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Working paper

**Linking environmental uncertainty to non-financial performance
measures and performance: a research note**

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Abstract

Several previous research studies have reported mixed results concerning the direct association between non-financial performance measures and performance. The presence of environmental uncertainty on this relationship has not been established. This paper makes a contribution to this area by proposing that it is in conditions of environmental uncertainty that non-financial measures are most useful in improving organisational performance. It analyses empirical data from a random sample of 52 New Zealand manufacturing firms to test the hypothesis that non-financial measures of performance would lead to improved organisational performance under conditions of increased environmental uncertainty. The findings suggest that performance should be a declining function of the size of the “mismatch” between an organisation’s environment and use of the different combinations of non-financial performance measures. Further, it is suggested that prior mixed results may be attributed to the omission of environmental uncertainty.

Keywords: Non-financial performance measures; environmental uncertainty; performance

1. Introduction

The recent performance management literature (Lynch and Cross, 1991; Kaplan and Norton, 1996, 2001; Otley, 2003) suggests that when monitoring their firm’s performance managers tend to place relatively less emphasis on traditional financial measures of performance such as return on investment or net earnings. This is usually explained in terms of traditional performance measures being unable to satisfactorily reflect firm performance affected by today’s changing business environments. Stemming from these concerns, the academic community largely supports claims that since non-financial performance measures focus on a firm’s long-term success factors such as customer satisfaction,

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internal business process efficiency, innovation and employee satisfaction they may lead to improved organisational performance (Lynch and Cross, 1991; Kaplan and Norton, 1996, 2001; Otley, 1999; Veen-Dirks and Wijn, 2002).

However, several recent studies linking the use of non-financial performance measures to performance have produced mixed findings. For example, Fisher (1995) found that organisations experienced difficulty linking the use of non-financial measures to performance. While Brancato (1995) found considerable use of non-financial measures, managers involved in her study could not quantify any links between non-financial measures and performance. Similarly, Ittner and Larcker (1998) found no positive and significant links between non-financial measures of quality and customer satisfaction and financial performance. On the other hand, Banker *et al.* (2000) found a positive association between customer satisfaction measures and financial performance. In another study, Ittner and Larcker (1996) provided evidence that hedge portfolios formed on the basis of customer satisfaction measures outperformed the stock market in subsequent periods. Anderson *et al.* (1994) found evidence to support their hypothesis that customer satisfaction in their subject firms was significantly and positively associated with financial performance, measured by return on investment.

These mixed findings may be explained by arguing that previous studies overlooked environmental uncertainty and that uncertainty was present. The major contribution of the current study is to examine the idea that it is in conditions of environmental uncertainty that non-financial measures of performance are most useful in improving organisational performance. This is because non-financial performance measures provide managers with a basis on which to manage the drivers of desired outcomes (Lynch and Cross, 1991; Shields, 1997; Otley, 1999; Hoque and James, 2000; Veen-Dirks and Wijn, 2002). Against this background, the purpose of this research is to search for a contingent effect of environmental uncertainty on the relationship between the use of non-financial performance measures and organisational performance. It analyses responses to a mailed questionnaire obtained

from a random sample of 52 New Zealand manufacturing companies to attempt to control for the possibility that increased environmental uncertainty moderates the impact of the use of non-financial performance measures on organisational performance.

The next section develops the study's hypothesis. Section three outlines the research method applied. The empirical results appear in section four. The final section discusses the results and concludes the paper.

2. The research hypothesis

To derive the research hypothesis, this study uses a contingency theoretic argument that organisational performance is contingent on the "fit" between an organisation's environment and use of performance measures in performance evaluation (for a review, see Van de Ven and Drazin, 1985; in accounting, see Otley, 1980; Chapman, 1997; Tymon *et al.*, 1998). The environmental uncertainty facing most companies has been increasing rapidly in the last fifteen years driven by factors such as manufacturing and operations technologies, customer tastes and preferences, market demand, relations with customers and suppliers, distribution channels, number of competitors and their actions, deregulation and globalisation and industrial relations (Miles and Snow, 1978; Hamel and Prahalad, 1994; Cooper, 1995; D'Aveni, 1995; Goldman *et al.*, 1995).

Non-financial performance measures may enable a firm to address environmental uncertainty by clearly monitoring the core competencies of the organisational processes as well as creating greater efficiency throughout the organisation (Kaplan and Norton, 1996, 2001). It has also been argued that, by monitoring the core competencies of the production process, a firm should be able to identify areas which are increasing the cost of the product without providing value, be it quality and reliability or some other elements (Lynch and Cross, 1991; Brancato, 1995; Ittner and Larcker, 1998). According to Kaplan and Norton (1996, p.6), "Breakthrough in performance requires major change, and that includes

changes in the measurement and management systems used by an organisation Navigating to a more competitive, technological, and capability-driven future cannot be accomplished merely by monitoring and controlling financial measures of past performance”.

A tested proposition in the contingency management accounting literature is that the effectiveness of an organisation’s system requires management’s knowledge of the organisation’s environment to determine the “fit” or alignment among the different organisational elements (for a review, see Otley, 1980; Chapman, 1997 and Chenhall, 2003). Considerable contingency studies in accounting provided empirical evidence to support this claim (for example, see Govindarajan, 1984; Gordon and Naryanan, 1984; Chenhall and Morris, 1986; Ezzamel, 1990; Mia, 1993; Gul, 1991; Gul and Chia, 1994; Hoque and Hopper, 1997; Hoque, 2004). Against this background, the central argument in this paper is that non-financial performance measures are more likely to favourably affect performance in situations of higher environmental uncertainty. This is because non-financial measures are likely to facilitate organisational decisions and actions that support strategies based on the needs of stakeholders, internal and external customers, regulatory bodies, managers, and employees (Atkinson *et al.*, 1997; Hoque and James, 2000; Otley, 1999, 2003). It has also been suggested (Kaplan and Norton, 1996, 2001) that non-financial performance measures help managers to assess changes in their business environments, determine and evaluate progress towards the firm’s goals, and affirm achievement of performance.

Based on the literature reviewed above, this paper proposes the relationship between the use of non-financial performance measures and performance to be moderated by the uncertainty level. These observations form the basis of the following research hypothesis:

The use of non-financial performance measures would lead to improved organisational performance under conditions of a higher level of environmental uncertainty.

3. Research method

3.1. *The sample*

A questionnaire with a cover letter and a postage-paid, self-addressed envelope was mailed to the chief executive officers of 100 New Zealand manufacturers randomly selected from the *New Zealand Business Who's Who*. Thirty-nine of the 100 questionnaires sent out in the first mailing were returned. A follow-up letter was posted to each non-responding firm four weeks after the initial mail-out, and several telephone calls yielded a further 19 returned questionnaires. Six of the 58 respondents failed to complete the questionnaire, citing reasons such as contravening company policy, staffing constraints and not relevant. Consequently, a total of 52 completed questionnaires, which represented a response rate of 52 per cent, was used for analysis of the results.

To test for the existence of possible response bias, *t*-tests for two independent samples were undertaken by testing first and second mailing returns as suggested by Oppenheim (1966). No statistically significant differences in the mean scores on the firm size, performance measures, or environmental uncertainty between the early and late respondents were noted. The firms surveyed employed between 50 and 2,200 employees, with annual sales between NZ\$12 million and NZ\$890 million and capital employed between NZ\$4 million and NZ\$892 million.

3.2. *Measurement of variables*

3.2.1. *Environmental uncertainty*. Environmental uncertainty was measured using eight items adapted from Khandwalla (1972), Govindarajan (1984) and Gordon and Naryanan (1984). Respondents were asked, on a five-point Likert scale ranging from 1 (very predictable) to 5 (very unpredictable), to indicate their perceptions of the relative predictability of the eight items of the firm's environment. A principal components analysis (PCA) with varimax rotation of the eight items yielded one factor with an eigenvalue greater than 1.0. This explained 68.3 per cent of the total variance. To facilitate the analysis, a single scale was constructed by taking the average of respondents' scores for the eight items within

the factor.¹ A reliability check for this measure produced a Cronbach alpha (Cronbach, 1951) of 0.75, which is considered to be well above the lower limits of normal acceptability (Nunnally, 1978). Descriptive statistics and the results of the factor analysis appear in Table 1.

INSERT TABLE 1 ABOUT HERE

3.2.2. *Non-financial performance measures.* The question on the use of non-financial measures included a total of 13 items similar to that developed by Hoque and James (2000), along the lines of Kaplan and Norton's (1996) three non-financial perspectives: customer; internal business processes; and learning and growth. The customer perspective included the following five items: market share; customer satisfaction survey; on time delivery; customer response time and warranty repair cost. The internal business processes perspective included the following four items: material and labour efficiency variance; process improvement and reengineering; new product introduction; and long-term relations with suppliers. And, the learning and growth perspective included the following four items: staff development and training; workplace relations; employee satisfaction; and employee health and safety. Respondents were asked, on a five-point scale ranging from 1 (to a little extent) to 5 (to a very great extent), to indicate their organisation's use of the stated measures in performance evaluation. A PCA of the 13 items yielded three factors with eigenvalues greater than 1.0, which explained 68.3 per cent of the total variance. To facilitate the analysis, a single scale was constructed for each factor by taking the average of respondents' scores for each item within the factor. It should be pointed out that although each non-financial factor is comprised of a number of separate measures, the clusters made intuitive sense and they were interpreted as representing the extent to which organisations used the *customer*,

¹ The other two commonly used methods in management accounting research are using the *factor scores* in the analysis and *weighted average scales* in which the respondents' scores for each item are multiplied (weighted) by the relevant factor score. There is a debate as to which of these three options is the more appropriate. The advantage of the unweighted average scale is that it is simple to administer and interpret. The disadvantage of this, on the other hand, is that the scale does not represent all the "facets" of a factor and is prone to measurement error. The advantage of the weighted average scale is that it uses the factor scores for each item in the computation. On the other hand, the use of factor scores has the advantage of representing a composite of all variables loading on the factor, although this is also a potential disadvantage in that all variables have some degree of influence in computing the factor scores and make interpretation more difficult (Bryman and Cramer, 1995; Hair *et al.*, 1998). This paper reports only the results based on unweighted scores from the factor

internal business processes and *learning and growth* perspectives for performance evaluation. The Cronbach alphas for the customer, internal business processes, and learning and growth perspectives were 0.82, 0.76 and 0.79 respectively, indicating satisfactory internal reliability of these scales. Table 2 presents the descriptive statistics and the results of the factor analysis.

INSERT TABLE 2 ABOUT HERE

3.2.3. *Organisational performance*. Organisational performance was measured using 12 items adapted from Govindarajan (1984). Respondents were asked, on a five-point scale ranging from 1 (below average) to 5 (above average), to indicate their organisation's performance along the 12 items. To test the hypothesis, a single global performance score for each firm was computed by taking the average for all items. The Cronbach alpha for this measure was 0.75.

INSERT TABLE 3 HERE

INSERT TABLE 4 HERE

4. Results

Table 3 provides descriptive statistics for all variables. Pearson correlation coefficients appear in Table

4. To test the hypothesis, the following regression model was run using the SPSS12.0 program:

$$Y = \alpha_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_1 X_2 + e$$

where Y = organisational performance; X_1 = environmental uncertainty; X_2 = use of non-financial performance measures; $X_1 X_2$ = the interaction term; α_0 = constant; and e = the error term. Tests of nonlinearity and heteroskedasticity of the data indicated no major problem for regression analysis. The

analysis for both the independent and dependent variables. However, weighted factor scores were also employed to test the research hypothesis and no discernible differences were found.

results presented in Table 5 indicate that the direct effect of the use of non-financial perspectives on organisation performance is not significant ($\beta_2 = 0.06$; $t = 0.35$, $p = 0.730$). As expected, the standardised beta coefficient for the interaction (β_3) between environmental uncertainty and non-financial performance measures is positive and highly significant ($\beta_3 = 0.44$; $t = 2.48$, $p = 0.017$). The overall regression model for the experimental variables explained 19.1 per cent (adjusted R^2) of the variance in the dependent variable, organisational performance ($F = 4.93$, $p = 0.005$). These results support the hypothesis that increased use of non-financial performance measures would lead to improved organisational performance under conditions of increased environmental uncertainty.

INSERT TABLE 5 HERE

To further explore the above relationship, regression analysis was also conducted using each of the three non-financial performance perspectives. The results presented in Table 6 indicate: (a) a positive and significant interaction between environmental uncertainty and customer perspective leading to improved organisational performance ($\beta_3 = 0.29$; $t = 1.61$, $p = 0.055$), (b) a positive but insignificant interaction between environmental uncertainty and internal business processes perspective affecting organisational performance ($\beta_3 = 0.53$; $t = 1.54$, $p = 0.626$), and (c) a positive and significant interaction between environmental uncertainty and learning and growth perspective leading to improved organisational performance ($\beta_3 = 0.34$; $t = 2.46$, $p = 0.017$). These results provide additional support to the study's hypothesis.

5. Discussion, conclusions and limitations

The paper sought to provide some insight into the impact of environmental uncertainty on the relationship between the use of non-financial performance measures and organisational performance. In general, regression analysis reported above suggested the positive and significant association

between managers' use of the non-financial measures and environmental uncertainty to produce a positive impact on performance. However, additional analysis using each perspective of the non-financial performance measures indicate that firms have a greater tendency to make use of measures related to customer satisfaction and learning and growth under conditions of a high level of environment uncertainty to produce an improved organisational performance.

The results reported in this paper have drawn attention to the importance of environmental factors in the effectiveness of a performance measurement system. In particular, it has led to a greater understanding of how non-financial performance measures may play an important role in improving the performance of an organisation. More specifically, it can be suggested that greater reliance on non-financial performance measures is associated with increased performance, but only when the level of environmental uncertainty within the organisation is high. In other words, an appropriate "fit" between the use of non-financial performance measures and environmental uncertainty has greater practical significance relative to the direct effects, as found in prior research reviewed in this paper. Managers who see themselves in situations of high environmental uncertainty would perceive non-financial measures more positively. These conclusions are, however, subject to the study's following limitations.

The first limitation of this study relates to its measurement of the variables. It should be noted that like all cross-sectional studies, this study is likely to suffer from endogeneity problems and subjective perceived measurements based on a survey compound these problems. A time-series study of similar business units facing different environmental uncertainty may shed light on the contextual nature of benefits from non-financial measures. The study is based on a small sample size of 52 firms. Although these firms were randomly selected, future research may shed further lights on the topic using a larger sample size.

Another limitation of this study is that it considered the interaction of the use of non-financial performance measures and increased environmental uncertainty to affect performance when there are

undoubtedly many other variables at work. For example, performance could be affected by other variables such as organisation size, competitive strategy, organisation structure, the leadership style of the CEO, intensity of competition and customer profile. Future research may wish to use these variables that may explain cross-sectional differences in organisational performance as a result of using non-financial performance measures. From the managerial significance, in this study simply finding that high environmental uncertainty is a good context for the use of non-financial measures may not provide the manager with useful information about the type of performance measures to be used in performance measurement. With hindsight, nevertheless this study suggested that prior mixed results concerning the direct association between non-financial performance measurement and performance may be attributed to the omission of environmental uncertainty.

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Table 1

Descriptive statistics and principal components analysis (PCA) of the environmental uncertainty items

Item	Mean	S.D.	Factor Loadings
1. Suppliers' actions	2.58	1.36	0.82
2. Customer demands, tastes and preferences	3.52	1.09	0.80
3. Deregulation and globalisation	3.98	0.94	0.79
4. Market activities of competitors	3.63	1.10	0.78
5. Production and information technologies	3.50	1.16	0.78
6. Government regulation and policies	3.06	1.27	0.73
7. Economic environment	3.25	1.21	0.68
8. Industrial relations	2.69	1.39	0.64

Percent variance explained = 68.3; n = 52

Table 2
 Descriptive statistics and the results of the PCA of the non-financial performance measures items (n = 52)

Item	Mean	Standard Deviation	Factor loadings Factor 1 (Customer perspective)	Factor loadings Factor 2 (Internal business processes perspective)	Factor loadings Factor 3 (Learning and growth perspective)
Material and labour efficiency variance	4.01	0.97		0.82	
Process improvements and re-engineering	3.56	1.11		0.78	
New product introduction	3.01	1.22		0.73	
Staff development and training	2.96	1.04			0.87
Customer satisfaction survey	3.90	0.92	0.86		
On-time-delivery	3.19	1.02	0.70		
Long-term relations with suppliers	2.89	1.26		0.67	
Workplace relations	2.90	1.13			0.79
Employee health and safety	3.53	1.16			0.75
Market share	3.94	1.03	0.86		
Warranty repair costs	2.84	1.32	0.50		
Customer response time	3.26	1.15	0.56		
Employee satisfaction	3.50	1.18			0.77
Percent variance explained			34.46	17.95	11.40

Table 3
Descriptive statistics and reliabilities for all variables (n = 52)

Variable	No of items used	Average mean	Standard deviation	Theoretical range	Observed range	Cronbach alpha
Customer perspective	5	3.42	4.95	5-25	5-25	0.82
Internal business processes perspective	4	3.36	4.30	4-20	4-20	0.76
Learning and growth perspective	4	3.24	4.50	4-20	4-20	0.79
Overall non-financial measures	13	3.35	8.55	13-65	21-60	0.87
Environmental uncertainty	8	3.28	5.79	8-40	14-37	0.70
Organisational performance	12	3.81	6.21	12-60	12-60	0.75

Table 4
Pearson Correlations (n = 52)

Code	Variable	CUSP	IBP	LGP	OVNONF	EU	OPER
CUSP	Customer perspective	1.00					
IBP	Internal business processes perspective	0.57**	1.00				
LGP	Learning and growth perspective	0.57**	0.52**	1.00			
OVNONF	Overall non-financial measures	0.85**	0.82**	0.83**	1.00		
EU	Environmental uncertainty	0.24*	0.23*	0.29*	0.23*	1.00	
OPER	Organisational performance	0.44**	0.18	0.26*	0.42**	0.07	1.00

** , * Significant at 1 per cent and 5 per cent level (2-tailed), respectively.

Table 5
Results of regression
Dependent variable = organisational performance (Y)

Variable	Coefficient	Standard error	t-value	p-value
Constant	45.48	8.06	5.64	0.000
Environmental uncertainty (X ₁)	-0.03	0.19	-.002	0.982
Non-financial measures (X ₂)	0.06	0.13	0.35	0.730
Two-way interaction (X ₁ X ₂)	0.44	0.02	2.48	0.017

$R^2 = 0.239$; Adjusted $R^2 = 0.191$, $F(3, 47) = 4.93$, $p = 0.005$

Table 6

Additional regression analysis using each of the three non-financial perspectives used

Panel A: Organisational performance on customer satisfaction perspective and environmental uncertainty

Variable	Coefficient	Standard error	t-value	p-value
Constant	39.85	5.89	6.77	0.000
Environmental Uncertainty (X_1)	-0.19	0.24	-1.15	0.256
Customer satisfaction perspective (X_2)	0.24	0.21	1.56	0.062
Two-way interaction (X_1X_2)	0.29	0.01	1.61	0.055

$R^2 = 0.427$; Adjusted $R^2 = 0.130$, $F(3, 47) = 3.48$, $p = 0.023$

Panel B: Organisational performance on internal business processes perspective and environmental uncertainty

Variable	Coefficient	Standard error	t-value	p-value
Constant	48.78	4.24	11.51	0.000
Environmental Uncertainty (X_1)	-0.39	0.28	-1.50	0.625
Internal business processes perspective (X_2)	-0.18	1.67	-0.18	0.503
Two-way interaction (X_1X_2)	0.53	0.02	1.54	0.626

$R^2 = 0.080$; Adjusted $R^2 = 0.021$, $F(3, 47) = 1.362$, $p = 0.266$

Panel C: Organisational performance on learning and growth perspective and environmental uncertainty

Variable	Coefficient	Standard error	t-value	p-value
Constant	41.29	3.34	12.35	0.000
Environmental Uncertainty (X_1)	-0.04	0.61	-.30	0.763
Learning and growth perspective (X_2)	0.12	0.85	0.84	0.401
Two-way interaction (X_1X_2)	0.34	0.01	2.46	0.017

$R^2 = 0.137$; Adjusted $R^2 = 0.082$, $F(3, 47) = 2.489$, $p = 0.072$

END OF PAPER