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The views expressed in published articles are those of the authors and not necessarily those of the editors, executive board, editorial board, WDSI, or Colorado State University. All submissions will be initially reviewed by the editor, and if appropriate, sent to referees for review. The authors are responsible for the accuracy of facts stated in the articles.

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FROM THE EDITOR'S DESK

Since the last WDSI meeting in Vancouver in April 2001, *JBM* has continued to receive submissions on a steady basis. This issue contains articles reviewed over the past year, including some papers from the past conference. Please continue to think of *JBM* as an outlet for your work. I will continue to expedite review of papers selected in the divisions as a "best paper." Increased submissions allow us to be more selective in the quality of our articles. Even after moving to a quarterly publication schedule, our acceptance rate remains at about 20 percent. While that figure is higher than the most competitive national journals, it nonetheless indicates that reviewers devote considerable attention to their work and screen out submissions which are clearly not suited for our journal. I very much appreciate the efforts of the reviewers and authors who make this project a reality.

Along with the increasing volume of materials, *JBM* made progress in other important respects. We are now registered with the Library of Congress and have an ISSN number (1535-668X). This number is important for librarians and other purchasers who want to identify the periodical. Also, like other recognized journals, we are preparing issues devoted to a special topic. The Summer 2002 issue (No. 3) features a set of articles on conflict resolution and decision making. We are also accepting submissions for a special issue to be published in 2003 featuring experience design and management in services. The guest editors have identified important areas of current research and believe these issues will make a scholarly contribution to the literature. Please contact me if you have ideas for future special issue topics.

Last, you can help *JBM* expand its revenue base by asking your library to subscribe to the journal. A higher subscription rate will assist *JBM* in its access to electronic databases and make the publication a viable option for a commercial publisher. The objective is to establish a stable basis for *JBM* in the future.

As always, I welcome your suggestions about the journal and appreciate your support.

Raymond L. Hogler
Professor of Management
Colorado State University

Stock Prices' Reactions to Layoff Announcements

Javad Kashefi and Gilbert J. McKee
California Polytechnic University

Despite continuing economic expansion and low unemployment, companies laid off about half a million workers between 1992-1998. The reasons for this massive work force reduction vary from disappointing sales growth, slowdowns in orders from international markets (particularly Asian countries), off-shore and maquiladoras production in Asia and Mexico which reduced labor costs, and reductions in payroll expenses to become competitive and to improve the bottom line of the business. Analysts often argue that a layoff announcement is a form of informational signaling to investors that the firm's management has embarked on plans to boost the company's stock.

This paper examines stock price reaction to layoff announcements over a seven-year period. A sample of 174 layoff announcements involving U.S. companies occurring between 1992 and 1998 is analyzed. Our findings support the hypothesis that layoff announcements do indeed convey information useful for the valuation of firms. We find positive abnormal returns for the firms with proactive announcements and negative abnormal returns for the firms with reactive announcements

INTRODUCTION

Large-scale layoffs and downsizing are reshaping corporate America. During the period 1992 - 1998, Fortune 1000 firms in the U.S laid off about half a million workers. General Motors Corporation, for example, announced plans in July 1998 to lay off more than 50,000 employees, or 22% of its work force, in order to become more competitive (Blumenstein, 1998) and Northwest Airlines issued notices to 27,500 employees representing 55% of its work force to reduce its payroll expense, which topped $3 billion in 1997 (Carey, 1998). When Boeing's overseas sales were impacted by Asia's economic problems, the company announced sharp production cutbacks for almost every jetliner model, a decision which eliminated 20,000 jobs on top of already announced cuts of 28,000 jobs in the previous year.

Numerous empirical studies have been conducted on various aspects of layoff announcements. For example, O'Shaughnessy and Flanagan (1990) studied the determinants of layoff announcements following mergers and acquisitions. Another study analyzed top management turnover following M&As (Cannella & Hambrick, 1993). While merger announcements have been linked to stock prices, Caves and Kreps (1993) found no support for the argument that merger activity influences the magnitude of the stock market's reaction to layoff announcements.

Hallock (1998) examined the connection between layoffs, executive pay, and stock prices. Cody, Hegemon and Shanks (1987) and Heenan (1989) investigated the impact of layoffs on employee morale and organizational effectiveness. McCune, Beatty, and Montango (1988) examined the design and implementation of layoffs. The evidence concerning the impact of corporate layoffs on the value of the firm is limited and controversial. Lin and Rozeff (1993) examined the relation between stock returns and a set of operating decisions, including layoffs, operation closings, and pay cuts. They found that changes in operations tend to be affected after the stock of the company has experienced substantial negative abnormal returns. Also, they found that temporary layoffs, permanent layoffs, and temporary operation closings are associated with negative abnormal returns. Their focus was on the comparison of different measures of cost cutting, including layoffs, when they developed a model to explain the behavior of market reaction to layoffs. Abowd, Mikovich and Hannon (1990) examined the price effects of a number of human resource decisions, including layoffs, and found no consistent valuation impact from the announcements. Worrell, Davidson, and Sharma (1991) examined the stock market response to layoff announcements, and they found that investors reacted negatively to announcements attributable to financial reasons. Their main focus was to examine whether the market reacts to layoff announcements and not to develop a testable hypothesis that would explain the behavior of the stock market around the time of announcement of corporate layoffs. The studies cited above have not focused on the reaction of stock price to layoff announcements.

Palman, Sun, and Tang (1997) examined the impact of layoff announcements (from 1982 to 1990) based on whether the information was perceived as negative or positive for the company. Layoff announcements induced by adverse market conditions, such as demand declines, resulted in negative cumulative abnormal returns, while positive announcements of improved operational efficiency from layoffs resulted in positive abnormal cumulative returns.

This paper investigates the impact of layoff announcements classified as reactive (negative) or as proactive (positive) which occurred during a period of robust economic activity. Proactive announcements are defined as layoffs that are part of a strategy or a restructuring plan that anticipates the direction of the competitive environment. Reactive announcements are layoffs that are a direct response to financial distress (Elayan, 1998).

In the context of our analysis, a layoff announcement is considered proactive (positive) when it is associated with sequential increasing growth rate in sales and earnings per shares (EPS). The resultant higher free cash flows increase firm value. The layoff announcements are considered reactive (negative) if the company has experienced a sequential declining growth rate in sales and lower EPS. The lower free cash flows lead to reduced firm value.

Our hypothesis is that the firm's layoff announcement is an information signaling to investors about the future prospects of free cash flows and the value of the firm. If true, the rate of return on equity should be abnormally positive for those firms with a prospect of higher future free cash flows and negative for those companies with a prospect of declining free cash flows.

This paper's contributions to the existing literature are as follows. First, the study provides evidence that stock prices respond to corporate layoff announcements considered proactive

(reactive) and generally generate positive (negative) abnormal returns. Second, we show that changes in a firm's stock price generally do not precede the layoff announcements. Third, the study analyzes the effects of corporate layoffs during a single up phase of the business cycle.

DATA AND METHODOLOGY

Data sources and Sample Construction

A sample of layoff announcements for the U. S. firms has been obtained from varied sources, including the *Wall Street Journal* and *Los Angeles Times* from 1992 to 1998. Layoff announcements with confounding events (*i.e.*, CEO dismissal, new executive appointments, mergers, etc.) have been deleted. This resulting sample consists of 174 layoff announcements for firms listed on the New York Stock Exchange, American Stock Exchange and NASDAQ. Since firms traded on exchanges as well as over-the-counter are included, the sample is not biased toward small or large firms.

The sample was further divided into two groups of 105 firms with proactive announcements and 69 with reactive announcements.

For both groups, we chose a 41-day event window, comprised of 20 pre-event days, the event day, and 20 post-event days. Brown and Warner (1985) suggest that when information release dates are identified with uncertainty, a wider window may be used. To the extent that a wider window introduces noise, returns are estimated with greater error, reducing the power of test statistics. However, a 20-day window does not introduce a significant amount of estimation error, thereby addressing concerns regarding the power of test statistics.

Stock return data was obtained from the AMSPEC tapes provided by the California data bank hosted at California Polytechnic State University, San Luis Obispo.

Testable Hypothesis

Our hypothesis is that the firm's layoff announcement represents new information to investors that affects their estimates of free cash flows and the value of the firm. If true, the cumulative abnormal rate of return (*CARR*) should be positive for those firms with an upward revision of its growth rate of sales and future free cash flows and negative for those companies with a revision downward for sales and free cash flows.

Event Study Methodology

Standard event study methodology (Fama, Jensen, & Roll, 1969, and Brown &Warner, 1985) is employed to measure abnormal returns of the company for the days on and around the event of interest (the layoff announcements). For each security *i*, the market model that is suggested by Brown and Warner (1985) to calculate an abnormal return (*AR*) for event day t as follows:

$$AR_{it} = R_{it} - (\alpha_i + \beta_i R_{mt}) \quad (1)$$

where R_{it} is the rate of return on security i for event day t, and R_{mt} is the rate of return on the CRSP value-weighted index on event day t. The coefficients of the linear market model in parentheses (α_i, β_i) are estimated by regressing observed rates of return for security i on the corresponding rates of return for a market index. This regression utilizes observed returns for a time period prior to the "event period" so as not to contaminate their estimation with the impact of the event under study.

For example, defining day 0 as the day in which the layoff announcement is publicized, day -1 as one day prior to the announcement, and +1 as one day after, the abnormal return for each security over the event days -20 through 20 days are calculated. Then, the abnormal returns are averaged across all companies for each event day to obtain an average abnormal return (AAR):

$$AAR_t = \frac{1}{N}\sum_{i=1}^{N} AR_{it} \tag{2}$$

where AAR_t is the average abnormal return for time period t, and N is the number of firms in the study.

The average abnormal returns are then aggregated to find the cumulative average abnormal returns. They are as follows:

$$CAAR_t = \sum_{t=-20}^{20} AAR_t \tag{3}$$

or

$$CAAR_t = AAR_t + CAAR_{t-1}$$

where $CAAR_t$ is the cumulative returns from day –20 to the date (through days +20).

For a sample of N securities, the mean $CARR$ is defined as:

$$\overline{CAAR} = \sum_{j=1}^{N} CAAR_t \tag{4}$$

The expected value of $CAAR$ is zero in the absence of abnormal performance.

The test statistic described by Dodd and Warner (1983) and Hit and Owers (1983) is the mean standardized cumulative average abnormal return. To compute this statistic, the abnormal return AR_{it} is standardized by its estimated standard deviation S_{it}.

$$SAR_{it} = AR_{it}/S_{it} \tag{5}$$

The value of S_{it}^2 is

$$S_{it}^{\ 2} = S_i^{\ 2}[1 + \frac{1}{D_i} + (R_{mt} - \bar{R}_{mt})^2 / \sum_{t=1}^{D_i}(R_{mt} - \bar{R}_{mt})^2] \quad (6)$$

where: S_i^2 = residual variance of security I from the market model regression

D_i = Number of observations during the estimation period

$\bar{R}_{mt}$ = Mean rate of return on the market index during the estimation period, and

R_{mt} = Return on the market for day t of the estimation period.

The standardized cumulative average abnormal return $SCAAR_i$ over the interval $t = T_{1i} \ldots T_{2i}$

$$\overline{SCAAR}_i = \sum_{t=T_{1i}}^{T_{2i}} SAR_{it} / \sqrt{(T_{2i} - T_{1i} + 1)} \quad (7)$$

The test statistic for a sample of N securities is:

$$Z = \sum_{i=1}^{N} \overline{SCAAR}_i / \sqrt{N} \quad (8)$$

Each SAR is assumed to be distributed unit normal in the absence of abnormal performance context. The variable Z is also unit normal.

RESULTS

Table 1 presents the averaged abnormal returns and the averaged cumulative abnormal return for each of the two layoff announcement categories. Plots of the cumulative abnormal returns are included as figure 1 and figure 2.

The results are largely consistent with the existing literature on the information content of layoff announcements. The evidence strongly supports the hypothesis that layoff announcements do indeed convey information useful for the valuation of firms. Focusing on the announcement day (day zero) the average abnormal return for the proactive information is 0.986%. The average abnormal return for reactive information is -.683%. The announcement effect is also evident on day one with average abnormal return of .258% and -.213% for proactive and reactive information respectively.

The $CAAR$ plots show that to some extent the market gradually learns (information leaks out) about the forthcoming announcement. The average $CAAR$ of the proactive information gradually drifts up in days -20 to -1, and the average $CAAR$ of the reactive information drifts down over the same period. The buildup of abnormal returns prior to announcement is consistent with the strong-form of market efficiency hypothesis that if information related to

TABLE 1
Abnormal and Cumulative Returns of Layoff Announcements for Firms: 1992-98

Event	Proactive (105 firms)			Event	Reactive (69 firms)		
Day	AAR	CAAR	Z-statistic	Day	AAR	CAAR	Z-statistic
-20	0.095%	0.095%	1.3380	-20	-0.109%	-0.109%	-1.0583
-19	-0.179%	-0.084%	-1.2431	-19	-0.188%	-0.297%	-0.7642
-18	0.090%	0.006%	0.5625	-18	0.031%	-0.266%	0.9226
-17	0.024%	0.030%	0.8889	-17	-0.081%	-0.347%	-1.9951*
-16	0.020%	0.050%	0.9091	-16	-0.012%	-0.359%	-0.2419
-15	0.041%	0.091%	0.9558	-15	-0.059%	-0.418%	-0.0571
-14	-0.042%	0.049%	-1.4483	-14	-0.023%	-0.441%	-0.0201
-13	0.059%	0.108%	1.9032**	-13	0.009%	-0.432%	0.0074
-12	0.069%	0.177%	1.9167**	-12	-0.095%	-0.527%	-0.5064
-11	0.071%	0.248%	1.7317	-11	-0.092%	-0.619%	-0.5324
-10	-0.030%	0.218%	-1.2000	-10	-0.097%	-0.716%	-0.4450
-9	0.165%	0.383%	1.5566	-9	-0.052%	-0.768%	-0.2980
-8	-0.061%	0.322%	-0.7922	-8	0.083%	-0.685%	0.5024
-7	-0.013%	0.309%	-1.3000	-7	-0.032%	-0.717%	-0.7306
-6	0.109%	0.418%	0.1313	-6	-0.014%	-0.731%	-0.2612
-5	0.089%	0.507%	1.1867	-5	0.166%	-0.565%	1.7548**
-4	0.101%	0.608%	2.0200*	-4	-0.141%	-0.706%	-0.1209
-3	0.119%	0.727%	1.8594**	-3	0.101%	-0.605%	1.1272
-2	0.009%	0.736%	0.8182	-2	-0.113%	-0.718%	-1.9894*
-1	0.172%	0.908%	2.7742*	-1	-0.179%	-0.897%	-2.6401*
0	0.986%	1.894%	2.4346*	0	-0.683%	-1.580%	-2.1244*
1	0.258%	2.152%	2.8166*	1	-0.213%	-1.793%	-1.8750**
2	0.018%	2.134%	2.0000*	2	-0.082%	-1.711%	-1.7680**
3	-0.169%	1.965%	-0.8802	3	0.019%	-1.632%	2.2669*
4	0.018%	1.947%	0.3197	4	-0.108%	1.524%	-1.1295
5	0.014%	2.090%	0.3062	5	0.119%	-1.335%	0.1710
6	-0.058%	2.032%	-1.3942	6	0.079%	-1.256%	0.9049
7	0.068%	2.100%	0.2985	7	0.132%	-1.124%	1.4103
8	0.128%	2.258%	0.4426	8	-0.051%	-1.175%	-0.0483
9	-0.010%	2.248%	-0.0398	9	-0.071%	-1.246%	-1.9241**
10	0.106%	2.434%	1.6909**	10	0.129%	-1.117%	0.1170
11	-0.083%	2.351%	-0.3281	11	-0.010%	-1.127%	-0.2283
12	0.062%	2.413%	1.6021	12	-0.039%	-1.166%	-1.0581
13	0.116%	2.237%	1.1503	13	0.073%	-1.093%	1.9363**
14	-0.093%	2.144%	-0.9451	14	0.018%	-1.0755	0.5065
15	-0.009%	2.135%	-0.3782	15	-0.049%	-1.1245	-1.2929
16	0.078%	2.213%	2.1727*	16	-0.088%	-1.212%	-1.2767
17	0.086%	2.299%	2.0673*	17	-0.053%	-1.2655	-0.5667
18	0.109%	2.478%	0.4918	18	0.068%	-1.197%	1.0236
19	-0.048%	2.430%	-0.0823	19	-0.059%	-1.286%	-1.2732
20	0.016%	2.446%	0.0599	20	-0.027%	-1.313%	-0.5581

* Significant at the 5% level.
** Significant at the 10% level.

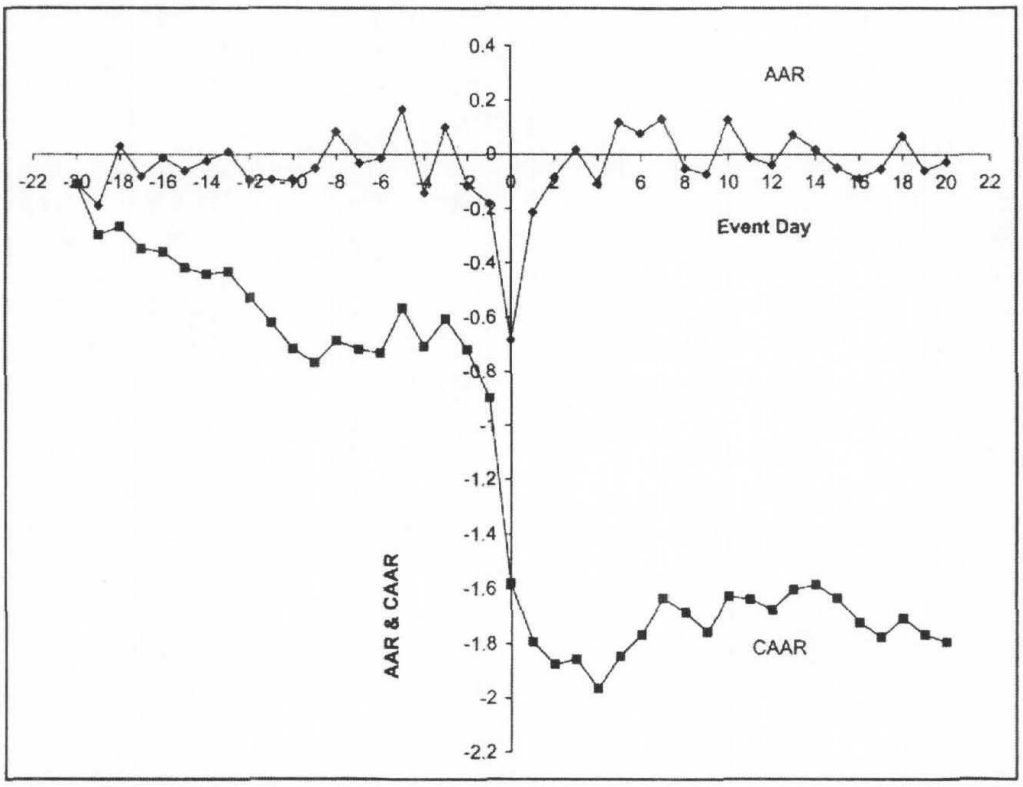

Figure 1. Plot of Abnormal and Cumulative Returns for Proactive Announcements.

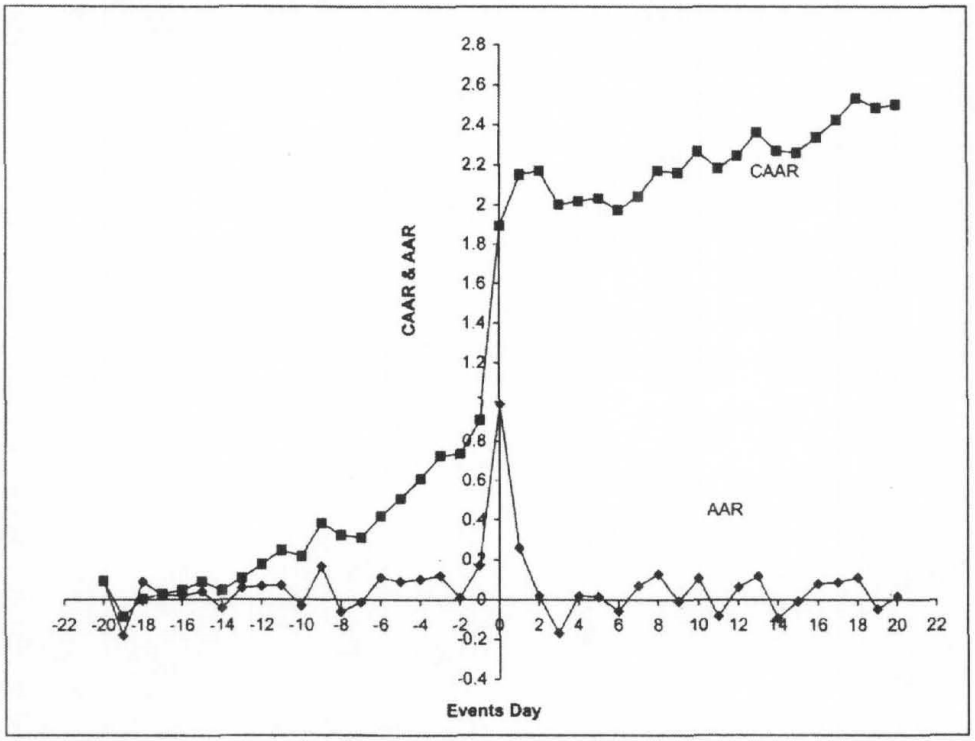

Figure 2. Plot of Abnormal and Cumulative Returns for Reactive Announcements.

the event leaks out prior to the announcement, the *CAAR* will gradually increase in the days prior to the announcement and then substantially increases on the day of the announcement, reflecting the responses of those stocks for which information did not leak out. In the days after the announcements, the *CAAR* for reactive information is relatively stable and no longer increases or decreases significantly. This is in accord with the market efficiency hypothesis that once the layoff announcements became public, the stock prices reacted to the nature of information.

The *CAAR* for the proactive announcement continues to move up suggesting that the layoff announcements were not completely anticipated, and prices continued to adjust after the day of the announcement. This is also in accord with some of the studies that have found evidence of a persistent lag in price adjustments (Brown & Kennelly, 1972; Joy, Litzenberger, & McEnally, 1977).

The results are consistent, albeit different from the cumulative returns reported by Palmon, Sun, and Tang for their sample of 140 layoff announcements over the 8-year period from 1982 to 1990. The results are also different from the -0.4% reported as the 3-day cumulative returns by Worrell *et al.* (1991) for a sample of 441 layoff announcements over an 8-year period from 1979 to 1987. Clearly, the magnitude of the stock price impact of layoff announcements is more profound in the 1990s.

SUMMARY

Over the sample period, U. S. corporations announced record-breaking employee layoffs despite robust economic growth. To investigate the effect of the layoff announcements on firm value, we have defined two types of layoff announcements. Layoff decisions that are part of a strategy or a restructuring plan are considered to be proactive announcements. Layoff decision that are motivated to reduce costs and increase profit margins, perhaps in anticipation of declining sales, are considered to be reactive announcements.

We find positive abnormal returns for the firms with proactive announcements and negative abnormal returns for the firms with reactive announcements.

Our results, while consistent with previous studies of layoff announcements, establish a higher magnitude of cumulative average abnormal returns for the two types of layoff announcements.

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The Different 'Faces' of Happiness - Unhappiness in Organizational Research: Emotional Exhaustion, Positive Affectivity, Negative Affectivity,and Psychological Well-Being as Correlates of Job Performance

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Philip J. Denney, Late of San Francisco, CA

This research examined relations among several commonly considered indicators of affective-based "happiness - unhappiness" in organizational research with job performance ratings. While psychological well-being predicted job performance, the results failed to establish relations among emotional exhaustion, positive affectivity (PA) and negative affectivity (NA) as correlates of job performance. Suggestions and implications for future research are introduced.

INTRODUCTION

Happily may I walk.
May it be beautiful before me.
May it be beautiful behind me.
May it be beautiful below me.
May it be beautiful above me.
May it be beautiful all around me.
In beauty it is finished.
(*Anonymous*, Navaho Night Chant)

As the above quote taken from a Navaho Night Chant indicates, the pursuit of "happiness" transcends both time and cultural boundaries. Nowhere does this appear more evident than in organizational research undertaken over the years to identify whether "happy" workers are also "productive" workers (Staw, 1986). In fact, many applied researchers have come to consider the happy/productive worker thesis as a "holy grail" of the organizational sciences (Landy, 1985). Despite the longevity of this ongoing discussion, the veracity of the happy/productive worker thesis remains in doubt, even as we enter the new millennium (Wright & Staw, 1999). We propose that part of this confusion may result from the widely varied manner in which "happiness" has typically been understood and measured in organizational research.

Without question, happiness is an imprecise term (Myers, 1993; Veenhoven, 1991). However, virtually all scientific approaches to happiness appear to converge around three defining phenomenon (Cropanzano & Wright, 2001; Diener, 1984, pp. 542-544). First, happiness is a subjective experience (Diener, 1994; Diener, Sandvik, Seidlitz, & Diener, 1993). Second, happiness includes both the relative presence of positively-toned emotions and the relative

absence of negatively-toned emotions (Argyle, 1987; Diener & Larson, 1993; Warr, 1987; 1990). Third, happiness is a global judgment; it is an overall evaluation that appears to exhibit some measure of stability over time (Diener, 1994; Myers, 1993). In organizational research, "happiness - unhappiness" has typically been operationalized by such seemingly disparate constructs as emotional exhaustion, dispositional affect, psychological well-being and job satisfaction (Wright & Bonett, 1997a; Wright & Staw, 1999). Typically, [un]happiness has been equated to job [dis]satisfaction in work-related research (Wright & Doherty, 1998). More specifically, we suggest that work-related research has primarily focused on examining the potentially negative consequences of worker distress or dissatisfaction, *i.e.*, absenteeism, turnover, poor performance, or a reliance on what is called the "disease model" (Wright & Cropanzano, 2000b).

The focus of the disease model involves attempts at minimizing the financial costs attributable to an unhappy or dissatisfied employee. This disease-based or utilitarian model is considered by a number of scholars to now be the prevailing research values perspective in the organizational sciences (Wright & Wright, 2000). As a result, an overriding emphasis of organizational research appears to be one concerned with identifying the pecuniary costs to the organization of distressed, dissatisfied and unhappy workers, as opposed to examining the possible benefits to all relevant organization stakeholders of research focusing on maintaining or developing attributes or profiles of physically and psychologically well employees. Interestingly, a similar emphasis appears to exist in the psychological sciences. Myers and Diener (1995) found that psychological publications focusing on negative states outnumber their positive counterparts by a ratio of 17 to 1! This emphasis on the negative, to the relative neglect of the positive, has undoubtedly had a significant [negative] effect on how many individuals have come to view the world. For instance, Myers and Diener (1997, p. 5) recently proposed "that most [Americans] are unhappy most of the time." As an alternative to this disease or utilitarian approach, we suggest a research values perspective which considers the issue of employee health as a worthwhile consequence or *end* in itself. This approach is known as the health model (Ruack, 1999; Wright & Cropanzano, 2000a; Wright & Wright, 2000).

In the health model, the research focus is on how to initiate, maintain, or make things better for people (Wright & Wright, 2000). From this approach, employee health is viewed as an *end* in itself, an intrinsic good for which all organization stakeholders should work. Thus, unlike the disease model, which focuses on minimizing the potentially disabling symptoms or manifestations of mental or physical dysfunctional behavior (Kendler, 1999), the health model takes its cue from humanistic psychology (Fromm, 1994; Maslow, 1961). That is, health is defined not only in terms of the absence of dysfunctional behavior, but in terms of the presence of the potential for individual "growth" or "fulfillment" (Jahoda, 1958). Furthermore, the basic premise of the health model is that each of the organization's stakeholders or constituents equally share in the responsibility to identify and help remedy preventable sources of organizational and individual distress (Quick, Quick, Nelson, & Hurrell, 1997). However, this change from a focus on a *means* to an *end* perspective constitutes a major transformation of how organizational research is typically framed and investigated (Wright & Wright, 2000; Wright & Wright, 2001).

Traditionally, following the disease model approach, organizational research has primarily concentrated on the possible maladaptive consequences of such employee health-related variables as job stress (Jex, 1998), job burnout (Lee & Ashforth, 1996), negative affectivity (Spector, Chen, & O'Connell, 2000), and job [dis]satisfaction (Spector, 1997). Moreover, because decades of research have failed to consistently demonstrate a strong link between job [dis]satisfaction and performance (*e.g.*, Vroom, 1964; Iaffaldano & Muchinsky, 1985), interest in research examining the job [dis]satisfaction - performance relation appears to have waned (Wright & Staw, 1999). Alternatively, some interesting work on the role of affect-based measures of "happiness – unhappiness" as potential correlates of performance has started to accumulate. Following common parlance, we consider affect (and its derivative affective) as a superordinate term that encompasses all other affect-oriented terminology (Hunt, 1997; Wright & Doherty, 1998).

To date, the prevailing orientation of a number of affect-based constructs purporting to measure aspects of the "happiness – unhappiness" dimension appears consistent with the precepts of the disease model. For example, research has widely examined the maladaptive role of job burnout, especially emotional exhaustion, and negative affectivity in a number of organizational behaviors (Spector, Zapf, Chen, & Frese, 2000; Wright & Cropanzano, 1998). In contrast, two affect-based constructs proposed to be linked to aspects of individual growth and fulfillment, *i.e.*, positive affectivity and psychological well-being, have been much less widely investigated (Wright & Staw, 1999). The present research was designed to afford an initial opportunity to investigate the role of both positively (positive affectivity and psychological well-being) and negatively-toned (emotional exhaustion and negative affectivity) measures of affect — the different 'faces' of happiness-unhappiness in organizational research — as correlates of job performance. We now provide the theoretical basis for *why* relations may exist among emotional exhaustion, positive and negative affectivity, and psychological well-being with job performance.

Emotional Exhaustion and Performance

Historically, most research on emotional exhaustion has been guided by Maslach and Jackson's (1986) three-component conceptualization of burnout. In this model, burnout has three interrelated parts: emotional exhaustion, depersonalization, and diminished personal accomplishment. Emotional exhaustion, the subject of the present research, is defined as a chronic state of physical and emotional depletion that results from excessive job demands and continuous hassles (Shirom, 1989). Emotional exhaustion describes affective feelings of being emotionally overextended and exhausted by one's work (Wright & Cropanzano, 1998). In addition, emotional exhaustion is more narrowly defined than other, more general, conceptualizations of activation or arousal (Shirom, 1989). In fact, it is proposed that even minimal occurrences of this type of emotional strain, experienced relatively few times a month, are indicative of substantial activation, which may warrant some form of intervention (Gaines & Jermier, 1983). Given Wright and Bonett's (1997a) finding of a substantial negative relation between emotional exhaustion and another widely acknowledged operationalization of the happiness - unhappiness dimension, psychological well-being, we propose that emotionally exhausted and unhappy individuals share much in common (Wright & Doherty, 1998). Using the conservation of resources (COR) model of stress (Hobfoll, 1989), we next

provide a theoretical basis for the proposed negative relation between emotional exhaustion and work-related performance.

According to the conservation of resources (COR) model of stress (Hobfoll, 1989; Lee & Ashforth, 1996), emotional exhaustion is most likely to occur when there is an actual resource loss, a perceived threat of resource loss, a situation in which one's resources are inadequate to meet work demands, or when the anticipated returns are not obtained on an investment of resources (Wright & Cropanzano, 1998). Thus, prolonged strain or emotional exhaustion occurs when individuals feel they no longer have sufficient emotional resources to handle the stressors confronting them (Hobfoll, 1989; Lee & Ashforth, 1996).

Hobfoll (1989) noted the similarity between COR theory and the popular management concept of person-environment (P-E) fit (French, Caplan, & Harrison, 1982). Like COR theory, P-E fit theory posits that an incongruent relation between organizational demands and an individual's resources to meet these demands leads initially to job stress, and, if left unattended over time, to emotional exhaustion and other potentially maladaptive outcomes. However, COR theory goes beyond P-E fit theory and makes specific predictions regarding both *what* individuals will do and *why* they do it when confronted with stress (Wright & Cropanzano, 1998). More specifically, COR theory predicts that individuals will experience a sense of discomfort and will attempt to minimize losses. Thus, use of COR theory as the theoretical framework affords researchers a great deal of precision in predicting the outcomes of emotional exhaustion (Lee & Ashforth, 1996; Wright & Cropanzano, 1998). For instance, based on COR theory, resource deficient or emotionally exhausted individuals are proposed to overemphasize avoidance or withdrawal coping mechanisms (Leiter, 1993). Arguably, the most costly of these employee withdrawal-related correlates to the organization is diminished job performance (Wright & Cropanzano, 1998).

The results of the limited available research to date examining the proposed negative relation between emotional exhaustion and job performance have been inconsistent, however. Our literature review revealed three published empirical studies linking emotional exhaustion to non self-report measures of performance (Wright & Bonett, 1997a; Wright & Bonett, 1997b; Wright & Cropanzano, 1998). More specifically, while Wright and Bonett (1997a) failed to establish a relation, Wright and Bonett (1997b) found modest support for a negative relation between emotional exhaustion and a composite measure of performance (measured 3 years later). Interestingly, this research failed to establish a cross-sectionally derived correlation between the measures, leaving overall interpretation of these results somewhat ambiguous. Finally, Wright and Cropanzano (1998) found support that emotional exhaustion was negatively related to a measure of job performance. Based on COR theory, we propose that emotional exhaustion is negatively related to job performance. We next examine the basis for relations among the two dimensions of dispositional affect, positive and negative affectivity, and job performance.

Dispositional Affect and Performance

Over the years, numerous personality traits have been widely identified and empirically tested by social scientists (Hough & Schneider, 1996). However, as noted by George (1996), these traits are not just randomly generated, but appear to be hierarchically structured with a

few broad, general traits at the top and more specific traits at the bottom of the hierarchy. While some controversy exists regarding the exact number and configuration of this trait clustering, there appears to be consensus that negative (NA) and positive (PA) affectivity are prominent among these general traits (George, 1996).

Negative affectivity or NA is the disposition to experience negative feelings. High NA is characterized by the experience of such negative feelings as anger, disgust, and contempt. Low NA is characterized by calmness and serenity (Watson, Clark, & Tellegen, 1988). Thus, while individuals high on NA tend to think and act in ways that result in negative affective experiences, individuals low on NA are not prone to think and act in this way. As noted by George (1996, p. 147), while high NAs are generally prone to experience distress over time and across situations, low NAs "are less likely to think and behave in ways that promote negative affective experiences."

The second dimension is positive affectivity. Positive affectivity is the disposition to experience positive feelings. High PAs experience a good deal of positive feelings, such as, joyfulness, exhilaration, and enthusiasm. Alternatively, low PAs are more likely to experience such feelings as sadness and lethargy (Watson et al., 1988). As a result, they tend to become somewhat disengaged from the world around them in a "nonpleasurable manner or style" (George, 1996, p. 147). Furthermore, since NA and PA are considered independent dimensions (Watson & Clark, 1984), an individual can be high on both NA and PA, low on both, or high on one and low on the other. In fact, according to the dispositional model, a happy person is one who is high on PA, while being low on NA. Thus, from this perspective, our second operationalization of happiness - unhappiness, dispositional affect, is seen as being composed of two traits rather than one (Diener, 1984).

NA and PA appear to be beneficial constructs for understanding *both* psychological and behavioral reactions to the work context. In this regard, they have considerable merit as predictors of a wide range of work-related attitudes and indices of work strain (*e.g.,* Brief, Butcher, & Robinson, 1995). NA has also been positively related to voluntary employee turnover (Wright & Cropanzano, 1998). Furthermore, recent research has used long-established models of motivation to hypothesize how NA and PA could predict employee achievement or performance (Brief, 1998; George & Brief, 1996). For example, from the perspective of expectancy theory (Vroom, 1964), PA could facilitate not only the expectancy that one's efforts lead to performance, but also the belief that performance leads to positive outcomes. Wright and Staw (1999) posited that the basis for these predictions comes from research showing that PA can lead to greater self-efficacy (Forgas, Bower, & Moylan, 1990) and optimistic biases in the estimation of future events (Seligman, 1991).

Further support for this hypothesis is found in goal-setting models of motivation (George & Brief, 1996; Wright & Staw, 1999). For instance, according to Wright and Staw (1999), one might posit that optimistic tendencies will lead individuals to set more difficult goals for themselves and/or accept more challenging goals provided by others. One possible consequence is increased productivity and performance. Additionally, one might also use an attributional model of motivation (Weiner, 1985) to hypothesize that PA has a facilitative influence on task persistence (Brief, 1998; George & Brief, 1996). Individuals who are high in positive affect or optimism tend to interpret failure more as a temporary setback caused

by situational, as opposed to individual, circumstances (Forgas, 1992). Thus, high PAs are seen as being more likely to persevere following adverse feedback than those with negative or pessimistic tendencies (Brief, 1998).

Taken together, the evidence suggests that people who are high in PA have different beliefs and experience different feelings than those who are high in NA. As a result, in many jobs, especially those requiring social contact or autonomous decision-making, one could expect individuals high on PA to be better performers (Staw & Barsade, 1993). However, to date, there is little direct empirical evidence linking dispositional affectivity and job performance (Wright & Cropanzano, 1998). Two studies failed to find a significant relation between dispositional affectivity and job performance ratings (Wright & Cropanzano, 1998; Wright & Staw, 1999), while two others reported only inconsistent findings (Cropanzano, James, & Konovsky, 1993, Studies 1 and 2).

Judge (1992) raised another issue regarding NA and PA. The dispositional perspective separates positive emotion into one dimension (PA) and negative emotion into another (NA). Observing that measures of psychological well-being combine positive and negative emotion into a single scale, Judge has suggested that it might be parsimonious to treat happiness as a bi-polar construct. Though available research is sparse, there is one piece of indirect evidence that supports Judge's position. In well-being scales, happiness is measured more directly. That is, these measures directly inquire as to whether one is "happy" or "sad." On the other hand, the measures of NA and PA do not ask direct questions regarding happiness. Rather, one infers the level of happiness from the respondent's NA/PA profile (for a more detailed treatment of these measurement issues, see Green, Goldman, & Salovey, 1993). Thus, a measure of well-being might afford both a more precise, as well as a more parsimonious, test of whether happy workers are productive ones. Given this possibility, we next examine the basis for the proposed relation between psychological well-being and job performance.

Psychological Well-Being and Performance

The importance of employee psychological well-being (PWB) has long been recognized by organizational scientists (Kornhauser, 1965). Psychological well-being measures the hedonic or pleasantness-based dimension of individual feelings and is widely conceptualized in terms of the overall effectiveness of an individual's psychological and social functioning. Clinical psychologists have long recognized the role of the pleasantness dimension of well-being (*i.e.*, happiness vs. sadness or depression) in the determination of various individual outcomes. For example, psychologically well individuals appear more likely to be satisfied with aspects of life and leisure, physically healthy, have high self-esteem, tend to be optimistic, and exhibit motivated behavior and constructive thought processes (DeNeve & Cooper, 1998; Holmes, 1991). Psychological well-being is typically considered an affectively-based "context-free" or global construct, one which is not tied to any particular situation (Wright & Bonett, 1997a). While psychological well-being has been considered as both a disposition or trait and a state or mood (*e.g.*, Diener, 1984; Diener, Suh, Lucas, & Smith, 1999), most typically it is viewed as a constant and stable trait.

In adherence to the disease model, research in organizational behavior has tended to focus on the extensive costs, in both financial and human terms, attributable to employee

dysfunctional psychological well-being (Cropanzano & Wright, 2001; Diener, 1984). For instance, depression, loss of self-esteem, hypertension, alcoholism and drug consumption have all been shown to be related to employee dysfunctional well-being (Ivancevich & Matteson, 1980). Since these variables have, in turn, been related to declines in various work outcomes, it is possible that psychological well-being and employee performance are related (Quick *et al.*, 1997).

Recent work-related research confirms that various affective-based measures of psychological well-being may be positively related to employee performance. For instance, Staw, Sutton, and Pelled (1994) re-analyzed a longitudinal data set to examine whether a single dimension measure of well-being could predict changes in performance outcomes. Staw *et al.* found support that their measure predicted changes in salary, performance evaluations, and social support. Staw and Barsade (1993) obtained similar results in an experimental study involving MBA students using a hedonically-toned composite measure of well-being. Likewise, Wright and his colleagues also found support for the psychological well-being to performance relation (Wright, Bonett, & Sweeney, 1993; Wright & Bonett, 1997a; Wright & Staw, 1999). The present research, composed of a sample of mental health workers, provides the initial opportunity to not only examine psychological well-being, but also emotional exhaustion, negative affectivity and positive affectivity as predictors of job performance. We tested the following three hypotheses:

Hypothesis 1: Emotional exhaustion will be negatively related to job performance.

Hypothesis 2(a): Positive affectivity will be positively related to job performance.

Hypothesis 2(b): Negative affectivity will be negatively related to job performance.

Hypothesis 3: Psychological well-being will be positively related to job performance.

Prior research examining various affective-based correlates of job performance has established significant bivariate relations among emotional exhaustion, positive and negative affectivity, and psychological well-being (Wright & Bonett, 1997a; Wright & Cropanzano, 1998; Wright & Staw, 1999). In addition, relations between each of these variables and work-related performance behaviors have been investigated (Wright & Cropanzano, 1998; Wright & Staw, 1999). However, to date, no research has simultaneously examined the relative contribution of emotional exhaustion, dispositional affect, and psychological well-being as correlates of job performance. Given the importance of further establishing the potential role of various affective-based correlates of job performance, we pose the following exploratory research question: What are the relative contributions of emotional exhaustion, positive affectivity, negative affectivity, and psychological well-being as correlates of job performance?

METHOD

The present study was designed to investigate the role of emotional exhaustion, positive affectivity, negative affectivity, and psychological well-being as correlates of job performance. The third author, Philip J. Denney, asked mental health case workers (N = 90) employed by a public sector agency in the western United States to participate in the study by means of a

direct contact procedure. The actual sample includes original data available from 66 employees, representing a response rate of 73%. All respondents were employed in the same department and performed similar job duties. The mean age for the sample was 47 years; the mean tenure was 17.7 years. The sample includes all respondents for whom measures of emotional exhaustion, positive affectivity, negative affectivity, psychological well-being, and job performance were available.

In field research, where research participants are often difficult to obtain, it is important to determine the minimum number of respondents necessary for the detection of meaningful effects (Bonett & Wright, 2000). Guilford (1956, p. 145) noted that a squared correlation of .25 is indicative of a substantial or meaningful relation. Prior research by Wright *et al.* (1993) and Wright and Bonett (1997a) found simple, bivariate correlations between psychological well-being and performance in the .40 to .50 range. Using a standard sample size procedure (Cohen, 1988), a sample size of at least 40 is required to detect a squared correlation of .25 with power equal to .75 and alpha equal to .05. Thus, the obtained sample size of 41 used in the regression analysis is adequate for testing the relations investigated in this field research.

MEASURES

Emotional Exhaustion

Emotional exhaustion was measured with Maslach and Jackson's (1986) nine-item emotional exhaustion scale (Maslach Burnout Inventory). This nine-item scale measures how often one feels emotionally overextended and exhausted by one's work. The inventory uses a 7-point scale (0 = never, and 6 = everyday). Sample items include "I feel emotionally drained from my work," "I feel fatigued when I get up in the morning and have to face another day on the job," and "I feel I'm working too hard on my job." Evidence of the construct validity of emotional exhaustion has been provided by correlations between emotional exhaustion and selected job characteristics (*i.e.*, direct contact with patients; Maslach & Jackson, 1986). The present study established a Cronbach's alpha of .81.

Dispositional Affectivity

This study used the PANAS Scale developed by Watson *et al.* (1988) as the measure of affectivity. The PANAS Scale is designed to measure both PA and NA. PA is measured by descriptors such as "active, alert, enthusiastic, inspired, and interested." NA is assessed by descriptors such as "afraid, hostile, irritable, jittery, and upset." Participants indicated the extent to which they experienced each descriptor of affect *in general* on a 5-point scale ranging from 1 (*very slightly or not at all*) to 5 (*extremely*). Cronbach's alpha for PA was .90; for NA, the alpha was .84.

Psychological Well-Being

As a measure of psychological well-being, this study utilized the eight-item Index of Psychological Well-Being developed by Berkman (1971). The Berkman scale uses many of the same items as Bradburn and Caplovitz' (1965) earlier measure, but with a more general

time horizon. For example, respondents were asked how often they felt: "depressed or very unhappy," "particularly excited or interested in something," "pleased about having accomplished something," and "on top of the world." For a more complete description of the scoring and prior validation of the index, the reader is referred to a number of recent organizational studies which have used it (*cf.*, Wright & Bonett, 1997a; Wright & Cropanzano, 2000b; Wright & Staw, 1999). In this study, the Cronbach's alpha was .70.

Performance

Employee performance was measured using the evaluation procedure validated by Wright and his colleagues (Wright & Bonett, 1993; Wright *et al.*, 1993). In the present case, management personnel from the current organization confirmed four dimensions as appropriate and relevant for assessing employee performance: support, work facilitation, goal emphasis, and team building. Each dimension was measured using a five-point scale ranging from "never" to "always" regarding the extent that employees emphasized a particular dimension. In this particular organization, each employee is typically evaluated on their yearly performance by their immediate superior. In this study, each employee's superior provided ratings of employee work performance on each of the four dimensions for the relevant evaluation period. The four items were summed to form a composite measure of performance (Cronbach alpha = .82).

RESULTS

Correlational Analyses: Hypotheses 1-3

Table 1 contains the means, standard deviations, and intercorrelations for the study variables. Hypothesis 1 predicted a negative relation between emotional exhaustion and job performance. This relation was not supported ($\underline{r}$ = -.14). Hypothesis 2 predicted positive (2a) and negative (2b) relations between PA and performance and NA and performance, respectively. These relations were not supported. Neither PA ($\underline{r}$ = -.01, ns) or NA ($\underline{r}$ = -.06, ns) were associated with performance. Hypothesis 3 predicted a positive relation between psychological well-being and performance. In support of Hypothesis 3, a significant positive relation was established between psychological well-being and performance ($\underline{r}$ = .34, $\underline{p}$ < .05).

These results provide support that psychological well-being is predictive of job performance. However, examination of Table 1 indicates that moderate correlations exist among psychological well-being, emotional exhaustion, positive affectivity and negative affectivity. Thus, a more thorough test of the psychological well-being/job performance relation should include controls for emotional exhaustion, positive affectivity and negative affectivity. To that end, a partial correlation coefficient was calculated in order to better gauge the relative contribution of psychological well-being in the prediction of job performance, above and beyond that of emotional exhaustion, positive affectivity and negative affectivity. The partial correlation of psychological well-being with performance, controlling for emotional exhaustion, positive affectivity and negative affectivity was .34 ($\underline{p}$ < .05).

TABLE 1
Means, Standard Deviations, and Intercorrelations for the Study Variables

Variables	M	SD	1	2	3	4	5	6	7	8
1. Age	47.0	7.6	—	-.13	.68**	-.12	.14	.14	-.08	.00
2. Gender[1]	—	—		—	.04	-.20	.09	.27*	-.19	.05
3. Job Tenure	17.7	6.2			—	-.09	.01	-.03	-.08	.01
4. Emotional Exhaustion	2.5	1.3				—	-.59**	-.42**	.74**	-.14
5. Employee Well-Being	3.4	1.5					—	.61**	-.63**	.34*
6. Positive Affectivity	3.4	0.7						—	-.49**	-.06
7. Negative Affectivity	1.8	0.6							—	.00
8. Job Performance	3.8	0.7								—

Note: All tests are two-tailed, *p<.05, **p<.01.
[1]Gender was dummy coded "1" for male and "2" for female.

Regression Analysis

Our exploratory research question proposed that we examine the relative contributions of emotional exhaustion, positive affectivity, negative affectivity, and psychological well-being as correlates of job performance. Multiple regression analysis was performed (n = 41) to control for the simultaneous effects of psychological well-being, emotional exhaustion, positive affectivity and negative affectivity. Thus, job performance is considered the dependent variable, with psychological well-being, emotional exhaustion, positive affectivity and negative affectivity as the independent variables. If any of the independent variables is a significant predictor of job performance, holding the other variables constant, then one can have greater confidence in the obtained results (Pedhazur, 1982). As shown in Table 2, these four variables, considered together, failed to account for a significant amount of the variance in job performance ($F(4, 36) = 1.66$, ns). The value of the t-statistics for emotional exhaustion ($t(36) = -0.80$, ns), positive affectivity ($t(36) = -1.40$, ns) or negative affectivity ($t(36) = 1.32$, ns) did not reach significance. However, a test for psychological well-being ($t(36) = 2.14$, $p < .05$; $R^2 = .10$; adjusted $R^2 = .06$) was significant. Taken together, these results demonstrate that psychological well-being, even when controlling for emotional exhaustion, positive affectivity and negative affectivity, is predictive of job performance.

DISCUSSION

Using various theoretical perspectives as guides (COR, attributional, goal setting and expectancy theories), the present study examined several widely used affective-based indicators of the happiness - unhappiness dimension in organizational research (e.g., emotional exhaustion, positive and negative affectivity, and psychological well-being) as correlates of job performance. Hypothesis 1 predicted a negative relation between emotional exhaustion and job performance. This prediction was not supported. Regarding Hypothesis 2, neither positive nor negative affectivity were related to job performance. Hypothesis 3 proposed that psychological well-being was positively related to job performance. This prediction was supported; psychological well-being was related to job performance. This result is consistent with a growing body of research establishing that a relation exists between various measures of psychological well-being and job performance (Staw & Barsade, 1993; Wright

TABLE 2

Regression Analysis Predicting Job Performance from Emotional Exhaustion,

Independent Variable	Beta	SE	t
Emotional Exhaustion	-0.10	.12	0.80
Positive Affectivity	-0.28	.20	-1.40
Negative Affectivity	0.32	.24	1.32
Psychological Well-Being	0.24*	.11	2.14

Note: N = 41; R^2 = .16; adjusted R^2 = .06
*p < .05 (all tests are two-tailed).

& Bonett, 1997a; Wright et al., 1993; Wright & Staw, 1999). Finally, regarding our exploratory research question, multiple regression analysis demonstrated that only psychological well-being was predictive of job performance, even after controlling for emotional exhaustion, positive affectivity and negative affectivity.

These results warrant further discussion. First, the present findings appear to indicate that psychologically well employees are oftentimes better performers. Thus, far from being a kind of "error variance" assumed by the disease model (Wright & Wright, 2000), issues of worker health and well-being are possible "main effect" determinants to organizational success. Second, given the equivocal findings of prior research investigating the emotional exhaustion to job performance relation (Wright & Bonett, 1997a; Wright & Bonett, 1997b; Wright & Cropanzano, 1998), the present findings reinforce the need for additional research to help clarify the role of emotional exhaustion as a correlate of job performance. In addition, given that research in this area has been primarily cross-sectional in nature, including the present study, we recommend that future research examine both independent and dependent variables at multiple points in time, to allow for a more thorough examination of the emotional exhaustion to performance relation.

Both prior research and the current study examined job performance using supervisory measures of performance. Although the findings are interesting, one could argue that they are the result of the type of performance instrument used. More specifically, the finding of a significant relation between psychological well-being and performance might be the result of halo bias (Wright & Cropanzano, 1998). That is, psychologically well employees may also be seen as being more likable and more fun to be around. Because people in general, and managers in specific, tend to be more tolerant of those they favor or like, managers may well provide higher evaluations for those employees who are psychologically well. As a consequence, rather than being directly related to changes in performance, our results might demonstrate that psychological well-being is a systematic source of halo in performance evaluations. However, in the present research, neither NA, PA or emotional exhaustion were associated with job performance. Thus, if rating bias was accounting for the psychological well-being - job performance relation, then one could have also expected significant bivariate relations among emotional exhaustion, positive affectivity, negative affectivity and job performance.

These relations were not found in the present study. However, it is possible that these measures may be related to job performance depending upon the content of the job (e.g., sales work versus mental health worker). For example, activation-based descriptors contained in the PA scale, such as, "alert, active, enthusiastic" might prove predictive of performance in sales and other occupations where performance is measured quantitatively. To that end, to provide a more thorough, comprehensive test, we recommend that future research examining these relations be undertaken using more quantitatively-oriented measures of performance.

These suggestions for more quantitatively oriented performance measures may prove a difficult task for future research endeavors. For instance, several authors have noted that many client and customer-oriented jobs emphasize non-task-specific performance dimensions in the appraisal process (Staw *et al.*, 1994; Wright & Cropanzano, 1998). As a result, in point of fact, the selection and appraisal processes of many jobs may be primarily based on supervisory perceptions of employee happiness or well-being (the ambiguous notion of "good fit" used in academic selection decisions comes readily to mind). However, this situation may not be as critical as it appears at first glance. For example, Staw *et al.* (1994) noted that regardless of whether performance evaluations include halo or other forms of bias, they are predictive of "success" from the employee's point of view. That is, supervisory performance evaluations are oftentimes the primary, if not sole criterion for promotional and pay raises — the primary means used to allocate various employee rewards. It now remains for future research, using additional participants in a variety of settings to establish the generalizability of these findings to other employee groupings.

Further research is also recommended to address another potentially limiting aspect of the present study. While examination of the Table 1 correlation matrix indicates moderate to substantial intercorrelations among the affective-based measures of "happiness – unhappiness" ranging from -.42 (emotional exhaustion to positive affectivity) to .74 (emotional exhaustion to negative affectivity), it also illustrates why, in the final analysis, these measures must be linked to "happiness – unhappiness" for descriptive purposes only. After all, even the obtained substantial correlation of .74 between emotional exhaustion and negative affectivity demonstrates that roughly 50% of the shared variance between these variables remains unexplained. In addition, while significant bivariate relations were established between psychological well-being and performance, neither measure of dispositional affect (positive and negative affectivity) nor emotional exhaustion was significantly related to performance. Taken together, these findings emphasize the fact that while emotional exhaustion, positive and negative affectivity, and psychological well-being share similar aspects, they are also distinct constructs. It now remains for research to further clarify and refine the various 'faces' of happiness in organizational research.

This need to further distinguish among these and other similar affect-based dimensions of happiness has long been recognized (Wright & Bonett, 1997a). Nearly 2000 years ago, Galen devised a four-fold typology (*e.g.*, melancholic, choleric, sanguine, and phlegmatic) to describe individual differences in emotions. More recently, this perspective has been formalized into the circumplex model (Larsen & Diener, 1992; Wright & Bonett, 1997a).

The circumplex model posits that self-ratings of various forms of affect often cluster in a circular configuration, referred to as a circumplex structure (Russell, Weiss, & Mendelsohn,

1989). One of these dimensions or factors has been alternatively labeled "hedonic tone," "happiness - unhappiness," or "pleasantness - unpleasantness." The second dimension has been labeled activation (Wright & Bonett, 1997a). The present study has now linked measures of both dimensions with job performance. Using the circumplex as a guide or framework, research is now recommended to further distinguish among the various proposed dimensions of "happiness" described in the current research. For example, both dispositional affect (PA & NA) and emotional exhaustion purport to examine aspects of the activation dimension. However, while emotional exhaustion examines the results of chronic levels of potentially intense activation, other activation-based scales, such as the PA and NA seem to be best suited to measure the more momentary or statelike fluctuations in activation-based activities (Watson *et al.*, 1988).

The distinction between chronic or traitlike and more momentary or statelike fluctuations raises the question of whether happiness is best considered as a trait or as a state. Typically, happiness is considered as a trait (Diener, 1984; Diener *et al.*, 1999). However, research has demonstrated moderate (*i.e.*, .40 to .60 range) correlations between dispositional or trait measures and affective mood (Wright & Staw, 1999). As a result, we emphasize that future research remember that happiness, however defined, has both "person" and "situation" aspects. For example, consider the work of George (1991). Using a sample of salespeople, George established a positive relation between a time-specific measure of positive mood and customer service performance-related behaviors. Following George, we suggest that research be undertaken to further delineate the relative merits of trait versus state explanations for the relations among affective-based measures of happiness and their correlates.

The issue of employee happiness or well-being brings to mind a very important, but widely neglected, organizational research topic: Ethical responsibility and the applied researcher. For instance, while there are numerous guidelines regarding the treatment of participants *before* and *during* a research experiment (AOM, 1997; APA, 1992), researcher responsibilities *after* the data are collected are less clear-cut (Wright & Wright, 1999). Consider the example of one of the participants in the current research study. As noted earlier, Maslach and Jackson's (1986) emotional exhaustion scale measures how often one feels emotionally overextended and exhausted by one's work (from 0 = never, to 6 = everyday).

In order to emphasize the extent to which he was emotionally exhausted, the participant in question added a 'how often' classification of '10,' which he attempted to behaviorally anchor by an 'expletive deleted' phrase. Regarding his responses to the PANAS scale, he noted that he was *dead!* alert, along with being not just *extremely* angry, but *extremely, extremely* ... angry. Finally, in the margin of the questionnaire, he noted the need for certain coworker(s) to be killed (no specific names used). Unfortunately, as one might expect, tragedy struck shortly after he completed this questionnaire. The individual placed a loaded gun in his mouth, pulled the trigger, and instantly died. His suicide note focused on his great anger and despair.

According to the AOM ethical credo, the ethical responsibilities of the researcher are fulfilled once the data are collected, as long as deception is not part of the study. Deception was not a part of the present study. However, Wright and Wright (1999) suggest that the AOM's ethical credo is woefully inadequate in this type of situation. More specifically, based on the

stakeholder approach to assessing outcome effectiveness, Wright and Wright (1999) proposed a committed-to-participant research (CPR) perspective. In this case, the CPR approach involved personal contact with the individual *after* the data were collected, a suggestion that the individual might want to consider seeking professional help, and an offer to help him take the first step in finding this professional assistance (notice the apparent irony given the subject's profession). While the intervention was not successful in preventing this suicide, the CPR approach has been beneficial in assisting other research participants. While further discussion of the CPR approach is beyond the scope of this paper, we would like to close by proposing that each and every organizational researcher has an ethical responsibility to carefully consider the interests of *all* relevant stakeholder groups involved in a research project. We consider this a very worthwhile and important topic area for future research.

CONCLUSION

In this research, we suggest that the ambiguous findings to date in organizational research regarding the happy/productive worker thesis can be considered a result of the various ways in which "happiness" has been operationalized. The present research examined the relations among emotional exhaustion, positive affectivity, negative affectivity, psychological well-being and job performance. Support is provided regarding the bivariate relation between psychological well-being and job performance. Multiple regression analysis further demonstrated the role of psychological well-being as a correlate of performance. We propose the circumplex framework as a potentially useful taxonomy for helping future research to better categorize and measure happiness and recommend additional research to help further address the specific circumstances or preconditional factors underlying the roles of emotional exhaustion, positive and negative affectivity, and psychological well-being as correlates of job performance.

As noted here and elsewhere (*cf.* Wright & Cropanzano, 2000b), all too often in applied research the emphasis has been on what we have called the disease model. That is, a focus primarily concerned with fixing what is wrong with an employee, as opposed to developing what is right. We now close by reiterating an important point. The promotion of employee happiness or well-being in the workplace is an intrinsic good for which all organizational stakeholders should work. That is, irrespective of its role in being instrumental in stimulating such organizational outcomes as enhanced performance, lower absenteeism and turnover, the issue of employee happiness remains of value for its own sake.

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The Threat-Rigidity Thesis in Newly Formed Teams: An Empirical Test

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An empirical test of hypothesized interactions between external or internal attribution of threat and likelihood of success or failure for newly formed decision-making teams based on Staw, Sandeland, and Dutton's (1981) threat-rigidity thesis. Results suggest that both the level of threat and internal attributions of threat have a significant effect on decision-making processes. Specifically, groups in this study with either a higher level of threat or internal attribution of the threat used more rigidity in their decision-making processes. Rigidity was defined as a restriction of information and constriction of control within the group. Based on this initial test and the extant literature, future research is proposed.

A popular belief in the business literature is that the competitive environment is growing increasingly complex, uncertain, and adverse. Hitt, Ireland, and Hoskisson (1999) suggested that firms in the "new competitive landscape" need to have abilities to adapt to environmental change with innovation and speed. Contingency theorists have maintained that firms in uncertain environments should develop flexible processes to react successfully to adversity or unexpected change (Burns & Stalker, 1961; Galbraith, 1977; Lawrence & Lorsch, 1967).

In addition, decision-making is believed to be at the heart of all organizational activity (Butler, 1997). Hambrick and Mason (1984) suggested that the core of all organizational action is a decision-making process, and strategic decision-making usually takes place in a group process using top management teams. Thus, if the decision-making process is at the core of all organizational action, then it is logical to infer that the flexibility or rigidity of the decision-making process will impact the ability of an organization to adapt and survive in an uncertain and often adverse environment. Moreover, researchers have indicated that decision-making teams of firms operating in adverse environments should develop decision-making processes that feature decentralized control, openness to new ideas, and benefits from diversity within team members (Eisenhardt, 1989; Krishnan, Miller, & Judge, 24; Sharfman & Dean, 1997). We posit that these attributes of the decision-making process tend to make it more "flexible." Further, we suggest that flexibility in decision-making processes is the key to effectively interacting with the environment in terms of adaptation, innovation and speed.

In 1981, Staw, Sandelands, and Dutton proposed the threat-rigidity thesis, which suggested that threat might cause decision-makers to rely on well-learned responses—restricting information processing and constricting decision control. This thesis suggested effects at multiple levels including the individual, group, and organization. Very little empirical research has been done testing this thesis. Most research using the threat-rigidity thesis has focused

on the organizational level (*e.g.*, Baker & Cullen, 1993; Palmer, Danforth, & Clark, 1995; Sharfman & Dean, 1997). Studies that considered the group or individual levels did not test the moderating relationships originally proposed in the thesis (Chen, 1992; Gladstein & Reilly, 1985; Pyle, 1989). The purpose of this analysis is to extend previous empirical research by investigating how the hypothesized moderating effects suggested in the threat-rigidity thesis may affect decision-making processes for group members in newly formed teams. Specifically, we test the hypothesized effects of internal or external attribution of threat and likelihood of success or failure on constriction of control and restriction of information. Our study intends to shed some light on the relationship of threat and rigidity in group decision-making processes by posing two main questions: Is the threat-rigidity thesis relevant in the group setting for newly formed teams? And, if it is, does the type of attribution and likelihood of success/failure have moderating effects on decision-making processes as originally suggested or differently for newly formed groups?

The second purpose is to suggest an extension of the threat-rigidity cycle to include other group-related constructs developed in the extant literature. Given that the empirical test verifies the hypothesized effects of attribution and likelihood of success on rigidity in group decision-making, what other variables might have a moderating impact in the case of newly formed groups? Here we hypothesize that group climate and composition may have moderating effects on the relationship between perceived threats and rigidity/flexibility in this unique circumstance.

DEFINITIONS AND BOUNDARY CONDITIONS

Over the past decade, interest in decision-making groups and teams has been of significant interest in the psychology, organizational behavior, and strategic management literature (Guzzo & Dickson, 1996; Krishnan, Miller & Judge, 1997; Wilpert, 1995). For the following discussion, "team" and "group" will be used interchangeably. The definition of team is "a collection of individuals who are interdependent in their tasks, who share responsibility for outcomes, who see themselves and who are seen by others as an intact social entity embedded in one or more larger social systems" (Cohen & Bailey, 1997, p. 241). In addition, our hypotheses are aimed at newly formed decision-making teams operating in an adverse environment. Our concept of a newly formed team is a group that may or may not be familiar with each other and have not worked together in this same project area. In other words, the team has not had the opportunity to develop preconceived scripts of how the team has dealt with similar situations in the past. An example of a newly formed team would be a newly created special project team. Our definition of an adverse environment is an environment that is perceived as having relatively high uncertainty; this may include unexpected or unpredictable change, fast-paced change or appear threatening to the team. The perceived adversity in the environment by the decision-making team is posited to include one or a configuration of these elements.

The concept of flexibility/rigidity considered in this study is based on an integration of previous studies that considered decision-making processes (Butler, 1997; Eisenhardt, 1989; Gladstein & Reilly, 1985; March, 1988; Sharfman & Dean, 1997). For example, Eisenhardt's (1989) analysis of decision-making in the microcomputer industry suggested high performing decision-making teams in adverse environments should develop flexible systems that allow

them to integrate more information, use decentralized decision-making, and effectively resolve conflicts.

Research in cognitive psychology has suggested that when placed in an adverse environment, a team's most well-learned script or schema may be emitted instead of a response appropriate to the new environment (Fiske & Taylor, 1991; Lord & Kernan, 1987; Zajonc, 1966). Similarly, the threat-rigidity thesis and "groupthink" research has suggested that decision-making groups in adverse environments may reduce their flexibility, sealing off new information and controlling deviant responses (Janis, 1972; Staw, *et al.*, 1981). Hence, decision-makers in an adverse environment might rely on well-learned responses, restrict information processing, and constrict decision control. In other words, the decision-making group may rely on centralized and rigid processes when an adverse environment is present. In this study, flexibility is defined as decision-making processes that utilize more information, create systems to promote debate and information sharing, and use a decentralized method of control over decision-making processes of the team, while rigidity is defined as just the opposite.

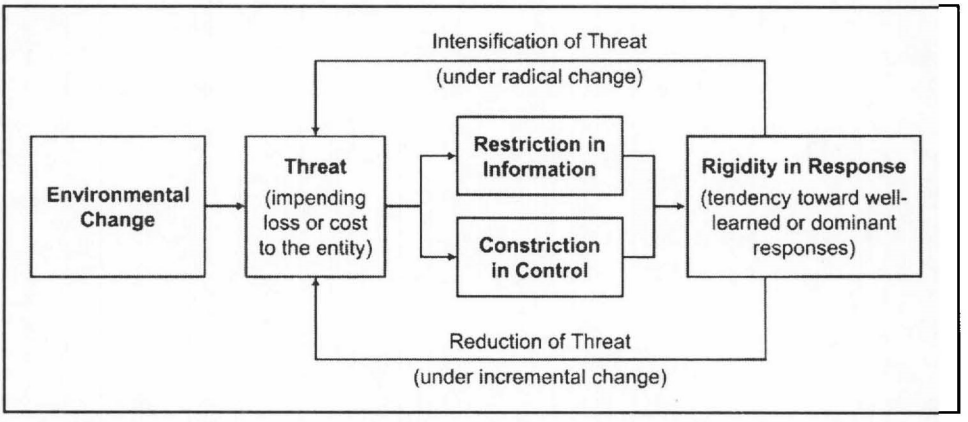

Figure 1. Staw, *et al.*'s Threat-rigidity Cycle.

THE THREAT-RIGIDITY THESIS

Staw, *et al.*'s general thesis proposed that a "threat to the vital interests of an entity, be it an individual, group, or organization, will lead to forms of rigidity" (Staw, *et al.*, 1981, p. 502). In this thesis, threat was treated as "an environmental event that has impending negative or harmful consequences for the entity" (Staw, *et al.*, 1981, p. 502). Figure 1 presents the original threat-rigidity cycle proposed by Staw, *et al.* (1981). Presumably, threat is brought on by environmental change, which will result in a restriction of information and constriction of control. When these two things occur, decision-makers will have a tendency to rely on dominant responses that are defined as rigidity. As in the general threat-rigidity cycle (Figure 1), Staw, *et al.* (1981) hypothesized that antecedents of a rigid response in the group setting (Figure 2) were restriction of information and constriction of control in their decision-making processes. This suggests that the use of more information and decentralization of control (in decision-making processes by group members) are antecedents of a "flexible" response. For

convenience, Staw, *et al.*'s (1981) antecedents of a rigid response (restriction of information and constriction of control) will be referred to as "rigidity" in group decision-making processes. Because the opposite of this (use of more information and decentralization of control) suggests a lower probability of formulating a rigid response by the group, "flexibility" in group decision-making processes will refer to just the opposite of "rigidity." This flexibility concept is closely aligned with suggestions by other research in decision-making processes (Butler, 1997; Eisenhardt, 1989; March, 1988; Sharfman & Dean, 1997). Following the threat-rigidity thesis, we hypothesize that teams in a high threat situation will respond with more rigidity in decision-making processes than teams in a low threat situation.

H1: Teams under high threat will use more rigid decision-making processes than teams in a low threat situation.

Beyond the basic threat-rigidity cycle, there are hypothesized effects of threat for groups in particular. Figure 2 provides the model for group response proposed by Staw, *et al.* (1981). The principle idea is that, when a threat impacts group processes, it will be analyzed in terms of external or internal attribution and likelihood of success or failure. Attribution of threat is concerned with whether the team interprets the threatening situation to be a result of factors outside of the team's control (*i.e.*, a lack of available information) or a result of factors internal to the team (*i.e.*, a lack of confidence in team members). The likelihood of success or failure concept relates to the team's belief in whether or not they have the ability to overcome the threatening situation. We acknowledge that these concepts are not (necessarily) mutually exclusive of each other.

Interpretation or perception of threat has been used as a construct in a number of recent studies on the impact of both group and individual responses. Although the distinction between threat and a number of related terms (*i.e.*, stress, harm or loss) is left unclear in the literature, summaries of individual findings include the link between threat situations and psychological stress and anxiety (Gladstein & Reilly, 1985). Typically, stress is defined as harm/loss, threat, or challenge to the individual (Lazarus, 1991). Early research on the effect of stress at the group-level found that threatened groups were less task-oriented, less forceful, initiating,

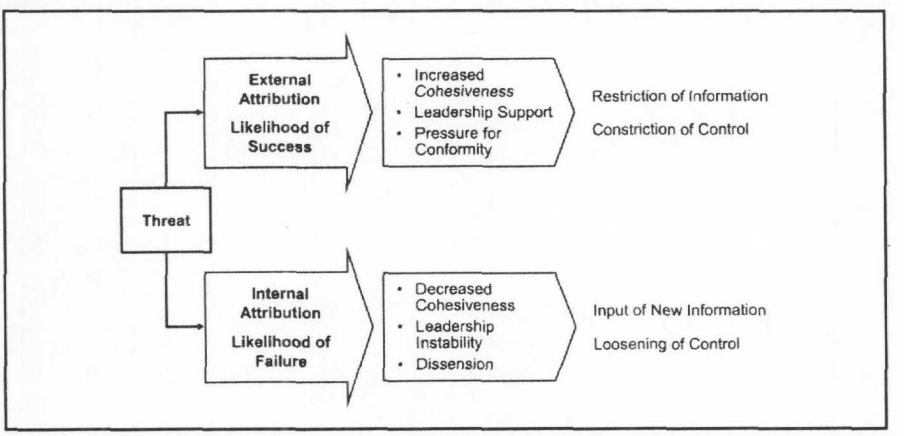

Figure 2. Staw, *et al.*'s, model of group response to threat.

and active in their attack on the problem (Lanzetta, Haefner, Langham & Axelrod, 1954). Although the findings have been inconsistent (Renner & Renner, 1972), early empirical research found that the level of stress resulting from perceived threat determines whether problem-solving ability is enhanced or decreased (Lanzetta, 1955).

Feldman and Stenner (1997) examined the relationship between perceived threat and authoritarianism. The authors suggested that distinctions exist between long-term societal threat and short-term threatening events. Their interest was in the latter and the impact of this personality trait (authoritarianism) under conditions of short-term threat. The measure of a perceived threat in this instance was the increase in anxiety caused from significant short-term change. The evidence presented in the study found an interaction between authoritarian predisposition and perceived threat. This interaction resulted in the manifestation of authoritarian behaviors, which lead individuals high in authoritarianism to become more intolerant and punitive. The findings suggested that perceived threat activity resulted in a manifestation of existing authoritarian traits rather than an increase in the traits themselves (Feldman & Stenner, 1997).

While the literature has been inconsistent in its findings, we propose that the group interpretation of the threatening situation (measured by attribution type in this study) is an important intervening variable between threat and rigidity as defined by the original threat-rigidity thesis. Not only that, but we suggest that attribution may be a moderating variable that helps define the relationship between the objective threat and the perceived threat. The concept of perceived threat is closely related to the measure for likelihood of success used in our analysis and appears to be related to team decision-making processes used by newly formed groups. However, objective measures of threat, such as economic or competitive factors, may impact an individual's interpretations of that threat. For example, an attribution of the threat as being caused by external (a competitor releasing a new product) or internal (our failure to get to the market with a new product before the competition) factors may have different impacts on decision-making rigidity.

As shown in Figure 2, the implicit assumption of Staw, *et al.*'s (1981) study was that attribution and/or likelihood of success/failure mediates the impact of threat on group processes. In addition, Staw, *et al.* (1981) suggested that attribution of threat and likelihood of success or failure would have an interaction or moderating effect on group processes. Specifically, they proposed that the group response to threat attributed to external sources with a high likelihood of success would moderate group processes resulting in restriction of information and constriction of control within the group. The interaction of external-attributed threat and likelihood of success is proposed to facilitate group cohesiveness, leadership support and pressure for conformity (Staw, *et al.*, 1981), thus, leading to rigidity in response as depicted in the threat-rigidity cycle (Figure 1).

In contrast, a group's response to a threat attributed to internal sources with a likelihood of failure moderates group processes and results in input of new information and loosening of control. This interaction facilitates decreased group cohesiveness, leadership instability and dissension within the group (Staw, *et al.*, 1981) and, presumably, more flexibility in decision-making. A problem with the Staw, *et al.* (1981) article and Figure 2 is that it is unclear what the group response will be with external attribution of the threat coupled with likelihood of

failure or with internal attribution of the threat coupled with likelihood of success. The lack of discussion for these potential interactions suggests that Staw, *et al.* (1981) presumed that these combinations would have little or no effect on group processes. In other words, the interaction between external attribution of threat and likelihood of failure or internal attribution of threat and likelihood of success would have no significant effect on restriction of information or constriction of control.

TABLE 1
Original Threat-rigidity Thesis Proposed Moderating Relationships

Attribution of Threat	Likelihood of Success	
	High	Low
External	Predicted More Rigidity	No Effect Explicitly Predicted
Internal	No Effect Explicitly Predicted	Predicted More Flexibility

HYPOTHESIZED EFFECTS FOR NEWLY FORMED TEAMS

The predicted moderating effects of the original threat-rigidity thesis are shown in a 2X2 matrix in Table 1. These predicted effects were based on the assumption that the decision-making teams are not newly formed but have previous well-learned responses to rely on. Because newly formed teams do not have a collectively developed well-learned response to the situation, we predict that attribution of threat will have an opposite impact on the decision-making processes of newly formed teams. Specifically, we hypothesize that an external attribution of the threat will be perceived as less threatening to the entity (in this case the newly formed team) and will be least disruptive to team decision-making processes. Conversely, we hypothesize that an internal attribution of threat by the newly formed group will result in more rigidity in decision-making processes. The reasoning behind this is that internal attribution of the threat implies that some members perceive deficiencies in other group members. This implies that group members will feel that more flexibility in decision-making processes (sharing information with deficient members and decentralizing decision control among all members of the group) will result in poor decisions. Thus, internal attribution of threat will be the most disruptive of teams in this context. In other words, we hypothesize that external and internal attribution of threat will have opposite effects on newly formed teams' decision-making processes than those predicted by Staw, *et al.* (1981) for intact decision-making teams. Formally stated:

H2a: Teams with externally attributed threat will use more flexible decision-making processes.

H2b: Teams with internally attributed threat will use more rigid decision-making processes.

The original threat-rigidity thesis suggested that the moderating effect of externally attributed threat and likelihood of success may increase rigidity in decision-making processes. For newly formed groups, we hypothesize the opposite effect from this interaction. Our reasoning for this hypothesized effect is that the source of the threat appears external to the team, and the task at hand does not appear to be insurmountable.

Further, internally attributed threat and likelihood of failure is explicitly stated in the original thesis to increase flexibility in decision-making processes. Because this situation will be perceived as the most threatening situation for the team, we predict that for newly formed groups this interaction will increase rigidity in decision-making processes. Formally stated:

H3a: Teams with an interaction of externally attributed threat and high likelihood of success will use more flexibility in their decision-making processes.

H3b: Teams with an interaction of internally attributed threat and low likelihood of success use more rigidity in their decision-making processes.

While the moderating effect of externally attributed threat and likelihood of failure or internally attributed threat and likelihood of success is not explicitly stated in the original thesis, we predict that when these two constructs are combined in this fashion, they will have significant effects on rigidity in decision-making processes. First, although we hypothesize that external threat will promote flexibility, the interaction of external attribution and likelihood of failure is hypothesized to increase rigidity of the team process. When the team interprets their probability of success to be low, they will perceive the threat to be much greater to the entity. Hence, their general perception of the threat will be greater and will result in more rigidity. Because an internal attribution of threat is most disruptive to the team, we hypothesize the interaction of internal attribution of threat and high likelihood of success will result in more rigidity in team decision-making processes of newly formed teams. Our next two hypotheses formally state the predicted effects.

H4a: Teams with an interaction of externally attributed threat and low likelihood of success will use more rigidity in decision-making processes.

H4b: Teams with an interaction of internally attributed threat and high likelihood of success will use more rigidity in decision-making processes.

METHODS

Study Context and Sample

The context of the study described below permits careful monitoring of the process, control of threats (treatments) and provides a realistic context for the participants. The study was conducted in an academic setting that provides more control than the typical field study, more realism than a laboratory study, and measures of both internal and external validity.

The subjects for this pilot study were undergraduate students enrolled in a large western U.S. university. The data was collected as part of a student team project in six classes during the spring and fall semesters. The study resulted in 534 individual measures and 153 initial

team measures. The task of the student teams entailed strategic decision-making and developing a strategic business plan. The average age of the respondents was 23.1 years (range 20-32). Sixty-one percent of the subjects were female and thirty-nine percent were male. The manipulation for this study was whether the threat was a high or low level.

We acknowledge that the student groups who formed our subject pool were not totally naive. By the time students are taking a strategy class, they have served on many student project teams. As such, they have probably "learned" a number of skills for dealing with social loafers, defining appropriate roles, and completing the task at hand. While this is acknowledged to be the case, this situation is no different than newly formed groups in other work settings that have a number of learned skills about how to function as a team. Thus, while these learned team skills are believed to have an impact on team decision-making processes in general, our interest in this study is the effect of increased threat and attribution of threat on team decision-making processes rather than measuring population parameters. The use of student groups in our study was highly appropriate because our objective was not to draw conclusions about a population but about the threat-rigidity thesis, which specifies what subjects ought to do (Mook, 1983). Therefore, previously learned team skills will not diminish the importance of any significant results that are found in this study.

The instrument used to collect data for this study was a 16-item questionnaire. The instrument measured perceived internal and external threat levels, likelihood of success, and group decision-making processes. The overall reliability of this instrument was .89. The instrument used a 10-point Likert-type scale with anchors at the upper and lower ends of each item. The items were chosen from previous research (Eisenhardt, 1989; Gladstein & Reilly, 1985; Sharfman & Dean, 1997; Taylor & Bowers, 1972) where possible so that the measurement instrument reflected the most reliable measures available. Items were modified slightly to fit the context of this study. For example, the wording of items was changed to match the nature of the student project.

The analysis for this study was linear regression to test main effects and a 2X2 ANOVA to test the hypothesized moderating effects (Baron & Kenny, 1986). For this analysis, aggregated team responses were used to test for differences and all of the groups were assessed for inter-rater reliability. Responses of teams were retained and used in the analysis if Cronbach's alpha was greater than .70 (George, 1990). Measures for 95 teams were included in the study because of a satisfactory level of agreement between group members.

Measures

- **High or low threat**

This variable was treated as dichotomous. The assessment of the relative level of threat during a particular measurement period was determined through agreement by the researchers in this study. The criteria used for this decision were based on the relative weight of the project on students' grade, the level of competition, time pressure, and the complexity of the project. Team measures assessed in a relatively high threat treatment were coded as "1" and team measures assessed in a relatively low threat treatment were coded as "0".

- **External attribution of threat**

This variable was measured using five items on the instrument. Example questions included "Did you feel threatened by the time constraints for this task?" and "How apprehensive do you feel about how your instructor will respond to your decision?" The mean of these five measures was assessed for each team. The team mean was used for tests of the main effects with a higher score representing more external attribution of threat. For tests of interactions between external attribution of threat and likelihood of success, a dichotomous variable was determined. Team responses that were at or above the mean for these five items were coded as high externally attributed threat, and team responses below the mean as low externally attributed threat.

- **Internal threat attribution of threat**

This variable was measured using three items on the instrument. Example questions included "How satisfied are you with your teams standards of performance?" and "To what extent do you have confidence in your team members?" The mean of these three measures was assessed for each team and was reverse scored for the analysis. This mean was used for tests of the main effects with a higher score representing more internal attribution of threat. For tests of interactions between internal attribution of threat and likelihood of success, a dichotomous variable was determined. Team responses that were at or above the mean for these three items were coded as high internally attributed threat, and team responses below the mean as low internally attributed threat. While it is conceptually possible for a team to be high in both external and internal attribution of threat, team scores were inspected to determine the primary type of attribution.

- **Likelihood of success**

This variable was measured using three items on the instrument. These items asked, "What is the probability of your being successful in the task?" and "How confident is your team that you will achieve your expected outcome for this task?" The mean team response for these three items was used to test the interaction effects of attribution type and likelihood of success; the variable was treated as dichotomous. Team responses that were at or above the mean were coded as "1" for a high likelihood of success, and team responses below the mean were coded as "0" for a low likelihood of success.

- **Flexibility/rigidity in decision-making processes**

Flexibility/rigidity in decision-making processes was viewed as a continuous variable for our analysis and was measured using five items on our instrument. The overall level of flexibility/rigidity was calculated as the summed score of 5 items that loaded on the team process component using principal component analysis. Greater flexibility in the group process was represented by a higher value, whereas, greater rigidity in the group process was represented by a lower value. Example measures included "To what extent do people in your team offer new ideas for solving decision related problems?" and "How much influence did each team member have in the final decision-making process?"

TABLE 2
Inter-correlation of Variables

		2	3	4	5	6
1.	Flexibility/Rigidity	-.810**	.030	.304**	-.822**	.231*
2.	Internal Attribution		.204*	-.521**	.973**	-.185
3.	External Attribution			-.352**	.157	.686**
4.	Likelihood of Success (LOS)				-.351**	.426**
5.	Internal X LOS					-.095
6.	External X LOS					

* = p<.05, ** = p<.01, *** = p<.001

RESULTS

The correlations between the variables used in our analysis are provided in Table 2. The inter-correlations indicate that the team measure of flexibility/rigidity in decision-making processes is highly correlated with internal attribution of threat in addition to the interaction between internal attribution and likelihood of success. Additionally, the flexibility/rigidity measure is moderately correlated with likelihood of success and the external attribution and likelihood of success interaction. Table 3 shows the sample size, mean, and standard deviation for each variable used in tests using ANOVA.

In general, the threat-rigidity thesis was supported. As suggested in Hypothesis 1, teams in the high threat treatment used a more rigid approach to the decision-making process. Teams in the high threat treatment had a mean flexibility/rigidity measure of 37.25; whereas, teams in the low threat treatment had a mean flexibility/rigidity measure of 41.77. This finding was significant ($p \leq .001$) and was in the predicted direction. Teams in the high threat treatment shared less information and ideas. In addition, decision influence was more centralized in the high threat group.

Hypothesis 2 was tested using linear regression to assess the main effects for external and internal attribution of threat on team decision-making process flexibility. When external attribution was regressed on the flexibility/rigidity measure, it was non-significant ($p = .776$) with an R^2 value of only .001. Thus, Hypothesis 2a was not supported and external attribution of threat had no significant effect on the flexibility/rigidity of decision-making processes for newly formed groups in this study.

When internal attribution of threat was regressed on the flexibly/rigidity measure, it was significant ($p \leq .001$), and it explained 65.6% of the variance in the flexibility/rigidity measure (Adjusted $R^2 = .652$). The unstandardized coefficient was -3.646; thus, a higher level of internal attribution resulted in more rigidity of team decision-making processes. Hypothesis 2b was supported. Results from the tests of main effects using linear regression are shown in Table 4.

TABLE 3
ANOVA Results and Descriptive Statistics

Variable	N	Mean	Std. Dev.
Flexibility/Rigidity in Decision-making Processes	95	39.96	5.51
Likelihood of Success	95	7.65	1.09
Internal Attribution (Reverse scored)	95	2.13	1.22
External Attribution	95	6.36	1.13
Flexibility/Rigidity - High threat vs. Low threat			
High threat	38	37.25***	5.51
Low threat	57	41.77	4.75
Flexibility/Rigidity - External Threat & High Likelihood of Success vs. Other			
External Threat & High Likelihood of Success	17	40.79	5.55
Other	78	39.79	5.51
Flexibility/Rigidity - Internal Threat & Low Likelihood of Success vs. Other			
Internal Threat & Low Likelihood of Success	29	35.62***	4.69
Other	66	41.87	4.72
Flexibility/Rigidity - External Threat & Low Likelihood of Success vs. Other			
External Threat & Low Likelihood of Success	31	39.78	5.51
Other	64	40.05	5.54
Flexibility/Rigidity - Internal Threat & High Likelihood of Success vs. Other			
Internal Threat & High Likelihood of Success	10	34.02***	4.50
Other	85	40.66	5.20

* = p<.05, ** = p<.01, *** = p<.001

Hypotheses 3 and 4 were tested using a 2X2 ANOVA design where attribution type and likelihood of success (high or low) were treated as dichotomous variables. This was done to test the hypothesized combination of variables while removing any multicollinearity problems (Baron & Kenny, 1986). Teams with external attribution of threat and high likelihood of success had a mean flexibility/rigidity score of 40.78. The level of flexibility/rigidity in decision-making processes used by these teams was not significantly different from the mean for all other teams ($p \leq .50$). Hence, Hypothesis 3a was not supported. Teams with internal attribution and low likelihood of success used more rigid decision-making processes with a mean score of 35.62, and the mean difference was significant ($p \leq .001$). Hypothesis 3b was supported.

Hypothesis 4a was not supported indicating no significant difference ($p \leq .827$) in flexibility/rigidity of decision-making processes for teams with external attribution and low likelihood of success. The mean flexibility/rigidity score for this interaction was 39.78 with all other

TABLE 4
Regression Output of Main Effects of Attribution on Flexibility/Rigidity

Model	Variable Entered	R	R Square	Adj R Sq.	Std. Error of Est.	
1	External Attribution	0.03	0.001	-0.01	5.53	
2	Internal Attribution	0.81	0.656	0.652	3.24	
	Analysis of Variance	Sum of Sq.	Df	Mean Sq	F Ratio	Sig.
1	Regression	2.504	1	2.505	0.082	0.776
	Residual	2850.574	93	30.651		
	Total	2853.078	94			
2	Regression	1871.504		1871.504	177.317	0.001
	Residual	981.574		10.555		
	Total	2853.078				
	Coefficients	B	Std. Error	Beta	T	Sig.
1	Constant	39.048	3.266		11.957	0.001
	External Attribution	0.144	0.506	0.03	0.286	0.776
2	Constant	47.741	0.672		71.015	0.001
	Internal Attribution	-3.646	0.274	-0.81	-13.316	0.001
	Dependent Variable: Flexibility/Rigidity					

interactions having a mean of 40.05. Hypothesis 4b was supported. Groups with an interaction of internal attribution and high likelihood of success had significantly ($p \leq .001$) more rigidity in decision-making processes (mean = 34.02) when compared to groups with other interactions (mean = 40.66).

DISCUSSION

In general, threat was shown to impact decision-making processes within groups in our study. Staw, *et al.* suggested that threat was a broad construct, and the threat-rigidity thesis defined threat as "an environmental event" (Staw, *et al.*, 1981, p. 502). Their view of the primary types of threat would be external in nature, interact with time pressure or anticipation, and "probably be the driving force behind most of the events that the term crisis attempt to explain" (Staw, *et al.*, 1981, p. 512). A review of studies considering the threat-rigidity thesis (D'Aunno & Sutton, 1992; Gladstein & Reilly, 1985; Pyle, 1989) indicates that an external and objective measure of imposed threat was generally used. As suggested for future research by D'Aunno and Sutton (1992), group member reactions to actual threat are based on their interpretation or perception of the threat. This view was supported with team attribution of the threat having an impact on decision-making. Specifically, higher levels of threat and an internal attribution of the threat increased rigidity in group decision-making processes.

Our data suggest that external attributions would not inhibit a more flexible response but that internal attributions would result in a more rigid decision-making process. Because our study utilized a sample of newly formed teams, our findings suggest that newly formed

groups place a greater apparent importance on internal attribution of threat. This is supported by previous research, which suggested that newly formed teams might react differently compared to groups who have worked together over a period of time. Specifically, internal factors such as group climate or group composition may have a significant impact on the flexibility/rigidity in decision-making processes of newly formed groups (Guzzo & Dickson, 1996; Lau & Murnighan, 1998; Veiga, 1991).

Support for moderating effects opposite of those proposed by the original thesis suggests that these interactions (attribution type and likelihood of success) may manifest themselves in different ways in different contexts (*i.e.*, existing teams vs. newly formed teams). Based on the variables we tested, the results suggest that attribution of threat is the strongest predictor of decision-making processes used by the team. Our measure of likelihood of success was highly correlated with attribution and the flexibility/rigidity used in the team process. Likelihood of success is closely aligned with a team's interpretation of the threat and appears to be closely connected with attribution type. While the reaction to an interaction of attribution of threat and likelihood of success or failure was hypothesized to impact the decision-making process, our measure of high or low likelihood of success had no significant interaction effects with attribution type. Therefore, future research should consider other important variables to replace the likelihood of success construct.

Overall, the findings suggest that a team's interpretation of the threat may be a better predictor of rigidity in group decision-making processes. This contention is consistent with the notion of open and closed system views of organizations and decision-making. That is, managers who view organizations as open systems look to the external environment and interfaces with it to guide decision-making. On the other hand, those with a closed system view focus internally and often revert to "tried and true" solutions that have worked in the past. Again, our conclusions are based on data from newly formed teams, but systems theory and contingency theory literature would suggest generalizability beyond that unique circumstance.

LIMITATIONS AND FUTURE RESEARCH

A limitation of this study is that it did not explicitly assess the impact of group climate and group composition. While the study assigned team members to minimize differences in their composition, the variance in composition/diversity between teams was not evaluated satisfactorily. Based on previous research and the findings from this study, a revised threat-rigidity cycle is presented in Figure 3. In this model, we have included the moderating effects of attribution, group composition, and group climate. Our logic here is driven in part by the phenomenon of newly formed groups and the associated literature, but again, it may be generalizable to all types of groups involved in decision-making.

Group Climate

Generally, the use of the term climate refers to the "social climate" or interpersonal practices of an organization or group (Schneider, 1985). Group climate has been shown to be a legitimate construct in research measuring consensus among group members of the consistency in perception of climate within a group (Howe, 1977). In addition, Howe (1977) found that the climate response of group members was more a function of group membership than person

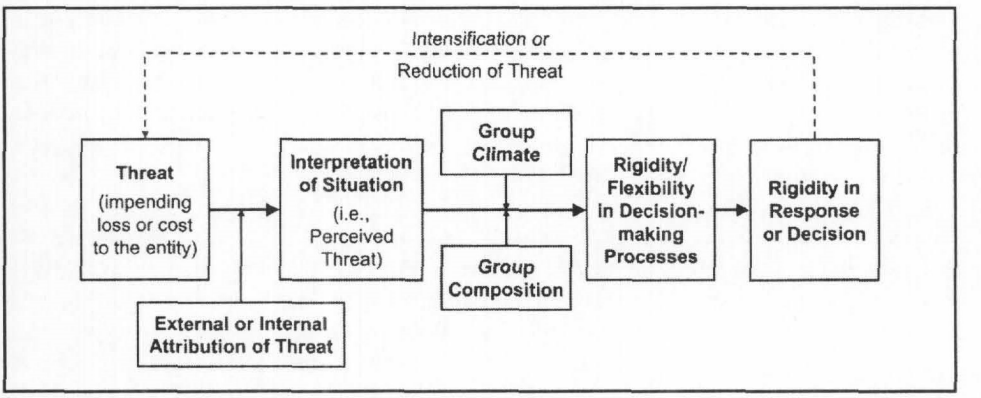

Figure 3. Proposed Threat-Rigidity Cycle for Newly Formed Groups.

type or group by person type effects. This suggests an interaction effect between group membership and the aggregated person type within the group.

Veiga (1991) suggested an indifferent group climate may be one reason that managers restrict their behavior within a group (*i.e.*, limit information sharing and debate within the group). Hence, group climate may impact the level and nature of information acquisition and information processing within the decision-making group. For the purposes of this paper, the group climate factors of interest are those factors that influence the social climate of the group. As such, group climate consists of a shared perception among the group members as to how the group functions in respect to member participation, support, group goals, and task orientation (Agrell & Gustafson, 1994). For our purposes, group climate factors are separated from group composition factors (*i.e.*, demographics, team size, backgrounds, *etc.*) with the realization that there is an interaction between what this study is defining as climate and composition factors.

Group Composition

The ability to process sufficient information and elicit input from all of the team members is partially determined by the composition of the group as well as the familiarity of group members with each other. Group composition design variables may include demographic characteristics, differences in backgrounds or experiences, group size and group tenure (Cohen & Bailey, 1997). For the current study, group size and tenure were controlled for and consistent between teams.

Group diversity refers to both visible demographic differences (such as age, race and gender) as well as differences in education levels, functional backgrounds, and values (Clark, Anand & Roberson, 1999). Group diversity and composition are closely related; Guzzo and Dickson define group composition as "the nature and attributes of group members" (1996, p. 310). For the purposes of this discussion, group diversity will refer to the variance within the team of attributes predicted to influence the decision-making process. These attributes include things such as age, race, gender, nationality, education level, functional background, and

values. A team with a greater variance in the composition of its members will have a higher level of diversity.

Previous research indicates that group diversity may impact the interpretation of cues in the environment. Interpretation occurs when a decision-making group has to make sense of environmental events that are important to the decision (Milliken & Martins, 1996). Because diversity influences perceived differences among members and their interpretation of events, diversity affects group information processing (Dougherty, 1990). Diverse group members may ascribe different labels or meanings to information because of differences in experiences or worldviews (Cox, 1993). Overall, however, studies have found an unclear relationship between heterogeneity of team members' backgrounds or expertise with effectiveness. The direction of the relationship seems highly dependent on the criterion of measurement and the group context (Guzzo & Dickson, 1996).

Lau and Murnighan (1998) suggested that a group's faultlines can be an important determinant of subgroup conflict. Faultlines are related to diversity within organizational groups and focus on the underlying patterns of group member characteristics. Specifically, group faultlines are defined as "hypothetical dividing lines that may split a group into subgroups based on one or more attributes" (Lau & Murnighan, 1998, p. 328). The strength of group faultlines is hypothesized to depend on "the number of individual attributes apparent to group members, their alignment, and, as a consequence, the number of potentially homogeneous subgroups" (Lau & Murnighan, 1998, p. 328). The authors suggested that members of new groups were more likely to develop faultlines due to initial impressions based on physical characteristics, and the formation of unspoken subgroupings that may limit cross-group communication and cohesion. As faultlines are likely to have the greatest effect early on in group formation, conflict becomes more prevalent and "the process sets a precedent for subsequent group processes" (Lau & Murnighan, 1998, p. 336).

Numerous researchers have discussed the effect group composition may have on the ability of decision-making teams to effectively communicate (Clark, *et al.*, 1999; Cox, 1993; Guzzo & Dickson, 1996; Larkey, 1996; Milliken & Martins, 1996; Palmer, Danforth & Clark, 1995). Recent evidence indicates that groups composed of individuals who are familiar with one another work with greater effectiveness than those composed of strangers (Guzzo & Dickson. 1996). Additionally, the likelihood of ineffective communication and unresolved conflict between team members in newly formed groups is significantly increased (Lau & Murnighan, 1998). A diverse team made up of unfamiliar members needs significantly more thought and effort to ensure that minority positions are heard and that the decision-making process develops a feeling of openness and flexibility from the beginning.

Figure 3 provides a basic framework to expand the threat-rigidity cycle to include other important constructs to consider in future research in this area: group interpretation of the threat, the impact of group composition, and the impact of group climate on decision process rigidity. Future research needs to be done to determine the interaction effects of attribution of threat and likelihood of success or failure on both newly formed and intact groups.

Additionally, few measurement instruments in this research area are supported with sufficient evidence of validity and reliability. Hence, a contribution of future research might be to

create discriminating measures and clearly define flexibility in team decision-making processes. Specifically, additional work is needed to clarify team processes that promote greater "flexibility" or less likelihood of rigidity in response by the team. Finally, tests are needed to look at changes in decision-making processes of newly formed groups over time, situational factors, trust, team cohesion, and team member commitment.

Management Implications

The results of this study suggest a number of issues that have direct implications for the formation and management of newly formed work teams in a variety of settings. First, a threatening situation may negatively impact the decision-making process and can be severely hampered if the decision requires an innovative response or solution. Therefore, those in charge of supervising the team need to ensure that the team members understand the importance of the situation at hand but that they do not feel overly threatened in their new role.

Second, the selection of the team members should be derived so that certain members of the team are not perceived as weaker in potential contribution to the solution or response. Therefore, the composition of the team membership should be designed to minimize the potential of internal attribution of the threat. There seems to be a fine line that needs to be followed to simultaneously take advantage of member diversity (whether functional backgrounds, tenure, demographic or other differences) yet not create faultlines that may increase internal attribution of the threat.

CONCLUSIONS

Eisenhardt's (1989) findings suggest that the success of decision-making teams in an uncertain environment is dependent on their ability to utilize more information, create systems to promote debate and information sharing, and use a decentralized method of control over decision-making processes of the team. Our findings suggest that internal attribution of threat had the greatest impact on decision-making processes of newly formed groups. Thus, teams that attributed the threat to internal causes were more likely to utilize less information and centralize decision-making within dominant members of the group. This suggests that other situational factors (internal to the group) may have a significant effect on the decision-making processes used by newly formed groups. The purpose of the new framework presented here (Figure 3) is to include the effects of situational factors such as group climate, group composition, and interpretation of the situation on decision-making processes (particularly for newly formed groups).

As suggested in this framework, threat should be measured and defined by the team's interpretation of the situation (*i.e.*, attribution type and perceived threat level). Because of differing interpretations of a situation, decision-making teams may use rigid or flexible decision-making processes to what seems to be the same level of threat by an external measure. Thus, it seems appropriate for future research to consider extending the threat-rigidity framework.

The discussions in this paper are a first step in attempting to clarify ambiguous relationships in flexibility/rigidity in decision-making processes. It also suggests that these measures of flexibility/rigidity in decision-making processes represent a significant factor that is later played out in the type of response implemented by the organization. For firms in uncertain environments, it is crucial that decision-making processes are flexible so that decisions will have a higher probability of success against a high level of threat.

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Mapping Strategic Consensus

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Strategic consensus generally refers to the extent that organizational members are in agreement with strategic priorities. While alternative methods for measuring consensus exist, the authors extend previous studies that have successfully applied conjoint analysis in capturing managerial opinions. The processes of collecting and interpreting data through conjoint analysis and reporting the results through the construction of cognitive maps is explained and illustrated. The techniques explored can be applied to all levels of an organization in the identification, communication, and subsequent alignment of strategic priorities and initiatives.

An integral part of the strategic management process is determining performance areas that are critical to the organization's success. The subsequent prioritization of these areas, often termed critical (or key) success factors, is considered by many to be a prerequisite for developing appropriate strategic initiatives for the organization (Rockart, 1979; Leidecker &Bruno, 1984; Vasconcellos e Sa' & Hambrick, 1989). The processes of communicating and achieving commitment to strategic initiatives are often thought to be equally important for successful strategy implementation. All of these activities—identifying, prioritizing, communicating, achieving commitment to, and implementing strategic initiatives—comprise the strategic alignment process.

As discussed in this paper, at least three sub-constructs of strategic alignment can be identified in the literature. External strategic alignment entails matching a firm's resources, capabilities and strategies with the demands of the external environment— customers, competitors, regulators, owners, community, etc. Internal strategic alignment is concerned with the coordinated mobilization of the firm's internal resources in strategy implementation. Both external and internal alignment involve a "meeting of managers' minds" to attempt a consensus of opinion before strategic decisions are made or strategies are implemented. Strategic consensus, then, is identified as a third component of the strategic alignment paradigm.

Since a direct meeting of humans' minds is not yet possible, managers often rely on a variety of cognitive mapping techniques to facilitate understanding of complex issues (Eden, 1992; Bougon, 1992) . Of particular relevance are those used to elucidate strategic thinking (Huff, 1990), scenario development (Warren, 1995), strategic options development and analysis (or SODA) (Eden, 1989), and strategy alignment (Broadbent & Weill, 1993; Thomas & Dewitt, 1996; Chan et al., 1997).

The purpose of this paper is to present conjoint analysis as a method for measuring the degree of consensus among members of an organization regarding strategic issues and options.

While conjoint analysis has been used in previous studies at the top management team level (Priem, 1990; 1992; 1994), we complement this research by using the resultant data to construct cognitive maps that represent managerial consensus. We first distinguish between external alignment, internal alignment, and consensus through a review of extant literature. We then discuss the application of conjoint analysis as a tool for collecting and analyzing managerial consensus of opinion. Finally, in a sample application of the technique, we show how the resultant data can be used in the construction of cognitive maps to assist organizations in the external and internal strategic alignment processes.

BACKGROUND LITERATURE: THE STRATEGIC ALIGNMENT-CONSENSUS CONSTRUCT

The construct of strategic alignment is widely discussed in the literature and is represented by a variety of descriptive labels (see Table 1). While some of the terms shown in Table 1 appear to be differentiated on semantics alone, it appears that there are at least three distinct sub-constructs within the alignment literature. For the sake of simplicity, we label these three constructs external alignment, internal alignment, and consensus.

TABLE 1
Expressions of Strategic Alignment and Consensus

Term *Source*	Meaning and/or Context
Strategic Fit *Naman & Slevin, 1993*	Alignment of firm's strategy with external environment
Strategic Fit; Strategic Compatibility *Newport et al, 1991*	Consistency and compatibility among strategies and their implementation within and between corporate, business, and functional levels in an organization
Corporate Coherence *Hambrick, 1997*	Integrated logic and basis for action within a company--its unity of action
Organizational Alignment *Powell, 1992*	Compares I/O strategic management paradigm with organizational alignment paradigm
Strategic Alignment *Henderson & Venkatraman, 1999*	Strategic Management of Information Technology Two parts: strategic fit and functional integration
Strategic Marketing Fit *Smith et al. 1995*	Alignment of manufacturers and retailers
Strategic Consensus *Floyd & Wooldridge, 1992*	Alignment of strategy with middle and operating managers' understanding, support, and commitment
Strategic Consensus *Priem, 1992*	Internal alignment of top management team
Manager-Strategy Alignment *Kerr & Jackofsky, 1989*	Alignment of managers with strategy through management development
Manager-Strategy Alignment *Szilagyi & Schweiger, 1984; Herbert & Deresky, 1987*	Alignment of managers with strategy through management selection process
Acculturation Incongruence *Nahavandi & Malekzadeh, 1988*	Alignment of acculturation process in post-merger firms
Goal Congruence *Witt, 1998*	Alignment of supervisor subordinate goals and priorities
Value Alignment *Mayer & Schoorman, 1998*	Degree to which employee and employer values are aligned
Strategic Coalignment *Venkatraman, 1990*	Alignment of three functional areas of business: marketing, manufacturing, and administration
Market Alignment *Cobb, et al., 1998*	Alignment of firm strategy with customer wants and needs

Arguably the most widely used definition of external strategic alignment relates to the "goodness of fit" between a firm's resources and the environment in which it operates. More precisely, "fit" has been defined as the degree to which a firm has adjusted and can adjust to environmental structure, processes and strategic characteristics (Naman & Slevin, 1993). This process of adjustment is the essence of the strategic management paradigm. It is the fundamental SWOT model, or in Mintzberg-speak, the "design school" model (Mintzberg, 1990). The relationship between fit and alignment has been summarized, "Optimum fit equates to maximum profit and, by assumption, needs no further justification." This (SWOT) model, sometimes called the "alignment" model, dominates the teaching and research of strategy. It takes all the issues that might upset the firm's progress toward its goals, whether they occur within the firm or within its environment, and relocates them at one or the other of these interfaces (Spender, 1992).

While industrial organization (IO) economists generally hold that firm performance is best explained by emphasizing the importance of external (industry) factors (Porter, 1980), and proponents of the resource-based view (RBV) of the firm (Barney, 1991; Wernerfelt, 1984) tend to emphasize internal factors, both paradigms share the SWOT model as a basic tool of strategy development. This process of external alignment, for both schools of thought, is the essence of strategy formulation.

In contrast, internal alignment is addressed primarily in the strategy implementation and strategic change literature (Day, 1999; Hambrick & Cannella, 1989; Kilman, 1989; Tichy, 1983). Research has been conducted in terms of vertical alignment (Newport et al, 1991; Floyd & Wooldridge, 1992), horizontal alignment (Venkatraman, 1990), and within top management teams (Priem, 1990; 1992). While these studies generally posit the need to keep the organization's resources internally aligned during strategy implementation, particular import is placed on alignment during times of strategic change, *e.g.*, in the implementation of new strategies and processes, change of leadership, or in post merger/acquisition activities (Nahavandi & Malekzadeh, 1988; Shanley & Correa, 1992).

Alternative labels have been used to represent the internal alignment construct. Newport *et al.* (1991) use the term "fit" to describe the "consistency and compatibility among strategies and implementation within and between corporate, business, and functional levels in an organization." Hambrick's (1997) "corporate coherence" is "an integrated logic and basis for action within a company—its unity of purpose, its unity of action." Additionally, Helton (1991) expresses the degree of "organizational alignment" in terms of the amount of time managers spend on core activities. Regardless of terminology, internal alignment appears to be a measurement of action, or the degree to which an organization is following expressed strategies. Consensus, on the other hand, is more a measure of intent—the degree to which organizational members are in agreement concerning what should be done with respect to choice of strategy—not a measure of what actually occurs. Strategic consensus has been investigated both at the top management team (TMT) level (Dess, 1987; Wooldridge & Floyd, 1989; Priem, 1990; Homburg et al., 1999) and with managers at the operational level (St. John, et al., 1991; Floyd & Wooldridge, 1992). While there is not complete agreement in the literature, there is strong evidence to suggest that at least in some areas of the organization, managerial consensus does lead to increased performance (Bourgeois, 1980; Priem, 1990; St. John *et al.*, 1991; Homburg *et al.*, 1991; Lindman *et al.*, 2001).

Just as a variety of labels exist for alignment, the consensus construct is also represented by a number of aliases: manager-strategy alignment (Szilagyi & Schweiger, 1984, Herbert & Deresky, 1987; Kerr & Jackofsky, 1989), goal congruence (Witt, 1998), value alignment (Guth, 1965), organizational commitment (Mayer & Schoorman, 1992; 1998), commitment (Guth & MacMillan, 1986), and acculturation congruence (Nahavandi & Malekzadeh, 1988), to name a few. Cobb *et al.* (1998) use market alignment to capture not only consensus, but also external and internal alignment as well. Here, market alignment is: (1) a measure of the internal consensus of perceptions about what customers want; (2) a measure of the difference between internal perceptions of customers' wants and actual customer want (what we term external alignment); and (3) a measure of employee understanding of the appropriate courses of action needed to satisfy these wants. (If it is assumed employees act effectively on this understanding, then this would correspond with internal alignment. Absent effective employee action, this is more a measure of communication effectiveness).

To summarize our interpretation of the consensus-alignment construct, external alignment is said to occur when there is an "appropriate" matching of a firm's resources with the external environment, *i.e.* an appropriate strategy has been selected. An organization is said to be internally aligned when managers in an organization are acting in accordance with this strategy—*i.e.*, the strategy is being effectively implemented. Strategic consensus is simply the degree of agreement that exists with respect to any issue or option of strategic importance.

Given these terms of reference, a number of conditions could theoretically exist in an organization, as is illustrated in Table 2. Intuitively, one would expect that a higher level of managerial consensus on the appropriateness of a strategy would help to ensure commitment to that strategy, and that this commitment would increase the likelihood of successful strategy implementation. While we do not disagree with this conventional wisdom, we are leaving it to other researchers to continue the investigation into whether a high degree of consensus and/or internal strategic alignment leads to increased performance. This paper, rather, is intended to complement existing research in the field by presenting conjoint-generated cognitive maps as an operable alternative for measuring strategic consensus. In the ensuing discussion, we illustrate how the technique can be used to assist in the prioritization of strategic issues and in the identification of individual and group preferences for strategic options.

Conjoint analysis is a marketing research technique designed to measure the trade-offs that occur in the minds of consumers among alternative product profiles (Green & Rao, 1971). It uses experimental design and analysis of variance to analyze preferences among combinations of product factors. It was developed as an alternative to traditional importance ratings of product attributes. Unlike a simple rating of importance (where everything might be important) conjoint analysis forces consumers to choose among alternative profiles. For example, in the design of an automobile, designers much choose among performance, comfort and price, that is, designers must "trade-off" among these factors. If consumers are asked to indicate the importance of these factors, they could easily say all are important. Designers, however, cannot provide an automobile that has simultaneously high performance, high comfort and low cost. The challenge is to identify the combination of levels within factors that will yield the highest utility and market share.

TABLE 2
Sample Permutations of the Alignment-Consensus Construct

Condition	Example
High External Alignment Low Consensus	An organization's selected strategy is "right" but not everyone is in agreement
Low External Alignment High Consensus	Everyone agrees on the choice of strategy, but it is absolutely the wrong thing to do
High External Alignment Low Internal Alignment	A great strategy has been selected, but has been poorly implemented
Low External Alignment High Internal Alignment	A poor strategy is perfectly executed
High Consensus Low Internal Alignment	Managers are in complete agreement about what should be done, but are completely inept at mobilizing resources in implementation
Low Consensus High Internal Alignment	Despite low managerial consensus on appropriate courses of action, the actions of the firm's employees are highly concerted

In a conjoint design, factors (product characteristics) are identified along with levels within each factor. Consumers are presented with combinations of the factor levels that represent alternative product packages. In the automobile example, the factors might be performance, comfort and price. The levels might be high and low performance, high and low comfort, and high and low price. One package or combination could represent the ideal design, that is, high performance, high comfort and low price. Another might be low performance, low comfort and high price. Obviously, this would not be preferred. While the extremes are easy to identify, the intermediate combinations are more difficult. How would a consumer rate the combinations of high performance, high comfort and high price; high performance, low comfort and high price, and; low performance, high comfort and low price? When forced, will they prefer price or comfort or performance?

In a full factorial design, all possible combinations (eight packages) would be presented to the consumer for a ranking of preference. Repeated measures analysis of variance provides utility weights for each individual for each factor. These weights allow the researcher to "model" alternative product packages to predict a preference for each individual. In most applications, a full factorial design is not possible. For example, with six factors and three levels each, the researcher would need to present consumers with 729 packages to evaluate. Fortunately, fractional factorial designs are available that allow consumers to evaluate relatively few packages, for example sixteen to twenty, and still provide utility weights on the main factors. The fractional factorial design confounds interaction effects.

Regarding reliability, Bateson *et al.* (1987) conducted an extensive study of reliability in conjoint and found that the mean reliability correlation was .75. With respect to validity, Green and Srinivasan (1990, p. 13) summarize the research in this area and conclude, "In sum, the empirical evidence points to the validity of conjoint analysis as a predictive technique."

Thus, conjoint analysis measures an individual's utility of product characteristics in a forced-choice context. The interest in this study is to apply the conjoint technology to another forced-choice situation, that of preference of strategic alternatives among decision-makers within an organization. As previously mentioned, conjoint analysis has been used to measure alignment within the top management team (Priem, 1990; 1992), strategic thinking (Bronn & Olson, 1999), and strategic judgment (Priem & Harrison, 1994). We propose using this technique as a means for assessing consensus on a broader organizational basis. Specifically, this pilot study explores the use of conjoint analysis in quantifying the degree of consensus among and between decision-making and planning groups in an organization. The hypothesis is that the variation among the weights of the factors can be used as an indicator of the degree of consensus among decision makers.

METHOD

A small not-for-profit organization (35 employees) was embarking on a strategic change initiative and agreed to participate in the consensus measurement exercise. The organization provides services to business in an urban area of about 1.2 million people. The organization used to consist of five independent offices but these were merged in the early 1990s. The new umbrella organization centralized several functions but retained the regional offices.

The organization has been experiencing external environmental pressures and has recently embarked on a major strategic change initiative. As a result, the leadership expected that there would be disagreement or confusion among employees regarding the direction of the organization. Thus, a primary objective in this study was to provide an initial measurement of consensus prior to a strategic planning initiative. They were particularly interested in getting a baseline measurement of consensus from which to gauge future efforts. They were interested in an overall measure of consensus for the organization and, to a lesser extent, were interested in the consensus among three levels within the hierarchy.

The first step in the consensus measurement process consisted of identifying the appropriate conjoint factors and levels. The traditional conjoint analysis terms "factors" and "levels" have been changed to "issues" and "options" respectively to better communicate the concepts in a strategic planning context. To identify the specific issues and options, one of the researchers met with the Director of Communications to review the strategic plan that was in the process of being developed. The researcher extracted eight potential issues from the plan and listed three possible options per issue. The Director also developed a list of possible issues and options. The researcher, Director, and President ultimately met to determine the final list of issues and options (shown in Tables 3 and 4).

The issue focus refers to internal or external orientation, that is, do the employees focus on the internal operations of the organization or do they focus on the external environment and what is affecting their "customers"? Historically the organization has tended to be inwardly focused, but it is now considering whether to take a more "customer needs" approach. Cohesion is the issue of centralization versus decentralization. In this case, it refers to the degree of power held by the central office and the degree held by the regional offices. Programming represents three alternative operating strategies (or options): should the organization continue to focus on the existing customer base (member services), change its

emphasis to actively building the customer base (economic development), or shift to a "political focus" (legislative affairs). Involvement refers to the degree to which the organization should have customers actively involved in the decision making of the organization. Historically, the involvement has been intentionally limited to a few major customers but they are considering expanding the involvement. Finally the issue of revenues represents the methods used to raise money in this not-for-profit organization. Should it be business as usual (traditional sources) or do they need to get creative and expand ways they can bring in money? The terminology in the issues and options reflects that of the organization. Many of the issues are unclear; the leadership admittedly has not provided clear direction.

TABLE 3
Issues and Options Results for a Sample Individual

Strategic Issue	Strategic Options	Sample Individual	
		Option Weights	Issue Importance
Focus	1. Internal	+1.50	3.0
	1. External	-1.50	
Cohesion	2. Local	-0.50	1.0
	3. Regional	+0.50	
Programming	4. Member Services	0.00	1.0
	5. Economic Development	+0.50	
	6. Legislative Affairs	-0.50	
Involvement	7. High	-0.50	1.0
	8. Low	+0.50	
Revenue	9. Traditional Sources	-1.50	3.0
	10. New Sources	+1.50	

SPSS Conjoint 8.0 was used to generate eight cards representing a fractional factorial design. A demographic questionnaire was used to collect information on gender and grade level (staff, management, and executive) within the organization. The individual results were anonymous; there was no way to link results to any individual.

Since the organization is small it was agreed that all 35 members would complete the exercise. One of the researchers briefly presented the concepts of alignment and the conjoint technique and administered the conjoint exercise at a monthly staff meeting. The participants were presented with the issues and options along with a brief description with time for questions. They were also given a definitions sheet for reference during the card sort exercise. They were then instructed to sort the eight cards into three preference piles (most prefer, least prefer, and something in between), placing roughly an equal number of cards on each pile. They then sorted each pile from most preferred to least preferred. When complete, the eight cards were to be ordered from most preferred to least preferred. The order number (1-8) serves as the dependent variable and the issue-option combinations as the independent variables in conjoint analysis.

The results were double keyed and analyzed using SPSS Conjoint 8.0. The nonmetric, additive conjoint model is used since the primary purpose is to measure an individual's preference for the main factors. The interaction effects are not considered relevant and are assumed to be minimal (Hair *et al.*, 1995). In fact, the R^2 value, which measures the proportion of the variance that is explained by the main effects, is used as quality control indicator. In pilot studies, low R^2 values were examined and found to be errors that had occurred in the sorting procedure. Therefore, all values below .60 were to be automatically examined; however, none were found in this application.

RESULTS

From the results of the conjoint analysis, three dimensions can be extracted for the consensus exercise. They are directional consensus, importance, and importance consensus. Directional consensus provides, for each strategic issue, the degree to which the participants are "going in the same direction." For example, do half the members prefer an internal focus and half an external or do all prefer an internal? Importance simply indicates the relative level of importance of one issue versus another, based on the average across respondents. Is "Focus" more or less important than "Cohesion" and by how much? Importance consensus measures the degree of agreement among respondents regarding an issue's level of importance. Did all respondents agree that Focus was important or did some consider it very important and others not at all important? With these three dimensions, we will know which issues are important, whether there is agreement as to this importance, and if employees concur on the preferred options within each issue. Each dimension is further defined next.

Directional Consensus

Because dependent and independent variables are available for each participant, SPSS reports the utility each individual has for each option within an issue. The utility is a weight that raises or lowers the degree of preference that an individual has for a card containing that option. Looking across individuals, then, it is possible to determine the amount of agreement that exists for the direction within an issue. For example, if an issue has two options, A and B, and all respondents agree that option A has a positive utility, then there is complete agreement on direction for that issue. If, on the other hand, half the respondents prefer option A (*i.e.*, it has a positive utility) and half prefer B, then there is no agreement on direction.

Thus, directional consensus may be quantified using the proportion of respondents who prefer an option. In the case of two options, the calculation is simply the absolute value of the difference between the proportion indicating one direction and the proportion indicating the other direction. If 60% indicated preference for one direction, then 40% must have indicated a preference for the other direction. The directional consensus is 20%. At the extremes, if 100% indicate one direction, then the directional consensus is 100%. If 50% indicate one direction, then the directional consensus is 0%. If there are three options, then the proportion indicating a preference for each option is calculated. The absolute values of each of the three possible combination differences is averaged and divided by .6667. Thus, complete agreement yields a measure of 100% and no agreement (33% for each option) yields a measure of 0%.

Importance

The utility weights for the options can also be used to provide a measure of the issue's importance to an individual. Those issues where the options have high weights (more extreme in direction) will be more important. Thus, the importance for an issue is simply the difference between the maximum weight and the minimum weight of the options within that issue. This is calculated for each individual. Averaging across individuals provides an overall measure of an issue's importance to the members of the organization.

Importance Consensus

Given the importance results for each individual it is possible not only to average the results for an overall measure of importance on an issue, but also to measure the degree of variability around that average. This would reflect the amount of agreement of an issue's importance. If there is wide variability, then there is poor importance consensus — little agreement among respondents that an issue is important or not important. If there is little variability, then there is high importance consensus. This is measured using a standard deviation.

The three dimensions above can be summarized in a consensus map (see Figure 1). The issues are plotted on two dimensions, directional consensus (x-axis) and issue importance (y-axis). Using the means to define quadrants, issues in the upper left quadrant (quadrant one) represents those that are considered important, generally, and in which there is poor agreement on direction. When all organization member results are overlaid, the weight values will be large and in opposing directions, that is, some members will prefer one option and some a different option. The lower left quadrant (quadrant two) contains issues that are of less importance, in general, and for which there is poor agreement on direction. The pattern is similar to that of quadrant one but the weights are less extreme. The right side, upper and lower quadrants, contains issues for which there is general agreement on direction. In quadrant three (upper right), there is general agreement on direction on important issues. In quadrant four (lower right), there is general agreement on direction on less important issues. The measure of importance is obviously relative and all issues should be considered important or they would not have been selected as strategic issues.

The third dimension in the summary is importance consensus and can be captured by placing bubbles within the map to represent an issue. A large bubble indicates less agreement on the importance of an issue, *i.e.*, some members could feel the issue was important while some do not. This reflects a large standard deviation and a large bubble. If members are consistent in their rating of an issue's importance it will have a small standard deviation and a small bubble.

To illustrate some of the measures, an individual from the organization has been selected at random. The option weights for this respondent are presented in Table 3. Adding and subtracting these weights from a constant term (4.5 for this individual) predict this individual's preference for the selected set of options. Since there were eight cards in this exercise, the range of predicted scores is from one to eight. The larger the difference on the weights the more important that issue is to the individual. The importance score (the maximum weight minus the minimum weight) for each issue is also shown in Table 3 for this individual.

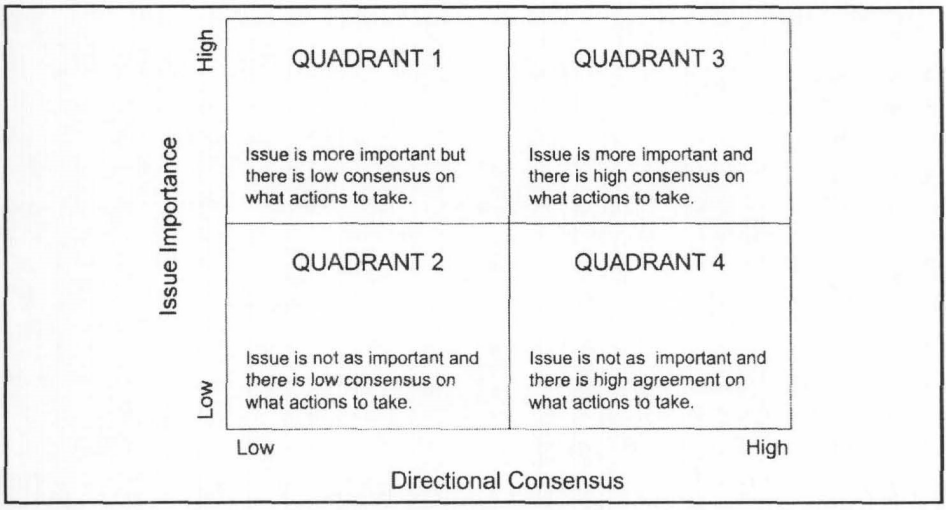

Figure 1. Issue Importance and Directional Consensus.

By overlaying the results for all members of the organization, it is possible to determine the degree of consensus among members. Figure 2 presents the results for the issue Focus for the selected individual and for all of the Staff category members. It is apparent that about half of the Staff members prefer an internal focus and half an external focus. The weights range from one to two and are therefore fairly important to the Staff members. Also, there appears to be a moderate degree of consistency in the importance ratings. Thus the issue of Focus among Staff members might be an area of concern – high importance and low agreement on direction. This should remain a hypothesis until the other issues are examined. Each issue can be examined this way.

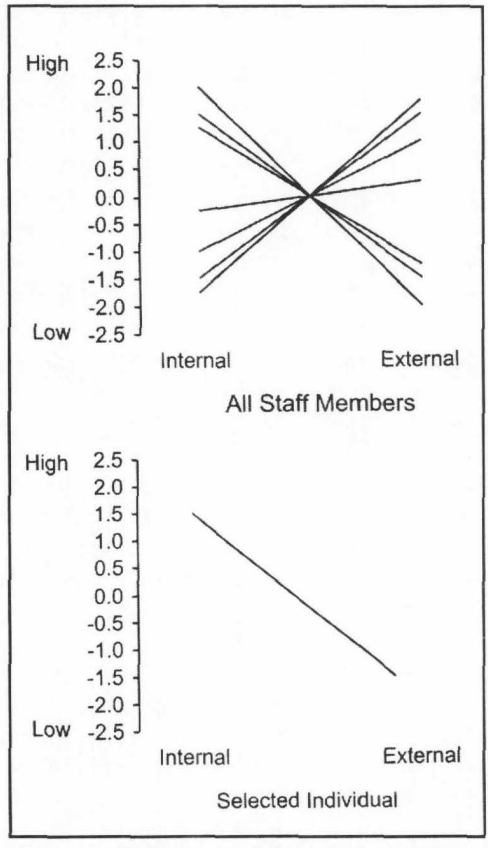

Figure 2. "Importance" Results for the Issue *Focus*.

Directional consensus for all issues and options for the organization as a whole and for each sub-group is summarized in Table 3. For the issue Focus, nearly two-thirds of all respondents preferred an external focus. For management, the proportion was 75%. A little over half of the staff members and executives preferred an

TABLE 4
Directional Consensus Details for Organization

Strategic Issue	Strategic Options	Staff	Mgmt.	Executive	Combined
Focus	Internal	44.4%	12.5%	28.6%	28.6%
	External	55.6%	75.0%	57.1%	64.3%
Cohesion	Local Control	11.1%	25.0%	0.0%	10.7%
	Regional Control	88.9%	62.5%	100.0%	82.1%
Programming	Member Services	22.2%	62.5%	28.6%	39.3%
	Economic Development	77.8%	37.5%	57.1%	60.7%
	Legal Affairs	22.2%	75.0%	42.9%	42.9%
Involvement	High	66.7%	87.5%	71.4%	75.0%
	Low	22.2%	12.5%	28.6%	21.4%
Revenue	Traditional Sources	44.4%	37.5%	14.3%	28.6%
	New Sources	44.4%	37.5%	42.9%	42.9%

external focus. For Cohesion, 83% of all respondents preferred a regional emphasis and this was consistent among levels. For Programming, staff members preferred economic development (78%), management legislative affairs (75%) and membership services (62%), and executives were more evenly divided but preferring economic development and legislative affairs. For Involvement, 75% of all respondents preferred high involvement and this was consistent across levels. Lastly, for Revenue, staff and management equally preferred traditional and new sources, whereas executives preferred new sources (43%) over traditional ones (14%).

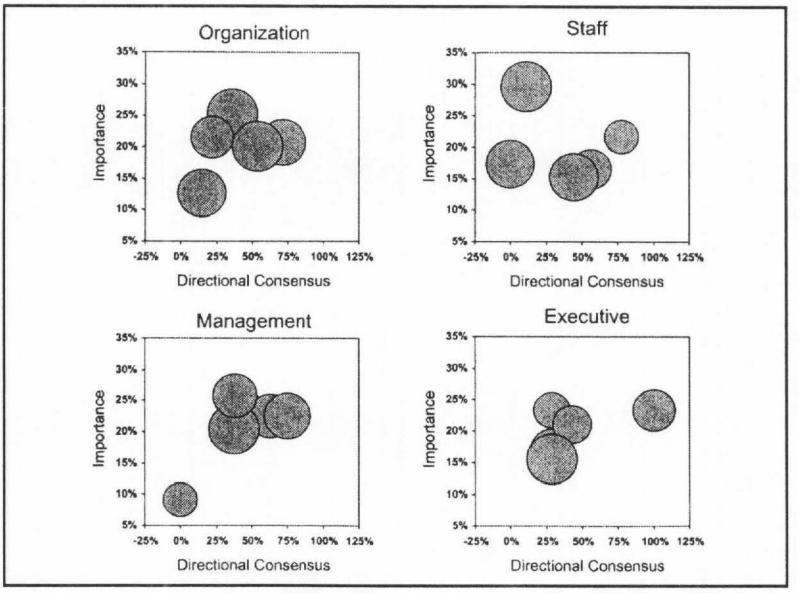

Figure 3. Consensus Maps for Staff, Management, Executives and Organization.

TABLE 5
Consensus Dimensions for Organization

	Focus	Cohesion	Program	Involve	Revenue
Overall					
Directional Consensus	35.7%	71.4%	21.6%	53.6%	14.3%
Importance	25.2%	20.7%	21.5%	20.0%	12.6%
Importance Consensus	14.8%	12.1%	10.5%	14.1%	13.7%
Staff					
Directional Consensus	11.1%	77.8%	56.1%	44.4%	0.0%
Importance	29.5%	21.6%	16.4%	15.2%	17.2%
Importance Consensus	14.0%	6.8%	9.3%	12.8%	12.5%
Management					
Directional Consensus	62.5%	37.5%	37.9%	75.0%	0.0%
Importance	22.5%	20.4%	25.7%	22.4%	9.0%
Importance Consensus	12.2%	15.9%	11.9%	13.4%	7.7%
Executives					
Directional Consensus	28.6%	100.0%	28.9%	42.9%	28.6%
Importance	17.0%	23.2%	23.3%	21.0%	15.5%
Importance Consensus	14.1%	14.4%	10.4%	12.5%	21.1%

Note: The data included in this table were used to construct the maps depicted in Figure 3.

Directional consensus is summarized, combined with importance and importance consensus, and illustrated in Figure 3 and Table 5. Continuing the example of the issue Focus among Staff members, it is apparent that Focus does lie in quadrant one – high importance and low agreement on direction. Importance consensus on this issue is not particularly strong, judging from the relatively large bubble size.

Comparing Staff results with those of Management and Executives, Focus is relatively less important and there is somewhat more directional consensus in both of these groups. For Managers and Executives, Programming is both more important and demonstrates less directional consensus than Focus. While Focus is a major concern among Staff members, Programming is the area for concern for Managers and Executives.

DISCUSSION

As stated earlier, the intent in this organization was simply to provide a benchmark regarding the degree of consensus at a point in time. The results were presented to the entire organization. They basically confirmed what they, especially the executives and mangers, suspected which was that the results would be "all over the place." There had been a concern initially by the authors and the Director of Communications as to how well the organization members — ranging in education from high school to graduate degrees — would understand the results.

Surprisingly, there was general understanding based on the quantity and quality of the questions asked during the presentation. Humorous comments were made regarding some of the charts showing discrepancies on directional alignment. It did not come as a surprise to them. They made specific reference to some of the differences among levels in the organization and pointed out how managers were at times being "caught in the middle."

Efforts within the organization following these results were focused on defining a clear strategy (selection of options) and communicating that strategy throughout the organization. Special efforts were given to delineating a clear plan regarding Programming, as this issue was not only critical in the eyes of the executives, but also had poor agreement on direction. Plans are in place to repeat the consensus exercise after one year to evaluate the effectiveness of the communication process and the strategic planning effort.

While the above results are specific to the application, there are four general topics that are generic to the conjoint application and that should be addressed. The first concerns how much alignment is good. We assumed at the outset that, in general, more alignment is better than less alignment. Whether or not there should be complete agreement among organization members is an issue frequently investigated in the organizational behavior literature. The importance of consensus may be a matter of where one is relative to the planning process. Early in the strategic planning stage, when direction is not obvious or clear, encouraging opposing views might be considered good and would result in low consensus. However, when the decision has been made on direction, then low consensus may not be good. It needs to be clear in the development of the issues and options which phase of the process the organization is in. If the preferred directions for some of the low consensus issues were clearly defined strategy, then a significant level of disagreement is a problem. Either some members are unaware of the agreed upon direction or they are failing to get on board with the decision. If these issues were exploratory, that is, the management wanted a take on what might be a preferred direction, then the level of disagreement may be acceptable.

Second, the results of the conjoint exercise are highly dependent upon having the right issues and options. There is nothing in the technique to tell us if those selected are appropriate, and there is nothing that can be done after the fact. Our experience to date with the technique indicates that the respondents should feel uneasy during the card sorting exercise. The subjects in this exercise were specifically asked if the sorting was easy and the resounding answer was no. This is a clue that the selected issues are appropriate or at least are useful. The fractional factorial design limits us to five or six issues with two or three options within each. While there are other approaches to conjoint that allow more issues to be addressed, we prefer the fractional factorial design due to its simplicity in demonstrating the trade-offs and for evaluating each card as a concrete scenario.

Third, the results demonstrate that which is and not that which should be. There may be high directional consensus for an issue, but it may be the wrong direction. Examining the appropriateness of the preferred options is another exercise. In this case, the technique can raise questions for dialogue regarding the preferred direction or the need for communication and or training and development efforts.

Finally, when the technique was initially considered, it was thought that the exercise would be useful in simply feeding back results to individual members as in the Delphi technique. Part of low consensus might be out of ignorance as in: "I though it was obvious that our major emphasis was legislative affairs. I didn't realize I was the only one who thought so."

While we have focused on the technique of identifying managerial consensus on strategic priorities, we recognize that this is only one part of the strategic alignment process. Alternative strategies for achieving internal alignment among managers exist in both preventing and correcting instances of actions that are inconsistent with explicit strategic priorities. Advocates of prevention strategies suggest that internal alignment is best achieved by "matching" managers with the position and/or strategy (Leontiades, 1982; Reed & Reed, 1989; Szilagyi & Schweiger, 1984; Herbert & Deresky, 1987), while others assert that corrective alignment can be achieved through management training and development activities (Kerr & Jackofsky, 1989). Regardless of the philosophical approach to achieving alignment that an organization holds, the process of measuring and mapping organizational consensus can assist greatly in the identification and communication of strategic issues and priorities.

Proponents of the knowledge-based view of strategy emphasize looking for potential sources of competitive advantage within the organization's members. Other strategy researchers have posited the importance of understanding strategy at all levels and of gaining organizational commitment to ensure effective strategy implementation. In this paper, we have presented a relatively easy method that can be used not only to help capture and communicate organizational knowledge, but also to measure and portray employee understanding of strategic issues and priorities.

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Defining Marketing Information Needs: An Exploratory Study of Senior Marketing Executives

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The identification of the information needs of marketing decision-makers lies at the very core of Marketing Information Systems (MkIS) design. Information needs can be defined as the user specifications of information characteristics involved in information seeking, and refer to those qualities of information perceived by managers to be 'useful' to facilitate their decision-making. Drawing on empirical results from three sets of literature and from studies of information systems design (particularly management and accounting information systems design), the authors review a framework for exploring the design of an MkIS. A qualitative study examining the information needs of senior marketing executives is also reported and discussed. By examining the appropriateness of the information characteristic continua advocated by Gorry and Scott-Morton (1971), the authors provide some preliminary insights into how the information needs of marketing decision-makers might be operationalized. The results, based on interviews with 20 senior marketing executives, indicate that marketing information needs can be defined using six information characteristics.

Conceptual and empirical work in the information systems literature suggests that the performance of an information system is influenced by the fit between information system characteristics and contextual variables (*e.g.*, Tushman & Nadler, 1978). Success (the benefits to be derived from the information system) is viewed as a function of the fit between these contextual variables and information system characteristics. Relatively little attention however, has been given to what kind of information marketing decision-makers regard as useful in performing their marketing tasks within MkIS research. As Proctor (1991) states, "*there is plenty of information around, but too much of the wrong kind and not enough of the right kind*" (Proctor, 1991, p. 55). Proctor (1991) further notes that the kinds of complaints usually encountered regarding information are that the information is too dispersed to be useful, it arrives too late to be useful, and it arrives in a form that leaves no idea of its accuracy and therefore lacks orientation or focus.

The function of an information system at any level in the organization is to provide information to enhance the decision-making process (*e.g.*, Jones & McCleod, 1986). Since a primary objective of an MkIS is to provide information that facilitates the marketing management decision-making process, the information content of that system must be linked closely to this process. Management accounting systems (MAS) and management information systems (MIS) researchers (*e.g.*, Dermer, 1973; Daft & Lengel, 1986; Gordon & Miller, 1976; Gordon & Narayanan, 1978; Munro, 1978; Chenhall & Morris, 1986; Senn, 1987; Choe & Lee, 1993; Goodman, 1993; Mitchell & Volking, 1993; Choe, 1996; Fisher, 1996; Choe, 1998) suggest that the information needs for decision-making can be considered in terms of general

information characteristics. These information requirements are the user specifications of information characteristics involved in information seeking and refer to those qualities of information perceived by managers to be useful to facilitate their decision-making (*e.g.*, Gordon & Narayanan, 1984; Chenhall & Morris, 1986; Mangaliso, 1995). These MAS and MIS researchers contend that by identifying the dimensions of information, the designers of an information system are more in tune with those qualities or characteristics of information perceived by decision-makers to be useful in performing their work tasks. Information is useful to an individual to the extent that it improves decision-making and hence the operating efficiency and effectiveness of the organization (Chenhall & Morris, 1986; Mangaliso, 1995; Choe, 1998).

Research pertaining to MAS and MIS design is largely based on the information characteristic continua advocated by Gorry and Scott-Morton (1971). These researchers suggest that each item of information has a source (information may come from internal or external sources), scope (information may be narrow or wide in its representation), level of aggregation (information may be detailed or aggregated), time-horizon (data items may report what has happened, *i.e., ex post*, or what is expected to occur, *i.e., ex ante*), currency (information may report on the most recent events or be older), required accuracy (information may be high or low in its correctness), and frequency of use (information may be used very frequently or infrequently). These information characteristics are summarized in Table 1.

While the general importance of these information characteristics for the design of accounting and management information systems is well documented in the literature (*e.g.*, Dermer, 1973; Gordon & Narayanan, 1978; Chenhall & Morris, 1986; Choe & Lee, 1993; Mangaliso, 1995; Choe, 1996; Fisher, 1996; Choe, 1998), there appears to have been no conceptual and empirical investigation of information characteristics in MkIS research. This paper seeks to shed some light on the characteristics of marketing information. In doing so, we hope to firstly, provide some preliminary insights into the information needs of senior marketing executives using these characteristics and secondly, establish an initial platform for further research in this area.

TABLE 1
Gorry and Scott-Morton (1971) Information Characteristics

Information Needs	
1. Accuracy	High/Low
2. Scope	Narrow/Very wide
3. Frequency of Use	Very Frequent/Infrequent
4. Time Horizon	Historical/Future
5. Level of Aggregation	Detailed/Aggregated
6. Updating	Highly Current/Old
7. Source	Largely Internal/External

This paper is organized into four sections. We first review the conceptualization reported by Ashill and Jobber (1999) and describe marketing information needs in terms of the user specifications of information characteristics. We then outline our research objectives specific to one aspect of this conceptual framework and follow this with data collection procedures, sample selection, and analytical methods. Finally, we discuss the results of our study, highlighting their exploratory nature, and suggest areas for future research. The study's limitations are also acknowledged in this section.

CONCEPTUAL FRAMEWORK

The conceptual framework advocated by Ashill and Jobber (1999) to study MkIS design is presented in Figure 1. The framework examines the influence of contextual settings on the effective design of MkIS, draws on three key literature bases, and illustrates three categories of antecedents of the usefulness of marketing information characteristics: environmental uncertainty perceptions, decision-maker characteristics, and work environment factors (Ashill & Jobber, 1999). Environmental uncertainty perceptions are drawn from conceptual frameworks and empirical investigations in organizational design and behavioral decision-making; decision-maker factors are drawn from the personality and cognitive psychology literature; work environment factors are drawn from theories of managerial information processing. Although considerable emphasis has been placed on potential benefits of contingency theory applications to accounting research, relatively few empirical investigations exist examining MkIS design.

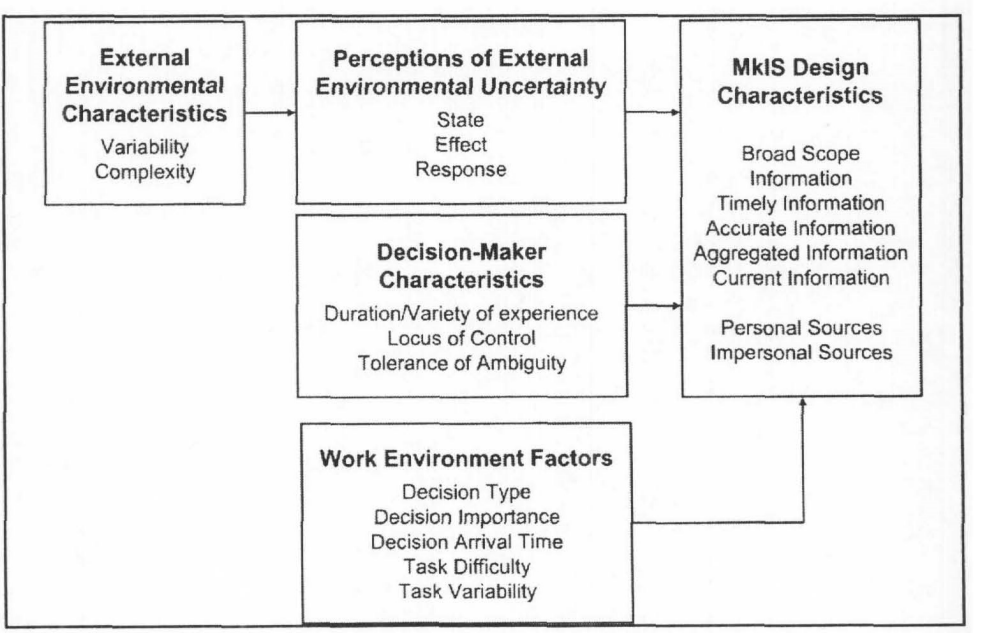

Figure 1. A Conceptual Model of Factors Affecting the Perceived Usefulness of MkIS Design Characteristics (Ashill & Jobber, 1999)

Using the Gorry and Scott-Morton (1971) conceptual framework (see Table 1) and empirical work cited in the information systems literature (*e.g.*, Chenhall & Morris, 1986), the authors suggest that the design of a MkIS can be operationalized in terms of the perceived usefulness of seven information characteristics: broad scope information, timely information, current information, aggregated information, accurate information, personal information sources and impersonal information sources. Information scope represents the scope of events, places, people, and things that are represented by information (Gorry & Scott-Morton, 1971; Senn, 1987; Choe & Lee, 1993; Wright & Ashill, 1998). Broad scope information thus describes information that is wide or broad in its representation (a wide or broad set of information inputs are required to facilitate marketing management decision-making). Timely information describes receiving information quickly and on time (*e.g.*, Chenhall & Morris, 1986; Mangaliso, 1995; Fisher 1996). Information aggregation refers to the degree of summarization performed on information (*e.g.*, Chenhall & Morris, 1986; Specht, 1986; Mangaliso, 1995; Wright & Ashill, 1998). For example, an MkIS can provide information in various forms of aggregation ranging from the provision of raw marketing data to a variety of aggregations around periods of time and areas of responsibility such as product/markets. Information currency refers to the age of the information appropriate for decision-making (*e.g.*, Senn, 1987; Li, 1997), and describes the length of time between something occurring and the event being reflected in the information. Current marketing information thus describes marketing data that reports on the most recent events. Information accuracy refers to the extent to which the output information is sufficiently correct to satisfy its intended use (Li, 1997). Accurate information thus describes data, which is correct for its intended use (Fredenberger et al., 1997). Personal information sources involve direct contact with other individuals (such as face-to-face conversations, telephone conversations and meetings); impersonal information sources describe those sources of information which are written in nature, such as computer generated reports and market research reports (Wright & Ashill, 1998).

The propositions advanced in this work posit that MkIS design should be aligned to a range of contextual factors. These include external environment factors (variability and complexity), environmental uncertainty perceptions (state, effect and response), decision-maker characteristics (experience, tolerance of ambiguity and locus of control) and work environment factors (nature of marketing management decision activity, decision importance, decision arrival time, task difficulty and task variability).

The framework is grounded in three sets of literature, namely organizational behavior and behavioral decision-making (*e.g.*, Duncan, 1972; Downey & Slocum, 1975; Tung, 1979; Milliken, 1987; Achrol & Stern, 1988; Glazer & Weiss, 1993; Gul & Chia, 1994; Mangaliso, 1995; Chong, 1996; Fisher, 1996; Wright & Ashill, 1998), personality and cognitive psychology (*e.g.*, Budner, 1962; Rotter, 1966; Downey et al., 1977; Ashford & Cummings, 1985; Specht, 1987; Govindarajan, 1989; Perkins & Rao, 1990; Wang & Chan, 1995; Vandenbosch & Huff, 1997), and managerial information processing (*e.g.*, Van de Ven & Ferry, 1980; Daft & Lengel, 1986; Jones & McCleod, 1986; White, 1986; Saunders & Jones, 1990; Menon & Varadarajan, 1992; Goodman, 1993; Zeffane & Gul, 1993; Bystrom & Jarvelin, 1995; Wright & Ashill, 1998). The framework suggests that user specifications of information characteristics may depend on the nature of the external marketing environment,

work conditions that decision-makers have to deal with, and the psychological disposition of the decision-maker. Specifically, the key premises which underlie this framework are:

- Perceptions of state, effect and response external environmental uncertainty are linked to the perceived usefulness of marketing information characteristics.
- Marketing decision-makers with different behavioral and psychological profiles will perceive the usefulness of marketing information characteristics differently.
- The perceived usefulness of marketing information characteristics are affected by a range of work environment factors, including (a) the nature of marketing management decision activity, (b) the importance of marketing management decisions, (c) decision arrival time, (d) marketing task difficulty, and (e) marketing task variability.

The authors discuss the components of the framework elsewhere (see Ashill & Jobber, 1999) and develop a set of research propositions for empirical study.

RESEARCH APPROACH

A recent review of the literature has shown that little is know about MkIS design in terms of marketing information characteristics (Ashill & Jobber, 1999). Bearing in mind that a "reason for using qualitative measurement is that for particular outcomes no acceptable, valid, and reliable quantitative measurement exists" (Patton, 1980, p. 75) and that "if relatively little is known about the phenomenon to be investigated, exploratory research will be warranted" (Churchill, 1991, p. 70), it was decided to undertake a qualitative study of marketing information needs. Specifically, the research sought to determine the appropriateness of the characteristics of information advocated by Gorry and Scott-Morton (1971) to define and operationalize the information needs of senior marketing decision-makers.

Given that information characteristics have been defined and empirically examined in the MAS and MIS literature, this study did not follow a purely inductive (grounded theory) approach to data collection (Strauss & Corbin, 1992). Its design was partly confirmatory, so as to further explicate the work of Gorry and Scott-Morton (1971), and partly exploratory, to shed some light on information characteristics within a marketing decision-making context. To this end, in-depth personal interviews were used as the data collection method. This research approach allows insights to be gained into the respondent's own interpretations of the information needed to facilitate the marketing management decision-making process and enhances the researcher's ability to understand underlying or latent issues (Miles & Huberman, 1994).

An experience survey (key informant survey) of 20 senior marketing executives was selected as the data collection method, given its applicability for studying decision-makers (Robson & Foster, 1989). While no pretence is made that the firms contacted constitute anything but a convenience sample, every effort was made at the selection stage to ensure substantial variability among the respondents in terms of the industries represented. The sampling frame consisted of large (employing 100+ full-time employees) manufacturing, business-to-business and service organizations identified as operating a MkIS (Statistics New Zealand, 1996). All

participants represented organizations within a 30 km radius of the University, proximity being important due to time and cost considerations. Past literature on information needs utilizing user specifications of information characteristics was used to develop questions to be included in a semi-structured, undisguised interview guide. The choice of a semi-structured versus a structured questionnaire was made due to the exploratory nature of the study (Strauss & Corbin, 1990). The length of the instrument was such that the interviews would last approximately one hour. The questions generated were related to the conceptualization shown in Figure 1.

That part of the research instrument, which focused on marketing information characteristics, centered on the following questions:

a) What marketing data should be made available (*e.g.*, competitor actions, customer demand shifts, governmental regulations, technological shifts, industry factors)?

b) What should the format of the marketing data be (*e.g.*, degree of summarization performed on the data, level of accuracy required, verbal/written formats)?

c) What should the form of the marketing data be (*e.g.*, quantitative and qualitative nature of the data)?

d) What should the orientation of the marketing data be (*e.g.*, internal/external orientation of the marketing data)?

e) What should the time horizon covered by the marketing data be (*e.g.*, historical, current, future)?

f) How frequently should the marketing data be communicated (*e.g.*, periodic reporting/ non-periodic reporting)?

Each interview was taped and then transcribed. The analysis followed the sequence of steps described in Miles and Huberman (1994, p. 10), who "define analysis as consisting of three concurrent flows of activity: data reduction, data display, and conclusion drawing/ verification." Data reduction was undertaken for each of the 20 interviews, using mainly in-vivo codes (Strauss & Corbin, 1990). Such codes (as opposed to codes determined prior to the analysis) were chosen because of the exploratory nature of the study; the issues raised during the course of the interviews were specific to marketing information needs. Rigid use of literature-based codes would have restricted the analysis to what was already known on information needs in other contexts. The codes were arranged in the form of 20 within-case displays which took the form of a matrix or a network according to which was most appropriate to the interview being analyzed (Miles & Huberman, 1994). The 20 displays were then integrated and synthesized into fewer cross-case displays capturing the information needs of senior marketing executives.

FINDINGS

A summary of the Gorry and Scott-Morton (1971) information characteristic continua and the findings of this exploratory study are presented below (see Table 2). The table displays six generic characteristics of marketing information. Senior marketing executives generally found the Gorry and Scott-Morton (1971) continua too vague and ambiguous, with many of

TABLE 2
Relationships between the Information Characteristics of the Gorry and Scott-Morton (1971) framework and the Information Characteristics generated from the Exploratory Research

Gorry and Scott-Morton (1971) Information Characteristics	*Information Characteristics Generated From This Research*
Source: Internal/External	**(implied in broad scope information, therefore dropped)**
Internal	Internally focused marketing information
External	Externally focused marketing information
Level of Aggregation: Detailed/Aggregated	**1. Aggregated Marketing Information:**
	Aggregated around time periods (e.g., quarterly, annual summaries)
	Aggregated around product/markets (e.g., sales data specific to product lines and market segments)
	Analytical marketing information/information for marketing decision models (e.g., SWOT analysis, segmentation analysis)
Time Horizon: Historical/Future	**(implied in broad scope information, therefore dropped)**
Frequency of Use (Reporting Interval): Very Frequent/Infrequent	**(implied in current information, therefore dropped)**
Scope: *Narrow/Very Wide*	**2. Broad Scope Marketing Information:**
	Internally focused marketing information (e.g., sales, costs, marketing performance indicators)
	Externally focused marketing information (e.g., macro and industry trends)
	Historical marketing information (e.g., sales, profitability, market trends)
	Future-orientated marketing information (e.g., environmental scanning information)
	Quantitative marketing information (e.g., costs, profit, market share)
	Qualitative and often subjective marketing information (e.g., buyer behavior, competitor strategy information)
Currency: Highly Current/Old	**3. Current Marketing Information:**
	Information reports provided on a frequent basis
	Information which reports on the most recent events
Required Accuracy: High/Low	**(should be as high as possible, therefore dropped)**
	4. Timely Marketing Information:
	Information which is received quickly
	Information which is received on time
	5. Personal Information Sources
	Face-to-face/telephone contact (verbal) from external agencies, customers, suppliers, competitors, distributors, internal staff
	6. Impersonal Information Sources
	Written Information from externally generated reports, internal memos, professional/trade journals, manual and computer generated information reports

the composite variables having no clear operational definition. For example, they were unsure about (1) what constituted broad and narrow scope information, (2) what encompassed 'detailed' information and 'aggregated' information, (3) how a senior marketing executive can reliably measure the accuracy of information, and (4) how much time must have elapsed for marketing information to be classified as "old." Instead, respondents found it easier to

describe information characteristics at one end of the Gorry and Scott-Morton (1971) continua, suggesting the need to specify information characteristics with more narrowly defined variables, *i.e.*, categorical (nominal) variables. Similar conclusions have been reported in MAS and MIS research operationalizing accounting information items. Chenhall and Morris (1986) for example, used categorical variables to measure characteristics of accounting information including aggregation, scope, and timeliness.

Respondents described broad scope information (marketing data which is broad in its representation) using six categorical (nominal) variables: marketing data which is quantitative in nature (*e.g.*, sales, costs, profitability, market size), marketing data which is qualitative in nature (*e.g.*, shifts in buyer behavior and competitive threats), marketing data which reports both internal facts (*e.g.*, costs, profitability) and facts with an external orientation (*e.g.*, broad environmental changes, industry environment changes), and marketing data which is ex post (historical) and ex-ante (future-orientated). The first two nominal variables describe the quantitative/qualitative nature of marketing data. As the Marketing Manager of Organization 14 stated, "*Hard data is important. Facts and figures are really important.*" Similarly, the Marketing Manager of Organization 11 stated, "*We need to be really in tune with market-place trends in terms of food consumption and in particular health trends, growing trends (technology) and all the science that goes into food technology such as the trend towards organic growth of product and what consumers are demanding now and what they will be demanding in the future. Qualitative information such as consumer trend information is really important.*" The second two nominal variables describe the orientation of the marketing data, *i.e.*, data may have an internal focus or an external focus. For example, the Marketing Manager of Organization 1 stated, "*There are three categories of marketing information. The obvious category is what is happening to the marketplace and what is happening to our performance (sales, profitability and market share). And also information relating to the consumer.*" Similarly, the Marketing Director of Organization 9 stated, "*Anything that tells me what is going on about the market, our sales, our performance relative to others in the marketplace, and our overall performance relative to what is happening in the market.*" The remaining two nominal variables describe the time-horizon of information. Marketing data can report what has happened (and is therefore historical) or can report what is expected to occur (and is therefore future-orientated). The Marketing Director of Organization 2 stated, "*The more data you can get about what might be happening in the market further out the better position you are going to be. So I am always looking at forecast information.*" Similarly, the Sales and Marketing Manager of Organization 4 stated, "*We need to know if there are any big changes coming up with our business and our customer's business, and we need to know how these changes are going to affect how we operate with them, how it is going to affect our revenue, and how it is going to affect the way in which we approach them for business.*" Respondents also identified historical marketing data as necessary to facilitate their marketing management decision-making. For example, the Marketing Director of Organization 9 stated, "*Historical information is key . . . we can look at what has happened in the last few years, and make a lot of assumptions about what we think is going to happen to the marketplace in terms of budgeting for example . . . this is based on critical historical information. Going on previous historical information we can look at what has happened, to establish what we think is going to happen . . .*"

Narrow scope marketing information was deemed irrelevant to facilitate marketing decision-making given the boundary spanning nature of a senior marketing executive role. All respondents identified themselves as being involved in a wide variety of tasks and processes that entail dealing with events which are complex and uncertain. Marketing data with an internal and external focus, historical and future-orientated marketing data, and quantitative (numbers) and qualitative data were demanded to deal with this complexity and uncertainty. While these findings support the work of Chenhall and Morris (1986), Gul and Chia (1994), and Mia and Chenhall (1994) by reporting the use of categorical variables to operationalize broad scope information, senior marketing executives use different variables to describe broad scope marketing information. Chenhall and Morris (1986) for example, operationalized broad scope accounting information with three nominal variables: data items which have an external focus (external orientated accounting data), data items which report what is expected to occur (future-orientated or ex ante accounting data), and data items which are expressed in non-financial terms (qualitative accounting data). The findings reported here suggest that broad scope marketing information also describes internal marketing data, quantitative marketing data, and historical data as data items required to facilitate the marketing management decision-making process.

Respondents described the format of marketing data in terms of three information characteristics: aggregation, accuracy and personal/impersonal information sources. Aggregated marketing information included aggregation around time periods (*e.g.*, summary reports specific to particular time periods such as monthly, quarterly and annual summaries), aggregation around product/markets (*e.g.*, marketing data on specific products/services and target markets), analytical information (*e.g.*, 'what-if' scenarios), and information suitable for input into marketing decision models (*e.g.*, segmentation information). For example, the Sales and Marketing Manager for Organization 16 stated, "*Summarized information pertaining to permit Values is extremely valuable, particularly in the industry we are working in, because it tells us where the market is going and what it should be doing. Also market share information, we do get information on how much concrete there is in various regions, so it gives us a good indication as to where we are placed in the marketplace.*"

Data analysis pertaining to the format of marketing data also suggests that information provision (the sources used to gather marketing information) can take a personal and impersonal format. Personal sources were described as involving direct contact with other individuals and included face-to-face/telephone/verbal contact with external customers, suppliers, competitors and distributors; impersonal sources were described in terms of written documentation such as marketing reports, professional/trade journals and computer-generated reports. These findings appear to support the recent work of Wright and Ashill (1998) who examine information provision as a component of MkIS design, and conclude that written reports are one part of a much larger range of information sources used by managers. Deshpande and Zaltman (1987) and Maltz and Kohli (1996) also report similar findings. The MkIS literature, however, has typically emphasised computer reports, ad hoc reports and marketing intelligence reports (formal reporting processes) as the major information inputs used by marketing decision-makers.

Finally, questions about the accuracy of marketing information were deemed irrelevant. All respondents felt that the accuracy of information should always be as high as possible. For

example, the Marketing Director of Organization 7 stated, "*Marketing data has to be accurate to begin with, otherwise you will have no confidence in the information . . .*"

Current information and timely information are the remaining information characteristics identified in Table 2. Respondents described current information as the periodic reporting of marketing data (*i.e.*, information is continually updated) and the provision of data that reports on the most recent events. For example, the Marketing Manager of Organization 12 stated, "*We need to maintain regular contact with customers to provide a continuous update on the market.*" Similarly, the Marketing Director of Organization 16 stated, "*Frequency of reporting is a major issue, for example in our regular monitoring of say the consumer market, we only do two tracking studies a year. What's happening between those studies and why this is impacting our campaign is something we don't know until we have got the outcomes of those. It's often too out-of-date to make any real changes.*"

In MAS and MIS research, current information has typically been operationalized as part of the timely information variable. However, the preliminary findings reported here suggest that timely information and current information are two distinct information characteristics. Senior marketing executives described timely marketing information as necessary to facilitate marketing management decision-making because it is received quickly and is on time. For example, the Sales and Marketing Director of organization 3 stated, "*I could do with much quicker response on financial analysis. Timely information is a major issue and feedback from our customers is often too late to make any real changes.*" Similarly, the Marketing Director of Organization 11 stated, "*I need pricing information at the point where I make the decision on what price to charge for the product. This information is timely because I need to have it there and then.*"

CONCLUSIONS AND FUTURE RESEARCH DIRECTIONS

Ashill and Jobber (1999) contend that little is known about the underlying characteristics of information in MkIS research. The research reported here has sought to determine the appropriateness of the characteristics of information advocated by Gorry and Scott-Morton (1971) to define the information needs of senior marketing executives. In doing so, the authors have provided some preliminary insights into how MkIS design might be operationalized. The findings suggest that the terms used to describe the characteristics of information advocated by Gorry and Scott-Morton (1971) need to be revised to accommodate the tasks, thinking, and practices of senior marketing executives. For marketing information to be needed by senior marketing executives, it must display certain characteristics in terms of scope, timeliness, currency, aggregation, and source.

The conceptual framework and propositions presented by Ashill and Jobber (1999) illustrates potential relationships between marketing information characteristics and the context of a marketing decision-maker's operating situation. External environment factors (variability and complexity), environmental uncertainty perceptions (state, effect and response), decision-maker characteristics (experience, tolerance of ambiguity and locus of control) and work environment factors (decision type, decision importance, decision arrival time, task difficulty and task variability), are potentially important dimensions of context in a study of MkIS

design. User specifications of information characteristics may depend on the external environment and work conditions that decision-makers have to deal with.

However, little is known about MkIS design is terms of marketing information characteristics. The focus of the qualitative study on the information needs of senior marketing decision-makers was explicitly on obtaining preliminary insights rather than testing theory; depth of understanding rather than generalization was the prime concern (Miles & Huberman, 1994). Further research is needed to: a) develop appropriate measures of these information characteristics and b) identify antecedents of information needs (operationalized in terms of the 'perceived usefulness' of information characteristics). On the methodological front, appropriate adaptation and further refinement of information characteristic measures derived in MIS and MAS research (Chenhall & Morris, 1986) would be an important step forward in a study of marketing information characteristics. On the substantive front, a systematic investigation of antecedent variables on the perceived usefulness of marketing information characteristics is needed. The conceptual framework illustrated in Figure 1 seeks to relate marketing information characteristics to the context of a senior marketing executive's operating situation.

Certainly, information characteristics have been the subject of considerable research in MAS and MIS design. However, there has been no empirical research exploring the interrelationships between contextual factors and the perceived usefulness of information characteristics in MkIS research. The link between contextual factors and the perceived usefulness of marketing information characteristics is crucial for MkIS design since the findings of such research would provide useful insights as to what particular characteristics or qualities of marketing information are required by marketing decision-makers to perform their work. By specifying information needs in terms of user specifications of information characteristics and recognizing that these information needs may depend on the context in which marketing decision-making takes place, MkIS designers can design systems to ensure that information with these characteristics are made available. While the present study has highlighted possible characteristics of marketing information, it does not link these characteristics with contextual factors such as environmental uncertainty, work environment and the psychological disposition of the decision-maker. Future research aims to shed some light on the association between these contextual factors and the perceived usefulness of these information characteristics using structural equation modeling. For some of the independent variables identified by Ashill and Jobber (1999), adaptation and further development of existing scales is a good starting point. However, it is important to ensure that these measures are applicable in a MkIS context. To this end, in-depth interviews with senior marketing decision-makers coupled with qualitative data analysis along the lines suggested by Miles and Huberman (1994) should help generate a pool of items for each of these variables with a high level of content validity. We further propose the testing of the MkIS model advocated by Ashill and Jobber (1999) using the statistically robust structural equation modeling-based partial least squares for model estimation. The Ashill and Jobber (MkIS) model posits relationships among a set of latent theoretical constructs measured with multiple manifest variables. Since the model advocates multiple relationships among several predictor and criterion variables measured with multiple measures, structural equation modeling is the most appropriate approach for comprehensively testing the proposed model.

By examining the relationship between contextual factors and marketing information needs, the results of this future research agenda may sensitize designers of the facets of a MkIS to the underlying qualities or characteristics of marketing information perceived by decision-makers to facilitate their marketing management decision-making.

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Procurement Policy and Supplier Behavior — OEM *vs.* ODM

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This paper has two purposes. The first one is to describe and contrast the cost-reducing efforts of original equipment manufacturing (OEM) and original design manufacturing (ODM) suppliers given a fixed, cost-plus contract. The result shows that the cost-reducing effort of the OEM supplier is in line with the assembler's requirement while the ODM supplier is able to keep some of the information rent and exerts less effort. The bargaining power of the ODM supplier is also stronger relative to that of the OEM supplier. It is consistent with the degree of information asymmetry residing in the contracting parties. The second purpose is to derive an optimal contract and procurement policy based on a simple institutional setting. The optimal cost-plus contract is obtained and its components deciphered. The drivers behind the supplier's cost-reducing effort are also studied.

Outsourcing is the strategic use of outside resources to perform activities traditionally handled by internal staff and resources.[1] It has been practiced for years, but the recent surge in excitement and growth is likely to result from changes in the competitive marketplace, which force the companies to take a hard look at their core competencies and to form a closer alliance with their suppliers to help reduce costs and improve services. Supply chain management, as part of the enterprise resource planning (ERP) paradigm, becomes critical for survival.[2]

The success of the Japanese auto makers has generated significant interest for researchers to look into many aspects of the Japanese style of management. On the operational side, important concepts in Japanese production systems such as the *kanban* system, zero inventory, and just-in-time have been formalized and heavily studied (*e.g.*, Monden 1983; Hall & Hall 1984). This development has also ignited research in analyzing the impact of setup cost reduction on production planning (*e.g.*, Porteus, 1985; Zangwill, 1987). When US manufacturers encountered difficulties in implementing *kanban* or just-in-time systems, researchers began to study the behavioral side of the Japanese system, especially corporate culture such as business groups and *keiretsu*, lifetime employment, and team work (*e.g.*, Hutchins, 1986; Abegglen & Stalk, 1985; Imai, 1986). However, when it comes to one of the building blocks of the Japanese auto industry, the suppliers, the incentive issues as applied to the relationship between the assembler and its suppliers receive little attention.

One major reason is that the data are difficult to come by. Researchers are not able to obtain the details of contract negotiations and the finalized version of the contract itself. Even if they are familiar with the operations, the research methodology used is based on case-by-case, descriptive field studies, which are difficult to generalize. Second, even written contracts sometimes are vague. Informal, implicit agreements constitute a large portion of these black-box elements. Third, most researchers in this area come from disciplines such as operations

research, industrial engineering, management science, and organizational behavior, which usually regard such supplier relationship as being smooth, thereby assuming away the incentive problems. Economists are indeed interested in optimal incentive schemes. However, their derivations are usually done without taking into account what practice dictates, a criticism rightfully advanced by Arrow (1985).

Asanuma (1985a, 1989) has conducted extensive field studies in the Japanese auto industry.[3] Three sources of components were identified: (1) design supplied (DS), where the assembler provides the technical drawings and the supplier provides only the manufacturing capability; (2) design approved (DA), where the supplier provides both the manufacturing capability and technical know-how for the design approved by the assembler; and (3) off the shelf (OS) for standard components. In the realm of supply chain management, the assembler is most interested in the first two sources, which will be called OEM (original equipment manufacturing) and ODM (original design manufacturing) in this paper for generality.

This paper describes and contrasts the cost-reducing efforts of the OEM and ODM suppliers given a fixed, cost-plus contract. Reducing and controlling operating costs is listed as the top reason companies outsource.[4] As the practice of target costing spreads rapidly, the assembler has every intention of "transmit[ting] the competitive reality faced by the firm to its suppliers" (Cooper & Slagmulder, 1997, p. 14). How the suppliers react to the assembler's demand and whether there is any difference among suppliers become interesting issues. In addition, this research derives an optimal contract and procurement policy based on a simple institutional setting in order to address the incentive issues involved in observed Japanese practice of adopting linear contracts (Asanuma, 1985a) in such relationships.

The remainder of the paper is organized as follows. The next section provides a literature review on related issues. This is followed by an analysis of the supplier behavior given a fixed, cost-plus contract, as well as the derivation of the optimal procurement policy. The last section concludes the paper.

LITERATURE REVIEW

Although target costing is usually classified as one form of market-based pricing,[5] its value as a cost-reducing tool cannot be overemphasized. Once set, "[t]*he target cost of a product can never be exceeded.*"[6] The firm then uses techniques such as value engineering and quality function deployment to modify design, material specification and production process to reduce costs while preserving the value as perceived by the customers. For outsourced components, the assembler transmits the market pressure to the supplier in the form of target price paid, which in turn becomes the supplier's target cost to meet.

Loeb and Surysekar (1998) studied whether and how payment ceilings should be set in cost-plus contracting. Their findings support the use of an overall payment ceiling to elicit the supplier's private (cost) information and to mitigate the moral hazard problem associated with cost-plus contracting. However, when target costing paradigm is adopted, as is done in this paper, both "whether" and "how" problems with respect to payment ceilings become moot at best. The ceiling is already determined by the market conditions.

Laffont and Tirole (1986) considered a static (one-period) control problem where a regulated firm with private information about its own efficiency parameter decides what level of effort to put into the production process. The regulator (*e.g.*, the government agency) has a prior belief of the firm's "type" and observes the actual cost of production. They are able to derive an optimal scheme which is linear in ex post cost. See Holmstrom and Milgrom (1987) for similar results.

In Laffont and Tirole (1988), the authors preserved most of the basic structure of their 1986 paper, including the efficiency parameter, but extended it to a dynamic (two-period) framework. This paper formalizes the concept of "ratchet effect"[7] by allowing the regulator not to "commit himself not to use in the second period the information conveyed by the firm's first-period performance."

The problem with the use of the efficiency parameter to identify the type of the firm is that when there are more than two periods, as the models in this paper adopt, it becomes difficult to update the regulator's belief reasonably well unless an appropriate equilibrium concept is invoked, such as a sequential equilibrium (Kreps & Wilson, 1982), an exercise not tried here. Instead, the efficiency parameter is replaced by a random variable that represents the unpredictable production environment (*e.g.*, how likely the machinery will break down or the yield rate of the output) against which the supplier exerts effort to tame the cost of production. The realization of this random variable is observable only by the supplier before she makes an effort decision but the assembler has some preliminary information about it (*i.e.*, knows its probability distribution).

Another problem with Laffont and Tirole (1988) is that although a two-period model provides sharper focus and tractability, it simply cannot capture the long-term relation between the assembler and his suppliers. The multi-period models presented in this paper thus subsume the two-period one and eventually are extended to infinite horizon.

The cost structure used in this paper is similar to that of McAfee and McMillan (1986) with two differences. First, it is indexed by time in a multi-period setting; second, the target cost at period t replaces the intrinsic cost that is observable only by the supplier. They also compare an incentive contract with cost-plus and fixed-price contracts[8] in a bidding situation and conclude that the incentive contract performs better. Since their model is essentially one-period,[9] target cost plays no role except in the trivial case where average cost is calculated from previous periods. Kawasaki and McMillan (1987) used their results to empirically examine the parameters of the incentive contract in the context of subcontracting in Japanese manufacturing industries.[10] It is tempting to use the incentive contract because of strong empirical implications. But as Asanuma (1985a) points out, the contracts between the assembler and his suppliers are basically cost-plus. So the efficiency issue of the incentive contract will be put aside for future studies

As to the ratchet effect, Weitzman (1980) provides an early treatment on this topic. He models a no-commitment situation by explicitly formulating target output as a function of the agent's previous performance, as is done in this paper. But he treats the parameters of the target as random variables. Instead, this paper leaves these parameters fixed, as is determined

in the negotiation process before mass production begins, so the bargaining power of the parties to the contract can be examined.

Recent development in the literature casts the issue of specific investment (or reliance investment in contract law jargon), such as the cost-reducing effort in this paper, in the realm of incomplete contracts and renegotiation (*e.g.*, Chung, 1991; Hart & Moore, 1988; Reichelstein, 1992). Gietzmann and Larsen (1998) analyzed how cooperation between the assembler and the supplier can be achieved via a careful design of the governance procedures in an incomplete contract setting. Since the parameters of the contract considered in the model are assumed fixed *ex ante*, such complexity is avoided.

SUPPLIER BEHAVIOR GIVEN FIXED CONTRACT

In this section, the supplier 's cost-reducing behavior given a fixed, cost-plus contract will be extracted. The model considered has two pairs of players: the assembler will be matched with the OEM and the ODM suppliers, respectively. They are all assumed to be risk neutral in order to focus on incentive issues. The assembler signs contracts with the two types of

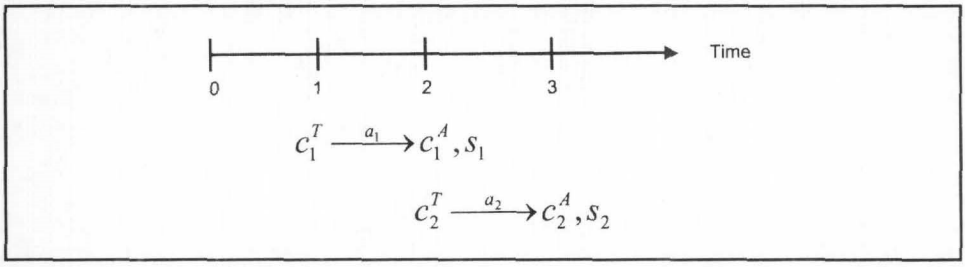

Figure 1. Contractual Scheme.

suppliers following the contractual scheme in Figure 1.

During time 0, a negotiation is initiated by the assembler to determine the parameters of the target costs (c_t^T) and the incentive payments (s_t) to be used for all future periods (t = 1, 2, ..., T). At the beginning of each period t, the assembler and the supplier will compare the previous period 's actual cost (c_t^A) with the target cost, settle the payment, and determine the current period 's target cost. During each period t, the supplier will then contribute her effort (a_t) to reduce cost as postulated by the target cost.

The target cost at time t is indirectly determined by

$$c_{t-1}^T - c_t^T = \delta + \lambda(c_{t-1}^T - c_{t-1}^A), \qquad (1)$$

where $\delta > 0$ is the fixed cost-reducing goal over the length of the contract and represents how much the cost should be reduced in period t if last period 's target cost were exactly met. $\lambda \in [0,1]$ is the adjustment parameter. Both δ and λ are determined ex ante at time 0. This formula has the supplier 's continuous improvement effort built into the contract. (1) can be rewritten (1) as

$$c_t^T = \lambda c_{t-1}^A + (1-\lambda)c_{t-1}^T - \delta . \quad (2)$$

It is easy to see that period t 's target cost can be expressed as a weighted average of period t-1 's actual and target costs, less a fixed cost-reducing goal. Given c_0^A and c_0^T as initial values, (2) can be further rewritten as

$$c_j^T = c_0^T(1-\lambda)^j + \sum_{t=0}^{j-1}(\lambda c_t^A - \delta)(1-\lambda)^{j-t-1} .$$

The actual cost at time t, c_t^A, can be denoted as

$$c_t^A = c_t^T + w_t - a_t \quad (3)$$

and is observable ex post to the contracting parties. w_t is an *i.i.d.* random variable at time t, representing unpredictable cost fluctuations whose realization is observed only by the ODM supplier during the manufacturing process, but the assembler has a prior belief of w_t, $f(w_t)$, defined over the interval $[\overline{w}, \underline{w}]$, a fixed support. As to that of the OEM supplier, it is assumed that there is no information asymmetry and the assembler is able to observe its realization with certainty. a_t represents the extent to which actual costs are reduced as a result of the supplier 's effort. It can also be interpreted as the relation-specific investment made by the supplier.

With a cost-plus contract, it can be assumed that the gross and net payments from the assembler to the supplier are, respectively,

$$g_t = s_t + c_t^A$$

and

$$s_t = k + \alpha(c_t^T - c_t^A) ,$$

where $k > 0$ is the gross profit margin and $\alpha \in [0,1]$ the reward parameter. k and α are determined ex ante. This format is in spirit similar to Laffont and Tirole 's (1986) result: a contract linear in ex post cost.

The supplier 's utility function, in monetary terms, is

$$u_t = s_t - H_t(a_t) ,$$

where $H_t(a_t)$ is the supplier 's cost of effort. It is assumed to be increasing and convex (i.e., $H_t' > 0$ and $H_t'' > 0$). A common discount factor is assumed for all parties: γ .

The assembler 's problem with respect to the OEM supplier can be described as follows:

$$\min_{\{a_t, s_t\}_{t=1}^T} \sum_{t=1}^{T} \gamma^{t-1} g_t \quad \text{(A-OEM)}$$

$$\text{s.t. } u_t \geq 0, \forall t .$$

The assembler wants to minimize his total discounted payment over T periods subject to the OEM supplier receiving at least a reservation level of utility (normalized to zero). Since this problem of perfect information is a stationary one, the assembler is in effect solving, for each period,

$$\min_{\{a,s\}} g$$

$$\text{s.t. } u \geq 0 .$$

Proposition 1

Without information asymmetry, the optimal contract between the assembler and the OEM supplier can be characterized by

$$u = 0$$

and

$$H'(a^{OEM}) = \alpha = 1 .$$

In this problem, the OEM supplier will receive only her reservation utility and exert a level of effort that is Pareto efficient because of symmetry of information.

Next, consider the assembler 's problem when he faces an ODM supplier:

$$\min_{\{a_t, s_t\}_{t=1}^T} \sum_{t=1}^{T} \gamma^{t-1} \int_{\underline{w}}^{\bar{w}} g_t f(w_t) dw_t \qquad \text{(A-ODM)}$$

$$\text{s.t. } u_t \geq 0, \forall t \text{ and } \{a_t\}_{t=1}^T \text{ maximizes } V = \sum_{t=1}^{T} \gamma^{t-1} u_t .$$

The revelation principle does not apply here in the absence of commitment.[11] Moreover, the assembler is not concerned about the ODM supplier 's report on w_t any more than her cost-reducing effort. So the assembler will minimize his total expected discounted payments subject to the ODM supplier 's individual rationality and incentive compatibility constraints.

Given the passive target-setting role of the assembler, a set of optimal decision rules $\{a_t^{ODM}\}$ for the ODM supplier can be found by solving her decision problem alone. The optimal solution can be described in the following proposition.

Proposition 2

The optimal contract between the assembler and the ODM supplier can be characterized by

$$H_t'(a_t^{ODM}) = \frac{\alpha}{1+\frac{\lambda\gamma}{1-\gamma}} \leq \alpha .$$

Proof

The ODM supplier 's objective function can be expressed as

$$V = \sum_{j=1}^{T} \gamma^{j-1} u_j . \tag{4}$$

To have a closed-form solution, let $T \to \infty$ [12] and use the fact that

$$\sum_{j=t+1}^{\infty} \gamma^{j-1}(1-\lambda)^{j-t-1} = \frac{\gamma^t}{1-\gamma+\lambda\gamma} .$$

Then (4) can be rewritten as

$$V_\infty = \sum_{t=1}^{\infty} \gamma^{t-1}[k + \alpha(c_0^T(1-\lambda)^t - c_t^\Lambda) - H_t(a_t)] + \sum_{t=0}^{\infty} \alpha(\lambda c_t^\Lambda - \delta)\frac{\gamma^t}{1-\gamma+\lambda\gamma}, \tag{5}$$

where V_∞ indicates that an infinite horizon problem is being solved.

Using (3), (5) can be reduced to

$$V_\infty = \sum_{t=1}^{\infty} \gamma^{t-1}[\frac{\alpha}{1+\frac{\lambda\gamma}{1-\gamma}} a_t - H_t(a_t)] + Z , \tag{6}$$

where

$$Z = \sum_{t=1}^{\infty} \gamma^{t-1}[k + \alpha c_0^T(1-\lambda)^t - \frac{\alpha}{1+\frac{\lambda\gamma}{1-\gamma}}(c_t^T + w_t)] + \alpha\lambda c_0^\Lambda \frac{1}{1-\gamma+\lambda\gamma} - \sum_{t=0}^{\infty} \alpha\delta \frac{\gamma^t}{1-\gamma+\lambda\gamma} .$$

Note that Z is a constant independent of $\{a_t\}$. The variable part of (6) is additively separable across periods in functions of a_t. Therefore, (6) will be maximized if and only if in each period t, a_t is selected to maximize

$$\frac{\alpha}{1+\frac{\lambda\gamma}{1-\gamma}} a_t - H_t(a_t) ,$$

or

$$H_t'(a_t^{ODM}) = \frac{\alpha}{1+\frac{\lambda\gamma}{1-\gamma}} \leq \alpha .$$

Note that the optimal value a_t^{ODM} does not depend on c_t^T. Given that the second-order condition ($H_t'' > 0$) is satisfied by assumption, the optimal value must be an interior solution. *Q.E.D.*

Overall, the solutions seem myopic at best. Both types of the suppliers will only look at the parameters negotiated at time 0 to determine their behaviors. In the case of (A-ODM), where the assembler has imperfect information about w_t, the supplier will be able to exert less effort and enjoy more information rent than in the case of (A-OEM), where the assembler has complete control. To induce more effort, the assembler has to reward more (*i.e.*, increase α) and/or punish less (*i.e.*, decrease λ) for the ODM supplier 's investment in cost-reducing effort.

The solution to (A-OEM) says nothing about λ with respect to the ODM supplier. Presumably, it should be higher than that for the ODM supplier to bring the OEM supplier in line with the assembler 's policy. It can be called a "carrot-and-stick" approach toward the OEM supplier.

On the other hand, since these parameters are determined ex ante during the negotiation process before mass production begins, this scheme calls for more bargaining power for the ODM supplier as opposed to the OEM supplier, relative to that of the assembler. This may be called a "honey-and-sugar" policy for the ODM supplier.

It seems paradoxical at first to compare the results of Propositions 1 and 2 because the OEM supplier receives $H_t'(a_t^{OEM}) = \alpha = 1$ while the ODM supplier receives $H_t'(a_t^{ODM}) \leq \alpha$, implying that the OEM supplier may be given a better bargaining position in terms of α. In fact, the larger share of (relation-specific) investment gain paid to the OEM supplier can be interpreted as merit from the assembler and his intention to cultivate the OEM supplier, who is more vulnerable, rather than an expression of larger bargaining power on the part of the OEM supplier.

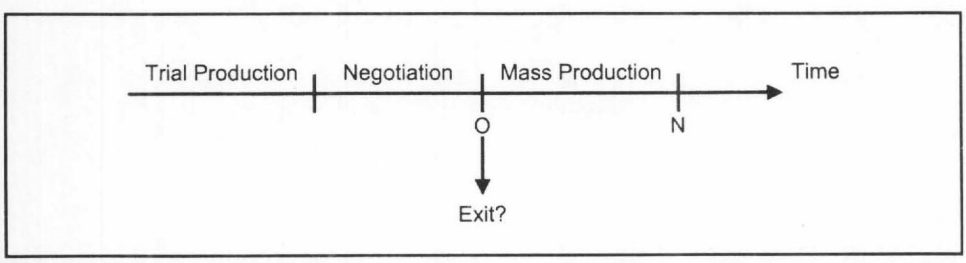

Figure 2. Procurement Process Sequence.

OPTIMAL PROCUREMENT POLICY

The detailed contractual relationship between the assembler and the supplier will be studied in this section. Figure 2 presents the sequence of the procurement process used.

In his procurement policy, the assembler specifies x units of a particular component for trial production and z units of projected demand for mass production by the designated supplier, if this stage is ever reached. The supplier realizes the unit cost of c during trial production and reports $\hat{c}$ instead.

Unit compensation is a function of the reported cost, $s = s(\hat{c})$ and is agreed upon beforehand. It is assumed that s is increasing in $\hat{c}$. The assembler has a procurement target cost, c^T, that he is willing to pay for each unit of the component acquired. This target cost is determined by considering competitive price in the market and his own desired target profit and is given exogenously in the model.

The final target unit price for mass production, p^T, is determined by

$$p^T = \min \{s(\hat{c}), c^T\} .$$

The rationale is simple. If the supplier reports $\hat{c}$ such that the required compensation $s(\hat{c})$ is smaller than c^T, the assembler will not insist on paying c^T. That is, $p^T = s(\hat{c})$ for $s(\hat{c}) \le c^T$. On the other hand, if $s(\hat{c})$ is larger, there will be no mass production allowed unless the supplier accepts a lower compensation, c^T. That is, $p^T = c^T$ for $s(\hat{c}) > c^T$.

In order to produce the x units (and the z units, if called for later) of the component, the supplier has to invest a fixed cost F in capital assets, which will also enable her to find out the actual cost of production. A portion of the fixed cost, $(1-\beta)F$, can be recovered if no mass production follows. In other words, βF can be regarded as sunk once trial production begins.

In this section, a long-term relationship between the assembler and the supplier exists when the mass production is conducted following the trial production. Short-term relationship, on the other hand, indicates a situation where the supplier quits after just the trial production.

The Supplier's Problem

The model is developed backward from the mass production stage on. At mass production stage, it is assumed that a price target, p^T, has been agreed upon. Then the supplier has to choose an optimal level of cost-reducing effort, a^*, to maximize

$$V^P = \int_0^N \{p^T - [c - B(a)]\} z e^{-rt} dt - \phi a ,$$

where

V^P = the net present value of the supplier 's profit during mass production, evaluated at time 0, when mass production begins (see Figure 2),

ϕ = the acquisition cost per unit of cost-reducing effort.

γ = the discount rate, or the supplier 's cost of borrowing funds elsewhere.

N = the length of the mass production period.

a = the number of units of cost-reducing effort, and

B(a) = cost saving per unit time upon adoption of a units of cost-reducing effort, $B'(a) > 0$.

Recall that c and z are, respectively, the supplier 's realized unit cost of production and mass production volume. The following proposition summarizes the supplier 's optimal responses at mass production stage.

Proposition 3

(1) Increases in cost-reducing effort reduce production costs at a diminishing rate.

(2) Cost-reducing effort will not be undertaken unless the supplier is allowed to at least recover her costs.

(3) Increases in the length of the mass production period encourage more cost-reducing effort.

(4) Higher cost of borrowing funds will lower the optimal level of the cost-reducing effort.

(5) Increases in the cost of cost-reducing effort decrease the optimal level of the cost-reducing effort.

Proof

V^P can be rewritten as

$$V^P = \frac{1}{\gamma}(1-e^{-\gamma N})\{p^T - [c - B(a)]\}z - \phi a .$$

Necessary and sufficient conditions for the supplier 's problem are, respectively,

$$V^{P'} = \frac{dV^P}{da} = \frac{1}{\gamma}(1-e^{-\gamma N})B'z - \phi = 0 \qquad (7)$$

and

$$V^{P*} = \frac{d^2V^P}{da^2} = \frac{1}{\gamma}(1-e^{-\gamma N})B^{*}z < 0 \tag{8}$$

From (8), we know that $B^{*} < 0$. In other words, cost savings are increasing at a decreasing rate as the level of cost-reducing effort increases.

If $N = 0$, then $V^P = -\phi a$. In this case, the optimal solution will have the supplier exert no cost-reducing effort; i.e., $a = 0$. Comparative statistics results are derived from (7) using implicit function rule.

$$\frac{da}{dN} = \frac{-\gamma e^{-\gamma N}B^{'}}{(1-e^{-\gamma N})B^{*}} > 0 .$$

$$\frac{da}{d\gamma} = \frac{[1-(1+\gamma N)e^{-\gamma N}]B^{'}}{\gamma(1-e^{-\gamma N})B^{*}} < 0 .$$

$$\frac{da}{d\phi} = \frac{\gamma}{(1-e^{-\gamma N})B^{*}z} < 0 \ .Q.E.D.$$

This proposition shows the possibility to implement a lagged price adjustment scheme in which the assembler sets a price which will last for a certain period of time (in this model, N periods) and allows the supplier to exert cost-reducing effort and enjoy cost savings therein.[13] However, it is only partially implemented because in this model there is no review of target cost after mass production begins and therefore no new (lower) target cost being set. The results are still valid and can provide policy guidance for the assembler. For example, to encourage cost-reducing effort, the assembler can extend the mass production period, arrange low-cost funds for the supplier, or even make the supplier 's effort less costly by providing technical assistance.

Next, assume that the supplier wants to maintain a long-term relationship with the assembler. To formalize this idea, let the supplier choose $\hat{c}$ so that $s(\hat{c})$ satisfies

$$V^S(a^{*}) + sx - F - cx \geq sx - \beta F - cx , \tag{9}$$

where

$$V^S(a^{*}) = \max_a \ V^S\left(= \int_0^N \{s(\hat{c}) - [c - B(a)]\}ze^{-rt}dt - \phi a\right).$$

The left-hand side of the inequality (9) represents what the supplier will receive, evaluated at time 0, if she participates in mass production when $s(\hat{c})$ is paid; the right-hand side, her exit compensation from trial production. (9) can be simplified to get

$$V^S(a^{*}) \geq (1-\beta)F . \tag{10}$$

In other words, it is assumed that the supplier will not exaggerate reported cost of production "too much" in order to earn higher short-term profit from trial production and quit afterwards. From this assumption follows the next proposition.

Proposition 4

(1) There exists a critical value, $\underline{s}$, such that the supplier will participate in mass production only if $s(\hat{c}) \geq \underline{s}$.

(2) In the model, a full-cost-plus compensation scheme is necessary to sustain the long-term relationship between the assembler and the supplier.

Proof

From (10), by solving explicitly for $s(\hat{c})$, a critical value, $\underline{s}$, can be found such that

$$s(\hat{c}) \geq \underline{s} = [c - B(a^*)] + \frac{\gamma}{1 - e^{-\gamma N}} \frac{(1-\beta)F + \phi a^*}{z}. \tag{11}$$

It is consistent with a full-cost-plus contract as is normally observed in practice. To see why, express $s(\hat{c})$ as

$$s(\hat{c}) = \underline{s} + k_1$$

or

$$s(\hat{c}) = \underline{s}(1 + k_2), \tag{12}$$

where $k_1 \geq 0$ is the profit margin and $k_2 \geq 0$ the profit margin ratio. It is obvious that both equations in (12) satisfy (11) and are indeed full-cost-plus contracts desired by the supplier. *Q.E.D.*

The right-hand side of (11) indicates that, from the supplier's perspective, the assembler should pay, for each unit produced, at least the cost of production less the cost savings achieved ($c - B(a^*)$) plus the compensation for part of the fixed cost ($(1-\beta)F$), which would have been recovered from quitting after trial production and cost-reducing effort (ϕa^*), both unitized by the mass production volume and multiplied by a time factor.

Notice that another part of the fixed cost, βF, is missing from the formula. It is tempting to interpret this as having been sunk already, with or without mass production. However, another interpretation for its absence in the critical value formula may be more plausible in this setting and has a counterpart in real-world situation. That is, it may be composed of capital outlays for equipment such as dies and tools which have alternative uses for the supplier in other projects. Since it is not specifically related to the assembler's project, the supplier does not expect to get reimbursed for such expenditures.

Since $s(\hat{c})$ is increasing in $\hat{c}$ by assumption, it is invertible. From (11), we can also find a critical value for $\hat{c}$, $\underline{c}$, such that

$$\hat{c} \geq \underline{c} = s^{-1}(\underline{s}) . \tag{13}$$

Proposition 5

To maintain a long-term relationship with the assembler and remain viable, the supplier will report cost of production satisfying (13).

Corollary

Whether the supplier reports the true cost or not is irrelevant in this model. Trying to induce the supplier to report the true cost of production may not be efficient.

Proof

The proof is done through a counterexample. Consider the case where the supplier underreports cost of production (*i.e.*, $\underline{c} \leq \hat{c} \leq c$) in order to launch mass production and recoup losses later through cost-reducing effort. If she is forced to tell the truth, mass production may never get started because of the assembler's target cost constraint. Both parties suffer. *Q.E.D.*

The Assembler's Problem

Designate the optimal value of V^P (the net present value of the supplier's profit during mass production, evaluated at time 0) by $V^P(a^*)$. Then it becomes obvious that, from the assembler's perspective, the supplier will participate in mass production only if she cannot do worse participating than simply pulling out after trial production. That is, the following condition must be satisfied:

$$V^P(a^*) \geq (1-\beta)F .$$

Equivalently, a sufficient condition for the supplier's departure is

$$V^P(a^*) < (1-\beta)F . \tag{14}$$

(11), (12) and (13) together show that the sufficient condition for the supplier's departure can be extended to

$$s(\hat{c}) \geq \underline{s} > p^T = c^T ,$$

or

$$\hat{c} \geq s^{-1}(\underline{s}) > s^{-1}(p^T) = s^{-1}(c^T) .$$

One the one hand, the supplier asks for at least $\underline{s}$ for each unit produced, taking into consideration cost savings potential from optimal cost-reducing effort exerted; on the other,

constrained by target procurement cost, the assembler wants to pay less than that, effectively asking the supplier to exert more effort (than she is willing to). In this case, no agreement can be reached and the supplier 's departure becomes inevitable.

If the supplier decides to quit, the assembler 's project may be in jeopardy. In the model, there is no obvious way out unless it is extended. One possibility is to introduce a second qualified supplier, the timing of which can be either at the beginning of trial production stage or after breakdown of negotiation. The first case allows for competition and presumably will lower the target price, thereby bringing it under the cap. The second case takes advantage of the first supplier 's reported cost ($\hat{c}$), which is publicly available, and allows the assembler to invite only those qualified suppliers who are willing to produce the z units at a cost less than $\hat{c}$.[14]

A second possibility is to negotiate a long-term contract with the supplier whose duration will cover several mass production stages. In such a contract, the supplier will be asked to stay throughout the whole contract period and accept pre-defined cost-reducing targets over time in exchange for initial higher compensation. This way, the assembler will break even or do better, depending on his target cost goal.

CONCLUSION

When confronted with increasing pressure to lower costs, a utility maximizing supplier will react to the assembler 's contract offer with corresponding level of cost-reducing effort exerted, given that the contract is accepted. However, different types of suppliers are expected to react differently. Considering the Japanese automotive industry in particular and manufacturing businesses in general as the backdrop, this paper compares the behavior of the OEM and the ODM suppliers in the presence of a fixed, cost-plus contract. The different degrees of information asymmetry between the assembler and the two suppliers lead the former to have complete control over the OEM supplier 's cost-reducing effort while leaving the ODM supplier room for information rent. The issue of bargaining power between contracting parties is also explored.

The contractual scheme is then relaxed to derive an optimal procurement policy for the assembler. It turns out to be a linear one, the transfer payment to the supplier consisting of net production cost (i.e., production cost net of savings from cost-reducing effort) plus compensation for the costs of cost-reducing effort and part of the fixed assets purchased for the project. The result also demonstrates the potential to implement a lagged price adjustment mechanism in which the supplier enjoys additional cost savings once the target cost has been met during the current contract period. In other words, the extra savings from the supplier 's cost-reducing effort will not be exploited by the assembler until the next round of contract negotiation begins, in which a new (and lower) target cost will be set. The assembler is encouraged to foster a closer tie with the supplier through longer-term relationship building, providing technical and technological assistance, and even arranging lower-cost loans for the supplier in exchange for the latter 's willingness to reduce costs further. The assembler will be better able to share market pressure with his network of suppliers and concentrate on improving products and services.

Two limitations to the modeling approach here can be relaxed or amended in future research. The assembler 's target procurement cost plays a crucial role in determining the fate of the mass production stage and the project as a whole, but it is given exogenously. It would be better if this target cost can be determined as a decision variable in the model. Also, the model entails essentially one big period, leaving price adjustment incomplete and the assembler 's role passive. Extending the model to one more period will infuse richer results.

ENDNOTES

The author would like to thank an anonymous reviewer and the participants of 30th WDSI annual meeting for their invaluable comments and suggestions.

1. See the Outsourcing Institute 's web site at www.outsourcing.com.
2. See, for example, Davis *et al.* (1998), Christopher (1998) and Simchi-Levi *et al.* (2000).
3. See also Gietzmann & Larsen (1998).
4. Survey of current and potential outsourcing end-users (The Outsourcing Institute Membership, 1998).
5. See, for example, Horngren, Foster & Datar (2000).
6. Cooper & Slagmulder (1997).
7. "An agent with a high performance today will tomorrow face a demanding incentive scheme. He should thus be reluctant to convey favorable information early in the relationship." (Laffont & Tirole 1988)
8. Let $p = b + a (c - b)$ be the unit price for a component, where b is the target price including negotiated profit margin and c the realized average cost preceding the price revision. If the sharing parameter a is zero, the contract is set at a fixed price. If a is one, the contract is cost-plus. If $0 < a < 1$, this is an incentive contract.
9. It will be interesting to see which contract form (i.e., incentive, fixed-price, or cost-plus) fares better in multi-period setting.
10. The industries included in their paper are textiles, clothing, iron and steel, nonferrous metals, metal products, machinery, electrical machinery and equipment, transportation equipment, and precision instruments. Some of them are related to the auto industry.
11. See Laffont & Tirole (1988).
12. Imagine that both the assembler and the ODM supplier determine the target infinitely often during the whole contract periods.
13. "Citizen Watch demands its suppliers decrease their costs a minimum of 3 percent per year. This 3 percent decrease in cost is included in the budget. *Suppliers keep any cost saving in excess of 3 percent* [emphasis added]" (Blocher, Chen & Lin, 1999, citing Cooper (1993)).
14. The timing differences may distinguish various types of sourcing schemes in the literature. In dual or multiple sourcing, the assembler sources from two or more suppliers at the same time. See Klotz & Chatterjee (1995) and Seshadri, Chatterjee & Lilien (1991). In second sourcing, the assembler allows a supplier to trial produce for some time, and then asks her to share technology with a second supplier, who will later compete with the first supplier in the reprocurement stage. See Anton & Yao (1987), Demski, Sappington & Spiller (1987), Farrell & Gallini (1988), and Riordan & Sappington (1989).

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The Numerical Accuracy of Statistical Calculations in Excel 2000 and Minitab Version 13

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Certain statistical procedures available in Excel 2000 and Minitab Version 13 are assessed for their numerical reliability. Both Excel and Minitab are widely used in teaching as well as in industry for statistical analysis, so numerical accuracy is important. Minitab is very accurate in the three areas tested: computing univariate statistics, regression, and anova. Excel has shortcomings of which users should be aware. Comparisons are also made to results from previous research on SAS and SPSS. Minitab compares favorably to both these statistical packages.

INTRODUCTION

Recently McCullough (1998) proposed a methodology for assessing the numerical reliability of statistical software using the Statistical Reference Datasets (StRD, available at http://www.nist.gov/itl/div898/strd). These datasets provide a collection of accuracy benchmarks that have been compiled by the National Institute of Standards and Technology (NIST). The data sets are provided along with values for certain statistics certified to a number of decimal places. The certified values can be used to assess the ability of statistical packages to provide accurate computation of these statistics.

In this paper, the procedures available in Excel 2000 and Minitab Version 13 are assessed for their numerical reliability. Since Excel is being used more and more often for educational purposes and in the business world for statistical computations, this type of assessment is important. At the least, recognition of any shortcomings in the numerical reliability should be noted. McCullough and Wilson (1999) examined the accuracy of the statistical procedures in Excel 97 and found them to be lacking. They recommend against the use of Excel 97 for analysis of data. Knüsel (1998) also examined the accuracy of statistical distributions in Excel 97 and found that tail area computations were often inaccurate. This paper extends the results of McCullough and Wilson (1999) to Excel 2000. The procedures in Minitab Version 13 are evaluated against the same benchmarks. Minitab has not been previously evaluated to my knowledge. Minitab is a widely used package for teaching and in industry, so numerical accuracy is important.

THE StRD DATA SETS

The StRD data sets created by NIST have been developed according to level of difficulty. Three levels of difficulty are available, denoted Low (L), Average (A) and High (H).

Univariate Statistics

There are nine data sets in the univariate suite. Six are classified as L: Michelso, PiDigits, Lew, Lottery, Mavro and NumAcc1; two as A: NumAcc2 and NumAcc3; and one as H: NumAcc4. For each data set, certified values are provided for the mean, standard deviation and the first-order autocorrelation coefficient to 15 digits. In this paper, only the mean and standard deviation will be examined.

Anova Tests

There are eleven data sets in the anova suite. Four are classified as L:SiRstv, SmLs01, SmLs02, and SmLs03; four as A:AtmWtAg, SmLs04, SmLs05, and SmLs06; and three as H: SmLs07, SmLs08, and SmLs09. Each data set is a one-way analysis of variance problem. For each data set, certified values are provided for the Abetween treatment@ degrees of freedom, Awithin treatment@ degrees of freedom, sums of squares, mean squares, the F-statistic, the R^2, and the residual standard deviation to 15 digits. Since most of the certified values are used in calculating the F-statistic, only this statistic will be examined.

Linear Regression

There are eleven data sets in the linear regression suite. Two are classified as L: Norris and Pontius; two as A: NoInt1 and NoInt2; and seven as H: Filip, Longley, Wampler1, Wampler2, Wampler3, Wampler4 and Wampler5. For each data set, certified values are provided for the coefficient estimates, standard errors of coefficients, the residual standard deviation, R^2, and the usual analysis of variance for linear regression table to 15 digits. The results shown are for the coefficient estimates and the standard errors of the coefficients.

RESULTS

The accuracy measure used throughout this paper is the negative base 10 logarithm of the relative error (LRE) defined as

$$LRE = -\log_{10}\left(\frac{|q-c|}{|c|}\right) \tag{1}$$

where q is the estimated value and c is the correct value. When q = c, the LRE is undefined, in which case McCullough (1998) suggests setting it equal to the number of digits in c. The LRE will be approximately equal to the number of correct significant digits in the estimate when q is close to c. However, using the LRE avoids certain problems encountered with counting of correct significant digits. The reader is referred to McCullough (1998, p. 360-361) for more detail on the LRE. Values considered acceptable for an LRE vary. McCullough suggests that low-difficulty linear procedures should have an LRE of at least nine, with decreasing LREs being acceptable for more difficult data sets.

Mean

The results for computing the sample mean are shown in Table 1. The certified value is shown for each data set as well as the computed values for Excel and Minitab. This table allows the reader to see the number of correct significant digits in the estimates. The associated LREs are in Table 2. Both Excel and Minitab are accurate in finding the value of the sample mean. The variation in the LREs reflects minor differences with all LREs either 14 or 15. For Excel, these results are the same as in McCullough and Wilson (1999) for Excel 97. In addition to the Excel 2000 and Minitab Version 13 values, the results given by McCullough (1999) for SAS and SPSS are shown.

TABLE 1
Computing the Sample Mean

Data Set	Certified Value	Excel	Minitab
Michelso	299.8524	299.8524	299.8523999999993
Pi Digits	4.5348	4.5348	4.5348.
Lew	-177.435	-177.435	-177.435
Lottery	518.95871559633	518.95871559633	518.95871559633
Mavro	2.001856	2.001856	2.001856
NumAcc1	10000002	10000002	10000002
NumAcc2	1.2	1.199999999999999	1.2
NumAcc3	1000000.2	1000000.2	1000000.1999999994
NumAcc4	10000000.2	10000000.2000001	10000000.2000001

TABLE 2
LREs for Computing the Sample Mean

Data Set	Excel	Minitab	SAS	SPSS
Michelso:	15	14.5	15	15
Pi Digits	15	15	15	14.7
Lew	15	15	15	15
Lottery	15	15	15	15
Mavro	15	15	15	15
NumAcc1	15	15	15	15
NumAcc2	14.0	15	14.0	15
NumAcc3	15	14.0	15	15
NumAcc4	14.0	14.0	14.0	15

Standard Deviation

For computation of the standard deviation, the story is different. The certified values and computed values for both Excel and Minitab are shown in Table 3. The associated LREs are in Table 4. This table also contains the LREs for SAS and SPSS as computed by McCullough (1999). Note that the Excel results are essentially the same as in McCullough and Wilson (1999). Minitab has LREs of 14 and 15 for all but two of the data sets. The average difficulty data set NumAcc3 has an LRE of 9 and the only data set in the H category has an LRE of 8. Excel has LRE=s of 15 on four of the lower difficulty level data sets along with LREs of 8 and 9 on the other two. On the average and high difficulty data sets, Excel's algorithm for standard deviation shows its weaknesses with LREs of 12, 1, and 0. The latter two results are disturbing.

TABLE 3
Computing the Sample Standard Deviation

Data Set	Certified Value	Excel	Minitab
Michelso:	0.0790105478190518	0.0790105482336454	0.0790105478190506
Pi Digits	2.86733906028871	2.86733906028871	2.86733906028871
Lew	277.332168044316	277.332168044316	277.332168044316
Lottery	291.699727470969	291.699727470969	291.699727470969
Mavro	0.000429123454003053	0.000429123453846293	0.000429123454003085
NumAcc1	1	1	1
NumAcc2	0.1	0.100000000000271	0.100000000000000
NumAcc3	0.1	0.107238052947636	0.100000000034925
NumAcc4	0.1	0.000000000000000	0.100000000558841

TABLE 4
LREs for Computing the Sample Standard Deviation

Data Set	Excel	Minitab	SAS	SPSS
Michelso:	8.3	13.8	13.8	12.4
Pi Digits	15	15	15	15
Lew	15	15	15	13.2
Lottery	15	15	15	15
Mavro	9.4	13.1	13.1	12.1
NumAcc1	15	15	15	15
NumAcc2	11.6	15	14.2	15
NumAcc3	1.1	9.5	9.5	9.5
NumAcc4	0	8.3	8.3	8.3

The performance of Minitab is reasonable for computing both the mean and standard deviation. As for Excel, the results suggest the need for incorporating a new algorithm to compute the standard deviation. Minitab performs well relative to SAS and SPSS in all cases.

As noted, these results mirror those of McCullough and Wilson (1999), suggesting that there have been no attempts at improving the algorithms of Excel. The deficiency in Excel's algorithm for the standard deviation leads MuCullough and Wilson to recommend against the use of Excel for data analysis. As an alternative in a teaching situation, this would provide an opportunity to have students program their own formula for standard deviation. It appears that Excel uses the formula:

$$\sqrt{\frac{\sum_{i=1}^{n} x_i^2 - n\bar{x}^2}{n-1}} \tag{2}$$

If the formula

$$\sqrt{\frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n-1}} \tag{3}$$

is programmed in Excel, the resulting LREs will be the same as those of Minitab.

Regression

The results for the coefficients in linear regression are shown in Table 5. Only the smallest LREs for the coefficients are shown in this table. This is consistent with McCullough's "a weakest link in the chain" principle: Use the minimum of the LREs for the statistic of interest. Excel does a reasonably good job of estimating the regression coefficients in all but one case. The Filip data set requires estimation of a 10^{th} degree polynomial regression, which results in a data set with extreme multicollinearity. Excel tries to estimate this equation but does not do a good job. Minitab prints out a warning about the high multicollinearity but goes ahead and computes the estimates and does a reasonably good job. SAS and SPSS do not even try to estimate the equation, pointing out the high multicollinearity. McCullough (1999) did note that the ORTHOREG command could be used in SAS to obtain a relatively accurate solution.

Excel has problems processing data sets with high multicollinearity. It would be better for Excel to compute some measure of multicollinearity and warn the user that estimates might be inaccurate or refuse to compute estimates if multicollinearity was extremely high rather than print out possibly inaccurate values. Given this caveat, Excel did reasonably well in all but the one case.

Minitab performs very well compared to SAS and SPSS in all cases.

TABLE 5
Minimum LREs for Estimates of Regression Coefficients

Data Set	Excel	Minitab	SAS	SPSS
Norris	12.1	12.2	12.3	12.3
Pontius	11.2	12.7	11.4	12.5
NoInt1	14.7	15	14.7	14.7
NoInt2	15	15	15	15
Filip	0	6.9*	ns	ns
Longley	7.4	12.7	8.6	12.1
Wampler1	6.6	9.6	8.3	6.6
Wampler2	9.6	12.6	10.0	9.7
Wampler3	6.6	9.3	7.0	7.4
Wampler4	6.6	8.7	7.0	7.4
Wampler5	6.6	6.8	7.0	5.8

* Prints out warning that predictors are highly correlated, but computes estimates.
ns Does not attempt to compute a solution.

Table 6 presents the LREs for the standard errors of the coefficients. The story here is essentially the same as for the coefficient estimates. Excel needs to check for extreme multicollinearity rather than trying to compute estimates. Otherwise it does reasonably well. Minitab does well overall.

To examine the deterioration of the estimates as the degree of multicollinearity increases, Table 7 shows the largest variance inflation factor for four of the data sets and also the LREs of the regression coefficient estimates for Minitab and Excel. Figure 1 shows the graph of LRE versus log (VIF). The LREs deteriorate much more rapidly for Excel than for Minitab. This relationship appears linear so a regression was fit using LRE as the dependent variable and log (VIF) as the independent variable. For Excel, the resulting equation is LRE = 10.5 - 0.264 log (VIF) while for Minitab it is LRE = 12.7 - 0.146 log (VIF). These equations can be used to predict the level where the two routines might be expected to fail. For example, with Excel, if an LRE of at least 5 is desired, log (VIF) should be no larger than 20.8. This would be a data set with an extremely high level of multicollinearity. However, since Excel does not include any multicollinearity diagnostics, it is impossible for the user to determine if a particular data set is a cause for concern.

ANOVA

Anova results are summarized using the F statistic value, since many intermediate values are used in computing this statistic. The LREs are summarized in Table 8. Excel handles the lower level difficulty data sets reasonably well, but performance on average and higher level

TABLE 6
Minimum LREs for Standard Errors of Regression Coefficients

Data Set	Excel	Minitab	SAS	SPSS
Norris	13.8	12.8	11.9	10.2
Pontius	14.3	11.8	9.2	8.9.
NoInt1	14.7	15	15	12.5
NoInt2	15	15	14.9	14.3
Filip	0	7.8*	ns	ns
Longley	8.5	14.3	10.3	13.3
Wampler1	7.1	15	15	6.6
Wampler2	11.8	15	15	9.7
Wampler3	11.2	13.5	10.9	10.6
Wampler4	11.2	13.7	11.5	10.8
Wampler5	11.2	13.7	11.5	10.8

* Prints out warning that predictors are highly correlated, but computes estimates.
ns Does not attempt to compute a solution

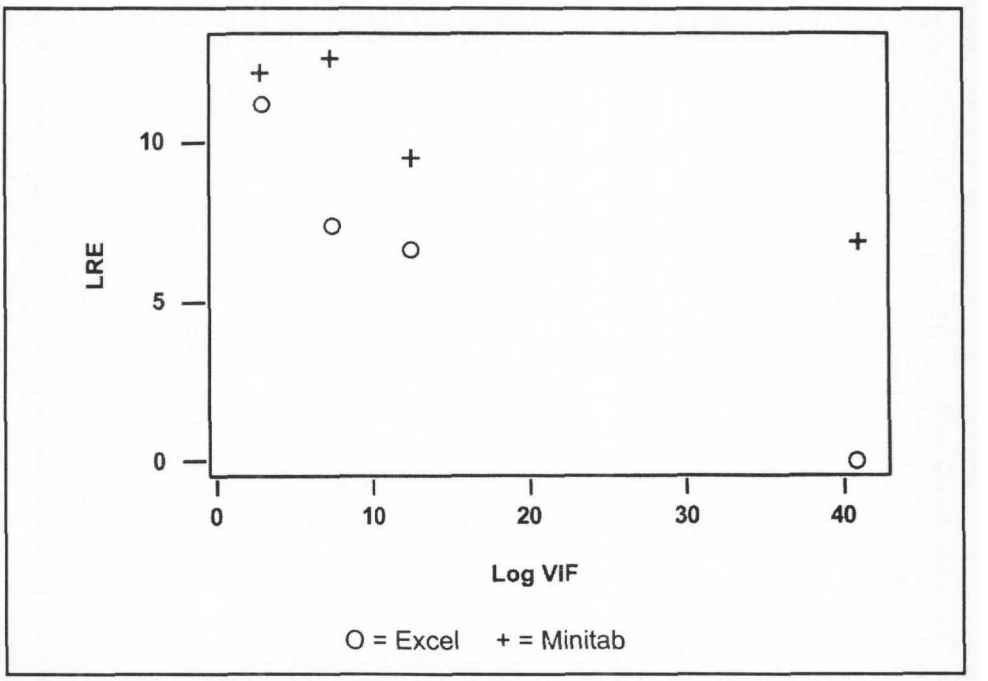

Figure 1. Graph of Log VIFs versus LREs for Minitab and Excel

TABLE 7
Minimum LREs and Maximum Variance Inflation Factors (VIFs)

Data Set	Maximum VIF	Excel	Minitab
Filip	5.5083E+17	0.0	6.9
Longley	1788.5	7.4	12.7
Norris	17.7	12.1	12.2
Wampler 1	261337.4	6.6	9.6

difficulty data sets is poor. Note that this is also true with SPSS and SAS. Revised algorithms for all three of these procedures should be implemented. It was more difficult to determine the LREs for Minitab since I could obtain the F statistic only to a limited number of significant digits. As a result, these values must be considered approximate. Given that, Minitab seems to do a good job with most of the data sets. The low value for SiRstv (3.4) is likely understated due to rounding. Three of the higher values (the 15s on SmLs04, SmLs05 and SmLs06) might be overstated due to rounding. Accuracy on the last three data sets drops for Minitab as well as for the other three packages although Minitab does better on SmLs07 and SmLs08.

TABLE 8
LREs for Anova F statistic

Data Set	Excel	Minitab	SAS	SPSS
SiRstv	7.4	3.4	8.3	9.6
SmLs01	14.3	15	13.3	15
SmLs02	12.5	15	11.4	15
SmLs03	12.6	15	11.8	12.7
AtmWtAg	1.8	3.7	0	miss
SmLs04	1.7	15	0	0
SmLs05	1.1	15	0	0
SmLs06	0*	15	0	0
SmLs07	0*	2.7	0	0
SmLs08	0	2.2	0	0
SmLs09	0*	0	0	0

* Computed negative F statistic value
miss Reported system missing-value

CONCLUSION

The accuracy of various statistical procedures in Excel 2000 and Minitab Version 13 was investigated using the StRD data sets. These results were compared to McCullough's (1999) results for SPSS and SAS. Results are as follows:

All packages compute the mean with acceptable accuracy. Excel has an inefficient algorithm to compute the standard deviation and will fail to compute an accurate value in some cases. It would be advisable to implement a different algorithm in Excel.

All four packages do a reasonable job of computing accurate values for regression coefficients and standard errors. Excel does fail when multicollinearity is extreme. SAS and SPSS may choose not to compute estimates in such extreme cases. Minitab produces a warning, but goes ahead and computes reasonably accurate estimates. The accuracy of Excel on less extreme data sets is not as high as that of the other three packages, but is reasonable.

All packages do reasonably well on the lower level difficulty data sets in the ANOVA category, but all have trouble on certain of the data sets in the average and higher level groups. Minitab seems to do the best job of all four packages in this category, although this result must be tempered somewhat, since enough digits of accuracy to make thorough comparisons for the F statistic were not available.

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