed. Large significance values (>0.05) of all indicate that the observed distribution corresponds to the theoretical distribution. The value of significance indicates that all the independent parameters are normally distributed.

Discriminant analysis has to be performed on the basis of two groups and discriminant scores has been obtained for each organization. The classification table (Ref Table 2) measures the extent of correct classification of this sample. The results indicate that 90% of the cases are classified correctly.

Table 2: Classification Table of Predicted Group Membership

Classification Results [a] [b] [c]

VAR00001			Predicted Group Membership		Total
			1.00	2.00	
Original	Count	1.00	5	0	5
		2.00	1	4	5
	%	1.00	100.0	.0	100.0
		2.00	20.0	80.0	100.0
Cross Validated	Count	1.00	5	0	5
		2.00	0	5	5
	%	1.00	100.0	.0	100.0
		2.00	.0	100.0	100.0

a.   Cross Validation is done only for those cases in the analysis. In cross validation each case is classified by the functions derived from all cases other than that case.

b.   90.0% of original grouped cases correctly classified.

c.   100.0% of cross-validated grouped cases correctly classifies.

Analysis –Stage III

The discriminant scores can be taken as a resultant effect of volatility measures of the sub-environment of each organization namely market volatility (MV), supply chain volatility (SCV), technological volatility (TV) and internal volatility (IV).

The construct of uncertainty index(UI) can be formed based on the standardized canonical discriminant function coefficients (a1, a2, a3, a4) of four volatility measures, namely, market volatility (MV), supply chain volatility (SCV), technological volatility (TV) and internal volatility (IV) (Ref Table 3).

Table 3: Standardized Canonical Discriminant Function Coefficients of Uncertainty Dimensions

Uncertainty Dimensions	Associated Co-efficient[ai]	Coefficient Value
Market Volatility (MV)	a1	9.127
Supply Chain Volatility(SCV)	a2	-2.366
Technological Volatility (TV)	a3	7.492
Internal Volatility (IV)	a4	3.888

The uncertainty index (UI) based on four volatility measures of each organization can be represented in the following mathematical form :

**UI= a1 (MV) + a2 (SCV) + a3(TV)+ a4(IV)-------(I)**

Analysis –Stage IV

Equation I indicates the construct of uncertainty index (UI) on the basis of objective measures of volatility of four dimensions corresponds to different sub-environment of each organization and the standard canonical discriminant function coefficients (ref Table 3) indicate the level of importance of volatility measure on uncertainty index. High coefficient values associated with market volatility (MV) and technological volatility (TV) measure indicate that volatility in the demand side and technological innovation are the most significant contributor to uncertainty of the fertilizer sector.

Analysis –Stage V

The dependent variable average value of sales turnover of each organization for the time period 2009-2014 is plotted against Discriminant Scores in the two dimensional space by the scatter diagram (Figure 1). The scatter diagram cannot establish any relationship between the dependent variable and the discriminant scores.

Fig 1.: Mapping of the organizations in respect of Average Sales and Discriminant scores

Discriminant Scores from Function 1 for Analysis 1
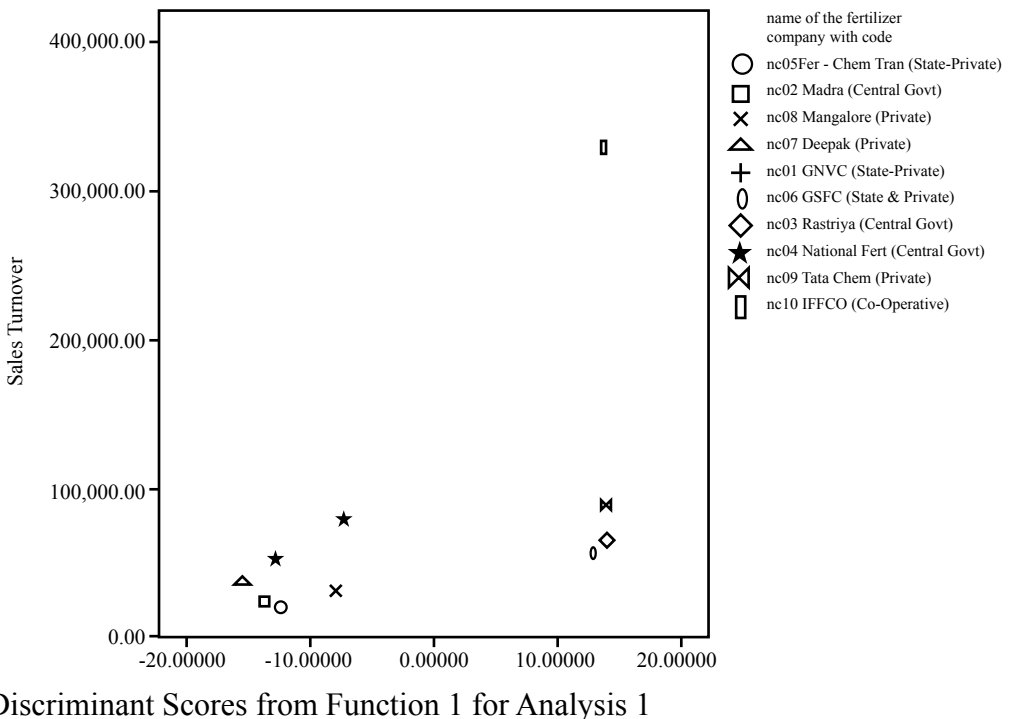
The scatter diagram is subjectively used to form the homogeneous segment on the basis of Sales Turnover & the discriminant scores. To make the homogeneity, only one organization is deleted from the dataset as outlier.

Analysis-Stage VI

Now, Regression analysis has been performed directly considering financial performance average sales turnover as dependent variable and the discriminant scores of the select organizations which are basically reflection of uncertainty, named as Uncertainty Index (UI) as independent variable.

Results show that R- value stands good for association between variables and R Square value indicates that uncertainty index related to volatility with respect to the four dimensions of the sub-environment can explain the performance of the select organizations at about 70.1 % level (Ref table 4). The coefficient that is associated with discriminant scores reflection of Uncertainty Index (UI) is highly statistically significant (Ref table 5).

Table 4 Output of Regression Analysis

Model Summary

Model	R identification of company except IFFCO (OUTLIER) = 1.00 (Selected)	R Square	Adjusted R Square	Std. Error of the Estimate
1	.837[a]	.701	.658	12828.4159

a. Predictors: (Constant), Discriminant Scores from Function 1 for Analysis 1

Table 5: Significance of Uncertainty Index

Coefficients [a,b]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	48296.186	4424.445		10.916	.000
Discriminant Scores from Function 1 for Analysis 1	1417.944	350.118	.837	4.050	.005

a. Dependent Variable : Average Sales

b. Selecting only cases for which identification of company except IFFCO (OUTLIER) = 1.00

DISCUSSIONS

The purpose of the research was to determine the generic construct of objective measure of volatility considering select firms of agrichem sector. The significance of this finding is that there appear to be an index that can be used to calculate the industry volatility. The uncertainty index (UI) is a resultant effect of the volatility present in the sub-environment i.e. marketing, materials, research & development and within organization, and that are also captured by four different dimensions of uncertainty measures namely, market volatility (MV), supply chain volatility (SCV), technological volatility (TV) and internal volatility (IV) respectively. The significant part of the research outcomes is that the volatility in the market end (MV) i.e. in the demand side and the technological volatility (TV) should receive more attention for the sustenance in this specific sector. Now, the researchers has established the level of influence of the objective measure of environmental uncertainty reflected in the uncertainty index(UI), on the performance of the organizations, measured in terms of average sales turnover of each organizations in the specified sector. The strong correspondence in between these two establishes the truth that the market complexity and dynamism which are inherent characteristics of uncertainty has made a significant impact on the performance of the organizations. This outcome would also motivate the strategic decision makers of the organizations of that sector to formulate effective model to address the uncertainty for better performance.

LIMITATIONS AND SCOPE FOR THE FUTURE RESEARCH

The findings reported in this paper suggest that future research efforts should be directed towards determining uncertainty index for more sectors. This model will enable the researchers to study the effect of environmental volatility on organization functioning and performance. It will also facilitate the cross-industry comparisons. Additionally, future research should focus identifying, refining and testing of new dimensions of environmental uncertainty.

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