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FROM THE EDITOR'S DESK

Articles for this issue were selected from the best papers of the Western Decision Sciences Institute's 24th annual conference held in San Francisco on April 11-15, 1995. Of the thirty-two best papers, twenty-one were submitted for publication consideration and seven were selected for inclusion in this issue.

The selection reflects the international composition of the WDSI; three of the seven articles were authored by individuals from countries outside the United States: Canada, England and Sweden.

This issue contains a number of interesting articles. Much of the research on the prediction abilities of various accounting ratios has focused primarily on predicting bankruptcies, bond ratings and beta while assuming a positive relationship between stock prices and profitability. The paper by **GUN-HO JOH** is an empirical investigation of that assumption. Nine profitability ratios from financial statements are selected to examine their relationship to the market's value. The findings indicate that among these ratios, return on total assets shows the highest correlation with stock prices.

Traditional management control systems have been under increasing criticism for their inability to promote organizational flexibility. The article by **SVEN MODELL** proposes a more holistic three-dimensional approach to management control systems. The author also recommends closer integration between management control and human resource management theory.

TERRY E. DIELMAN and **ELIZABETH L. ROSE**'s study compares several different estimation techniques in least absolute value (LAV) regression with autocorrelated errors. Using Monte Carlo simulation methods, the authors argue for always correcting for autocorrelation since there is little loss in terms of estimation performance. Furthermore, the

Prais-Winsten-type correction is preferable to the Cochrane-Orcutt-type correction.

SUSAN A. SIMMONS aims to determine whether the pharmaceutical industry becomes more efficient as it grows larger. Her results indicate that while returns to R&D and sales are characterized by diseconomies of scale, firms of all sizes experience increasing returns as their research efforts increase.

The Total Quality Management (TQM) approach was started within industry, but has been spreading to other sectors. After an overview of some strategic issues facing higher education, **GLORIA L. LEE** argues for implementing Business Process Redesign (BPR) by building on the gains achieved through TQM as a way forward. The discussion and recommendations draw on her experiences in her own institution in England and another in the U.S.A.

Teaching the principles and applications of TQM has been challenging partly because of their complexity. Using iconization and diagrammatic mind mapping rather than text, **GEORGE E. McMASTER** and **JOHN CHYZYK** illustrate a methodology successfully used for training to teach the principles and implementation of TQM. The authors find their methodology more effective than theirs.

Traditional approaches to classroom instruction may not be appropriate because today's environment is becoming more interdependent. One important change in this connection is a shift of emphasis from individual performance to team performance. This shift has produced the so-called "competitive" versus "cooperative" debate. In our last article, **JANET B. WOLVERTON** and **LAURA J. YALE** report student perceptions suggesting that in both objective and subjective learning, the cooperative model is superior to the traditional competitive model.

FRANKLIN STRIER

BURHAN F. YAVAS

ON THE USEFULNESS OF ACCOUNTING RATIOS IN EXPLAINING SECURITY RETURNS

Gun-Ho Joh*

Many financial analysts argue that a firm's profitability is related with its stock price. Examining a sample from 1993 Annual Industrial Compustat and monthly CRSP, we find that return on total assets shows the highest correlation with stock prices among various profitability ratios. After controlling for industry classification, the average adjusted R^2 of the price-profitability regressions improves significantly. Including another profitability ratio in addition to return on total assets does not significantly increase the explanatory power of the relationship between abnormal returns and profitability ratios. The adjusted R^2 of the regressions are in general marginally significant and this study weakly supports the analysts' belief.

Research on accounting ratios has generally progressed on two fronts. The first is descriptive: to examine the properties of and correlations among the ratios available in an attempt to find a manageable set of ratios suitable for analytic purpose. There are many papers documenting the stochastic properties of these accounting ratios in this area¹. The second approach uses ratios as inputs in specific prediction models. Most papers in this area study prediction abilities of various accounting ratios for bankruptcy, bond rating, and beta². A few studies document whether each of these ratios represents a firm's market value or a firm's profitability ratios in relationship with its market value. Pinches et al. (1975) documents that there is a group of accounting ratios that signal a firm's return on investment using factor analysis. Other studies including Chen

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and Shimerda (1981) and Johnson (1979) show that the ratios documented in Pinches et al. are stable and comprehensive. Peter Easton (1985) documents that an average R^2 between the levels of stock prices and earnings is approximately 60 percent. The regressions in Peter Easton, however, have a heteroscedasticity problem inflating the coefficient of determination. (see: Footnote 19 of Peter Easton, 1985 and Joseph Magliolo III, 1985). A more appropriate method for our study is to compute the changes of the ratios instead of the level to control for the share size effect.³ Bowen et al. (1987) evaluates incremental information content of accrual and cash flows, running multivariate regressions of cumulative standardized abnormal returns on the growth rates of both variables. The growth rate may be biased when the prior year's value is negative. The average R^2 of the bivariate regressions is 4.5 percent. This paper evaluates changes of the financial ratios instead of the growth rates and examines accounting ratios more comprehensively, which possibly increase the correlation. Few other authors, however, test empirically any direct relationship between a group of profitability ratios based on the numbers available from financial statements and a firm's value. Although little research documents the relationship between a firm's value and its profitability ratios, numerous analysts assume a strong and positive relationship between stock prices and profitability as follows.⁴

1. When corporate earnings rise as companies' profitability increases, investors are willing to pay more for shares in hopes of reaping bigger dividends. (The Toronto Star, August 14, 1994)
2. CEO has been working on a plan to return it to profitability and boost its stock price.(USA Today, July 14, 1994)
3. [T]he profitability pushed many bank stock prices to new highs. (Business Journal-Milwaukee, June 25, 1994)

This paper tests the analysts' belief, evaluating the relationship between stock prices and profitability ratios. Since the newspaper articles do not

specify which profitability ratios are closely related with stock prices, we select nine profitability ratios, which are based on the numbers available from financial statements, and examine whether a ratio or a group of ratios can explain a significant part of stock price changes.

"A knowledge of the direct relationship between a profitability ratio and a firm's value . . . enables owners to design a better compensation contract using accounting ratios even when the firm's security price data are not available."

This paper examines relative and marginal information contents of nine accounting ratios of profitability based on the accounting numbers available from financial statements to evaluate their correlations with the firm's values. The nine accounting ratios examined in this paper are net income on total assets, earnings before interest and income taxes on total assets, operating cash flow on total assets, net income on sales, operating cash flows on sales, net income on capitalization, operating cash flow on capitalization, net income on owners' equity, and operating cash flow on owners' equity. Finding out a manageable set of the ratios can be very beneficial for financial analysis as it reduces the number of ratios that must be computed and monitored. Gibson (1987) summarizes the responses of 52 chartered financial analysts (CFAs) who were asked to rank the relative importance of 60 accounting ratios. The nine profitability ratios have the same ranks according to the survey. This study empirically compares relative and incremental information contents of each profitability ratio in

order to document a more parsimonious set which may have the same predictive power as the set of all nine ratios.

"Changes in earnings before interest and income taxes on total assets has the highest association with residual returns."

A knowledge of the direct relationship between a profitability ratio and a firm's value may help management direct their efforts to manage their firm's value and enables owners to design a better compensation contract using accounting ratios even when the firm's security price data are not available. Nevertheless, financial analysts can estimate an average effect of profitability change on the firm's stock price.

We examine the extent to which various profitability ratios are related with the firm's values. We document that changes in earnings before interest and income taxes on total assets has the highest association with residual returns, followed by changes of earnings before interest and income taxes on sales. This result suggests that, if a firm's performance is to be mapped into a single accounting ratio, earnings before interest and income taxes should be considered. When these numbers are divided by owners' equity, the ratio shows the lowest prediction power. The negative values of the denominator or the extreme values of the ratio significantly decrease the association between the ratio and firm value. In general, at most two accounting ratios jointly explain a firm's valuation sufficiently because of high correlations among various ratios which share the same accounting numbers as either their numerator or denominator. Although financial analysts expect a strong relationship between profitability and stock price, our test results suggest that the average of the explanation powers of the price-profitability relationship is disappointingly low. We

should be careful in interpreting analysts' articles on this price-profitability relationship.

This study is organized into five sections. In the following section, we describe our test hypotheses as well as the methodologies employed to calculate abnormal returns. Section III contains our sample construction procedure and basic descriptive statistics of the profitability ratios. Section IV explains our test results of relative and marginal information contents of the profitability ratios. We present a brief summary and conclusion in section V.

II. METHODOLOGY AND HYPOTHESES

A. The Basic Model

The basic model is a cross-sectional regression of abnormal returns on change in each ratio.

For firm i in period t :

$$CAR_{i,t} = \beta_{i,o} + \beta_{i,1}(PR_{i,t} - PR_{i,t-1}) + \varepsilon_{i,t} = \beta_{i,o} + \beta_{i,1}\Delta R_{i,t} + \varepsilon_{i,t} \quad (1)$$

where $CAR_{i,t}$ is firm i 's cumulative abnormal return during a period starting from nine months before and to three months after the end date of fiscal year t , $PR_{i,t}$ is firm i 's profitability ratio (to be defined)⁵. Assuming a random walk of each accounting ratio, $\Delta R_{i,t}$ is a change of accounting ratio i in year t .

B. Computing Abnormal Returns

The dependent variable in (1) is estimated based on the standard market model methodology. That is, for each firm (i) in the sample, we estimate:

$$R_{i,t} = \alpha_i + \beta_i R_{mt} + \eta_{i,t} \quad (2)$$

using 60 monthly-return observations prior to the month when residual accumulation begins, $R_{i,t}$ being the equally weighted dividend adjusted monthly market return index from the tapes constructed by the Center for Research in Security Prices (CRSP) of the University of Chicago. Abnormal returns computed as the prediction errors using parameters estimated via (2), cumulated over a 12-month period, from 9 months prior to 3 months after the fiscal year end. When a firm changes its accounting period, the year of the change was dropped.

C. Evaluating Relative Information Content

In the Compustat tapes, variables are obtained as follows:

- (1) net income before extraordinary items
- (2) income before interest and income taxes
- (3) operating cash flow= net income before extraordinary items
+ depreciation expense - increase in working capital
+ decrease in working capital
- (4) total assets at the beginning
- (5) total common equity at the beginning
- (6) total capitalization amount at the beginning
- (7) net sales

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Based on these accounting numbers, we computed nine profitability ratios by dividing earnings variables by accounting numbers from balance sheet as follows:

	(1) Net Income	(2) EBIT	(3) OCF
(4) total assets	NITA	EBTA	OCTA
(5) O.E.	NIOE	EBOE	OCOE
(6) capitalization	NICP	EBCP	OCCP
(7) net sales	NISL	EBSL	OCSL

The nine accounting ratios examined in this paper are earnings before interest and income taxes over total assets (EBTA), net income over total assets (NITA), operating cash flows divided by total assets (OCTA), net income over net sales (NISL), operating cash flows over net sales (OCSL), net income over capitalization (NICP), operating cash flows over capitalization (OCCP), net income over owners' equity (NIOE), and operating cash flows over owners' equity (OCOE). We do not compute the three ratios (EBOE, EBCP, EBSL) because no prior research suggests to use these ratios. Computing accounting ratios for profitability of a firm, Lev and Sunder (1979) noted that a major function of the denominator of financial ratio is to control for size. However, a ratio approach to factorial control often causes deviations from what it really intends to measure. For example, Foster (1986, pp.99-101) suggests two computation issues: negative denominators and 'extreme' observations. This paper examines whether they cause disparity between the profitability ratios and market value of a firm. Regarding the selection of the numerator of each accounting ratio, net income is the final operating result after interest and taxes are deducted. It is therefore affected by the proportion of debt in the capital structure and the resultant interest charges. A somewhat more meaningful result can be obtained if we eliminate both interest and taxes

from the profit figure (White et al., 1994, p. 226). The earnings before interest and income taxes expresses the gross earnings power of the capital employed in the business independent of the pattern of financing that provided the capital and independent of changes in the tax laws. Operating cash flow is also examined because recent literature including Ali (1994) supports the importance of operating cash flows on valuation.

ΔR_k represents a change of the k th ratio. We estimated model (1) nine times in each period for the nine accounting ratios. And we compare the adjusted R^2 s of the nine regressions.

The null hypothesis for testing relative information content is:

$$H_0 1 : R_{\Delta R_j}^2 - R_{\Delta R_k}^2 = 0 \quad \forall k \neq j$$

where $R_{\Delta R_j}^2$ is the adjusted R^2 of the regression using accounting ratio j change (ΔR_j).

D. Evaluating Incremental Information Content

For this analysis, we use a step-wise regression and check the increased adjusted R^2 going from model (1) to:

$$CAR_{i,t} = \gamma_0 + \gamma_1 (PR_{i,j,t} - PR_{i,j,t-1}) + \gamma_2 (PR_{i,k,t} - PR_{i,k,t-1}) + \dots + \mu_{i,jk\dots,t} \quad (3)$$

Thus, the related null hypothesis is:

$$H_0 2 : R_{\Delta R_k | \Delta R_j \dots}^2 = R_{\Delta R_k \cdot \Delta R_j \dots}^2 - R_{\Delta R_j \dots}^2 = 0$$

where $R_{\Delta R_k | \Delta R_j \dots}^2$ denotes the increase in the adjusted R^2 due to the accounting ratio k 's change (ΔR_k), conditional on accounting ratio j 's

change (ΔR_j), etc. and $R^2_{\Delta R_k, \Delta R_j, \dots}$ denotes the adjusted R^2 due to accounting ratios $j \dots k$'s changes.

E. Controlling for Intertemporal and Cross-Sectional Differences

The return-profitability relationship is estimated (i) by year and (ii) by year but with sample firms separated into several major industry categories. Production technologies, input and output markets, regulations and accounting standards change over time. Thus, one would expect the return profitability ratios relationship year by year will reduce specification errors caused by this intertemporal variation. In addition, prior research such as Collins and Kothari (1989) has shown that one could further reduce specification errors by holding constant industry effects, since firm characteristics and industrial norms tend to change over time. We therefore estimate the return-profitability relationship by major industry categories in each year. To separate the firms into industry categories, we use the first digit of each firm's SIC classification. This approach potentially results in more cross-sectional specification errors than a finer classification, such as one based on the first two digits of each firm's SIC classification. However, our approach is dictated by the need to have sufficient degrees of freedom in each industry category.

III. DATA AND DESCRIPTIVE STATISTICS

A. Data Description

The sample period spans 17 years, from 1975 to 1991. There is an average of 479 firms in each of the 17 years, giving a total of 8139 observations. The sample was selected using the following criteria: (a) that data for calculating the nine profitability measures (total assets, net sales, owners' equity, capitalization, net income, net income before interest and income taxes, operating cash flows) are available from 1993 Expanded

Annual Compustat and 1993 Research Compustat, (b) that firms did not change their fiscal ending dates during last and current years and (c) that monthly return data are available from the CRSP Monthly Return File for 69 months prior to and three months after, the fiscal year end. Since both Expanded Annual Compustat and Research Compustat are used for the sample selection, the results are free from sample survivorship bias. The number of observations each year is, however, decreasing because of the observations from Research Compustat.

B. Descriptive Statistics

Table 1 presents some of the descriptive statistics of the changes of the nine profitability ratios assuming a random walk. For example, the first row shows that there are 808 sample firms for 1975. In that year, average change of NISL (Δ NISL) of the 808 firms was -0.0063; Δ OCTA, 0.0549; Δ OCOE, 0.1371; Δ NITA, -0.0049; Δ NIOE, -0.0182; Δ EBTA, -0.0093; Δ OCSL, -0.0106; Δ OCCP 0.0991; and Δ NICP -0.0085.

NI, in general, seems to have smaller cross-sectional variations than EBIT comparing NITA to EBTA. Out of 17 years, the 14 sample standard deviations of NITA are smaller than those of EBTA. Other gains and losses including interest expenses seem to smooth the cross-sectional differences. Since total assets are, in general, larger than O.E., OCTA shows smaller changes than OCOE. Absolute values of 16 average changes in OCTA are smaller than those of OCOE. A comparison between NITA and NIOE also shows the same results. This may imply that OE may increase the variations and the average values of accounting ratio changes because of its negative values. When OE is used as a denominator in each ratio, the ratio shows the largest average changes and variations. This is due to the negative values of OE.⁶ Since net sales are similar to total assets, NISL and NITA show a similar level of average changes.

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Table I
Descriptive Statistics of Yearly Changes of Accounting Ratios

Year	NO.	ΔNISL	ΔOCTA	ΔOCOE	ΔNITA	ΔNIOE	ΔEBTA	ΔOCSL	ΔOCCP	ΔNICP
1975	808	-0.63 (3.88)	5.49 (12.8)	13.71 (108)	-0.49 (3.07)	-1.82 (28.7)	-0.93 (4.92)	-1.06 (4.47)	9.91 (48.2)	-0.85 (5.09)
1976	761	0.31 (3.70)	-2.52 (11.3)	-7.67 (86.9)	0.47 (2.94)	1.20 (16.2)	0.79 (4.55)	0.41 (4.91)	-4.13 (44.6)	0.85 (5.09)
1977	720	0.22 (2.78)	-0.92 (10.1)	-2.71 (65.3)	0.32 (2.29)	0.69 (7.16)	0.44 (3.29)	0.22 (4.09)	-2.19 (26.5)	0.59 (3.49)
1978	657	0.47 (4.74)	-0.72 (15.8)	-3.94 (48.2)	-0.12 (13.7)	0.46 (16.7)	0.13 (14.3)	0.71 (5.71)	-0.85 (15.6)	0.60 (9.21)
1979	617	0.27 (3.92)	0.28 (9.15)	-10.9 (204)	0.30 (3.71)	-5.17 (132)	0.23 (4.84)	0.27 (5.52)	-4.44 (133)	-4.97 (132)
1980	554	-0.52 (6.70)	1.46 (10.8)	9.96 (224)	-0.79 (2.99)	-2.12 (114)	-1.04 (4.50)	-0.68 (6.58)	-1.92 (87.5)	-4.79 (83.4)
1981	514	-0.64 (5.35)	-0.11 (12.3)	7.10 (208)	-0.46 (4.44)	-0.21 (124)	-0.65 (6.46)	-0.90 (7.64)	6.23 (115)	3.61 (101)
1982	465	-0.22 (11.7)	0.93 (11.0)	-6.42 (193)	-1.74 (5.89)	-13.5 (171)	-2.90 (7.06)	-2.79 (12.2)	-7.81 (173)	-11.6 (170)
1983	446	1.04 (13.6)	-0.78 (16.8)	-0.41 (75.1)	-0.25 (15.1)	-3.12 (82.2)	-0.17 (15.5)	0.89 (13.8)	-2.27 (65.6)	-0.84 (69.5)
1984	423	1.31 (13.4)	-0.53 (10.6)	1.79 (91.8)	0.95 (4.64)	6.12 (104)	1.39 (5.45)	2.07 (20.9)	0.30 (38.9)	4.95 (98.9)
1985	387	-1.52 (15.3)	-0.41 (13.8)	-25.1 (365)	-0.85 (4.78)	-6.63 (119)	-1.56 (6.11)	-2.39 (20.8)	9.04 (249)	-10.3 (113)
1986	355	-3.26 (53.6)	-0.59 (11.1)	-0.65 (48.1)	-0.47 (5.10)	-2.53 (37.8)	-0.53 (5.63)	-2.49 (53.9)	-11.2 (251)	3.47 (78.8)
1987	320	-1.07 (17.3)	1.17 (9.96)	6.02 (89.2)	0.39 (3.87)	4.31 (66.9)	0.66 (4.78)	-0.46 (16.9)	0.58 (26.4)	1.35 (22.4)
1988	293	2.11 (21.0)	-2.77 (14.6)	-19.6 (142)	0.68 (3.98)	-1.32 (32.0)	0.54 (4.72)	1.84 (18.4)	-18.7 (187)	-7.37 (143)
1989	279	-2.73 (32.1)	3.12 (14.1)	22.83 (146)	-0.44 (5.39)	67.23 (1077)	-0.37 (4.75)	-1.96 (25.9)	20.25 (201)	9.22 (154)
1990	268	-0.31 (22.0)	0.69 (12.0)	138.3 (2071)	-0.37 (7.64)	14.43 (280)	-0.53 (7.20)	-0.83 (17.9)	2.02 (24.7)	-0.10 (11.3)
1991	272	1.90 (34.6)	0.46 (10.9)	-16.4 (231)	-0.26 (5.76)	-28.8 (337)	-0.91 (5.18)	0.95 (31.2)	-0.51 (23.2)	-2.07 (10.8)
mean	479	-0.19	0.25	6.23	-0.18	1.718	-0.318	-0.37	-0.34	-1.07

* In parentheses are sample standard deviations of changes of the respective ratios.

Table 2 presents the median values of the 17 yearly product-moment correlations of profitability ratio changes, with data pooled across firms. When two ratios have a common denominator or a common numerator, their correlation values are high such as the correlations between NISL and OCSL; NITA and EBTA; NICP and NIOE; and OCOE and OCTA. Since capitalization amounts are similar to total assets, NICP has a high correlation with NITA. These high correlations are consistent with Foster (1986, pp. 113-118).

Table 2

Median Values of Product-Moment Correlations

Δ NISL	1.000								
Δ NITA	0.721	1.000							
Δ NIOE	0.419	0.584	1.000						
Δ NICP	0.597	0.885	0.758	1.000					
Δ EBTA	0.573	0.881	0.426	0.733	1.000				
Δ OCSL	0.879	0.605	0.311	0.497	0.672	1.000			
Δ OCTA	0.196	0.280	0.095	0.205	0.263	0.158	1.000		
Δ OCOE	0.082	0.105	0.366	0.190	0.087	0.067	0.717	1.000	
Δ OCCP	0.149	0.256	0.169	0.310	0.246	0.139	0.944	0.759	1.000
Δ NISL	Δ NITA	Δ NIOE	Δ NICP	Δ EBTA	Δ OCSL	Δ OCTA	Δ OCOE	Δ OCCP	

Consequently, the related slope coefficients in multiple regressions using more than one accounting ratio having a common denominator or numerator should be interpreted with care. These high correlations may imply that the marginal information content of an additional ratio is not significant.

IV. TEST RESULTS

A. Relative Information Content

Model (1) is estimated in two ways, producing two sets of adjusted R^2 s. First, they are estimated year by year, pooling all sample firms available for each year. This results in 17 adjusted R^2 s, which are presented in Panel A of Table 3. Second, for each year we separate the sample firms into seven major industry categories using the first digit (from one to seven) of each firm's SIC classification and regressions are run by industry category.⁷

This is done for each of the 17 years, resulting in a total of 119 regressions for each profitability ratio. We then average the adjusted R^2 over time for each industry category. This gives seven adjusted R^2 averages for each ratio. The averages of the seven adjusted R^2 s are presented in panel B of Table 3. A comparison of the adjusted R^2 s in panel A in comparison with those in panel B indicates that controlling for industry effects is a useful procedure. Mean adjusted R^2 s in panel A range between 0.0001 and 0.0895 while mean adjusted R^2 s in panel B are between 0.0179 and 0.0967. Except $\Delta NISL$, the other ratios' mean adjusted R^2 s are increasing 38 times by controlling for industry. This is a significant improvement in explanatory power considering that only the first-digit SIC classification of industry is used. Panel A of Table 3 shows that $\Delta EBTA$ has the highest adjusted R^2 , followed by $\Delta NITA$, $\Delta NISL$, $\Delta OCSL$ and the others. An inspection of the adjusted R^2 s categorized by industries (panel B of Table 3) confirms the order.

Panel A of Table 4 strongly reinforces this belief. The Wilcoxon Z-statistic for $R^2_{\Delta NISL} - R^2_{\Delta EBTA}$ is -2.864, which is significant at the level of 0.05 and that for $R^2_{\Delta EBTA} - R^2_{\Delta NICP}$ is 3.195, which implies that the adjusted R^2 of $\Delta EBTA$ is significantly larger than that of $\Delta NICP$. It shows that the adjusted R^2 s of $\Delta EBTA$ are significantly larger than the adjusted R^2 s of the other ratios unanimously and the null hypothesis regarding the equality of

Table 3

A Comparison of the Goodness-of-fit of Model (1)

Panel A Year by Year Comparisons

Adjusted R² for Profitability Ratios

	ΔNISL	ΔOCTA	ΔOCOE	ΔNITA	ΔNIOE	ΔEBTA	ΔOCSL	ΔOCCP	ΔNICP
1975	0.0595	0.0099	-0.001	0.1254	0.0174	0.1301	0.0930	-0.001	0.0917
1976	0.0326	-0.001	0.007	0.0931	0.0388	0.1029	0.0436	-0.001	0.0551
1977	0.1981	0.0268	0.0176	0.1868	0.1214	0.1768	0.1758	0.0092	0.1773
1978	0.0220	0.0006	0.0005	0.0014	0.0023	0.0052	0.0331	0.0022	0.0124
1979	0.1612	0.0324	0.0030	0.1489	-0.001	0.1929	0.1986	0.0010	-0.001
1980	0.0021	0.0050	-0.002	0.0898	-0.002	0.0970	0.0108	-0.001	-0.001
1981	0.3872	0.0023	0.0016	0.0761	-0.002	0.0860	0.0467	-0.001	-0.002
1982	0.0248	-0.002	-0.002	0.0502	0.0004	0.0890	0.0393	-0.001	0.0008
1983	0.0228	-0.000	0.0042	0.0070	0.0031	0.0139	0.0307	-0.001	0.0024
1984	0.0114	0.0173	-0.002	0.0603	0.0022	0.0690	0.0051	0.0014	-0.002
1985	0.0044	-0.002	-0.002	0.0823	-0.003	0.0614	0.0033	-0.003	-0.002
1986	-0.002	0.0077	0.0024	0.0416	-0.003	0.0437	-0.002	0.0257	0.0127
1987	0.0123	-0.001	-0.003	0.1063	0.0197	0.1345	0.0181	0.0049	0.0803
1988	0.0066	0.0204	-0.001	0.0760	0.0051	0.1124	0.0125	0.0004	0.0013
1989	0.0036	-0.004	0.0122	0.1291	0.0126	0.1844	0.0020	-0.001	0.0014
1990	0.0047	-0.004	-0.002	0.0033	-0.004	0.0153	0.0105	-0.002	0.0090
1991	0.0611	-0.003	0.0003	-0.002	0.0027	0.0066	0.0705	-0.003	0.0371
mean	0.0596	0.0062	0.0020	0.0750	0.0115	0.0895	0.0466	0.0001	0.0282

Panel B

Industry-wise Comparison

SIC	Δ NISL	Δ OCTA	Δ OCOE	Δ NITA	Δ NIOE	Δ EBTA	Δ OCSL	Δ OCCP	Δ NICP
1	0.1237	0.0438	0.0505	0.0754	0.0816	0.0825	0.1224	0.0486	0.0438
2	0.0687	0.0066	0.0146	0.0747	0.0337	0.0755	0.0582	0.0152	0.0707
3	0.0547	0.0136	0.0097	0.1284	0.0497	0.1501	0.0761	0.0074	0.0865
4	0.0497	0.0280	0.0153	0.1057	0.0527	0.0989	0.0301	0.0396	0.0954
5	0.0901	0.0279	0.0458	0.1634	0.1114	0.1936	0.1109	0.0449	0.1695
6	0.0985	0.0040	0.0066	0.0359	0.0327	0.0336	0.0409	0.0455	0.0737
7	0.0291	0.0011	0.0001	0.0863	0.0863	0.1170	0.0857	0.0041	0.0581
mean	0.0576	0.0179	0.0204	0.0861	0.0640	0.0967	0.0749	0.0293	0.0854

SIC 1 is extractive industry; 2, food, textile, and paper; 3, rubber, metal, and machinery; 4, transportation; 5, wholesale and retail; 6, banks and insurance; and 7, hotels, services, and pictures.

R^2 is rejected overall. Δ NITA's adjusted R^2 s are higher than those of the other ratios except for that of Δ EBTA. Δ NISL and Δ OCSL show the same levels of significance, but not as strong as Δ EBTA and Δ NITA. When the mean adjusted R^2 s are examined (Panel B of Table 4), the levels of significance are increasing and their results are consistent. Δ EBTA may be the most useful profitability ratio among the nine ratios to explain the security price changes. The ratios using owners' equity as a denominator or operating cash flows as a numerator usually show the lowest explanatory power.

Table 4

Wilcoxon Sign Test of Adjusted R^2 Differences

Panel A

Pooled Sample (Panel A of Table 3)

Hypothesis: $R^2_i - R^2_j = 0$

while i is the ratio listed in the first column and j in the first row.

$i \setminus j$	$\Delta OCTA$	$\Delta OCOE$	$\Delta NITA$	$\Delta NIOE$	$\Delta EBTA$	$\Delta OCSL$	$\Delta OCCP$	$\Delta NICP$
$\Delta NISL$	2.817**	3.247***	-2.391**	2.769***	-2.864**	-2.343**	3.100***	1.159
$\Delta OCTA$		1.491	-3.62***	-0.592	-3.62***	-2.911**	1.018	-1.538
$\Delta OCOE$			-3.53***	-1.491	-3.62***	-3.38***	0.355	-2.107**
$\Delta NITA$				3.430***	-2.580**	2.012**	3.574***	2.911**
$\Delta NIOE$					-3.62***	-3.20***	1.775*	-2.201**
$\Delta EBTA$						2.485**	3.621***	3.195***
$\Delta OCSL$							3.243***	1.870*
$\Delta OCCP$								-2.201**

Panel B

Mean of adjusted R^2 categorized by seven industries (Panel B of Table 3)

$i \setminus j$	$\Delta OCTA$	$\Delta OCOE$	$\Delta NITA$	$\Delta NIOE$	$\Delta EBTA$	$\Delta OCSL$	$\Delta OCCP$	$\Delta NICP$
$\Delta NISL$	5.336***	2.711**	-1.351	1.762*	-2.192**	-0.564	5.251***	-0.528
$\Delta OCTA$		-0.063	-5.27***	-3.033**	-5.23***	-3.68***	-0.438	-4.91***
$\Delta OCOE$			-5.14***	-2.854**	-5.25***	-4.04***	0.725	-5.32***
$\Delta NITA$				2.246**	-1.852*	1.405	5.522***	0.796
$\Delta NIOE$					-2.407**	-1.172	3.069**	-2.067**
$\Delta EBTA$						2.854**	5.32***	2.120**
$\Delta OCSL$							3.677***	-0.743
$\Delta OCCP$								-5.34***

*, **, *** indicate statistical significance at the level of 0.10, 0.05, and 0.01 levels, respectively.

B. Incremental Information Content

Figure 1 shows the adjusted R^2 improvements of increasing the number of independent variables. Among the simple regressions, the highest adjusted R^2 is 0.0967, of which is from the regression of $\Delta EBT A$. The average value of the simple regressions is 0.0591. The adjusted R^2 s of the bivariate regressions are higher than those of the simple regressions. The values of the multivariate regressions including more than two accounting ratios are lower than those of the bivariate regressions. The step-wise regressions also stop including more than two ratios. We, accordingly, evaluate the incremental information contents of adding a second variable only.

Figure 1

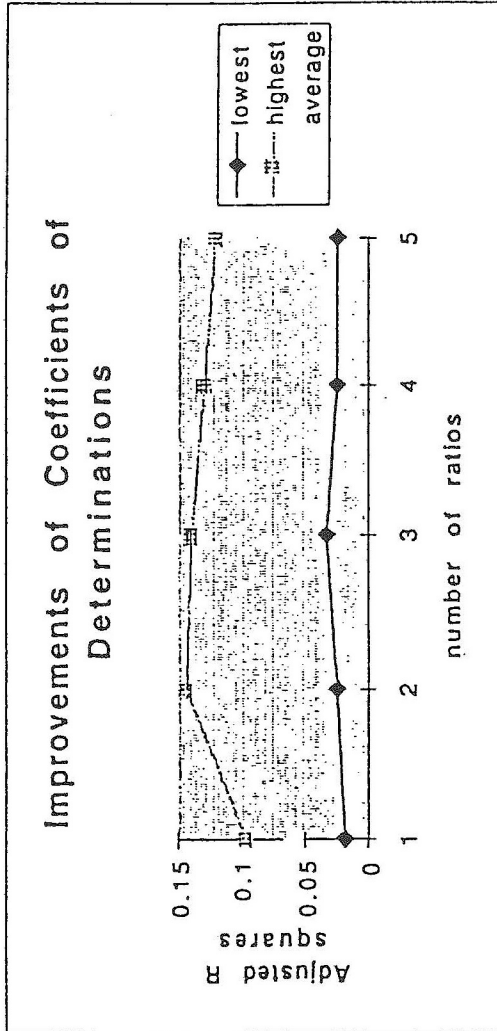


Table 5 is constructed to show the adjusted R²s of regressions using two independent variables listed in the first column and the first row.

Table 5
Averages of Industry-Wise Adjusted R²

of Regressions Using Two Independent Variables (model 3)

ratios	ΔOCTA	ΔOCOE	ΔNITA	ΔNIOE	ΔEBTA	ΔOCSL	ΔOCCP	ΔNICP
ΔNISL	0.0757	0.0880	0.1246	0.1144	0.1440	0.1016	0.0892	0.1216
ΔOCTA		0.0411	0.0960	0.0601	0.1108	0.0777	0.0244	0.0858
ΔOCOE			0.1081	0.0746	0.1187	0.0907	0.0346	0.0931
ΔNITA				0.1155	0.1254	0.1263	0.1112	0.1076
ΔNIOE					0.1344	0.1158	0.0677	0.1163
ΔEBTA						0.1314	0.1231	0.1383
ΔOCSL							0.0909	0.1311
ΔOCCP								0.0922

In each industry category, a regression of two accounting ratios was run for each year. There are 17 adjusted R²s in industry category. The number in each cell is an average of the 17 adjusted R²s. The regressions using ΔEBTA, ΔNISL, or ΔNITA show higher adjusted R²s, which are consistent with table 3 and 4. The range of these adjusted R²s are between 3.46%(ΔOCCP and ΔOCOE) and 14.40%(ΔEBTA and ΔNISL). By using two accounting ratios instead of one accounting ratio, the adjusted R²s seem to improve.

"Empirical evidence . . . can help analysts and corporate owners make more informed decisions as to what profitability ratios they have to look at in order to maximize the firm's value."

In order to test marginal information content, the adjusted R^2 s of each year are subtracted by the higher average adjusted R^2 s of the two simple regressions of the two variables in panel B of table 3. For example, the 17 adjusted R^2 s of the regressions of $\Delta OCTA$ and $\Delta NISL$, one for each year, were subtracted by 0.0576, which is the higher between the two average adjusted R^2 of simple regressions, $\Delta NISL$ and $\Delta OCTA$, (0.0576 and 0.0179). The marginal improvement of the bivariate regression of $\Delta OCTA$ and $\Delta NISL$ is averaged over seven industry categories, which is 0.0087 in panel A of table 6. Panel A of table 6 shows that on average the average adjusted R^2 improves by increasing number of independent variables.⁸ Panel B of table 6 shows significance of these marginal improvements. The regressions of $\Delta NICP$ and $\Delta OCSL$, $\Delta EBTA$ and $\Delta NIOE$, and $\Delta NICP$ and $\Delta NISL$ show significant improvements. The bivariate regressions show improvements (most of the t-values are positive) but their t-values are not significant.

V. CONCLUSION

No prior research has examined as to which profitability ratios are useful in assimilating capital market returns, although many financial analysts assume a group of profitability ratios is useful to predict a firm's

market values. To test the analysts' belief, this study seeks to address the usefulness of nine profitability ratios in explaining residual returns. Empirical evidence from such an analysis can help analysts and corporate owners make more informed decisions as to what profitability ratios they have to look at in order to maximize the firm's value. The methodology of the analysis is primarily cross-sectional regression of residual returns on profitability ratios. Usefulness is defined as goodness-of-fit of the regressions. The analysis is conducted from two perspectives: relative usefulness and incremental usefulness. The former compares the explanatory power of the various profitability ratios; the latter, the incremental explanatory power of the profitability ratios that are not included in the original simple regression.

Based on the large sample selected over 17 years, the analysis leads to three generalizations. First, the earnings before interests and income taxes divided by total assets, net income by total assets, and net income by sales dominate the other ratios. Especially, the ratios using owners' equity are noisier than the other ratios. This is due to the negative values of owners' equity. Another possible reason is that net income affects the numerator and denominator of NIOE significantly and dividing NI by OE generates extreme values. Because of this technical limitation, NIOE has the lowest R^2 , although current literature suggests this ratio is the most appropriate for common stock valuations.

The second generalization is that, with controlling for industry, the levels of usefulness of the most profitability ratios improve. The controlling for industry may decrease the noisiness of each accounting ratio and the knowledge of industry may be useful in using and choosing appropriate profitability ratios,

The third generalization is that using more than one profitability ratios in addition to ΔEBTA , ΔNITA , or ΔNISL does not improve the explanatory powers. Using ΔEBTA may sufficiently explain what various profitability ratios can predict.

"Using Δ EBTA may sufficiently explain what various profitability ratios can predict."

A practical implication of these findings is that, in situations where one has to use a parsimonious model, it would be appropriate to use Δ EBTA ratio alone. When analysts want to use any profitability ratios using owners' equity or operating cash flows, it is important to control for industry differences. This paper shares some common limitations as Lev (1989) argued. The typical R^2 s from price-earnings relationship studies are disappointingly low and this study seems to support the analysts' common belief weakly. These R^2 s do not seem to improve even when the number of independent variables is increased due to a high correlation between profitability ratios. When more than two profitabilities are used, the average R^2 decreases. This may possibly imply that we have to investigate the usefulness of other variables from non-financial statements and we should carefully interpret analysts' opinions when they use this price-profitability relationship predicting stock prices.

Table 6

A Comparison of the Goodness-of-fit of Model (3)

Panel A								
Marginal Adjusted R ² averaged over industry categories of Model (3) over Model (1)								
ratios	ΔOCTA	ΔOCOE	ΔNITA	ΔNIOE	ΔEBTA	ΔOCSL	ΔOCCP	ΔNICP
ΔNISL	0.0087	0.0211	0.0196	0.0356	0.0281	0.0205	0.0223	0.0547
ΔOCTA		0.0231	0.0057	-0.0037	0.0066	0.0091	0.0070	0.0750
ΔOCOE			0.0150	0.0109	0.0145	0.0220	0.0083	0.0727
ΔNITA				0.0192	0.0200	0.0295	0.0196	0.0173
ΔNIOE					0.0275	0.0436	0.0021	0.0525
ΔEBTA						0.0237	0.0172	0.0341
ΔOCSL							0.0203	0.0625
ΔOCCP								0.0704
Panel B								
T-values of Improvements of Industry-wise Average Adjusted R ² using Model (3) over Model (1)								
ratios	ΔOCTA	ΔOCOE	ΔNITA	ΔNIOE	ΔEBTA	ΔOCSL	ΔOCCP	ΔNICP
ΔNISL	0.2505	0.5842	0.8748	1.5474	1.1175	1.0147	0.6226	2.024**
ΔOCTA		0.7238	0.1917	-0.1444	0.2481	0.2886	0.2048	1.5258
ΔOCOE			0.7972	0.3690	0.5855	0.6231	0.3517	1.5514
ΔNITA				1.0958	1.2838	1.0943	0.5188	0.3871
ΔNIOE					1.6941*	1.5361	0.0726	1.5345
ΔEBTA						1.1245	0.5956	0.8770
ΔOCSL							0.5953	3.328***
ΔOCCP								1.4989

NOTES

1. Deakin (1976) conducted a comprehensive study of stochastics of accounting ratios. After examining the cross-sectional distribution of 11 ratios over the 1953-72 period for large populations of manufacturing firms, he concluded that the typical normality hypothesis had to be rejected. Lee (1985) extended this study evaluating stochastic characteristics of accounting ratios based on factorial control. Other papers in this avenue are Frecha and Hopwood (1983), Lev and Sunder (1979).
2. There are many studies that examine the predictive ability of accounting ratios for bankruptcy. For example, Abel-Kjalik et al. (1980), Altman (1968), Beaver (1966), Deakin (1972), Libby (1975), and Ohlson (1980) studied bankruptcy predictions.
3. Numerous papers after Peter Easton (1985) divide earnings by stock prices or other variables in order to control for the share size effect. A few of them are Baginski et al. (1993), Joh and Lee (1992), Ou and Penman (1989), Freeman and Tse (1989), Wilson (1987), and Rayburn (1986). Wilson (1987) and Rayburn (1986) are two of many papers examining the relative and incremental information contents of cash flows and accrual income. These papers report the adjusted R^2 between five percent and ten percent. (Lev, 1989) These papers use the stock price which is not available from financial statements. This paper, However, evaluate the information contents of ratios from financial statements.
4. This paper uses the changes of each accounting ratio for the tests of association between market value changes and ratio changes. Changes of the ratios in the first year of the test period are not computed since the prior year data are not available. Changes in 1972 are also excluded because 1993 Compustat includes only a part of total available firms.

5. Since there is a large body of research using the level of accounting ratio (in addition to changes), the entire empirical analysis here is repeated by adding the level of accounting ratio. However, the two sets of results are qualitatively the same, so only those results based on (1) are reported for parsimony.
6. Because of the negative values of owner's equity, the adjusted R^2 s are computed and compared based on the ratios of the sample of positive owner's equities. They improve slightly but not significantly. The results are based on the sample of both positive and negative owner's equities, accordingly.
7. Industry categories 0 (agriculture), 8 (service), and 9 (conglomerate) were dropped because they did not give a sufficiently large sample size.
8. In order to examine any additional improvements by increasing the number of independent variables more than two, step-wise regressions and regression models of three variables were run. Step-wise regressions did not include more than two profitability ratios when a criteria of 10% marginal significance level was used. The regressions of more than two variables provided lower adjusted R^2 than those in table 5.

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A THREE-DIMENSIONAL APPROACH TO MANAGEMENT CONTROL SYSTEMS

Sven Modell*

Traditional management accounting and control practices have come under severe criticism in recent years, indicating that the time may be ripe to reconsider our approach to management control system (MCS) design. To accommodate the call for a more holistic approach in management accounting research a typological framework is developed by positioning the formal MCS along the feedback/feedforward, the financial/non-financial and the formal/informal dimensions of control. The framework developed through cross-fertilization of these dimensions in three steps across eight archetypal MCS designs and characteristics is outlined. An overall contingency perspective is applied and contextual factors with a potential influence on systems design are discussed briefly in conjunction with the presentation of the typology, while recommendations for more thorough research in this respect are given. Also, closer integration between management control and human resource management theory is recommended, particularly when conducting control research in human resource intensive service organizations.

Traditional management accounting and control practices have come under severe criticism in recent years.¹ Some recurring themes in this context are management accounting's propensity to induce a dysfunctional, myopic employee behavior, its backward-looking character, its neglect of relevant non-financial (particularly market related) indicators and its inability to promote organizational flexibility (Fischer, 1992; Johnson, 1992; Johnson & Kaplan, 1987; Lynch & Cross, 1991).

While the inherent problems of evaluating performance based on short-term profitability and rentability measures are nothing new in accounting

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research (cf. Dearden, 1969; Merchant, 1989), the recent works cited above challenge us to relate to management control systems (MCS) in a different way than what has long been perceived as the common practice. However, the arguments presented also generate some ambiguity as to how such control systems can be conceptualized and designed. For instance, the use of non-financial data is sometimes suggested to lead to more forward oriented control practices, providing more timely and frequent feedback on events that are relevant for the ultimate competitiveness of the organization, compared to aggregate historical financial information (Fischer, 1992; Johnson, 1992). By definition, however, all information based on past events is of a historical character. The distinguishing character of various control processes would rather be the actual use of different types of information. Unfortunately, none of the critics cited above go into any greater detail regarding what constitutes feedback and feedforward cycles along the non-financial dimension and how this relates to the wider control context. The use of non-financial information is merely presented as a more forward-oriented practice than providing feedback in aggregate financial terms to managers for motivational purposes.

In addition to the critique briefly referred to above, the need for further examination of the interplay between formal accounting-based controls and informal controls has been recognized in management control research for some time (Ansari, 1977; Dent, 1987; Emmanuel et al., 1990; Preston, 1991a), increasingly so in studies of management control issues in the economically important service sector (Berry et al., 1991; Abernethy & Stoelwinder, 1990, 1995). To grasp a fuller extent of the management control process, it would appear advisable to view the role of the formal MCS in a wider control context (Dermer & Lucas, 1986; Otley, 1980). This might inform research efforts aiming at provision of insights into how to overcome limitations of formal MCSs and may shed some further light on issues targeted by critics of traditional management control practices. It may also be a step towards a more holistic view of management control, which has been advocated in order to counterbalance the fragmentation and

reductionistic tendency of much accounting research (Otley, 1980; Samuelson, 1990).

"To grasp a fuller extent of the management control process, it would appear advisable to view the role of the formal MCS in a wider control context (Dermer & Lucas 1986, Otley 1980)."

As the management accounting and control debate referred to above is largely based on empirical observations of current control problems and, at least in part, the emergence of innovative management control techniques, the time may be ripe to reconsider our approach to MCS design. The aim of this paper is to further the conceptual clarity surrounding the character of formal MCSs in organizations, through the development of a typology linking MCS design to the three dimensions briefly outlined in the foregoing. These are:

- The feedback/feedforward dimension.
- The financial/non-financial dimension.
- The formal/informal dimension.

In this respect, the paper is particularly concerned with behavioral and motivational aspects of management control. While the paper was originally inspired by the contemporary critical debate on management accounting and emerged as an attempted response to this, the discussion is here concentrated to the development of a comprehensive typology for reasons of space limitations. This is believed to be a more fruitful way of

carrying research forward. The recapitulation of previous critique of management accounting is consequently kept relatively brief. An overall contingency perspective is applied and some examples of factors influencing systems design are included in the description of the typology for illustrative purposes, while recommendations for future research in this respect are given in the concluding section of the paper. Despite these restrictions the typology and the premises on which it is founded will be discussed in sufficient detail to allow future research to relate the framework to various contextual factors and develop testable hypotheses.

The paper starts with a brief outline and discussion of the three dimensions in order of presentation above. Thereafter, eight archetypal MCS designs are elaborated through cross-fertilization of the dimensions in three steps to arrive at a framework for further analysis. Finally, implications of application of the framework in future research are discussed in the concluding section of the paper.

THE FEEDBACK/FEEDFORWARD DIMENSION

Management accounting and control systems are often conceptualized as a set of activities linked together by a number of feedback and feedforward loops (e.g., Emmanuel et al., 1990; Flamholtz, 1983; Otley & Berry, 1980). The total MCS typically embodies both *ex-ante* and *ex-post* controls. Traditionally, planning and resource allocation aspects have been in particular focus in *ex-ante* activities such as goal and standard setting and budgeting, while the *ex-post* activities of performance measurement, evaluation and rewards have been viewed as the main components of the feedback process (Flamholtz, 1983; Flamholtz et al., 1985).

In other words, feedback systems wait for performance to occur, while feedforward systems are more anticipatory in nature (Ansari, 1977). However, the two types of system may be expected to be interlinked in that feedback on certain events is often the starting point of a feedforward

process leading to enhanced organizational learning. For instance, past results frequently serve as a point of reference when planning ahead. Moreover, ex-post evaluation presupposes an ex-ante activity of establishing targets (Govindarajan, 1984). It may thus be reasonable to assume that some balance between forward- and backward-oriented mechanisms is instrumental for a well-functioning control system, even though situational factors may require some trade-offs between the two types of controls when considering design options. According to recent critics, however, the feedback element has been allowed to dominate contemporary management accounting systems to an inappropriately great extent (Fischer, 1992; Johnson, 1992). More specifically, the emphasis on historical *cost accounting* for control purposes is suggested to have largely overshadowed more forward-oriented control mechanisms, which ideally lead to *cost management*, or continuous process innovation and improvement (Johnson, 1992).

Anthony (1965, 1988) has presented an influential conceptual division between various formal control processes. He separates between strategic planning, management control and task (or operational) control, which display a varying degree of emphasis on planning (ex-ante) and evaluation (ex-post) processes. Strategic planning assigns the greatest relative importance to medium to long-range planning in comparison to evaluative processes. Operational control represents the opposite case, with highly frequent feedback, but limited emphasis on planning. Management control is assigned a relatively balanced mix of planning and evaluative processes. Even though this characterization of the various formal control processes in organizations may seem somewhat crude or over-simplified, it is a useful point of departure for positioning the MCS along the feedback-feedforward dimension and in relation to other formal control systems. As discussed further in the following section, though, Anthony's framework may be losing some of its validity. Focusing on MCS design it would therefore be more appropriate to view this as displaying a varying degree of imports of strategic planning and operational control elements. This is a fundamental thesis underpinning the framework presented in this paper.

THE FINANCIAL/NON-FINANCIAL DIMENSION

As indicated in the introductory part of the paper, another major concern in the current management accounting debate is the extensive reliance on financial information for control. A recurring argument in this context is that traditional financial indicators provide information of a too aggregate, untimely and simplistic nature (Fischer, 1992; Johnson, 1992; Lynch & Cross, 1991). In recent years, several authors have also emphasized the benefits of integrating financial and non-financial measures more closely within the frame of MCSs (Fischer, 1992; Kaplan & Norton, 1992, 1993; Lynch & Cross, 1991).

Returning to the framework developed by Anthony (1965, 1988) some initial insight into the financial/non-financial dimension may be achieved by relating to organizational control processes along his tripartite conceptual division. Strategic planning and control is defined as the process of deciding and evaluating goals of the organization, while management control comprises mechanisms to ensure that the organization's strategy to meet these goals is carried out in an efficient manner. Task control, finally, relates to the performance of specific operational activities. The use of non-financial information has mainly been associated with strategic planning and control (e.g., analysis of long-term market trends and demographic developments) and particularly operational control (e.g., production scheduling, quality control), while management control has ordinarily been viewed as being built around a financial structure (Emmanuel et al., 1990).

Non-financial information may be of either a quantitative or qualitative character in contrast to monetary measures, which are normally quantitative in nature. Our notion of accounting has been shaped by a numerical image of reality (Davies et al., 1982), which may be part of the reasons for the alleged overemphasis on a 'managing it by the numbers' approach among accountants and managers (cf. Johnson, 1992; Johnson & Kaplan, 1987).

A rough division regarding the character of non-financial measures for control can here be made between the strategic and operational levels (King et al., 1991). Strategic goals are frequently expressed in broad, qualitative terms (e.g., mission statements) even if some quantified goals may also exist (e.g., "grow number of outlets by an annual rate of X%"). A significant amount of the information used for strategic decision-making also tends to originate from sources external to the organization. On the other hand, non-financial goals at the operational level are normally dominated by more narrowly specified quantitative measures of internal origin (e.g. scrap rates, delivery reliability measures).

While stating that the three control processes discussed above shade into each other, Anthony et al. (1989) emphasize the importance of maintaining a sharp distinction between them as far as control systems design and analysis are concerned. However, some recent critics of Anthony's framework and contemporary theoretical and practical advances provide arguments for abandoning the strict conceptual division embodied in it. First, and in line with the criticism highlighted earlier in this section, it has been suggested that the framework assigns too much weight to financial information for management control purposes (Emmanuel et al., 1990). The rise to prominence of new techniques, such as *strategic management accounting*, has also revealed important benefits of using accounting information for strategic decision-making as well as integrating non-financial measures into the MCS (Bromwich, 1990; Simmonds, 1983; Shank & Govindarajan, 1993). Moreover, the increasing emphasis on integration of quality management and management control requires closer links between the MCS and strategic and operational control systems (Kaplan & Norton, 1992, 1993; Lynch & Cross, 1991). At the empirical level, students of Japanese management accounting practices have emphasized their close integration with strategic objectives and extensive use of non-financial indicators (e.g., Hiromoto, 1988). Second, the empirical observation of Berry et al. (1991) that managers exercise control across the boundaries of Anthony's framework, led them to question its appropriateness for analyzing interdependencies between the various

control processes. Third, and related to the issue of interdependency, the rapid information technology development is likely to offer new opportunities for further integration between various types of controls, with the aid of for instance integrated database solutions (Johnson, 1992; King et al., 1991; Macintosh, 1985). However, Schneider et al. (1995) have recently expressed concerns regarding the impediments created by accounting artifacts, such as double-entry bookkeeping, in this context. Last but not least, I would argue that if the ultimate aim of control is to encourage organizational members to apply a holistic view of the organization, erecting water-tight barriers between control processes at various hierarchical levels makes little sense as it may be detrimental to communication between managers and subordinates.

THE FORMAL-INFORMAL DIMENSION

It is sometimes suggested that many of the problems surrounding management accounting and control emanate from an unduly high degree of formalization of control (Preston, 1991b) and that managers and accountants frequently nurture an illusion of managerial control and its merits (Dermer & Lucas, 1986). Hence, it might be interesting to position the MCS in relation to the formal/informal dimension as a complement to the other two dimensions outlined in the foregoing.

Starting with Dalton's (1971) broad classification between *organizational*, *social* and *self-controls*, a framework is derived where operationalizations of the first of these include what we generally relate to as formal means for controlling behavior (e.g., budgets, standard costs, sales targets). The latter two control types, however, are based on elements which are generally not part of any officially sanctioned control system. Social controls are administered by informal groups and originate from a mutual commitment to ideals, with group norms setting the standards for control. Peer approval and social membership are important elements of this type of control. Self-controls, finally, relate to individual goals and

self-expectations directing a person's behavior. Perceived impending failure in relation to these aspirations triggers corrective actions at the individual level.

"Erecting water-tight barriers between control processes at various hierarchical levels makes little sense as it may be detrimental to communication between managers and subordinates."

However, it can be argued that Dalton's (1971) widely cited framework makes a too crude distinction between formal and informal controls, whereby it fails to cover a number of intermediary control types. *Informal accounting and information systems* (Clancy & Collins, 1979; Earl & Hopwood, 1980) are examples of control mechanisms administered by individuals or groups on an unofficial basis, although they are sometimes of a highly elaborate and sophisticated character (Macintosh, 1985). They can also be said to be formalized in a sense that they are used on a recurring basis and are built around some systematized computational model (cf. Macintosh, 1985). They may be useful complements to formal control systems providing information of a too aggregate, general and untimely character (Mintzberg, 1974).

A similar category of information systems are so called *grapevine systems* (Earl & Hopwood, 1980). These systems are visualized as informal communication between people joining the grapevine. Information of a mainly qualitative character is transmitted at business lunches, encounters in the hall and other social events (Earl & Hopwood, 1980). This type of system represents yet another intermediary form of control, not explicitly

accounted for in Dalton's (1971) framework. Indeed, grapevine systems embody means for conveying social norms or corrective cues for individual behavior, but at the same time they fulfill an important function of transmitting factual information, facilitating achievement of organizational goals. Still, they represent a less formalized and systematized type of control than the keeping of informal records and the use of financial and other quantitative measures and rules of thumb to assess the efficiency of operations on an unofficial basis. In this capacity, they can be expected to constitute means for managers to deal with complexity and convey nuances in information (Earl & Hopwood, 1980; Macintosh, 1985).

Consequently, we need to consider a number of intermediary types of controls to overcome the crudeness of the classification between formal and informal controls. Perhaps the term intermediary control types is somewhat misleading in this context. A more appropriate conceptualization might be to classify informal accounting and information systems and grapevine systems as *semi-formal* types of controls, in that they display a varying degree of formality or systematization, while not being part of the official control system. Moreover, they embody explicit functions aiming at facilitating achievement of (formal) organizational goals (e.g., breaking down budgetary goals on an unofficial basis, dissemination of nuances in formal information). In this capacity they are distinct from informal types of controls like 'pure' social and self-controls, which are largely based on group norms and self-expectations, respectively.

Coming full circle, we also need to consider the role of *organizational culture* in a control context. The importance of achieving consonance between the design of control systems and the prevailing organizational culture has been stressed by a number of authors (e.g., Flamholtz, 1983; Markus & Pfeffer, 1983), while culture may also be viewed as a powerful control mechanism per se (Jaworski, 1988; Ouchi, 1979). In this context, some authors include organizational culture as a form of social control or largely equate the two concepts (e.g., Flamholtz et al., 1985), while others separate cultural control from social and self-control (e.g., Jaworski, 1988;

Merchant, 1985; Wakefield, 1991). Drawing on the more fine-grained continuum between the formal and informal extremes outlined above we can reconcile this conceptual ambiguity by viewing organizational culture as yet another intermediary type of control. Cultural control mechanisms facilitate the socialization process between individuals by reinforcing a normative pattern of behavior within an entire organization (Ouchi, 1979). In this regard, culture can be seen as a means of rendering legitimacy to (formal) organizational goals, while suppressing individual and group goals which are inconsistent with these. However, its intangible and often subtle character qualifies cultural control to be grouped towards the informal end of the control continuum (cf. Jaworski, 1988; Wakefield, 1991).

Accepting that the formal control system can play a pro-active role, influencing individual behavior (Collins, 1982), we may expect organizational culture to interact with both formal and other informal controls in a complex web of interdependencies. Drawing on Wakefield (1991) cultural control can be viewed as an ideology, acted out by organizational members and hence influencing the design of formal controls. Formal controls in turn, foster self-control in that they are intended to effect individual behavior. Then, individuals acting out their commonly held values, reinforced by self-controls, influence the organizational culture. For instance, accounting systems can be used to prescribe normative role behavior to organizational members (Collins, 1982), whereby specific cultural phenomena may be reinforced.

TOWARDS A TYPOLOGICAL FRAMEWORK

Drawing on the discussion above we can now synthesize the three dimensions presented and expand the discussion to the development of a typological framework. This emerges from positioning the MCS along the three dimensions, which are cross-fertilized in three steps. Hereby we arrive at an eight-headed typology. It should be emphasized that the system in focus throughout the discussion below is the *formal* MCS built around

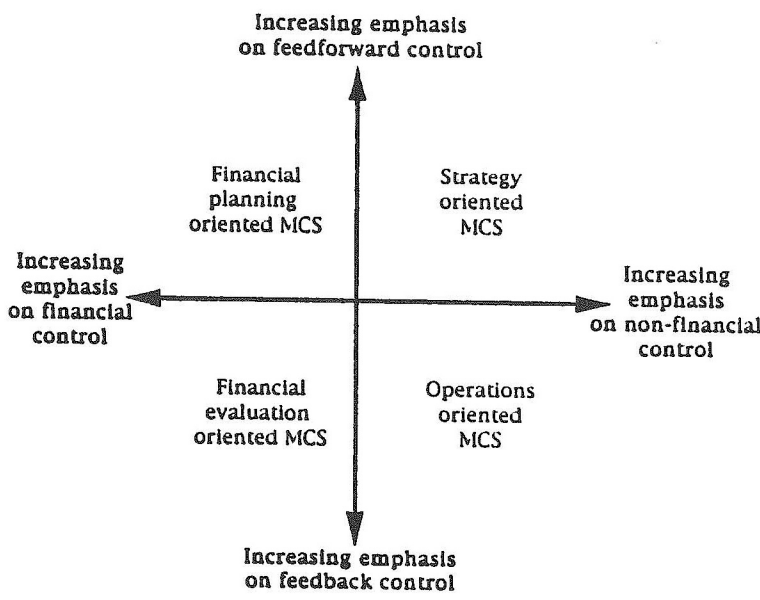
a core of financial information processing, even though this is positioned in relation to other formal control systems as well as informal systems. It should also be noted that the types presented signify ideal and extreme forms, which are not mutually exclusive. One control system may embody characteristics of more than one type. However, features of one type or the other are likely to dominate and render the system its overall character and it is in this capacity the typology can be a useful vehicle for analyzing systems design.

The first set of MCS types is derived from cross-fertilizing the feedback/feedforward and the financial/non-financial dimensions (see Figure 1). It should be noted that all four of these types mainly rely on formalized control processes and pay limited attention to informal control mechanisms. They can be expected to be found in organizations where management stresses the need for formal control and responsibility and tends to play down the use and legitimacy of informal controls. In other words, a formal control paradigm is likely to prevail.

Characteristics of the four types presented in Figure 1 are discussed below. The first two of these, which are positioned at the left hand side of Figure 1, would be most akin to the traditional view of MCSs in the accounting literature, as they are primarily built around a financial structure (cf. Anthony et al., 1989).

Figure 1

**MCS Types Derived From Cross-Fertilization Of The
Feedback/Feedforward And The Financial/Non-Financial
Dimensions.**



The Financial Planning Oriented MCS

This type of system assigns primary importance to feedforward control mechanisms. This can be expected to encompass elaborate capital investment calculation and product costing systems. These would in turn display a high level of integration with the formal planning system, which constitutes the central control mechanism. This would be associated with elaborate budgeting procedures, where particular weight is assigned to the allocation of financial responsibility. However, the main role of the budget would be as a planning device, rather than using it for motivational purposes. Rewards would tend to be linked to long-term financial performance (e.g., over several years), rather than achievement of short-term budgetary goals.

The paramount interest guiding the control process is the striving for financial precision. The extreme type of control system in this category would aim at financial programming, with extensive use of simulation techniques for decision-making. Hence, we may expect organizations relying on these types of systems to be confronted with relatively few but major decisions affecting the financial position of the organization over long time periods (e.g., extensive capital investment projects). A long-term managerial view is crucial, hence the need to retain managers and reward a long-term focus and their extended loyalty to the organization. However, the external environment can be expected to be stable, or fairly predictable (cf. Govindarajan, 1984). Further, we may envisage organizations relying on this type of system to employ relatively well-known or routine technology, which is indicative of low uncertainty regarding task design (cf. Hayes, 1977; Mia & Chenhall, 1994). In other words, both the external environment and the technology are largely given, perhaps due to regulated market conditions and/or application of commodity technology. For instance, research and development efforts are likely to have relatively low priority and technological break-throughs with a fundamental impact on competitive conditions in the industry are probably rare. As a consequence of these contextual factors, the financial outcome of various

alternatives can be predicted with fairly high accuracy. In combination with the far-reaching consequences of investment decisions, this makes financial planning a meaningful control mechanism.

The Financial Evaluation Oriented MCS

This type of system emphasizes the feedback element of the control process rather than financial planning aspects. There is lesser concern with financial precision, but speed of reporting is considered more vital. Compared to control systems focusing on financial planning, reporting and evaluation become more frequent. Feedback is received over shorter time spans (e.g., months, quarters) and revenues and costs are broken down to reflect short-term financial performance of organizational sub-units to a significant extent. Timeliness rather than accuracy of reporting is emphasized. It is more important for managers to receive quick feedback than to make correct long-term estimates of the consequences of future events. The system aims at promoting financial flexibility, rather than providing a robust planning tool. As a consequence, the planning techniques in use will be less sophisticated than what is the case of financial planning oriented systems. The budget is viewed more as a means of promoting communication and creating managerial motivation and commitment than a planning tool (cf. Arwidi & Samuelson, 1991). Hence, participation in the budgetary process may be expected to be extended to managers at a greater number of organizational levels and rewards are closely linked to performance in relation to short-term budgetary targets or other pre-defined financial standards.

An important cause for reliance on more frequent reporting and feedback would be increasing environmental dynamism, or uncertainty (Gordon & Miller, 1976). Rapidly and unpredictably changing environmental conditions are also likely to drive enhanced participation in budgeting (Waterhouse & Tiessen, 1978). However, the technology (or task environment) may still be expected to be of a routine character, since managers are likely to consider feedback based on accounting information

to be more credible under such conditions, than if technology is complex and non-routine (Hayes, 1977; Luckett & Eggleton, 1991). This factor might also impede the extent of decentralization and participatory budgeting somewhat (Waterhouse & Tiessen, 1978). The need to delegate authority to the technical core is limited as it is not vital to seek the involvement of lower level employees to determine the financial outcome of operations. Consequently, decentralization can be expected to be only moderate (e.g., formal delegation of responsibility stops with middle-managers). Since the technology applied is relatively well-known and simple, there is also likely to be little need for management to closely monitor tasks by the aid of operational measures. They can instead rely on short-term financial measures (e.g., standard cost deviance) to evaluate subordinates.

Partly drawing on the new directions in management control research discussed in the foregoing, the traditional approach can be complemented by two additional types of systems, which are found at the right hand side of Figure 1.

The Strategy Oriented MCS

This type of system, like the financial planning oriented MCS, takes a long-term view of the organization. However, the scope of the system would be broader, with a greater number of non-financial parameters being considered in the planning and control process. These can in turn be expected to be of a quantitative as well as qualitative character and be closely linked to the strategic objectives of the organization. Significant attention is directed to external factors (e.g., competition, company's position in industry) and these are directly linked to the control system with the aim of inducing managerial actions to support the long-term strategy of the organization. Further, financial and non-financial measures are closely integrated in the control system (cf. Kaplan & Norton, 1992, 1993; Lynch & Cross, 1991).

Significant weight is assigned to the planning process, but the relatively one-sided focus on budgeting is exchanged for a wider set of planning techniques. Forecasts reflecting market trends and other external factors are likely to be in extensive use. Control devices with a primarily internal focus, such as product costing systems may still be important, but the primary interest is shifted to the use of measures reflecting strategic key success factors linked to events over which the organization has only partial if any control. These measures are frequently of a non-financial character (e.g., reflecting image and customer reputation). Rewards are linked to both financial and non-financial evaluation criteria, reflecting performance in relation to key success factors of strategic importance.

A major force driving organizations to broaden the scope of the planning process to include non-financial factors would be increasing environmental uncertainty (Chenhall & Morris, 1986; Fischer, 1992; Gordon & Miller, 1976; Govindarajan, 1984). For instance, growing competition, deregulation and technological break-through with a profound impact on an industry represent factors which conventional accounting information reflects poorly if ever. In addition, higher environmental uncertainty was found by Govindarajan (1984) to be positively related to enhanced reliance on subjective performance appraisal styles, with extensive use of qualitative evaluation criteria. This would support the assumption of qualitative measures being increasingly emphasized in the planning and control process.

The Operations Oriented MCS

This type of system emphasizes the feedback and evaluation component of the control system, but like the strategy oriented MCS it broadens the scope to include several non-financial indicators as a complement to financial measures. At first sight it may be difficult to distinguish between operations oriented and strategy oriented MCSs. As discussed in the foregoing, the inclusion of non-financial measures in the control process

is often seen as a means of tailoring control systems more closely to business strategy (cf. Fischer, 1992; Hiromoto, 1988; Johnson & Kaplan, 1987; Kaplan & Norton, 1992, 1993; Lynch & Cross, 1991). However, it will still make sense to separate between the two types of systems for analytical purposes. Operations oriented MCSs are characterized by greater concern with measures directly indicating the effects of actionable steps at the operational level. Strategy oriented MCSs on the other hand primarily focus on monitoring changes in the external environment even though some internal factors might also be considered.

Another major division line is the time horizon involved. Operations oriented MCSs integrate frequent feedback on short-term operational measures into the financial reporting system, so that the links between activities and their subsequent financial outcome are more clearly visible. In contrast, strategy oriented MCSs focus on the ability to plan ahead with for instance changing industry trends in mind and mainly reflect altered environmental conditions with a long-term impact on the organization. In the operations oriented MCS, performance measures may be linked to issues of vital importance for the long-term competitiveness of the organization, but these are likely to require a high level of continuous attention (e.g., quality, delivery reliability). As opposed to strategy oriented MCSs, the non-financial measures in use in the operations oriented MCS will almost exclusively be of a quantitative and internal character (e.g., response time to fill orders or lead time for new products development). Temporal measures are likely to be in extensive use, as time might be a scarce resource constraining operations (Munro & Hatherly, 1993). In contrast to the financial evaluation oriented MCS, the budget is regarded more as a loose guideline and rewards are linked to a broader frame of objectives to avoid dysfunctions of focusing too narrowly on financial performance. Evaluation criteria would reflect performance in relation to several non-financial measures in combination with budgetary targets (cf. Merchant, 1989).

The simultaneous need for broad scope (i.e., inclusion of several non-financial indicators) and timely information (i.e., frequent feedback) would be associated with significant environmental uncertainty (Chenhall & Morris, 1986; Gordon & Miller, 1976; Waterhouse & Tiessen, 1978). Again, flexibility rather than long-range planning excellence would be sought. However, the nature of environmental uncertainty may be expected to differ from the forces driving MCS design towards the strategy oriented type. It can be expected to be related to factors with a more immediate impact on the organization and which therefore require quick adjustment. In addition to the uncertain external environment, the technology applied can be expected to be of a non-routine character. Support for this can be gathered from Hayes' (1977) study which indicates that financial measures are poor indicators of performance in departments with non-routine activities such as marketing and R&D, but are more compatible with less complex and routine technologies in production departments. Similar results were presented by Mia and Chenhall (1994), suggesting that a broader scope of MCSs (i.e., inclusion of several non-financial indicators) is more functional under conditions of high task uncertainty. To summarize these arguments, increasing technological uncertainty may be expected to drive MCS design towards the operations oriented rather than the financial evaluation or strategy oriented types.

Further, the interaction effect between significant environmental and technological uncertainty is likely to have a profound impact on MCS design. For instance, it may be crucial for the organization to be able to respond quickly to technological shifts in the industry and promote initiatives aiming at rapid product development from employees at all levels. Hence, the organization would tend to be highly decentralized (Waterhouse & Tiessen, 1976) and place significant emphasis on widespread participation in the budgetary process (Brownell & Dunk, 1991). Feedback would not stop with middle-management, but be provided in a formalized manner to employees throughout the organization. Incentive schemes for non-managerial staff can be expected to be fairly elaborate, linking rewards to performance on key measures reflecting what

constitutes vital issues to attend to at various task levels. Rewards may also be designed to promote a holistic view of the organization (e.g., bonuses linked to both individual, group and/or organizational performance).

Exchanging the financial/non-financial dimension for the formal/informal dimension a new set of MCS types emerges (see Figure 2). The four MCS types relying on a predominantly formal control paradigm, which have been outlined above are positioned at the left hand side of Figure 2. At the right hand side, two types of MCS's displaying an increasing emphasis on informal control mechanisms appear. These are termed selection oriented and socialization oriented MCSs and are discussed below.

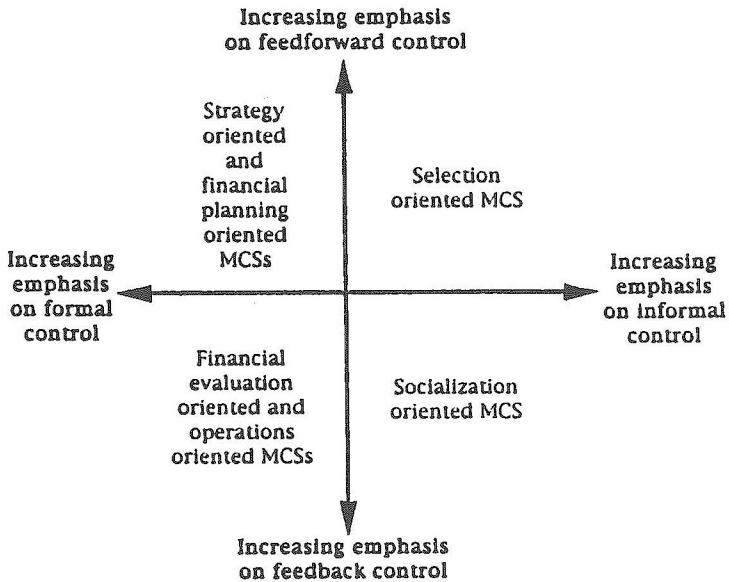
The Selection Oriented MCS

This is a mainly feedforward-based system, which integrates behavioral control largely exercised through elaborate selection procedures into the MCS (cf. Emmanuel et al., 1990; 58). The recruitment procedure and the establishment of long-term career and compensation plans can be expected to be important control mechanisms and are closely interlinked with the formal MCS, while informal control mechanisms are extensively relied upon. Career paths would tend to be hierarchic, with a number of predetermined steps linked to formal competence and continuous training, although individual performance differences often have an impact on the speed of advancement or size of rewards (cf. Maister, 1982). The major part of the socialization process has often taken place before individuals join the organization, through extensive formal training (cf. Ouchi, 1979). Thus, the type of organization where selection oriented MCSs would be most clearly visible probably have a high proportion of professional employees (e.g., university teachers, architects, medical doctors, lawyers).

Management of professionals frequently implies extensive reliance on social and self-control, rather than formal accounting-based controls

Figure 2

**MCS Types Derived From Cross-Fertilization Of The
Feedback/Feedforward And The Formal/Informal Dimensions.**



(Abernethy & Stoelwinder, 1995). In addition, professional values may in some cases induce a "club mentality" (e.g., among lawyers and chartered public accountants), contributing to the establishment of formal sets of rules governing a particular profession or industry. Such regulatory frameworks generally constitute powerful control mechanisms in terms of behavioral outcome and might therefore reduce the importance of the accounting component of the MCS for evaluative purposes even further. However, while professionals are often suggested to strive for extensive self-regulation, there are indications that they may become more amenable to some accounting-based controls if properly implemented (Abernethy & Stoelwinder, 1990, 1995; Paulsson, 1993). This illustrates the pivotal challenge embedded in designing a MCS which is in tune with and reinforces the cultural traits fostering efficiency in professional organizations.

As it is crucial to retain the expertise of the technical core to stay competitive, we may expect a principal aim of the MCS to be promotion of long-term loyalty to the organization. However, relatively limited attention can be expected to be paid to accounting information for evaluative purposes (McDonald & Stromberger, 1969), even though the speed of advancement in some professional service firms may partly hinge on the ability to generate revenue (Maister, 1982). The predominant evaluation criteria can be expected to be linked to competence-based measures. The role of accounting information is likely to be largely restricted to financial planning and control purposes and financial measures for performance evaluation, if any, are often of a fairly simple construction (McDonald & Stromberger, 1969). The possibilities to change the organizational culture through the use of formal control mechanisms can be expected to be limited, as the value system is largely ingrained in the long established professional culture (cf. Abernethy & Stoelwinder, 1995). Therefore, it becomes crucial to rely on feedforward control through careful selection of organizational members. In other words, it is of vital importance to do things right the first time and the emphasis placed on the recruitment procedure is analogous to the sophisticated techniques for

assessing long-term financial effects of investment decisions of financial planning oriented MCSs.

The technology of professional service organizations is typically complex or of a craft nature (Maister, 1982; Mintzberg, 1979). The character of the external environment, however, can be expected to vary from stable and regulated (e.g., public health care in countries with strong governmental control of this sector and little competition) to highly dynamic and uncertain (e.g., management consultancy with fierce competition for both clients and professional expertise). Particularly under the latter types of conditions can appropriately balanced reward systems be expected to be a vital factor for sustained competitiveness. Reward systems become more than just simple contribution-inducement models. They must also be considered as potential strategic advantages in their capacity to attract resources (expertise) to the organization (cf. Maister, 1982).

The Socialization Oriented MCS

This type of system primarily aims at reinforcing the socialization process by relying on feedback mechanisms which indicate to individuals what constitutes desirable behavior. Contrary to professional organizations with selection oriented MCSs, inherited value systems among organizational members do not play any major role and do not form prerequisites for acceptance into the organization. Instead, socialization mainly takes place *within* the organization and the socializing effect of prevailing management control practices therefore becomes a point of central interest. The recruitment procedure primarily aims at spotting individuals who are likely to adapt well to the organizational culture in existence.

We may expect this type of control system to be most easily detectable in organizations with strong organizational cultures, which serve as powerful control mechanisms per se (cf. Ouchi, 1979; Jaworski, 1988). In this capacity, culture is sometimes suggested to be a more powerful

behavioral determinant than formal control systems (Wakefield, 1991). However, if the prevailing culture induces dysfunctional employee behavior from an organizational perspective, management may have strong incentives to use the MCS to attempt to effect cultural change (cf. Collins, 1982). In any case, the MCS is likely to make extensive use of relatively frequent feedback to reinforce the desired behavioral pattern. The ability of the MCS to change behavior is probably greater than in organizations using selection oriented MCSs, as professional value systems and affiliations would tend to be relatively weak. Reward systems are likely to be a central component of socialization oriented MCSs. Contrary to selection oriented MCSs, rewards would tend to be linked to relatively short-term performance measures, since *ceteris paribus* the effectiveness of feedback can be expected to be positively related to the frequency with which it occurs (cf. Luckett & Eggleton, 1991).

The feedback message and the measures used for performance evaluation are likely to vary with the objectives of the socialization process, or in other words what behavior is considered to be the desirable outcome. Consequently, performance evaluation criteria can be linked to financial as well as non-financial measures, depending on what functions or tasks are given priority. Participative budgeting may be used extensively in its commitment instilling capacity (Arwidi & Samuelson, 1991; Waterhouse & Tiessen, 1978), while rationalistic planning aspects are likely to be of less concern. Rewards may be material in nature, but can also consist of mainly social acceptance cues (e.g., inducing a "family atmosphere"). A notable example of the latter is the multinational furniture distribution chain IKEA, which is famous for its pronounced reliance on socialization, partly achieved through for instance systematized job rotation and delegation of responsibility from an early stage of employment, while pecuniary rewards are not of primary concern, relatively speaking. The extreme socialization oriented MCS may have a tendency to reward loyalty rather than competence. While this is likely to be dysfunctional in complex task environments requiring a highly skilled workforce, it may be better fitted to more simple technologies. However, systems inducing a strong

organizational culture are often suitable for dealing with environmental uncertainty as it decreases the need to motivate people through long-winding rationalistic decision processes (e.g., planning). Thereby, organizational action is facilitated and organizations become more flexible and adaptable to environmental changes (Brunsson, 1985).

We now arrive at the final set of MCS types, by cross-fertilizing the financial/non-financial and the formal/informal dimensions (see Figure 3). Again, we find the four MCS types primarily relying on a formal control paradigm at the left hand side. At the right hand side, two types of systems placing more emphasis on the informal side of control emerge. These are termed decoupled accounting oriented and grapevine oriented MCSs and are discussed below.

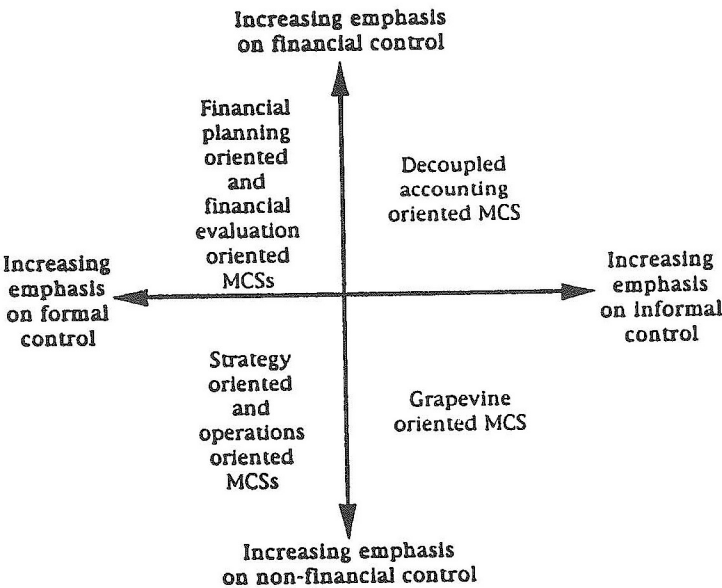
The Decoupled Accounting Oriented MCS

This type of system focuses on the financial side of management control. However, the formal accounting system is complemented by extensive use of informal accounting systems (Clancy & Collins, 1979). The latter may have accrued and are maintained on a more or less spontaneous basis by line managers and other employees with non-accounting functions. The use of informal accounting systems is encouraged by top management and the controller's department. It can also be facilitated by access to data generated for formal reporting purposes or which are accessible through central databases. This way, the formal and informal accounting systems may have a mutually supporting effect on each other.

An ongoing research project (Modell, forthcoming) provides evidence of how this may work in practice. As part of a process of increasing delegation of responsibility, top management of the studied organization has strived to instill a greater degree of financial awareness at the

Figure 3

**MCS Types Derived From Cross-Fertilization Of The
Financial/Non-Financial And The Formal/Informal Dimentions.**



operational level. One means of accomplishing this has been to direct more attention to participation in the planning and budgeting process and linking rewards more closely to financial performance. This has in turn resulted in increasing informal use of financial information by line managers for calculation and continuous monitoring of costs. This is endorsed and supported though not officially imposed by top management and the central accounting staff. Even though the use of financial information by line managers is still voluntary, its necessity is becoming increasingly apparent to many of them. Interestingly, similar empirical observations to the ones outlined above have been made by Berry et al. (1991) in their study of management control practices in a financial services company.

The term decoupled accounting is an accurate label of the type of MCS encountered here, since the use of formal accounting information for control is not restricted to accountants but dispersed throughout the organization. The system is also decoupled in a sense that even though there are important links between the formal and informal uses of accounting information they are clearly separate. However, little conflict is caused by the disparate use of accounting information at various organizational levels and the formal control paradigm is somewhat relaxed.

Compared to MCSs emphasizing formal financial structures, controllees may have greater possibilities to explain and motivate deviances from targets as they have access to analytical tools to meet this end. This might mute superiors' strict focus on pre-set performance targets for evaluation. Formal evaluation procedures can therefore be more dynamic and motivational contracts are sometimes adjusted in hindsight with respect to uncontrollable events (cf. Merchant, 1989). The possibility to construct accounting systems of one's own can also be an important motivational factor in its own right, which leads to enhanced understanding and acceptance of accounting information.

Decoupled accounting oriented MCSs would appear suitable for organizations employing complex technologies, where operational realities

are ill-reflected by aggregate formal accounting information and accountants have limited insight into the process of transforming input into output (cf. Fischer, 1992). Furthermore, the effective use of decoupled accounting oriented MCSs requires some degree of delegation of responsibility, and empowerment of employees throughout the organization. Hence, we may expect this type of system to be suitable in decentralized organizations, operating under relatively uncertain environmental conditions (Waterhouse & Tiessen, 1978).

The Grapevine Oriented MCS

This type of system, like the decoupled accounting oriented MCS, incorporates an increasing number of informal control mechanisms. However, the control process is less concerned with exclusively financial measures. Significant weight is assigned to the exchange of qualitative information, even though some informal non-financial records may be kept by managers or individual employees for control purposes. The grapevine oriented MCS encompasses less systematized control processes than the decoupled accounting oriented type. A central element of the control process may be the concept of management by walking around (MBWA). Control problems are frequently dealt with on an ad-hoc basis, where the use of formal accounting information may provide a general background to the issues at stake, but the epicenter of the control process is a less systematized exchange of information.

The reasons for this may vary, but one plausible explanation may be that operations are of a character which requires a significant degree of mutual adjustment between organizational members (Mintzberg, 1979). Relying exclusively on accounting information therefore becomes inadequate. Formal accounting information may require some further specifications and additional information to clarify complex issues, explain deviances and so forth. This is done through face-to-face encounters and other less systematized means, rather than relying on formal channels of

communication, such as budgetary and operational reports. Again, the budget may primarily be regarded as a loose guideline and the budgetary procedure is unlikely to be very elaborate or participative. A common justification for this may be that the involvement of line managers and operational staff in budgetary work should be kept to a minimum, since their time is constrained and too valuable for being spent on administrative tasks.

The budget may have some legitimacy for financial planning and control, but its use for motivational purposes is limited. Formal objectives are often vague and perhaps ambiguous and rewards are only linked to formal financial measures to a limited extent. Instead, performance appraisal is likely to be of a subjective and perhaps interactive character (e.g., personal career development discussions), with the impact of situational factors and differences in individual ability being taken into account to a great extent.

The grapevine oriented MCS is probably an effective means for dealing with environmental uncertainty and ambiguity, as it transmits information quickly and enables the organization to be responsive to change (cf. Earl & Hopwood, 1980; Mintzberg, 1979). As noted in the foregoing, significant environmental uncertainty may also be expected to be positively related to the subjective style of performance appraisal and control (Govindarajan, 1984). Furthermore, the ad-hoc style of decision-making that the use of this type of system implies is suitable for complex task environments, where control situations are often of a unique character and the benefits of standardization are small (Mintzberg, 1979).

CONCLUDING DISCUSSION

This paper has addressed the issue of MCS design, by focusing on three distinct descriptive dimensions of control. By cross-fertilizing these dimensions in three steps and applying a considerably broadened view of management control in organizations, eight alternative though not mutually exclusive archetypes of formal MCS design were developed. The broad perspective on management control in this paper can partly be justified by a need to address various issues raised by the contemporary critical debate on management accounting and control. In a sense, the proposed typology can be seen as an extension of some implications of this critique. It is hoped that the framework may constitute a platform for generation of new theoretical perspectives on management accounting and control.

Implications of a contingency perspective on the eight MCS types have been discussed briefly, leading to some tentative suggestions for future research to assess. In this respect, the contextual factors with a potential influence on systems design mainly emanate from the external environment of the organization, the kind of technology employed (or the task environment) and from the notion of organizational culture as a determinant of systems design as well as a control mechanism per se. While it has not been the aim of this paper to provide a comprehensive theory of how the proposed typology relates to a wider set of contextual variables, it is hoped that it can serve as a starting point for more holistically oriented research into how management control relates to the context in which it operates. Some other contingencies worth examining in relation to the proposed typology include organizational structure (e.g., Bruns & Waterhouse, 1975; Gordon & Miller, 1976; Waterhouse & Tiessen, 1978), size (e.g., Bruns & Waterhouse, 1975) and interdependencies (e.g., Chenhall & Morris, 1986; Fischer, 1994; Hayes, 1977; Wakefield, 1991).

"The wider behavioral impact of providing accounting feedback has not been sufficiently explored."

Focusing on business strategy, which is receiving increasing attention in contingency oriented management control research, may also provide interesting perspectives on the proposed typology. A relevant research question in this context is whether MCS design should be viewed as primarily contingent upon business strategy (Govindarajan & Gupta, 1985) or to what extent it can pro-actively effect strategic change (Dent, 1990; Dermer, 1990) and play a role in the creation of competitive advantage (Simons, 1990).

A third contingency perspective accrues from the insight that the effectiveness of evaluative feedback varies with differences in individual characteristics such as ability and self-esteem (Sorensen & Franks, 1972). This can in turn be related to how human information processing and cognition influence and constrain MCS design (Driver & Mock, 1975). Focusing on individual differences along these lines would present an opportunity to extend the use of the proposed typology to an analysis of what type(s) of MCS will be most suitable for different types of decision-makers under various situational conditions. Combining different levels and units of analysis may in turn support the evolution of a more comprehensive contingency theory of management control, spanning over how MCS design relates to individual features as well as the larger whole (environment) that both individuals and the control system are part of.

"Despite the importance of the service sector in most industrialized societies of today, no specific theory of service accounting and management control has yet evolved."

Finally, the inclusion of selection and socialization oriented MCSs stresses that a close link between management control and human resource management may be envisaged in some types of organizations. While this theoretical intersection has been observed in research focusing on the role of accounting information in performance appraisal and reward systems (e.g., Merchant, 1989), the wider behavioral impact of providing accounting feedback has not been sufficiently explored (Lockett & Eggleton, 1991). As indicated in the discussion of selection oriented MCSs, this would be particularly relevant for management control research in human resource intensive service organizations. Despite the importance of the service sector in most industrialized societies of today, no specific theory of service accounting and management control has yet evolved (Lowry, 1993; Modell, 1995). Closer integration between management control and human resource management theory may be one way of helping matters in this respect. It is hoped that the proposed typology will be a useful guide to a multifaceted and holistic view of the MCS in this context as well.

NOTES

1. The management accounting system is often regarded as a component of the management control system (Anthony et al., 1989; Paulsson 1993). In this paper, a wide definition of the management control system as built up by a number of interdependent subsystems is used. Apart from accounting systems, this initially includes budget, product costing and reward systems, but also structural features such as the allocation of financial responsibility (cf. Paulsson, 1993). As discussed later on in the paper this view is broadened to account for new perspectives on management control.

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ESTIMATION AFTER PRE-TESTING IN LEAST ABSOLUTE VALUE REGRESSION WITH AUTOCORRELATED ERRORS

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We study least absolute value (LAV) estimation and inference in the context of simple time series regression when the disturbances are autocorrelated. Several different estimation techniques are compared: uncorrected LAV, LAV after a Cochrane-Orcutt (CO)-type transformation to correct for autocorrelation, LAV after a Prais-Winsten (PW)-type transformation to correct for autocorrelation, and two pre-test estimators that transform (by CO and by PW, respectively) when a pre-test suggests that autocorrelation is present. Monte Carlo simulation methods are used to compare the small-sample performances of the different estimators. The Prais-Winsten approach to correction for autocorrelation is preferable to the Cochrane-Orcutt approach, and there appears to be minimal loss associated with always correcting.

The most commonly-employed approach to estimating the parameters of regression models is that of ordinary least squares (OLS). The OLS approach provides estimates that are unbiased and have minimum variance, as long as the errors are independent and identically distributed normal random variables. However, when the distribution of the errors is nonnormal and subject to outlying values, OLS estimators may perform

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quite poorly. In that situation, the use of an estimation technique that is robust to such violations of the assumptions of OLS is advisable. Least absolute value (LAV) regression is one of the most commonly-employed robust regression techniques.

The use of regression models for time series data often involves the violation of another assumption crucial to the optimality of OLS. With time series applications, the error terms often are not independent, displaying a correlation structure through time. This autocorrelation can arise for many reasons, including the existence of random shocks whose effects extend for more than one period. For example, a natural disaster, such as an earthquake or hurricane, can be expected to affect the local economy (e.g., construction activity) for months or years. On a more positive note, a corporation hopes that the effect of a large advertising campaign on its sales is not a single-period phenomenon, but will endure for some time. In this paper, we investigate the use of LAV estimation approaches in the presence of the first-order autocorrelation of the disturbances that is so frequently an issue when dealing with time series regression.

The problem of first-order autocorrelation has been investigated extensively in the context of OLS (see e.g., Dielman & Pfaffenberger [1989]), and some work has also been done in the context of least absolute value (LAV) regression. Weiss (1990) investigated the asymptotic properties of the LAV estimator when the disturbances are autocorrelated, and suggested a correction for first-order autocorrelation. Weiss' method is analogous to the approach proposed by Cochrane & Orcutt (1949), which is used frequently in least squares regression. Dielman & Rose (1994a) examined the performances of several estimators in the regression model with first-order autocorrelation of the disturbances, including uncorrected OLS and LAV, and OLS- and LAV-based versions of the Cochrane-Orcutt and Prais-Winsten (1954) corrections for first-order serial correlation.

"The use of regression models for time series data often involves the violation of another assumption crucial to the optimality of OLS. With time series applications, the error terms often are not independent, displaying a correlation structure through time."

The results obtained by both Weiss (1990) and Dielman & Rose (1994a, 1994b) suggest that correction for autocorrelation is important for moderate to large values of the autocorrelation coefficient, whether estimation is by least squares or least absolute value. For LAV estimation, Dielman & Rose (1994a) found that the efficiency of the uncorrected estimator is considerably worse than that of the corrected estimator, particularly as the severity of the autocorrelation increases. In another study, Dielman & Rose (1994b) observed that the out-of-sample forecasting performance of the models suffers when the autocorrelation correction is not employed. As with many problems of mismatching between the data and the model assumptions, the problems associated with uncorrected autocorrelation tend to be magnified when the sample sizes are small. Dielman & Rose (1994a) found that the inclusion of the first observation in the correction process is important for LAV estimation, particularly for small-sample situations. This result has also been observed with least squares-based methods, and leads to a preference for Prais-Winsten (PW)-type correction over Cochrane-Orcutt (CO)-type correction.

Previous studies have examined the use of a pre-test procedure when the estimation is conducted using least squares-based techniques; see, for example, King & Giles (1984) and Griffiths & Beesley (1984). In this

research, we extend the literature by considering the use of a pre-test procedure with LAV regression. Five estimation techniques are compared: LAV estimation with no correction, LAV estimation with CO-type and PW-type transformations to correct for autocorrelation, and two pre-test estimators that transform (by CO in one case and by PW in the other) only if a pre-test suggests that autocorrelation is present. Monte Carlo simulation methods are used to compare the small-sample properties of the estimators and the observed significance levels of the tests.

MODEL, ESTIMATION, AND INFERENCE

Model

We consider a simple regression model of the form

$$\begin{aligned} Y_t &= \beta_0 + \beta_1 x_t + \epsilon_t \\ \epsilon_t &= \rho \epsilon_{t-1} + \eta_t, \end{aligned} \quad (1)$$

for $t=1,2,\dots,T$. In (1), y_t and x_t are the t^{th} observations on the dependent and explanatory variables, respectively, and ϵ_t is a random disturbance for the t^{th} observation. The η_t are assumed to be independent and identically distributed, but not necessarily normal. The parameters β_0 and β_1 are unknown and must be estimated. The parameter ρ is the autocorrelation coefficient, with $|\rho| < 1$.

Using matrix notation, the model can be written as

$$\mathbf{Y} = \mathbf{X}\boldsymbol{\beta} + \boldsymbol{\epsilon}, \quad (2)$$

where

$$\mathbf{Y} = \begin{bmatrix} Y_1 \\ Y_2 \\ . \\ . \\ Y_T \end{bmatrix}, \quad \mathbf{X} = \begin{bmatrix} X_1 \\ X_2 \\ . \\ . \\ X_T \end{bmatrix}, \quad \boldsymbol{\epsilon} = \begin{bmatrix} \epsilon_1 \\ \epsilon_2 \\ . \\ . \\ \epsilon_T \end{bmatrix}, \quad \boldsymbol{\beta} = \begin{bmatrix} \beta_0 \\ \beta_1 \end{bmatrix}. \quad (3)$$

The LAV criterion selects estimates of β_0 and β_1 to minimize the sum of the absolute residuals. This problem can be stated and solved in a linear programming context. See Dielman & Pfaffenberger (1982) for a general survey of LAV regression.

We consider two different two-stage procedures to correct for autocorrelation in the LAV regression model. These procedures are analogous to the CO and PW procedures commonly employed in least squares regression, and differ in the treatment of the first observation. Both procedures transform the data using the autocorrelation coefficient, ρ . LAV estimation can then be applied to the transformed data. The PW transformation matrix is:

$$\mathbf{M}_1 = \begin{bmatrix} \sqrt{1-\rho^2} & 0 & . & . & . & 0 & 0 \\ -\rho & 1 & . & . & . & 0 & 0 \\ . & . & . & . & . & . & . \\ . & . & . & . & . & . & . \\ 0 & 0 & . & . & . & -\rho & 1 \end{bmatrix}. \quad (4)$$

Premultiplying the model in (2) by \mathbf{M}_1 yields

$$\mathbf{M}_1 \mathbf{Y} = \mathbf{M}_1 \mathbf{X} \boldsymbol{\beta} + \mathbf{M}_1 \boldsymbol{\epsilon}, \quad (5)$$

or

$$\mathbf{Y}^* = \mathbf{X}^* \boldsymbol{\beta} + \boldsymbol{\eta}, \quad (6)$$

where \mathbf{Y}^* contains the transformed dependent variable values and \mathbf{X}^* is the matrix of transformed independent variable values, so

$$\mathbf{Y}^{*'} = \begin{bmatrix} \sqrt{1-\rho^2} & Y_1 & Y_2 - \rho Y_1 & \dots & Y_T - \rho Y_{T-1} \end{bmatrix} \quad (7)$$

and

$$\mathbf{X}^* = \begin{bmatrix} \sqrt{1-\rho^2} & \sqrt{1-\rho^2} x_1 \\ 1-\rho & x_2 - \rho x_1 \\ \cdot & \cdot \\ \cdot & \cdot \\ 1-\rho & x_T - \rho x_{T-1} \end{bmatrix}. \quad (8)$$

In (6), $\boldsymbol{\eta}$ is the vector of serially uncorrelated η_t errors.

The CO transformation matrix is the $(T-1) \times 1$ matrix obtained by removing the first row of the \mathbf{M}_1 transformation matrix. Note that the use of the CO transformation means that $(T-1)$ observations, rather than T , are used in the model estimation. The first observation is omitted, rather than transformed and included in the estimation. Asymptotically, the loss of this single observation is relatively inconsequential. However, for small

samples, omitting the first observation has been shown to result in a least squares estimator inferior to that obtained when the first observation is retained and transformed; see Dielman & Pfaffenberger (1984), Maeshiro (1979), and Park & Mitchell (1980). Dielman & Rose (1994a) observed the same phenomenon in the context of LAV-estimated models.

Operationalization of the model requires that the correlation coefficient, ρ , be estimated from sample data. We estimate ρ by applying LAV estimation to the following equation:

$$\hat{\epsilon}_t = \rho \hat{\epsilon}_{t-1} + \eta_t, \quad (9)$$

where the $\hat{\epsilon}_t$ are the residuals from the LAV fit to the model in (1).

In this paper, we consider the following estimators for the coefficients β_0 and β_1 in (1):

1. LAV estimation with no correction for autocorrelation: the "LAV" (never-correct) estimator.
2. LAV estimation after using the CO correction for autocorrelation: the "CO" (always-correct) estimator.
3. LAV estimation after using the PW correction for autocorrelation: the "PW" (always-correct) estimator.
4. LAV estimation after using the CO correction if a test for autocorrelation indicates that correction is required; otherwise LAV estimation with no correction: the "PRE-CO" (pre-test) estimator.
5. LAV estimation after using the PW correction if a test for autocorrelation indicates that correction is required; otherwise LAV estimation with no correction: the "PRE-PW" (pre-test) estimator.

The test for autocorrelation used in the pre-test estimators is the Durbin-Watson test applied to the residuals from the LAV fitted model. Weiss (1990) examined tests for autocorrelation in models estimated using LAV regression, and found that the Durbin-Watson test applied to the LAV residuals performed well. The test concludes that correction is necessary if the test statistic falls below the Durbin-Watson lower bound. Otherwise, no correction is performed and uncorrected LAV estimation is used.

THE MONTE CARLO DESIGN

The experimental design for the Monte Carlo simulation consists of the following factors.

Sample size: The sample size is $T=20$, chosen to represent a data history that is short enough so that asymptotic results cannot reasonably be assumed to be valid. Many applications of practical interest in business and economics involve samples of approximately this size (e.g., five years of quarterly data). In addition, previous LAV-related studies (e.g., Dielman & Pfaffenberger [1990, 1992]) have indicated few differences in model behavior for $T \geq 40$, which would imply that asymptotic results may be applicable above that threshold. These studies also showed that results for $T=20$ and $T=30$ were similar to each other, while results for $T=14$ were noticeably different. Therefore, the selection of the sample size for this study is motivated by a desire to investigate small-sample results, while considering a sufficiently large number of observations to maintain the viability of the model.

Coefficient values: The parameters β_0 and β_1 are both set equal to zero. This selection causes no loss of generality. Refer to Andrews (1986), who showed that the choices of the parameter values are irrelevant in Monte Carlo efficiency comparisons using iterative generalized least squares or LAV estimators of the type considered in this study.

Degree of autocorrelation: $\rho = 0, 0.2, 0.4, 0.6, 0.8, 0.95$. We do not include values for $\rho < 0$ in the study, since negative autocorrelation is not encountered frequently in practical business and economic applications.

Disturbance distributions: Four different distributional forms for the η_t disturbances are considered, to include a variety of outlier-producing distributions:

1. Normal, with mean 0 and variance 1; i.e., $N(0,1)$.
2. Contaminated normal, where the η_t are drawn from a $N(0,1)$ distribution with probability 0.85 and from a $N(0,25)$ distribution with probability 0.15.
3. Laplace (double exponential), with mean 0 and variance 2. Uniform $(0,1)$ random deviates are generated and transformed to Laplace deviates using the inverse c.d.f. transformation.
4. Cauchy, with median 0 and scale parameter 1.

After generating the η_t values, the ε_t values are created as $\varepsilon_t = \rho\varepsilon_{t-1} + \eta_t$, where $\varepsilon_0 = \eta_0/(1-\rho^2)$, and η_0 is an initial draw from the disturbance distribution.

Explanatory variable: The explanatory variables are generated in the following ways, to enhance the generalizability of the results:

1. Normally distributed: $x_t = u_t$, with $u_t \sim N(0,2)$.
2. Autoregression: $x_t = \lambda x_{t-1} + u_t$, for $\lambda = 0.4, 0.8$, with $u_t \sim N(0,2)$.
3. Stochastic time trend: $x_t = \lambda t + u_t$, for $\lambda = 0.4, 0.8$, with $u_t \sim N(0,1)$.

The patterns in the explanatory variables generated in these ways should be representative of patterns encountered in practical time series

applications. Once generated, these values are held fixed throughout the experiment.

For each factor combination in the experimental design, 5000 Monte Carlo trials are used, and the resulting parameter estimates are recorded. All random numbers are generated using IMSL subroutines, and the explanatory variable values are generated independently of the disturbances. The simulation software is written in FORTRAN and run on an IBM 4341, Model 12.

RESULTS

The performances of various estimators can be compared using a variety of criteria. In this study, we consider the mean absolute deviations (MAD) of the slope and the intercept estimates, $\hat{\beta}_0$ and $\hat{\beta}_1$, for each method, computed as

$$\text{MAD} = \frac{\sum_{i=1}^{5000} |\hat{\beta}_i - \beta_i|}{5000},$$

where β_i represents the true value of either β_0 or β_1 , as appropriate, and $\hat{\beta}_i$ is the estimated value of β_i . Note that the MAD value can be viewed as a measure of an estimator's efficiency. Since a smaller MAD value is better, pairs of estimation methods can be compared by considering the ratio of their MAD values. These ratios are then measures of relative efficiency. Clearly, if the MAD ratio has a value that is less than 1, the estimation approach represented in the numerator is preferable to that represented in the denominator, based on this criterion.

"Is pre-testing better than always correcting? The answer is a resounding 'no.'"

Various MAD ratios for the 5000 trials have been tabulated for testing β_0 and β_1 . Figures 1-6 provide graphical displays of some of the most important results, showing median MAD ratios (across explanatory variable types) for estimating β_0 and β_1 , for the values of ρ and the four different error distribution types.

As expected, the performances of the PW-type and the CO-type corrections are quite similar with respect to the estimation of β_1 , with some preference for the PW-type approach; these results parallel those observed by Dielman & Rose (1994a). The comparison between the two approaches is much more dramatic when estimating β_0 . The CO-type correction performs extremely poorly when estimating the intercept term. Therefore, our analysis of the results focuses more heavily on the PW-type corrections. Three questions are of primary interest and are addressed below.

Is pre-testing better than never correcting? This comparison is made by studying the MAD ratios for LAV:PRE-PW and LAV:PRE-CO. (We report only PW results; complete results can be obtained from the authors.) Consider, first, the slope parameter (Figure 1). Not surprisingly, the preference for the pre-test correction increases with ρ . For Cauchy-distributed errors, correction is never worse, and is always preferred when $\rho \geq 2$. When the errors follow a Laplace distribution, correction is preferred when $\rho \geq 4$. For normally-distributed errors, correction is not uniformly preferred until $\rho \geq 8$, and correction is generally preferred for errors that follow a contaminated normal distribution. The loss associated with correction is minimal (e.g., relative efficiency=.96), whereas the loss associated

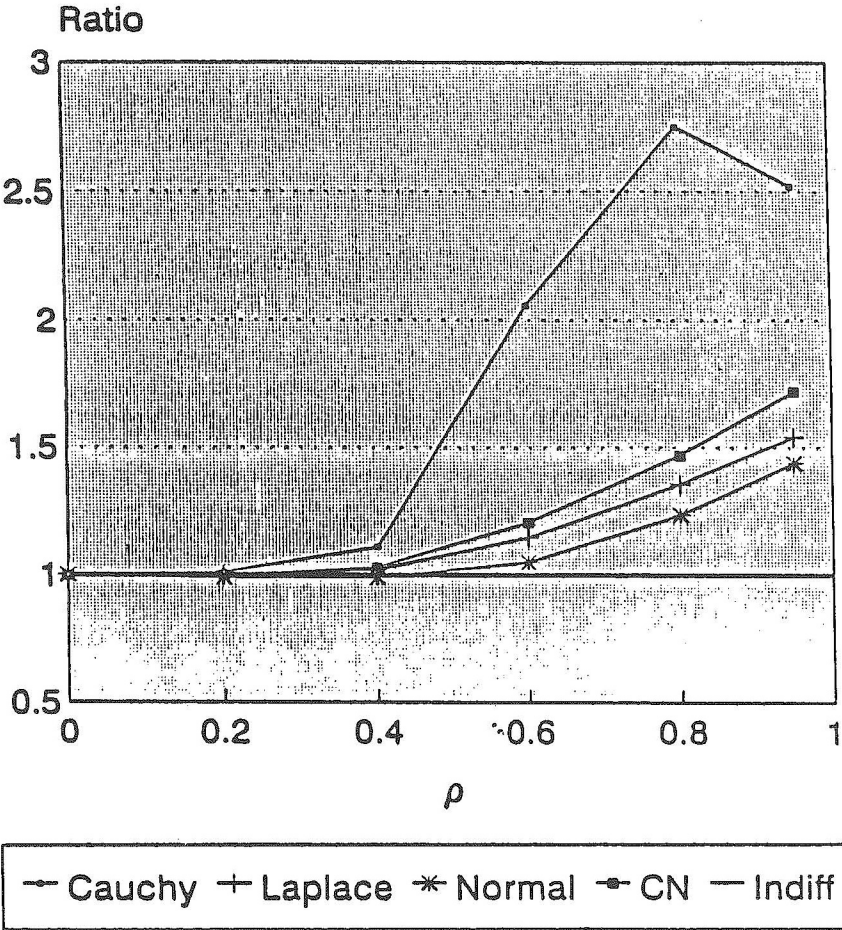
with not correcting can be quite large (e.g., relative efficiency=2.65). For the intercept term (Figure 2), correction is generally preferred for Cauchy, Laplace, and contaminated normal errors. When the errors are normally-distributed, the preference is generally for uncorrected LAV estimation.

"The pre-test estimator exhibits its best performance when the errors follow a normal distribution."

Is pre-testing better than always correcting? The answer is a resounding "no." Given the preference for the PW-type approach to correction, this comparison is made primarily by considering the MAD ratio for PRE-PW:PW. For the slope parameter (Figure 3), there is little loss associated with always correcting, even when $\rho=0$. The pre-test correction performs poorly for Cauchy errors and $.2 \leq \rho \leq .8$. The loss associated with pre-testing is reduced for $\rho=.95$ (the pre-testing results in correction for virtually all of the 5000 trials). While Laplace-distributed errors yield a slight preference for pre-testing when $\rho=0$, the loss associated with pre-testing with relatively low autocorrelation far exceeds this small gain. The pre-test estimator exhibits its best performance when the errors follow a normal distribution, which is not surprising, since the Durbin-Watson pre-test is based on an assumption of normality. The pre-test approach is preferred for contaminated normal errors only when $\rho=0$ and the explanatory variables follow a time trend. The results are fairly similar for the intercept term (Figure 4). Again, the pre-test correction is particularly bad for Cauchy-distributed errors and performs best for normally-distributed errors. For all error distributions, the pre-test approach is most appropriate when the explanatory variables follow a time trend.

Figure 1

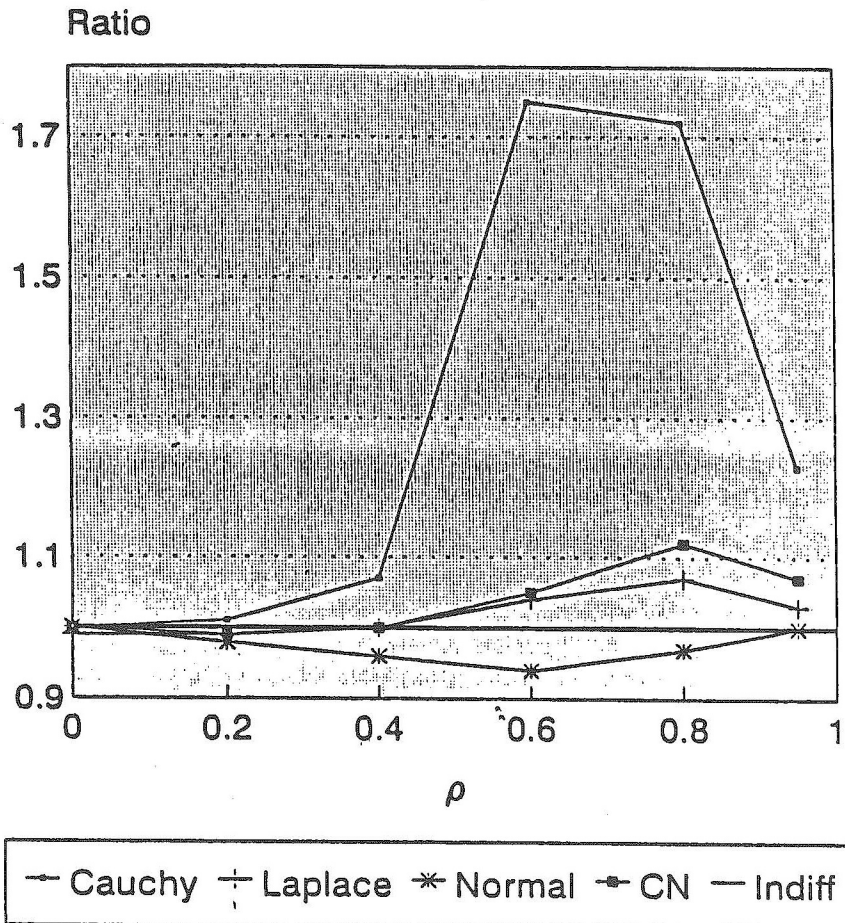
MAD Ratios For Estimating β_1 , LAV:PRE-PW (Ratio greater than 1 implies preference for pre-testing, rather than never correcting)



Medians across explanatory variable types

Figure 2

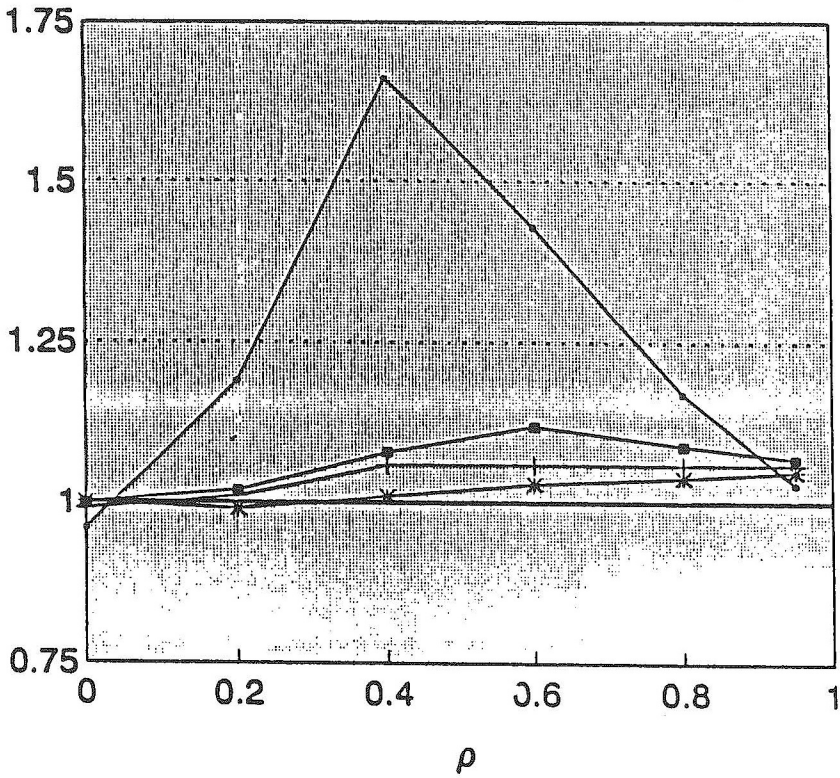
MAD Ratios For Estimating δ_0 , LAV:PRE-PW (Ratio greater than 1 implies preference for pre-testing, rather than never correcting)



Medians across explanatory variable types

Figure 3

MAD Ratios For Estimating δ_1 , PRE-PW:PW (Ratio greater than 1 implies preference for always correcting, rather than pre-testing)
Ratio

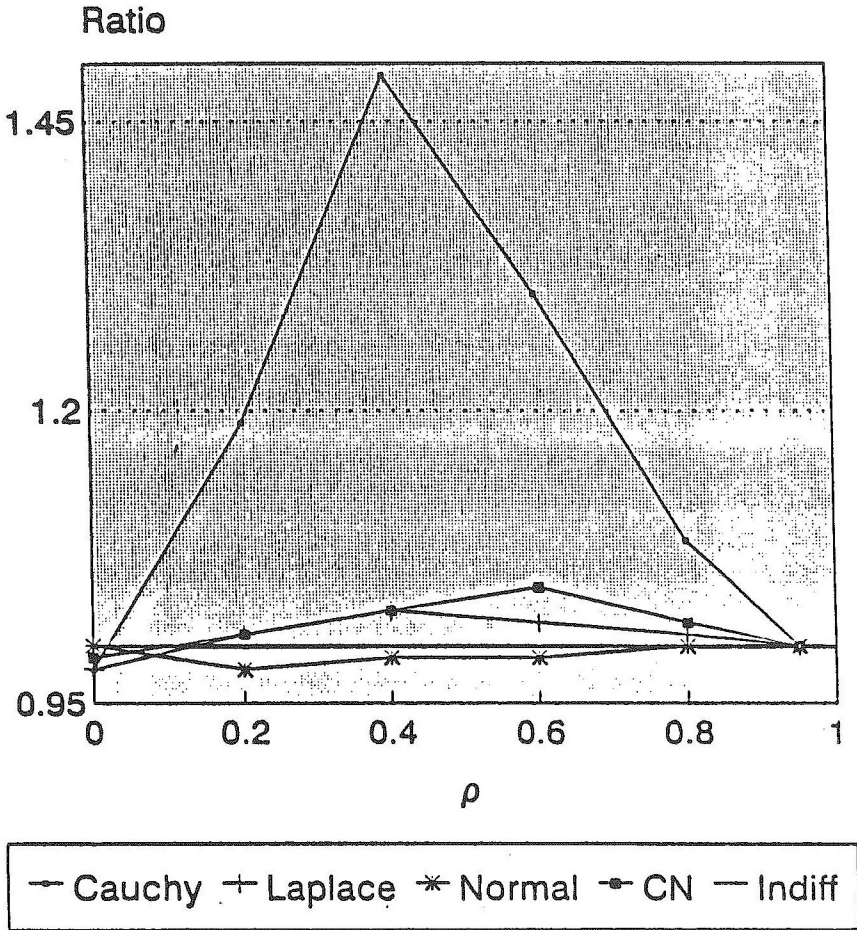


— Cauchy + Laplace * Normal ■ CN — Indiff

Medians across explanatory variable types

Figure 4

MAD Ratios For Estimating δ_0 , PRE-PW:PW (Ratio greater than 1 implies preference for always correcting, rather than pre-testing)



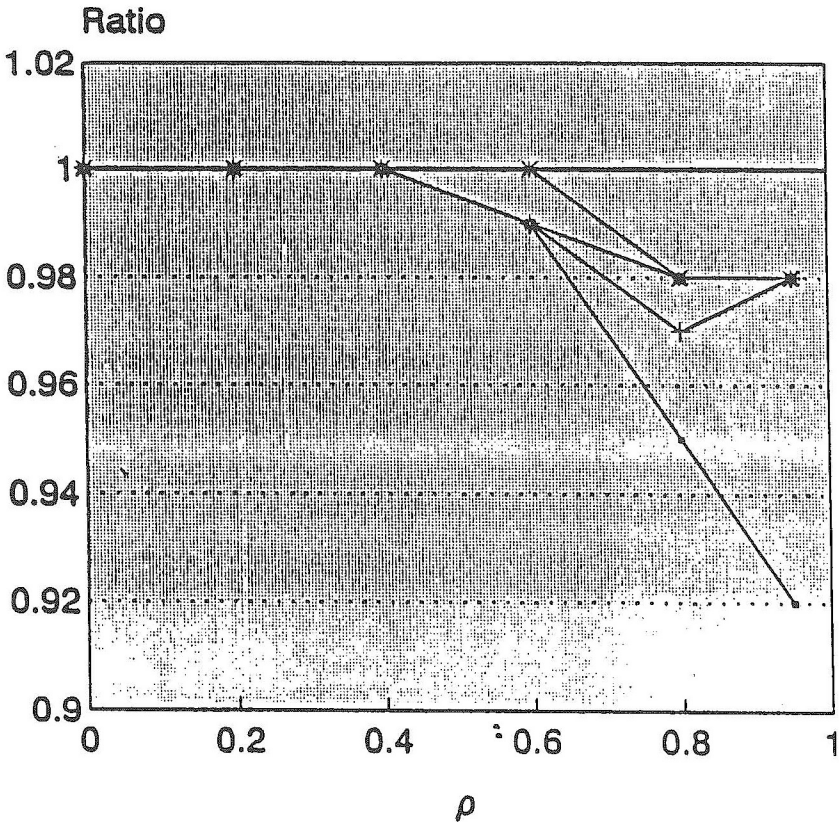
Medians across explanatory variable types

"There seems to be little loss associated with adopting the always-correct approach, in terms of estimation performance."

When pre-testing, is the PW approach better than the CO approach? Comparing the MAD ratios for PRE-PW:PRE-CO, the two approaches seem relatively similar for the slope coefficient (Figure 5), although the results indicate a preference for the PW approach when the autocorrelation is stronger, and a strong preference for the PW-type correction when the errors follow a Cauchy distribution. PRE-CO is never preferred to PRE-PW, except for normally-distributed explanatory variables and $\rho=.95$. However, in estimating the intercept term (Figure 6), PRE-CO exhibits remarkably poor performance when $\rho \geq .4$. Therefore, the PW approach is preferred to the CO approach.

Figure 5

MAD Ratios For Estimating β_1 , PRE-PW:PW-CO (Ratio less than 1 implies preference pre-testing using PW, rather than pre-testing using CO)

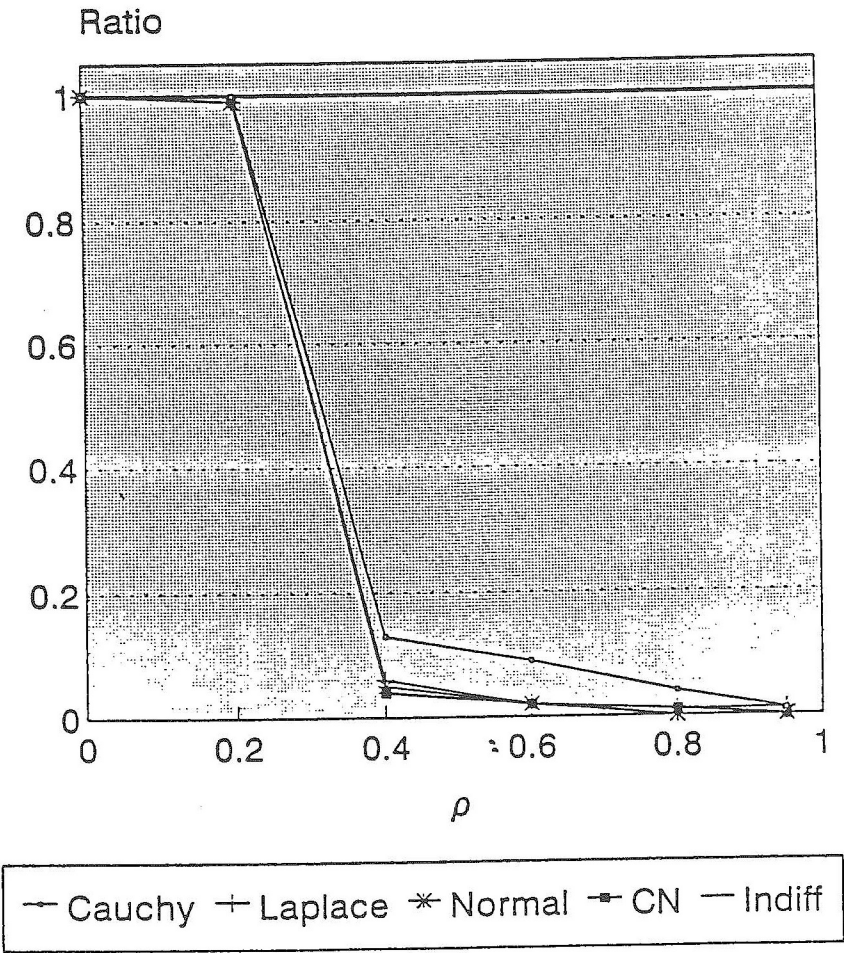


— Cauchy + Laplace * Normal ■ CN — Indiff

Medians across explanatory variable types

Figure 6

MAD Ratios For Estimating β_0 , PRE-PW:PW-CO (Ratio less than 1 implies preference pre-testing using PW, rather than pre-testing using CO)



Medians across explanatory variable types

"In the context of LAV regression . . . this study does provide additional evidence that Prais-Winsten-type correction should be used, rather than Cochrane-Orcutt-type correction."

CONCLUSIONS

In comparing the pre-test approach against the strategy of always correcting for autocorrelation, this study indicates that there seems to be little loss associated with adopting the always-correct approach, in terms of estimation performance. Additional research is needed to develop a more complete understanding of the circumstances under which the use of a pre-test for serial correlation is useful in the context of LAV regression. This study does provide additional evidence that Prais-Winsten-type correction should be used, rather than Cochrane-Orcutt-type correction. The choice of correction is particularly crucial when inference is made regarding the intercept term, due to the remarkably poor performance of the Cochrane-Orcutt correction in that context.

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DO ECONOMIES OF SCALE EXIST IN THE PHARMACEUTICAL INDUSTRY?[†]

Susan A. Simmons*

To determine whether the pharmaceutical industry becomes more efficient as it grows larger, economies of scale were measured with a translog multi-product statistical cost function. Returns to two outputs—research and development and sales—revealed that overall firms are characterized by diseconomies of scale. But, firms of all sizes experience increasing returns as their research efforts grow larger.

An issue of concern for many years is the degree to which economies of scale are present in the pharmaceutical industry. Since the early 1990s, the health care system has been undergoing a restructuring. President Clinton, in a December 1994, letter to Congress, reaffirmed his commitment to broad health care reform (McGinley, 1995). As health care streamlines to become more cost efficient, understanding the relationship between firm size and cost effectiveness seems imperative. The purpose of this paper is to estimate pharmaceutical industry cost functions that explicitly recognize the multi-product nature of firms. Previous cost studies ignored the multi-product nature of pharmaceutical firms by focusing on a single output measure (see Simmons, S. A.; Shull, S.; and Smith, M. C. [1978]; Schwartzman [1975]; Graves and Langowitz [1992]; DiMasi et al., [1991]) or assuming that the firm can be treated as a collection of separate and independent production functions. (Studies that emphasize only research and development [R&D] or drug innovation

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activities include those by Schwartzman [1976], Grabowski [1976], Vernon and Gusen [1974], Jensen [1987], and Graves and Langowitz [1992]). Also, this research gives attention to overall scale economies as well as returns to R&D and sales.

"As health care streamlines to become more cost efficient, understanding the relationship between firm size and cost effectiveness seems imperative."

BACKGROUND OF THE PROBLEM AND PURPOSE OF THE STUDY

The original methodology for studying production and cost structures in the pharmaceutical industry employed the Cobb-Douglas production function. The traditional Cobb-Douglas production function takes the form:

$$Q = A L^{\alpha} K^{\beta}$$

where

Q represents output

K and L represent capital and labor, respectively

A is a constant term

α is the elasticity of output with respect to labor, and

β is the elasticity of output with respect to capital.

The sum of the elasticity coefficients, $\alpha + \beta$, decides the scale characteristics. As an example, assume labor and capital inputs are increased by an equal percentage. Three results are possible:

1. Output increases by a greater percentage than the increase in inputs. In this outcome the production process yields economies of scale, becoming more efficient as the firm becomes larger. As output volume increases, long run average costs decline. The sum of the coefficients $\alpha + \beta$ exceeds unity.
2. Input and output increase by the same percentage. With constant returns to scale general efficiency remains the same as the process grows larger. An increase in output volume results in constant long run average costs. The coefficients $\alpha + \beta$ sum to one.
3. Coefficients $\alpha + \beta$ sum to less than one. Decreasing returns to scale result when a 1 percent increase in inputs results in less than a 1 percent increase in output. As output volume increases so do long run average costs.

Recently, researchers have embraced more flexible functions, such as the translog multi-product statistical cost function, to overcome restrictions imposed by the Cobb-Douglas form. The Cobb-Douglas production form is constrained to measure increasing, decreasing, or constant returns to scale, but not a combination of these.

The translog cost function provides an appropriate functional form for answering questions about economies of scale. By not restricting scale economies, it provides the flexibility necessary to estimate "U"-shaped average cost curves, derive scale economies or diseconomies, and allow these economies to vary by size of firm. The translog multi-product cost function is expressed as:

$$\ln C = a_0 + \sum a_i \ln Y_i + \sum b_i \ln W_i + 1/2 \sum \sum a_{ij} \ln Y_i \ln Y_j + 1/2 \sum \sum b_{ij} \ln W_i \ln W_j + \sum \sum c_{ij} \ln Y_i \ln W_j \dots \dots \dots \text{(Equation 1)}$$

where C is total cost, the Y_i represent outputs (research and development and sales) and the W_i represent input prices (cost of goods sold; employee wages; and net property, plant, and equipment). With m outputs and n inputs, the following linear restrictions on the coefficients in Equation 1 are necessary and sufficient for linear homogeneity in factor prices.

$$\begin{aligned} b_j &= 1; \\ b_{ij} &= 0 \text{ for } j = 1, 2, \dots, n; \\ c_{ij} &= 0 \text{ for } j = 1, 2, \dots, m; \text{ (Shoesmith, 1988)} \end{aligned}$$

The determination of scale economies is straightforward. Brown et al. (1979) and Bothwell and Cooley (1982) and Cebenoyan (1988) suggest that the appropriate measure of overall scale economies (SE) is the sum of the individual output cost elasticities. This research recognizes two outputs: research and development and sales.

$$SE = (\partial \ln C / \partial \ln Y_i), \quad n = 1, 2.$$

If SE is greater than one there are decreasing returns to scale; if SE equals one the industry is characterized by constant returns to scale; if SE is less than one there are increasing returns to scale (Gilligan and Smirlock, 1984).

The purpose of this research is to apply the translog statistical cost function to the pharmaceutical preparations industry. Attention will focus on economies of scale for two outputs, sales and R&D, along with economies of scale for the firm's overall operation.

REVIEW OF RELEVANT LITERATURE

The translog statistical cost function has been employed for measuring returns to scale for firms in various industries. One frequent application is the estimation of cost functions for multi-product banking firms. (See,

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for example, Cebenoyan [1988]; Rezvanian, R., Rangan, N., and Grabowski, R. [1983]; Gilligan, T.; Smirlock, M; Marshall, W. [1984]; Kolari, J. and Zardkoochi, A. [1991], Gilligan, T. W. and Smirlock, M. [1984]; and Bentson, G.; Hanweck, G.; and Humphrey, D. [1982]).

The translog multi-product cost function has also been applied to universities by considering undergraduate and graduate instruction and research publications as outputs. Evidence of economies of scale was found along with economies of scope in the joint production of graduate and undergraduate instruction (DeGroot, McMahon and Volkwein, 1982).

An application to petroleum refining firms measured outputs as daily production of motor gasoline, distillate fuels, and other refined products. Petroleum refining is subject to classical "U"-shaped average cost (Shoesmith, 1988).

The securities industry provides another arena for application of the translog multi-product cost function. Merger activity, competition from other industries, and proposed legal changes precipitated structural changes in the industry. If economies of scale or scope exist, then firm entry may be limited to banking firms large enough to capture the available economies of scale by offering the entire range of securities services. Alternatively, if the securities industry does not exhibit scale or scope economies, smaller banking organizations may be able to operate profitably at smaller scales. Research by Goldberg et al. found an industry composed of smaller, specialized firms demonstrating economies of scale and larger, more diversified firms exhibiting diseconomies of scale (Goldberg et. al., 1991).

A recent study of retail banking by Leemputte, Burgess, and Kilgore (1993) criticizes the misuse of economies of scale research. Economies of scale has been used to justify bank mergers—a potentially dangerous notion when size alone is emphasized and not management efficiency. Their unique approach to scale economies looks not at the entire business

but at functions within the business. Within retail banking the billing and accounting function, for example, offers high returns to scale while marketing does not (Leemmputte, Burgess and Kilgore, 1993). Businesses contemplating merger activity should examine scale economies of its individual functions as well as its overall operation. Likewise, pharmaceutical firms can benefit from cognizance of overall economies as well as returns to specific outputs.

METHODS

The purpose of this research is to estimate economies of scale in the overall operation of the pharmaceutical industry. Further, function specific economies of scale will be estimated for two outputs--the research and development function and sales. The Pharmaceutical Preparations Industry, SIC 2834, makes up a subdivision of the drug industry and comprises firms primarily engaged in manufacturing, fabricating, or processing drugs in pharmaceutical preparations for human or veterinary use (U. S. Department of Commerce, 1990).

Data on individual firms within the pharmaceutical industry are found in the *Disclosure* (1993) data base, which provides detailed financial and textual information on public companies. Reports filed with the U. S. Securities and Exchange Commission (SEC) form the basis of the data set. Annual data for 1993 were collected for each pharmaceutical preparations firm reported in the *Disclosure* database. Only firms with complete data bases are used in the analysis. Variable descriptions and notations appear in Table 1.

Total cost (C)

Total cost is the sum of sales, general, and advertising expense; interest expense; and cost of goods sold.

Table 1

Variable Definitions and Notations

Notation	Definition
EXPEND	Total Cost = cost of manufacturing; sales, advertising, and general expense; and interest expense. EXPEND is the dependent variable
SALES	Annual sales (000)
RDEXP	Research and development expenditures (000)
EMPLOY	Employee wages
CGS	Cost of goods sold (000)
NPPE	Net property, plant, and equipment (000)
LNSALES	Natural log of SALES
LNRDEXP	Natural log of RDEXP
LNEMPLOY	Natural log of EMPLOY
LNCGS	Natural log of CGS
LNNETPRO	Natural log of NPPE
LNSQSALE	$LNSALES * LNSALES$
RDSALES	$LNRDEXP * LNSALES$
LNSQRDEXP	$LNRDEXP * LNRDEXP$
LNSQEMPL	$LNEMPLOY * LNEMPLOY$
EMPCGS	$LNEMPLOY * LNCGS$
EMPNETPR	$LNEMPLOY * LNNETPRO$
LNSQCGS	$LNCGS * LNCGS$
CGSNETPR	$LNCGS * LNNETPRO$
LNSQNETPR	$LNNETPRO * LNNETPRO$
SALENETP	$LNSALES * LNNETPRO$
EMPRDEXP	$LNEMPLOY * LNRDEXP$
RDEXPCGS	$LNRDEXP * LNCGS$
RDNETPRO	$LNRDEXP * LNNETPRO$
SALECGS	$LNSALES * LNCGS$
EMPSALES	$LNEMPLOY * LNSALES$

"This analysis does not support the notion that large is better in terms of sales efficiency. But, it does suggest . . . research operation becomes more efficient."

Output (Sales and R&D)

Sales and research and development (R&D) expenditures comprise the outputs. A question may arise about considering R&D expenditures an output when it could be viewed as an input. If data were available on new drug innovation, then R&D could be regarded as an input that results in the output of new drugs. Without the data on new drug introductions, R&D expenditures will serve as a proxy measure of innovative output. To recognize R&D output only when a new drug is introduced, and not along the development time horizon, would needlessly exclude from the data set firms that had no new drugs in 1993. R&D expenditures overcome this bias and provide a satisfactory measure of innovative output.

Inputs (employees; cost of goods sold; and net property, plant, and equipment)

Labor, raw materials, and capital comprise the inputs into pharmaceutical production. Labor input is represented by employee wages. Cost of goods sold defines the price of raw materials, and the price of capital is captured in the depreciated value of plant, property, and equipment.

All outputs and input prices are scaled to one at their sample means to be able to interpret the regression coefficients as elasticities of the "average" pharmaceutical firm.

ESTIMATION AND RESULTS

The functional form used for tests of economies of scale will be the translog multi-product cost function. Two outputs, sales and R&D expenditures, and three inputs, employee wages; cost of goods sold; and net value of property, plant, and equipment; define the model. Total cost comes from expenses of manufacturing products, selling products, and maintaining the physical plant. Multiple regression analysis provides the multivariate technique necessary for model estimation. Table 2 displays the regression coefficients and statistics for estimates of Equation 1.

Table 2
Multi-Product Cost Function Estimation
Multiple Regression Analysis Results

Total Expenditures -- Dependent

Variable	Regression Coefficient	P-value
LNSALES	0.9106	***
LNRDEXP	0.8330	
LNEMPLOY	-0.3755	*
LNCGS	0.3779	*
LNNETPRO	-0.0025	
LNSQSALE	0.1573	***
RDSALES	-0.1993	***
LNSQRDEXP	0.0489	
LNSQEMPL	0.4471	**
EMPCGS	-0.2795	
EMPNETPR	-0.3954	
LNSQCGS	0.0775	
CGSNETPR	0.1112	
LNSQNETPR	0.0392	
SALENETP	0.0207	
EMPRDEXP	-0.1640	*
RDEXPCGS	0.0918	
RDNETPRO	0.1668	*
SALECGS	-0.1193	
EMPSALES	0.0040	

R²: 0.988 P-value: 0.0001

P-Values: *** Significant at least at the 0.01 level
 ** Significant at least at the 0.05 level
 * Significant at least at the 0.10 level

Note the following about the multiple regression equation:

- The coefficient of determination shows that approximately 99 percent of the variance in total cost is explained by the independent variable set.
- The complete equation is significant at least at the 0.001 level.
- The coefficients of the quadratic terms for outputs are positive and significantly different from zero for both sales and research and development expenses. Average cost per dollar of sales or average cost per dollar of research and development expenditure eventually will increase with continued expansion of those outputs.
- A t-test shows that $a_1a_2 + a_{12}$ is positive (0.0004) and not significantly different from zero. This implies no economies of scope between sales and R&D expenditures at the sample mean.

To broaden interpretation of the cost function, scale economies were calculated for different output mixes. Table 3 displays both the individual output cost elasticities and scale economies for all firms in the sample and also for firms grouped into three expenditure categories: small firms defined as those with expenditures of less than \$30,000,000 medium firms with expenditures between \$30,000,000 and \$150,000,000 and large firms with expenditures over \$150,000,000.

Pharmaceutical firms in all size categories seem characterized by diseconomies of scale ($SE > 1$). But, it is noteworthy that the economies of scale improve as the firms become larger. The most severe diseconomies of scale are experienced by the smallest firms.

Observing the cost elasticities for research and sales, it is interesting that all firms, despite size, experience economies of scale in research, with the largest firms displaying the most advantageous economies of scale. Note

how the cost elasticity on research decreases as firm size increases (from 0.98 for the smallest category of firms to 0.026 for the largest expense category). Thus, it appears large firms experience more efficient research operations as compared to small firms.

For all size categories the cost elasticity for sales is above one. Average costs rise as sales volume increases.

Table 3

Estimates of Cost Elasticities and Economies of Scales

Firm Size	Average Expenditure	Number of Firms	MC Sales	MC R&D	Scale Economies
Total Sample	\$632,140	149	1.1789	0.2519	1.4308
< \$30,000	\$9,015	46	1.69	0.98	2.67
\$30K \$150,000	\$40,400	33	1.56	-0.3212	1.2388
>\$150,000	\$1,580,000	34	1.23	0.026	1.256

DISCUSSION

Any thoughts of regulation of firm size should be reconsidered based on these results. Evidence suggests that pharmaceutical production is not Cobb-Douglas in nature and that studies that have imposed this assumption may contain questionable results. This analysis does not support the notion that large is better in terms of sales efficiency. But, it does suggest that firm size expansion results in declines in per unit research costs; that is, the

research operation becomes more efficient. The relationship between firm size and research efficiency deserves attention. Because of rising R&D costs and their effect on profitability, more pharmaceutical companies will be forced to merge in the 1990s (*R & D Magazine*, 1991). As pointed out in a study by DiMasi et al. (1991), within the past few years there have been several major mergers and acquisitions in the pharmaceutical industry including SmithKline—Beecham, Bristol Myers—Squibb, Eastman Kodak—Sterling Drug, Merrell Dow—Marion Labs, and American Home Products—Robins. The present study suggests that as firm size increases, research and development activity becomes more efficient. It would be interesting to look at R&D and innovation activity in these firms before and after the mergers to see if they do, in fact, experience lower average costs.

Prior studies of pharmaceutical firms have not conclusively accepted or rejected the hypothesis that innovative output increases with firm size. Comanor (1965) examined the relationship between the number of new chemical entities introduced to firm sales. Economies of scale existed for small firms while large firms displayed diseconomies of scale. Grabowski (1976) found that research output initially increased with firm size but decreased with respect to size for larger firms. Vernon and Gusen (1974) found the number of new chemical entities introduced increased with firm size, giving larger firms an advantage over smaller ones. Schwartzman (1976) also concluded that large firms display economies of scale in research and development. Jensen (1987) found a positive relationship between R&D expenditures and the number of new chemical entities introduced. But, Jensen concluded that for most firms the elasticity of new chemical entity introduction with respect to R&D expenditures is not significantly different from one, which implies constant returns to scale. Thus, volume of R&D expenditures leads to neither efficiency nor inefficiency in terms of innovation.

More recently a study of the pharmaceutical industry by Graves and Langowitz (1992) employed a unique measure of innovation. After

classifying innovations according to type and significance, they measured the relationship between innovations and R&D expenditures. Their results show decreasing returns to scale for all firm sizes. Small firms have higher innovative productivity as compared to larger firms.

"As firm size increases, research and development activity becomes more efficient."

So this research adds to the equivocal findings regarding the connection between firm size and R&D efficiency. The relationship between firm size and sales efficiency is clarified. Perhaps another research step would apply the method explained by Leemputte et al. (1993). They find that simply being bigger often does not result in lower costs. Their approach examines separate banking functions and measures returns to scale for each function. Scale matters in some functions within a given business, but not in other functions. An application of this method to the pharmaceutical industry could shed light on the question of whether firm size should be regulated. Instead of saying that a larger firm size is inherently good or bad, look at the returns to various functions (e.g., marketing, development, production) to determine whether firm size and average costs are related.

Future research might investigate the relationships across firm size, returns to scale for R&D activities, and costs of new drug introductions. A question of concern to all consumers, as well as the federal government, is: If increasing firm size translates into lower production costs, can and will the consumer benefit from lower drug prices? Development of the national health plan necessitates investigation of this question. Consumers, whether the U. S. Government or individuals, should pay a smaller average price per drug if economies of scale exist in R&D.

CONCLUSIONS

As plans for a national health care plan evolve, production characteristics of the pharmaceutical industry must be considered. Based on this research we cannot say that bigger is better for pharmaceutical firms. If we look at the overall operation of the firm, increasing firm size does not lead to lower average cost. But, for those firms trying to improve research efficiency, bigger is better; this research discloses economies of scale in research. The final decision of which health care policies are applicable to take advantage of these characteristics is left to those with a decision-making role.

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WHATEVER HAPPENED TO THE IVORY TOWER?

PROCESS CHANGE IN HIGHER EDUCATION: FROM TQM TO BPR[†]

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This paper considers the impact of the unprecedented changes facing higher education upon the traditional assumption that the hallmark of universities has been and always will be that of quality. This implicit assumption now faces the challenge of new ways of demonstrating quality, at a time of an eroding unit of resource. The paper briefly overviews the changes taking place within British higher education which require a new approach to quality management. A way forward is explored through the implementation of Total Quality Management (TQM) and Business Process Redesign (BPR), drawing on experiences at the author's own institution, and at another in the USA.

Most academics would like to believe that quality has always been part of the tradition of higher education, even though the processes for achieving this have varied between different cultures and countries. As Frazer (1994) illustrates however, in recent years and in a variety of ways, this comforting assumption has been called into question in many countries.

[†] The author wishes to acknowledge the contribution of all her colleagues on the path to TQM at Aston University. She stresses however, that the observations and views expressed in this paper are entirely her own and in no way represent an official interpretation of events at Aston.

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Essentially the "ivory tower" image of universities, whereby the academic way of life was considered by many to be remote from the rest of society has eroded in the face of consumerism and movements towards mass higher education. Universities are now having to demonstrate the quality of their work in unfamiliar ways to a much wider audience, in the face of increasing intervention from external agencies.

For instance, the last decade and a half has seen various far reaching changes affecting the size, structure and resourcing of the British higher education system. In 1979, only one in eight young people entered higher education, whereas by the mid 1990s the participation rate has risen to nearly one in three. The expansion has gathered pace over this period with a 53% increase in home students on undergraduate and postgraduate courses since 1988/89. There is also much more heterogeneity within the system in terms of both the student population and the courses which they follow. This expansion has been achieved despite a lowering of the unit of resource, as overall funding per student has been cut by over 25% in real terms over the past five years and the next three years are likely to see at least a further nine percent reduction (CVCP, 1995).

Structural change has also been introduced which has removed the "binary line" as until 1993 British higher education was divided into university and polytechnic sectors with different missions and funding arrangements. The universities concentrated on research and on teaching undergraduates and postgraduates, whereas the polytechnics had a much wider portfolio of teaching, including sub-degree work and many vocational courses but carried out less research. In comparison with polytechnics and colleges of higher education, universities were accorded more autonomy and benefited from a system of specially designated funding for research.

In 1993 universities and other higher education institutions all came under the same funding body and the former polytechnics and many of the colleges of higher education, also took on the title of university. Thus the

"university sector" more than doubled as a result of these changes, and with the sharing of a common title and basis for funding, former distinctions about the type and quality of educational provision have rapidly become more blurred. Alongside these structural changes various new forms of quality control have been introduced. Back in the mid 1980s research selectivity was introduced by the government funding body, with institutions graded in terms of the perceived quality of their research, based upon peer review. Initially no direct funding implication followed from this system but along with the other changes in the 1990s and the repetition of the exercise, now direct funding for research (as opposed to funds distributed via research councils) is based on an institution's research rating, rather than the "old" university system, whereby research funding was based upon student numbers.

Attention has now turned to quality assurance processes within universities. First of all quality audit was introduced to determine the adequacy of an institution's quality assurance procedures. A separate process has also been put in place to assess the quality of educational provision for different disciplines within an institution. It is anticipated that the two systems of audit and assessment will be brought together. Although at present the grading of disciplines is not tied to funding for English universities, the experience with research assessment and indeed teaching assessment within the Scottish Higher Education system, suggest that such a move is only a matter of time.

Such a period of unprecedented change has inevitably brought strains in the system. Universities are now educating more students for a lower unit of resource, even though total funding for teaching has increased in real terms by 45% since 1989 (CVCP, 1995). Thus the implications of expansions in student numbers for public expenditure, coupled with the quest for better public services generally, growing competition for both resources and students and the inevitable tensions between efficiency and effectiveness in service delivery have led to much of the current concern over quality and standards in higher education (Green, 1994).

Although circumstances vary, the situation for higher education as the century draws to a close is not so very different in other countries. For instance, Lewis & Smith identify changes in American higher education, which heighten the need to take issues of quality seriously. As in Britain, there is a changing environment in which competition for students and funds continues to increase, at a time when institutions are having to accomplish more with less (Lewis & Smith, 1994). Australian higher education is also characterized by change, having undergone rapid expansion since the late 1980s, coupled with declining levels of funding. This has occasioned concerns over quality assurance and the setting up of a national structure, independent of the government, to report and comment on university quality assurance (Hambly, 1995).

An international study of quality in higher education which considered the UK, USA, and Australia, as well as France, Germany, Hong Kong, India, the Netherlands, New Zealand and South Africa found multiple sources of concern for quality coming from government, tax payers, employers, students and their parents and academics and managers in universities in the various countries. The author identifies a range of different types of agency concerned with quality in these countries, including university-owned agencies, government agencies, validating and accrediting bodies, and awarding and other non-governmental agencies. He argues for the importance of self-evaluation by institutions, rather than evaluation by external agencies but suggests that it should be aided by external quality assurance agencies. This requires staff development and training to facilitate self-evaluation and information on best practice and innovation in teaching, learning and assessment to be disseminated (Frazer, 1994).

TACKLING QUALITY IMPROVEMENT

Thus the global scene for higher education is one of change coupled with more overt concerns over quality assurance and the ways in which

this can be managed. Faced with a changing environment and the need to demonstrate quality of provision in research and teaching, universities have had to respond to these pressures by finding their own path towards improving their performance as a deliverer of services, in ways which are commensurate with their particular mission and cultural context.

"Educational institutions have been seen as slow to adopt TQM even though business schools and various . . . engineering departments now teach courses in this area."

At the author's institution Aston University in the United Kingdom, an awareness of the need to manage processes more effectively, began in the mid 1980s with a programme of management development for senior academics and administrators. This was followed by further workshops and seminars to provide insights into the various attempts to bring about quality improvements in industry. At the same time, a more bottom up movement was also taking place with Quality Circles being formed by groups in different parts of the university, for example amongst support staff in the business school and by the university cleaners.

Then, in the early 1990s, the university decided to adopt a Total Quality Management philosophy based upon Kaizen and the principles of Deming. A consultant, with experience of TQM in industry, was appointed to facilitate the setting up of a university Quality Council, composed of senior academics and administrators, including the Vice Chancellor, the Pro-Vice Chancellors, the Deans of Faculties and Heads of all the central services departments. The Quality Council identified the major processes within the university and their related critical success factors (CSFs). Each

process was then nominated a process owner, who invited others to join that Process Council from across the university. The different Process Councils went through the same procedure, in order to establish their sub-processes and CSFs and then identified problem areas where quality improvement projects (QIPs) would help to enhance the effectiveness of that process. These QIPs would recruit new members, thus through a cascading principle, continuous improvement could be achieved across the university. The movement was facilitated by training courses on quality awareness and tools and techniques of quality management, which were open to all staff in the university. Those involved in Process Councils were encouraged to complete the training programme as early as possible.

SOME REFLECTIONS ON TQM IN ACTION IN THE UNIVERSITY CONTEXT

The TQM approach was pioneered within industry, but has been spreading to other sectors in many parts of the world (Lawler et al., 1992). Educational institutions have been seen as slow to adopt TQM (Madu et al., 1994; Weller & Hartley, 1994) even though business schools and various engineering departments now teach courses in this area. Also successful implementation of TQM has been far from universal and there is growing recognition that the various principles propounded by the TQM gurus are not universally applicable to all organizations and organizational activities but contingency dependent (Sitking, Sutcliffe & Schroeder, 1994). Boaden (1994) argues that there is now recognition amongst organizations that a universal definition is neither desirable nor applicable and that they therefore develop their own definitions of TQM to suit their own particular culture. Nevertheless, she identifies four "Hallmarks" of TQM from the literature as: customer satisfaction, leadership, quality awareness by all employees and a supportive organizational culture (Boaden, 1994:470).

In the university context, such basic elements have different implications from in industry. For instance, there are different facets to the concept of the external and the internal customer for universities, as their two core products, student education and research have various different customers. In the case of the teaching and learning experience, there are not only the students themselves as customers and their parents who support them but also employers who have a stake as consumers of the products of universities. Similarly, in the case of research, various funding bodies representing government, industry, etc., have to be satisfied, as well as the academic community.

Universities are "people intensive" organizations, with for instance around 70% of the resources of universities in the UK taken up with employment costs. There is growing recognition in the literature of the importance of human resourcing issues for the successful implementation of TQM (Boronico & Mosca, 1994). What is often referred to as the "soft" side of TQM relies on the ability of the institution to create an organizational culture in which quality awareness is endemic. This requires people to have a deep rooted commitment to quality and the competence to build these concerns into their everyday work. Leadership is central to building such a culture but training and development in appropriate tools and techniques is also required to turn intentions into reality.

Leadership in professionally based institutions like universities might at first sight appear not to be as complex an issue as say finding appropriate tools and techniques for the academic environment, but this is not necessarily the case. There are cultural traditions in universities about academic freedom and autonomy, which typically make the exercise of leadership a more diffuse and less top down process, than say in industry or government. The commitment and active involvement of the most senior members of an organization is a key factor in diffusing the TQM approach in any type of organization. Thus leading by example is

important in all organizations, including universities but there are other differences in relation to the diffusion process.

"Academics tend to view any participation in activities which is not directly and immediately related to teaching and research as a distraction from their 'raison d'être'."

In a command structure, it may be acceptable to require employees to participate in quality training as a way of overcoming initial resistance. In the more democratic structures of the university, it is easier for academics in particular to remain complacent about quality and simply to reject the need for a new approach. Others who are interested and ready to be involved are still likely to be very skeptical of an approach, if it does not appear to deliver results in the areas which directly affect their teaching and research. Thus the form and content of the training has to be handled with sensitivity. Models lifted directly from an industrial context are unlikely to capture the imagination and enthusiasm of participants from higher education. Although cultural change is less easily facilitated in these circumstances, arguably if achieved, it may be more thoroughly internalized and profound, as it has successfully run the gauntlet of those trained to question and challenge the assertions of others. These are just some of the facets of attempting to implement TQM in universities, which is in any case recognized as neither a quick nor easy process.

The slow path to process improvement via TQM is further exacerbated in the university context, through the decision making structures which abound, with academic boards, committees, sub-boards, working parties etc. The existence of such a plethora of often democratically structured

bodies, not only makes for slow decision making, but also has implications for the introduction of still more groups in the form of say process councils. The latter are normally based upon cross functional membership but this too can be the case with traditional university bodies and the possibilities for confusion, duplication of effort and suspicion are seemingly endless. Also the outcomes of the "business as usual" approaches to work in the traditional bodies can certainly, at least at first, appear to be far more productive than the early faltering steps in attempting to apply TQM principles and techniques.

The strength of the TQM approach is that it is based around the vision, mission and strategic direction of the organization, so that any quality improvements that follow should address the core concerns of the institution. Nevertheless the complexities of sorting out TQM issues within universities and getting agreement on such matters as "what are the critical success factors for a process?" "who are the customers?" "what are the root causes of a problem?" or "how can we measure this process?" are seemingly very slow, even to those directly involved and familiar with the methodology. The absence of the kinds of clear and tangible results, which are typically arrived at more quickly say through the often simpler function based work of Quality Circles, or even the traditional "business as usual" committee structures, can make it particularly hard to establish the credibility of a TQM approach in a university, even to those who claim to be aware and concerned about issues of quality. This is especially the case with academics, who tend to view any participation in activities which is not directly and immediately related to teaching and research, as a distraction from their "raison d'être".

Shared Experiences

A recent account of the implementation of TQM in an American University acknowledges that it too has proved to be "more challenging

than many of us realized at first" (Coate, 1992, cited in Lewis & Smith, 1994:255). At Oregon State University the barriers were identified as:

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| <i>Skepticism</i> | - it's seen as a fad. |
| <i>Time</i> | - it's another assignment. |
| <i>Language</i> | - suspicion of industry based jargon-laden language. |
| <i>Middle management</i> | - teamwork approach is unfamiliar. |
| <i>University governance</i> | - committees are used to "doing their own thing" without reference to overall institutional mission and vision. |
| <i>Dysfunctional units</i> | - TQM brings hidden problems to the surface and perhaps intensifies them. |
| <i>Attitude</i> | - individual resistance to change is compounded organizationally. |

In the account of Oregon's experiences, as at Aston, the argument is made that these barriers have to be recognized as part of any change and should not distract from what has been achieved. Rather, Coate argues that they should be tackled through: Support from the top, the "Just do it" principle, focussing teams on process improvement, finding champions to see it through, using breakthrough (Hoshin) planning and introducing TQM into the service or administrative side first (Coate, 1990, cited in Lewis & Smith, 1994:259).

In many respects the last prescription could be seen alternatively as either walking away from the real problems or as a sound short-term tactic. Certainly the experience at Aston suggests that progress on process improvement projects has been more immediate in some of the central

services areas, as for instance in bringing about process redesign within the library to meet the reduction in staffing. Also quality improvement projects, even if they are led by people associated with a support service, are likely to be more readily supported by academics if they are seen say to benefit the student experience. In the end though, to realize TQM in an educational institution it cannot be left to support services to drive the initiative, as it has to have commitment from academics and directly infuse their approach to their work.

FROM TQM TO BPR?

The step-wise approach to quality improvement through TQM provides an institution with an important underpinning to process change but sometimes external events in particular intervene, which cannot be addressed, simply through continually improving existing processes. Although still maintaining the TQM thrust, some of the thinking behind BPR is also being implicitly adopted at Aston. BPR originally stood for Business Process Re-engineering but has subsequently encompassed a range of variations including Business Process Redesign, Business Transformation and Re-engineering but all imply radical organizational change (Courtney, 1994:226).

BPR, like TQM, aims at achieving strategic redirection but according to BPR proponents, this is done through more fundamental rethinking and the radical redesign of business processes (Hammer & Champy, 1993). Thus it is argued change is taken further through BPR to achieve organizational transformation. This is achieved most effectively through a fundamental reappraisal of business activities, by revising the business strategy and business planning, redesigning business processes and rethinking management approaches (CCTA, 1994).

Organizations have been depicted as turning to the more radical approaches to change propounded by BPR, when faced with significant

external threats (Burke & Peppard, 1994). Certainly for universities today, the external environment is perceived as exceptionally hostile and posing a threat to a well established and much valued academic way of life. This may require a more fundamental reappraisal of organizational processes than would stem naturally from the methodology for continuous improvement with TQM. Also it is argued that successful re-engineering requires attention to be given to changing management processes, as well as operational processes (Champy, 1995).

In response to the need to become more effective and efficient, at Aston a trading company model (TCM) approach has been recently introduced to give heads of individual departments (both academic and support services) greater knowledge and understanding of their finances in relation to those of the rest of the institution. In some respects TCM is seen as divisive and moving in the opposite direction to TQM. Whereas TQM is based upon cross functional teamwork to achieve process improvements, the TCM encourages an individualized departmental perspective. Hence when changes in funding forced the university to cut its staff costs, heads of academic departments argued successfully for the greater burden to fall upon central services. One path towards resolving such tensions has been to redesign part of the process for allocating resources. Service level agreements are now being negotiated between departments which specify the services required and their cost implications. Thus for instance an academic department would specify the core services it requires from a support service to be met from central funding. If additional services are also requested, the costs would then have to be met by the academic department.

This type of process redesign helps to resolve some of the tensions arising from reductions in funding but it does not fundamentally change the ways in which academic work is conducted. When universities are faced with taking more and often more diverse types of students, without commensurate increases in funding, there is a limit in the extent to which economies can be made, whilst continuing to teach in traditional ways.

One way to maintain standards but make more effective use of resources is to redesign the teaching processes, involving say more stream lined structures which cut out duplication of effort in teaching and in support. This may also require a radical rethinking of the role of technology in teaching to find effective ways of exploiting the use of technologies to enhance the learning experience, whilst also easing the burden on staff time.

The democratic traditions of universities involve a great deal of time being taken up for academics in different types of committee work, to arrive at consensus decision making. At the author's institution it is recognized that a radical review of the university committee system is needed, to create a more responsive and dynamic approach to decision making. At present the work of the more recently created process councils runs in parallel to the traditional committee structures, which is not an effective use of scarce resources. To have a major impact upon the ways in which the University goes about its business, a strategic redesign of organization wide processes is required. As Ovenden has argued a customer focus is at the core of successful BPR, as without them there would be no business. He questions how many activities are in place in a business just to satisfy the internal wishes of the company's own organization (Ovenden, 1994:57). This same question can usefully be asked of universities, as an acid test of the need for a particular committee say would be to demonstrate how it contributes directly to the educational experience of the student - would the students or indeed research suffer if this activity did not take place?

It has been argued that BPR, in its current stage of development, more often focuses on projects in particular functional areas (Morgan, 1994), but where some of the most successful applications have taken place, these have been across the supply chain. For instance Proctor and Gamble and Wal-Mart have co-operatively set out to redesign radically their joint consumer - retailer - manufacturer chains, to benefit both companies. (Hewitt, 1995:151).

Within the context of higher education the supply chain focus to process change also has much potential. For instance the greater diversity of students entering higher education makes it difficult to continue to work with teaching programmes based upon earlier assumptions about prior learning and discipline knowledge. In the British context universities have traditionally relied upon recruiting students who have passed nationally recognized "A" level examinations. Now that more open access to universities is being encouraged, applicants are coming forward through recently introduced "Access Courses", which are very different from conventional "A" levels. These applicants are often more mature students who live in the vicinity of a university. Close collaboration with local colleges can help universities to adapt their selection procedures and to design courses which are appropriate for such non- traditional university entrants.

At the other end of the supply chain, closer links with employers can greatly assist the successful placement of students in employment upon graduation. Aston University has many "sandwich" programmes where students work for a year for an organization during the third year of their four year programme. Managing these schemes involves very close links with employers nationally and abroad. The types of programmes that it offers and its close links with employers has enabled Aston for many years to be at the top of the league for the employability of its graduates. Drawing on these links with employing organizations to ensure a user perspective during the redesign of programmes, facilitates the ease of transition for students from education to work.

CONCLUSIONS

This paper has overviewed some of the strategic issues which are facing higher education in the final stages of the twentieth century and has cited attempts by institutions to work towards more viable approaches for the future. TQM is gaining acceptance in various quarters as a means of

bringing about process improvements, although it has had less visible success in the context of education than in industry (Weller & Hartley, 1994).

"Thus current thinking suggests that a way forward is for BPR to build on to the gains being achieved through TQM rather than replace it."

The question is whether continuous improvement in processes alone will prove to be a sufficiently effective route to greater efficiency and effectiveness in higher education or whether a more radical approach, say in the form of BPR is needed? Whilst TQM according to some proponents is the answer to every organizational ill, it can also be criticized for its reliance on the cumulative benefits of many small improvements, inherent in the continuous improvement approach. The improvements that are achieved through TQM will be important to the organization but situations may require things to be done radically differently and this is where the BPR approach can provide a way forward. Nevertheless this does not mean that organizations are faced with an either-or decision, as both approaches can add value and be complementary (Burdett, 1994).

Thus current thinking suggests that a way forward is for BPR to build on to the gains being achieved through TQM rather than replace it. Reflecting on the experiences of her own and other institutions, this author concludes that if the core business of a university, that of teaching and research, is to be significantly enhanced, it is unlikely that any one recipe for change will provide an adequate answer. The higher education sector is particularly dynamic and an institution needs to be capable of both

anticipating and responding to change, in ways which have not been typical of much of British higher education to date. One way of creating a more dynamic system is for institutions to be prepared to sacrifice their tried and tested ways and to experiment with other approaches, whilst avoiding the situation where the "new of today", becomes the "sacred cow of tomorrow". TQM has an attraction for universities as a response to the need to manage more effectively, especially if it is perceived as an adaptive way forward. However, faced with scale of changes confronting higher education in the UK and elsewhere, it is unlikely that improving the ways in which the same can be done with fewer resources is likely to provide an adequate strategy for survival. This is why the more radical approach associated with BPR, especially if it is conceived in terms of supply chain relations, is likely to become a more propitious way forward for higher education.

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USING ICONIZATION AND MIND MAPPING IN THE TRAINING AND DEVELOPMENT ENVIRONMENT OF THE MACRO-INDUSTRIAL ERA

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Our goal for the training and development environment is to be able to present as much information as possible that applies to the designated task and accomplish this in the shortest time so that the trainee or learner understands the material, retains the information, applies the concepts effectively, and optimizes their innovation potential. They are then able to pass on this information as accurately as possible and with minimal preparation to a new trainee.

In this paper, a methodology that has been used effectively for training for over 10 years in a large home health care corporation and in a university computer science / business administration program is presented. A small portion of a training curriculum will be described and illustrated with a real life example that is used to teach the principles and application of Total Quality Management (TQM) in a classroom and boardroom.

Conviction for the methodology described here was attained through the study and application of systems analysis techniques for describing the activities of businesses where the analyst understands the business, can interact with the user effectively to gain a thorough

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understanding of the business, can optimize the way the business is conducted, and then can ensure that software is written to implement all or a part of what has been learned. Good, clean diagrams have played an essential role in the design of complex systems and in the developing of programs. Philosophers, leading computer scientists (Iverson, 1982) and others have often stated that what we are capable of thinking depends on the language that we use for thinking and it becomes a “tool for thought”. Mathematical notation succinctly describes complex processes and allows effective problem solving and communication. The diagrams that we draw of complex processes are a form of language. With computers, we often create processes that are more complex than those which we would perform manually. Appropriate diagrams help us to visualize and invent those processes. When the analyst is developing a system design for a program, the diagrams that they use are an aid to clear thinking. A good choice in diagramming can speed up their work and improve the quality of the results.

When a number of people work on a system or a program, diagrams are an essential communication tool. The diagrammatic technique is needed to enable developers to interchange ideas and to make the components fit together with precision. When systems are changed, clear diagrams are essential to the maintenance process. They make it possible for a new team to understand how the programs work (often highly complex) and to show their understanding by designing the required changes. A critical point occurs when a change is made. It often affects other parts of the program. In other words, the association of that one component to many other components must be made evident. This is not as clear in the linear statements of a programming language. A major competitive advantage in any corporation today is innovation (a second is quality service) and this requires the ability to think creatively, and the association ability is at the heart of creativity.

Given an appropriate diagramming technique, it is much easier to describe complex activities and procedures by using diagrams than by

using text. A picture can be much better than a thousand words because it is concise, precise and clean. It does not allow the sloppiness and woolly thinking that are common in text specifications.

"It is much easier to describe complex activities and procedures by using diagrams than by using text."

Diagramming techniques in computing are still evolving. This is necessary because when we examine the techniques in common use today, many of them have serious deficiencies. Flowcharts have fallen out of use because they did not present a structured view of a program, yet as a training tool they are very useful in describing decision processes.

The authors recall clearly the description of an entire university registration and billing system described on several blackboards using a data flow diagram methodology. It was easy to jump in and quickly gain an understanding of this rather complex process. Gane and Sarson (1979) have described an entire company on an 11 inch x 17 inch sheet of paper. Again the reader can quickly gain an excellent understanding of this complex process.

Of particular importance in computing today is the involvement of end users. We want them to communicate well with systems analysts and to understand the diagrams which are drawn so that they can think about them and be involved in discussions. Hence any diagrammatic technique has to be user friendly, and designed to encourage user understanding, participation and sketching. Much of the future battle in computer systems and business is a battle with complexity, and diagrammatic tools aid in this battle. Zey (1994) illustrates a situation at the Polaroid company in which

trainers use words on flashcards that correspond to camera parts to be assembled on the job. The results have been encouraging, with dramatic gains in worker versatility, ability to transfer their skills and attention from one job to another. This is a clear example of how a diagrammatic technique proves itself out in the business environment.

When one examines the challenges that the analyst faces in the complex and rapidly changing world of computers and business, it is very evident that all these same components characterize the trainer's challenge, and correspondingly the trainees' (used in analysts terms) challenge.

THE METHOD

In this paper, we propose expanding and combining several tools into the training arena. The first diagramming tool is the mind map. Other names by which this tool is known are spoke diagram, thought web, and clustering diagram (Buzan, 1989). The mind map as described by DePorter (1992) indicates that it provides the details that are easy to remember because they follow the brain's pattern of thought; hence, it is a simple but powerful diagrammatic tool. The surprising thing is that most of us have never been shown how to use a mind map during the course of our education.

The following is a summary of how a mind map is created. Starting at the center of a page, the goal, theme or purpose of the map is recorded. For example, if you are generating a mind map to introduce the Total Quality Management concept, you can draw this as shown in Figure 1. From this central theme, branches or lines are drawn towards the edges of the page. On these branches are printed any ideas that relate to the problem or project. Primary ideas are recalled on separate branches near the center of the page. In Figure 1, the focal point is TQM and efforts to improve performance. Primary ideas are the improvement parade which discusses why TQM is important, a historical background that discusses the

improvement parade, and the penalties if a corporation does not follow the improvement parade. Secondary branches are drawn exiting from the primary branches.

"The mind map is a powerful way of generating many ideas quickly."

This is where the secondary ideas that relate to the main ones are recorded. Many branches can be drawn adjacent to the secondary ones to record a third level of ideas.

The mind map is a powerful way of generating many ideas quickly. Rico (1983) calls it the design-minded shorthand because it uses a right-brain technique to release a person's natural expressive powers. Its advantages are:

1. It is compact. Many ideas can be located on one page. If needed the mind maps can be expanded to additional pages where a secondary or tertiary node is the focal point for the new map. (In systems analysis, we refer to this process as leveling.)
2. Ideas are put into categories making it easier to group ideas. It also means that when new ideas are derived, they have a place to go. In linear text, it is difficult to add a new idea unless one does so in the margin.
3. It is a marvelous tool for innovation and/or creativity so that the user can think of new ideas. Seeing the whole picture and the association of one element to another facilitates creativity for the reader or trainee.

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4. It is a long-term tool. After setting it aside for a day, week or month, the person using the map can come back and review the map in several minutes, and their recall is greatly enhanced. This is ideal for the trainer.
5. The mind map is useful because it is a picture (circles, lines, and text form a picture) and this stimulates the right brain and creative activity.
6. The mind map also lends itself to the left brain activities such as planning, speech plans, goals, and presentation notes.

All of these characteristics fit the trainer and trainee goal which is clearly specified in the abstract. It is important to note, as well, that mind maps have been used for a long time. People who used them effectively were Albert Einstein, Leonardo da Vinci, Thomas Jefferson, John F. Kennedy and Thomas Edison.

It is important to observe that the mind mapping technique that Buzan (1990) advocates uses one word or two word descriptions of a concept. We propose here that longer phrases be used where appropriate. We found that a word by itself in summarizing a concept is very cryptic and, although they may be useful for the quick generation of ideas in brainstorming, they often lead to associations which are not necessarily correct when a person uses the map at a later date.

The second observation is that the size of the paper is very important. We use 11 by 17 inch paper in training. Letter size paper (8-1/2 by 11 inches) does not allow the mind mapper to place many ideas on one page. This leads to fragmentation when text and diagrams are presented over several pages. Additionally, association—one of the most powerful abilities of the brain, and one that distinguishes it from the computer—is inhibited.

If smaller sheets of paper are utilized in any situation, this further inhibits effective learning.

The second tool that we propose can be termed "iconization". This involves summarizing a concept in the form of a picture. In the book, *The Fifth Discipline*, Peter Senge (1990) states that our success as leaders depends on our ability to create mental models. He indicates that our mental models determine not only how we make sense of the world, but how we take action. The icon for a concept fits that category. Apple Computer Corporation used this idea to gain a competitive edge over IBM, where pictures or icons were used instead of word commands (e.g., DIR for "directory"). In his excellent text, McNeil (1988) proposes the hurricane concept as a mental model for the importance of vision and values in a corporation. In Figure 1 is a diagram of these important components of the model: the eye in the center; the wind coming in at high speeds; and the values feeding the hurricane and the vision guiding its movement. If one examines a hurricane, it is similar to the operation of most businesses. In the home health care corporation, We Care Home Health Services, several thousand employees deliver services to thousands of clients. The activity in the office is very much like the high winds that funnel into the center of the hurricane (McNeil, 1988). The hurricane gets its strength from the water, and if it stayed over water it would maintain its strength; that is, over land it no longer has the warmth and the moisture that the ocean provides. The parallel for the director in a We Care office is that they are very busy, and if they forget their vision, which is expressed in their mission statement, they too will lose out in the long run just as a hurricane does. Additionally, at hectic times in the day (the high winds), the director might lose his/her composure. We recommend that the director go into the eye of the hurricane; that is, we recommend that the directors remember their values which are summarized in the guiding principles associated with the mission statement. In summary, these guiding principles are: to respect individuals; to provide the best service; and, to expect and demand excellence from every employee. As a result of this mental model, we often hear directors saying in a hectic time, "I stepped into the eye of the

hurricane". Additionally, directors in training describe their office in terms of the hurricane model so that the staff does not see "chaos" at busy times, but sees activity that is carefully guided.

We term the above process "iconization"; that is, a body of text is represented by a picture. The picture by our definition can be circles and lines with text, or it can be a rough sketch such as the hurricane in Figure 1. By changing the text into a picture and text, the user has processed the data and created an picture which is easy to remember. The exercise itself facilitates memory. An important side effect when we perform this process is that we make the material our own. We believe that many trainers do not "own" the material and hence can not convey the material with the emotion, confidence and enthusiasm that is required for high quality training and speaking. To paraphrase a point that Sagan (1989) makes in the excellent text, *The Dragons of Eden*, we have survived as a species by being very effective picture processors. It is our belief that text alone is deadly to the training process and that text and icons form the most effective combination for the training environment.

An Example

The challenge for the training division of We Care Home Health Services is to take nurses, most often with no business background, and after several days of intensive training, mould them into effective business people. This requires an innovative training method. We not only have to train these individuals, but we also have to give them the tools to train others. The corporation has manuals to describe the business process and the trainee is asked to read them prior to training. Training takes place using the Mind Mapping Method combined with the iconization concept. Figure 1 is an example of the introduction to the Total Quality Management lesson. Our research has shown that Clemmer's text (1992), *Firing on all Cylinders*, is the best text for the Total Quality Management effort due to Clemmer's extensive use of mental models. Indeed the title

connotes the fact that to be effective like a car, your corporation's motor must fire effectively on all cylinders.

When we examine the mind map in Figure 1, we start reading at the upper right corner, and proceed clockwise around the map. Just as a clock, where timing is important, this drives the order in which we proceed through the map.

The first icon is a simple rectangle representing a sticker that says essentially, "in this package is the new improvement parade". The text to the right laments the fact that few corporations are doing it or are walking the talk. At the right we see plus signs standing for positive benefits, the first being an upward arrow. This signifies growth. If the trainer does not remember the facts associated with the growth, the facts are stated to the right in the text. The next icon is a dollar sign behind bars which stands for cost containment. The trainer expands on the many ways that TQM saves on costs and finally the dollar sign indicates that there is a monetary benefit to the corporation that adapts its business to effectively employ TQM concepts.

The rest of this map is very self explanatory. One point that we make is that a negative concept is put in the upper left corner (we do not shake hands with ones left hand; the origin is a sanitary one where we did not want disease to spread). This can be used for negative concepts off the secondary or tertiary nodes. For example, the penalties of not following Total Quality Management principles appear to the upper left in this diagram.

CONCLUSION

Mind maps have been effectively used for training at We Care Home Health Services for ten years. From Figure 1, it is evident that when the trainer prepares for a session., it takes only a few minutes to review the

material. Recall the effect when someone shows you a picture from the lake ten years ago. You can suddenly remember the day, the people that were there, the temperature, and some of the events that you had long forgotten. The icons quickly bring the trainer's mind to bear on this aspect of their portfolio since they may train only periodically (every other month or two) and might have many areas of responsibility, such as TQM or computer work, that they need to recall. The ideal situation is one in which the trainer has created the mind map, for they now own the material. It is an interesting phenomenon that when you create an icon for a body of text it becomes yours. You speak with conviction and emotion. We believe that many trainers do not "own" the material and as a result do not speak with conviction.

Buzan (1990) states that after two days we remember ten percent of what we have read and he stresses the importance of timely reviews. In today's world, we are fortunate to find the time to read a book only once. This inhibits the review process. The trainer, by providing a mind map, allows the trainee to review the material and commit it more readily to long term memory. We have found that our trainers remember more using these associative networks (Buzan, 1990), or mind maps.

Training the trainer is an important ingredient in an effective corporation. Zey (1994) indicates that in order to thrive in the Macro-industrial Era, society must be blessed with a strong and flexible educational system. With the use of this flexible methodology, the We Care directors can train their staff very readily with the map. Also, we want them to be able to give public talks about how the corporation implements TQM. One incident will serve to illustrate the effectiveness of this system. A director of one franchise in the We Care system had attended a TQM training session. The trainer could not attend a morning portion in the next training session and asked the director to attend the morning session. This was done and when the trainer walked into the session after two hours, the conference room was alive with enthusiasm and the material had been reviewed. This suggested the ready

transferability of the material. As Bloom (1956a, 1956b) indicated, this was an illustration of the affective domain (receiving, responding, valuing, organization, and a characterization by a value or value complex) working with the cognitive domain (application; if the student really comprehends something, then he/she can apply it).

"Once the mind map and iconization methods were used, the presentations were more organized, clearer, more enthusiastic and less stressful."

What is most rewarding is that while doing the training session a lot of material is in front of the trainee. The availability of all this material leads to the generation of new ideas which can be readily added to the map. We have found that the trainees are constantly adding new ideas that are discussed, and not only is the material being covered, but also the trainees are thinking, processing, and brainstorming for new ideas. We believe that this is an ideal state for optimum learning.

We have discussed the point that the process of iconization allows the trainer to take ownership. We have found that an effective way for a trainee to take ownership is to ask them to color the map using fluorescent-colored markers. The resulting effect, in addition to ownership of the material, is to make the material much more attractive to the trainee when they review. It is most interesting to see executives color maps and we have found that it also increases their attention span.

In another application, this process is used in a third year systems analysis class at Brandon University. Computer Science students are often

not noted for their sociability. We ask them to read and mind map the text by Carnegie (1940), *How to Win Friends and Influence People*. This simple exercise has made these classes much easier to work with and facilitate. The applied section of the course involves the students analyzing a real business. They are asked to make a presentation on the results of their analysis. Again, this presentation must be mind mapped. Prior to using this method, the instructor would often wonder why he was teaching these people since the presentation caused them so much stress. Once the mind map and iconization methods were used, the presentations were more organized, clearer, more enthusiastic and less stressful.

It is helpful if the mapper can sketch pictures to facilitate the iconization process. Hand-written diagrams were used effectively for over five years in training situations. The only requirement was that they be readable. In converting the training materials, we use a large data base of icons that are commercially available, and we retain the services of a graphic artist to draw any additional ones that we require. These drawings are scanned in to become part of an icon data base.

The method has been used in a variety of computer and business situations (for example, to teach data structures in a computer science curriculum), so that it applies in a variety of areas.

We Care has used texts such as Blanchard's (1984) *The One Minute Manager* for training. We have found that it was popular for several reasons: it was a quick read (we are all under time constraints), and the material is good. We have found that people who read this book could most often not recall the essential components nor the system that was described. We mind mapped texts such as this and each book is adequately summarized on one map. Directors often frame them for easy review on their office walls prior to applying a concept.

In conclusion, the authors have investigated a variety of new methodologies such as computer based learning, distance education using

computers and so on. The most effective of all the methodologies for us is that described here. Using iconization and mind mapping in training and development environments of the macro-industrial era is the progress towards the next age of universal participation in the creation and production process of our future.

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STUDENT PERCEPTIONS OF COOPERATIVE LEARNING IN THE COST/MANAGERIAL ACCOUNTING CLASSROOM

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Traditional methods of teaching accounting relegate students to passive learning roles. In an attempt to shift from a passive to an active learning environment, a cooperative learning format was introduced. Cooperative learning has been found superior to the traditional competitive class environment in terms of learning and interpersonal skill enhancement in studies involving primarily elementary and middle school students. In this article, the authors report student perceptions concerning cooperative learning in the collegiate managerial and cost accounting classrooms. The reported perceptions suggest that cooperative learning in the business school classroom enhances both objective and subjective learning and increases communication skills.

In the traditional method of teaching accounting the professors lecture, demonstrate problems in class, review assigned homework, and answer questions. The students are relegated to playing a passive role, for the most part, in each of these activities. In this environment they listen, observe and take notes. The instructor assigns grades based on such easily quantifiable areas as attendance and preparedness (as measured

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through quizzes and tests). The emphasis is on the individual and success is dependent on individual effort and evaluation.

"Our culture is based more and more on our dependence upon one another and our ability to interact with one another in group settings. Throughout the accounting profession the emphasis is shifting from individual performance to teamwork."

But, as Boyer et al. (1984-85) point out, our culture is based more and more on our dependence upon one another and our ability to interact with one another in group settings. Throughout the accounting profession the emphasis is shifting from individual performance to teamwork. Jim Butler, chairman of KPMG Peat Marwick, stated that the biggest challenge facing him was fostering teamwork among the 76,000 people in KPMG firms worldwide in face of the rapidly changing sociopolitical environment (Adriance, 1992).

This changing emphasis is seen from the largest public accounting firms to the smallest, as well as within private and governmental organizations. For example, Mavrovitis (1992) details the necessity for cooperative working relationships between accounting and treasury within a firm for corporate success. Yet, it is estimated that over 85% of the instruction taking place in school is centered around lectures and work involving no interaction among students: in many instances, students are discouraged from interacting and are pitted against one another in a competitive classroom environment (Johnson & Johnson, 1983).

Traditional approaches to classroom instruction may no longer be appropriate in today's interactive and action-oriented world community. Of the three classroom learning environments - individualistic, competitive and cooperative - research has shown the latter to be the most conducive to learning (Johnson & Johnson, 1989). The skills needed to function in the teamwork-oriented accounting arena of today are not being taught in a competitive classroom design. In the cooperative environment, where students are organized into small groups and work together to attain common goals, these skills are emphasized. In this paper, we offer empirical evidence that many of the suggested benefits of cooperative learning can be obtained in collegiate teaching of accounting.

BACKGROUND

Classroom learning environments have been classified into three general types: individualistic, competitive and cooperative (Johnson & Johnson, 1975). In the individualistic classroom, students' goal achievements are not related to the goal achievements of their fellow students. Students involved in computer assisted instruction are an example - where students work at their own pace to complete the exercise. In the competitive classroom, individuals attain their goals only when their fellow students fail to achieve their own. Here students have individual responsibility to attend classes and must compete with one another for grades. Although most of today's collegiate classrooms are oriented to a competitive environment, research has shown that, of the three approaches, a cooperative environment is the most conducive to learning (Johnson et al., 1981).

In the cooperative environment, students are organized into small groups and then work together to attain common goals. Students discuss the material among themselves, which helps them to gain a better understanding, and encourage one another to work harder (Johnson & Johnson, 1984-85). The cooperative environment not only fosters

teamwork, but also develops better social interaction and communication skills required in the business world today.

"Traditional approaches to classroom instruction may no longer be appropriate in today's interactive and action-oriented world community . . . the skills needed to function in the teamwork-oriented accounting arena of today are not being taught in a competitive classroom design."

An example of the potential impact of group learning was demonstrated by Barnes (1991) in a simulation of a cooperative learning environment. In this simulation, there was an obvious shift in emphasis from an individual, competitive atmosphere to one of group responsibility and cooperation. After participating in the cooperative learning simulation and reading selected research describing successful attempts at alternate approaches to classroom instruction (Cook et al., 1993; Johnson & Johnson, 1975, 1983, 1984-85; Johnson et al., 1981), the primary author introduced group learning techniques into a managerial accounting class.

To implement a cooperative learning environment at the college and university level, part of the challenge is to overcome resistance to change from a system that has encouraged and rewarded competition to one where the emphasis is on group interaction. The traditional competitive learning environment is oriented toward individual achievement and personal choices where instructors can assign grades based on such easily

quantifiable areas as attendance and preparedness (as measured through quizzes and tests). In contrast, a cooperative learning environment requires students to meet group expectations, thereby subjecting them to more personal risks. Faculty also face more personal risk in the cooperative environment as they abandon the traditional, secure teaching methods for their new roles as facilitators in the learning process.

For decades cooperative learning (previously termed "small-group learning") has been used successfully in a variety of elementary and secondary classroom settings (Davidson, 1990; Hassard, 1990; Johnson & Johnson, 1989; Newmann & Thompson, 1987). But only in recent years has cooperative learning been looked at as an alternative approach to the traditional lecture/competitive format used in the college classroom (Cottell & Millis, 1992; Cooper et al., 1990; Cooper & Mueck, 1989).

Simply placing students in groups does not create a cooperative learning environment. Several criteria must be met for this type of environment to occur: (a) positive interdependence, (b) individual accountability, (c) responsibility for each other's learning, (d) collaborative skills, (e) instructor observation and intervention, and (f) group processing (Johnson & Johnson, 1984-85).

Positive interdependence is achieved by structuring the groups in such a way that individual success is dependent on the success of the group. Balancing interdependence, individual accountability stresses individual student assessment and feedback from the instructor on the student's progress. The group members are also expected to help one another complete the assigned work and, thus, have responsibility for each other's learning. Collaborative skills such as leadership, communication and decision making are an integral part of the group environment as the instructor observes the groups and gives each group feedback on their performance. Group processing includes the procedures and time that enable students to analyze how effectively their group is functioning in the

cooperative learning environment and to determine how well they were using their collaborative skills.

"Positive interdependence is achieved by structuring the groups in such a way that individual success is dependent on the success of the group."

Based on the apparent and anticipated benefits to be gained from a cooperative learning environment, the preceding criteria were incorporated into a pedagogical design for a one semester managerial accounting class. In approaching this undertaking, several concerns needed to be addressed: (a) number and size of the groups; (b) assignment of grades; (c) permanency of the groups; (d) if changed, how often; (e) quantity of in-class lecture vs. group time; (f) size and arrangement of the room. Workable solutions to most of these problems were developed from information contained in previous research on group practices (Johnson et al., 1981; Cook et al., 1993), discussions with other faculty members, and intuition.

PROPOSITION DEVELOPMENT

Benefits of cooperative learning have been recognized for many years. Slavin (1990) asserts that there is wide agreement among cooperative learning scholars regarding its positive effects on learning. Reviews of empirical research indicate that learning is usually enhanced by the incorporation of cooperative learning (Slavin, 1989; Johnson et al., 1981).

In addition to increased learning, other effects result from the use of the cooperative learning format (Nastasi & Clemens, 1991). The cooperative environment not only fosters teamwork, but also develops better social interaction and communication skills (Dennee, 1991; Hassard, 1990). Students have shown gains in liking and respect for each other and in the ability to work together effectively, as well as increased liking of the subject, school, studying, and improved attendance.

However, problem areas have also been cited in previous research. As Jalajas and Sutton (1984/1985) point out, human groups bring out the best and the worst of the species. They have identified five types of students associated with inter-group conflict, which they label the Whiner, the Martyr, the Saboteur, the Bully and the Deadbeat. Others have also described problem students as "hitchhikers" (Cottell, 1991) and "social loafers" (Schnake, 1991). These terms refer to students who come to class unprepared to participate in their group, or who do not come at all. They rely on the other members of the group to carry them through the process.

Slavin (1990) points out that relatively little investigation has occurred at the college level. The strongest effects have been exhibited at elementary and middle schools. Collegiate level results are less consistent than those found in elementary and middle school studies.

In an exploratory study, Wolverton (1993) designed a cooperative learning environment for a college level managerial accounting class - changing the emphasis from a traditional lecture format to a group-oriented approach. This research was to determine the suitability of cooperative learning in a collegiate setting and to identify areas of concern for future research. The overwhelming student response to open-ended evaluation questions regarding the group environment was favorable. The benefits mentioned most often were that the students received help from others in learning and understanding the material, had the opportunity to meet other people in class and get to know them, had the opportunity to apply what they were learning to a problem (hands on experience), obtained faster

feedback to questions than in a traditional setting, and the format forced harder work and a higher level of preparation due to group pressures. Answers to the open-ended evaluations suggested that students perceived two primary problems: Some students came to class unprepared or unwilling to participate in the group problem solving, and some dominated the group.

Based on previous literature and the results of the just-described exploratory study, we offer and subsequently test the following propositions.

P1 Collegiate accounting students will report more positive learning attitudes and study behaviors attributed to the cooperative learning environment.

P2 Collegiate accounting students will report enhanced social and communication experiences and skills due to the cooperative learning format.

P3 Collegiate accounting students will report problems regarding negative group member behaviors (such as social loafing) due to the cooperative learning format.

P4 A cooperative learning environment will enhance academic achievement among collegiate accounting students.

Propositions one through three represent students' subjective perceptions regarding cooperative learning, while proposition four relates to the objective learning effect. In order to test these propositions we introduced the cooperative learning environment in two separate collegiate accounting classes. These two studies are described in detail below.

STUDY 1 - MANAGERIAL ACCOUNTING CLASS

Classroom Design - Study 1

The collegiate accounting class in the first study was a sophomore level managerial accounting class. This class of 17 students met twice a week for two hour periods during the semester. The students were divided into groups of three or four with those students sitting closest to one another making up the groups (Artzt & Newman, 1990). The groups were changed after each exam (three times) during the term with the intent of having the groups made up of different students each round. No special consideration was given to class standing of the students.

Each class period began with a brief lecture covering the concepts that would be illustrated in the textbook problems for the day. Following the lecture, one to three problems were assigned for the groups to complete. Collaborative skills of leadership, decision making, conflict management and trust building were included in the design by requiring each group to select a "designated writer" for every problem assigned. For a problem, each group could prepare only one solution which represented the collective efforts of the group. Group members were responsible for dividing this responsibility equally among themselves over the course of the term.

Through the use of presentations, an environment was created in which students were responsible for each other's learning. Toward the end of the class period, several students were selected by the instructor to present their groups' solutions to the class. All members of the groups, therefore, had to be sure that everyone in their group understood the material and could explain it to the rest of the class. The presentations thus required and reinforced the need for collaborative communication skills. Copies of the textbook solutions to all problems were handed out to the students after the presentations. Presentations took place in approximately 1/3 of the class sessions. When presentations did not occur, solutions to the problems

were handed out as each was completed. This allowed for immediate feedback to the groups.

Grading was structured in such a way that both group and individual performance could be evaluated. By incorporating group factors into the grading, a positive interdependence was achieved - students could easily discern that part of their evaluation was based on the performance of other group members. The group portion of each student's grade was assigned by combining two factors: (a) instructor observations of the group performance and (b) the use of a structured peer evaluation form (Cook et al., 1993). A copy of the peer evaluation form was given to students the second week of class. This enabled students to become familiar with the criteria that would be used to evaluate group performance. A review of the criteria was designed to impress upon them the importance of individual participation in group activities and eliminate problems of social loafing (Schnake, 1991).

The peer evaluation form not only asked students to assign an overall rating to each person in their group, but it also broke down ratings into other criteria (collaborative skills) such as leadership, quality and quantity of contribution, creativity, effort, turntaking and attendance. Each student also explained in a short paragraph the good and bad points of how well their group worked together. The evaluation forms were completed by the students three times during the term as group membership changed. The individual accountability criterion was accomplished through individual quizzes and exams.

Method for Empirical Investigation - Study 1

To test the preceding propositions we utilized both objective and subjective measures of learning. An end-of-semester survey was administered in the managerial accounting class just described ($n = 15$) to obtain student perceptual input regarding the success and effects of the cooperative learning environment. Survey items were Likert scale

agree-disagree statements (1 = strongly agree, 5 = strongly disagree), developed to ascertain student perceptions of learning, group interaction, and problem situations. In addition to these subjective student self-report measures, an objective measure of learning was obtained by comparing students' total point scores on three accounting problems with those from a "control group." The control group consisted of twenty-one students taking the same course, using the same text, at approximately the same time of day from a different instructor using the traditional lecture class format.

Results - Study 1

Likert scale responses were analyzed to determine student perceptions of learning and study habits, communication and social experiences and skills, and negative student behaviors. Means and standard deviations were calculated for each scale item. To test for significant effect, t-tests were conducted comparing item means to the neutral point of each scale (3).

Learning Effects

We proposed that students would report more positive attitudes and behaviors toward learning (P1). Students reported that the group class format increased their learning, their attentiveness, the amount of time they studied, and their preparedness. Overall, they perceived the group design positively, preferring the group format over the lecture format and desiring that such groups be used in other courses. See Table 1 for means, standard deviations, t scores and p-values of scale items used.

Communication/Social Interaction Effects

Items relating to communication and social interaction effects were used to test P2. (See Table 2 for specific items.) Students indicated that they enjoyed working in groups, and that the group format allowed them to become better acquainted with their classmates and made class more fun.

In addition, they believed that working in groups enhanced their oral skills. The "designated writer" component of the groups was seen as a generator of group interaction, although the oral presentations in front of the class were not viewed as significant skills boosters. Students strongly believed that explaining to other group members helped them learn and agreed they frequently had been helped to learn and understand by their fellow group members. They also indicated that the group format added an applied, real world, "hands-on" dimension.

Contrary to our expectation, in-class group activity did not result in out-of-class group activities. For both homework and tests, students reported that they studied outside of class by themselves, not with their in-class group members. Interestingly, although they did not take advantage of the group "support system" outside of class, students did agree that working in groups increased their sense of control and their commitment to the class.

Negative Effects

Although experts have suggested that cooperative learning may lead to various negative behaviors (P3), the students in our study did not report any significant negative effects. They reported no serious problem with unprepared members, dominating members nor social loafers. They did not relate that any members needed to do a disproportionate amount of the work in order to make up for members who did not carry their share of the workload. In addition, students did not agree that they could cover up poor preparation because of the group format. Items suggest that the peer evaluation process may have been a strong motivator for all students to contribute to their groups. (See Table 3 for items and means.)

Objective Learning Effects

We also proposed that students would exhibit higher objective learning when taught in the cooperative education format (P4). Therefore, to

supplement the subjective measures of learning, individual student scores on three accounting problems were acquired and then averaged over the 17 students. Students from the "control group" were administered the identical three problems. The primary author graded these 21 students' answers, and their scores were averaged. Treatment group students missed an average of 6.29 points over the three problems (s.d.= 5.698) while the "control group" missed, on average, 10.33 points (s.d.= 6.191). This difference is significant and in the direction proposed (i.e., cooperative learning environment students exhibited higher objective learning than traditional lecture/individual format students).

STUDY 2 - COST ACCOUNTING CLASS

Classroom Design - Study 2

The second collegiate accounting class was an upper division cost accounting class which met three times a week for three hour periods during a seven week summer semester at a different university. The class consisted of junior/senior level accounting majors. At first, the 16 students were divided into groups as described in Study 1. The groups were only changed once half way through the term. At that time the students self-selected a partner with whom to work. These "learning pairs" then worked together for the rest of the term.

The structure of the classes was similar to that in Study 1. Each class period began with a brief lecture covering the concepts that would be illustrated in the problems for the day. Following the lecture, one to three textbook problems were assigned for the groups to complete. The groups also used the "designated writer" approach to achieve interdependence. Presentations did not take place on a daily basis, but only two or three times during the term. Solutions to the problems were handed out as each group problem was completed.

As an additional means of generating a cooperative learning environment, the case method was used in the last week of class to integrate the cost accounting concepts covered throughout the term. Each "learning pair" was assigned a case to present during the final week of class. The case presentations were graded on a number of criteria including content, completeness, professionalism, and use of visual aids. The grading structure and procedures, including the peer evaluation, were the same for this class as that described in Study 1.

Method for Empirical Investigation - Study 2

Students in this second classroom design were also asked for their perceptions of the group learning environment. Virtually the identical end-of-term survey was administered ($n = 15$). No objective measure of learning was obtained as no "control group" was available. Again, Likert scale responses were analyzed to determine if the perceptions of students in Study 2 were similar to those in the initial empirical study. Means, standard deviations and t-tests indicated that for all but a few of the statements, student perceptions in the two studies were not significantly different (could have come from the same population).

Results - Study 2

The junior/senior level cost accounting students in Study 2 reported positive attitudes and behavior toward learning, lending additional support to proposition 1. Similar to the students in Study 1, Study 2 students reported that the group format increased their learning, and that they preferred the group design over the traditional lecture form. They expressed a desire for the group format to be used in other classes. However, unlike the sophomore level Study 1 students, Study 2 students did not report that the group format resulted in greater attentiveness nor an increase in the amount of time that they studied. See Table 4 for specific scale items and their means, standard deviations, t-scores and p-values.

Study 2 responses also supported proposition 2. Study 2 respondents indicated that they enjoyed working in groups and believed that the group format had allowed them to get to know their classmates better. They also reported that the group processes enhanced their oral skills and that the "designated writer" led to an increase in interactions. They, too, agreed that explaining to others helped them learn, and that other group members had aided them in understanding the material. Similar to the results in Study 1, in-class group communication and interaction had not generated greater outside class interaction. Study 2 respondents did not prepare for class nor study for tests with their group members. (See Table 5 for details.)

Like Study 1 participants, Study 2 students perceived no ill effects from the group learning environment (P3). However, Study 2 respondents were somewhat stronger in their perceptions regarding the negative consequences of groups. They were neutral to the idea that some group members were a problem due to lack of preparation. They disagreed with the idea that they could cover up poor preparation through group membership or that dominating group members were a problem. They strongly disagreed with the statement "Some did all the work." Again, results suggest that peer evaluations may have proven to be a useful stick/carrot combination in reducing the social loafing, "nonpreparedness" problems. (See Table 6.)

MAJOR SIMILARITIES AND DIFFERENCES BETWEEN PERCEPTIONS OF STUDY 1 AND STUDY 2 STUDENTS

In a few instances, the mean response of Study 2 students differed significantly from Study 1 students (t-test for difference between two means, $p < .05$). Among the statements used to measure learning effects, means of the two groups differed on three items. Although Study 1 students agreed that the group format increased both their study time and their attentiveness, Study 2 respondents did not (Study 2 mean response of 2.867 and 2.733, respectively: 3 representing the neutral point.) However,

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Study 2 students more strongly believed that the group format should be used in other classes (Study 2 mean = 1.667, Study 1 mean = 2.267).

In terms of communication/social interactions items, Study 2 mean responses were not significantly different from those of Study 1 save a single statement. Whereas Study 1 students were neutral about the skills-building effect of presentations, Study 2 respondents agreed that the presentations in the class did aid in developing their oral skills.

As mentioned previously concerning potential negative effects of group learning, the cost accounting students of Study 2 vehemently denied that some did all the work while the managerial accounting Study 1 students were neutral to the statement.

Interestingly, the two groups differed in their desires concerning the mechanics of group selection. The managerial accounting students indicated preference for teacher selection of groups while the cost accounting upperclassmen indicated they would prefer to choose their own members.

REASONS FOR DIFFERENCES OBSERVED

All in all the groups were quite consistent in their perceptions of the group learning environment and its effects. The few observed differences between the group mean responses suggest logical reasons for their existence.

First, regarding the difference between study time and attentiveness effects, Study 1 respondents were primarily sophomore level students who may still have been "learning the ropes" in study habits and listening/integrating skills. The Study 2 cost accounting students were upperclassmen whose study habits and skills were likely more advanced than those of the Study 1 underclassmen. This difference in years in

college may also explain the difference in preference regarding group composition. Due to their longer tenure in college, Study 2 students may have been better acquainted and knowledgeable of their fellow class members and therefore more interested in determining the composition of groups on their own. On the other hand, the less experienced underclassmen of Study 1 may have been unfamiliar with the others in their class, and, therefore, preferred that the instructor determine group membership.

The statements regarding class presentations are not directly comparable between the two studies. In the lower division managerial accounting course of Study 1, students were asked to present problem solutions in front of the class. In the upper division cost accounting class of Study 2, the students presented case analysis and solutions. The type of presentation asked of students apparently affected the perceived benefit to oral skills development. It is possible that the closer cooperative effort required of each member of the "learning pair" resulted in the reported higher skill development.

LIMITATIONS

The results of the empirical tests of effects of cooperative learning on collegiate accounting students suggest optimism about the pedagogical method. However, due to the exploratory nature of the studies, the results are subject to several limitations. Although two different courses and two sets of students attending two different institutions were used, the groups were quite small in size, therefore diminishing the generalizability of the results. In addition, the Study 1 "control group" was only comparable to the treatment group in a crude sense. Size of class, time of day and student composition were similar in only a rough way, and a different professor taught the control section. Additional research must be conducted to determine if the effects found here are indicative of effects that would be found if the cooperative method were used in other courses,

taught by other professors, and used at other institutions in teaching other groups of students (with their own idiosyncracies).

Although the results of Study 1 and Study 2 are similar, Study 2 is less a replication of Study 1 than an extension to a different arena. The two studies differed in several major ways: lower vs. upper division courses, regular semester term vs. abbreviated summer term, and U.S. vs. Canadian students. Study 2 therefore adds breadth to the application and sample. Studies of similar groups must be conducted in order to try to replicate the findings here.

CONCLUSION AND FUTURE RESEARCH

Business schools are coming under increasing criticism from the business community concerning the lack of student collaborative and interpersonal skills - skills mandatory in today's teamwork-oriented business environment. The Accounting Education Change Commission (1990) has also called for greater emphasis on teamwork, stressing the development of the skills involved in group interaction. Our studies represent an attempt to heed the Commissions's call and measure the results.

In these empirical studies, the students in two different accounting courses at two different institutions perceived positive learning effects. In one of the studies, evidence also suggests that greater objective learning may also be achieved by the cooperative learning classroom technique. Both groups of students reported that the cooperative format increased their communication and social interaction skills with little negative effect in terms of problem student group members. However, the primary author (the class instructor) observed problems with social loafing and hitchhikers in several of the groups from the lower division, managerial accounting class. These less-experienced students may have been hesitant to report negative behaviors of fellow group members on the evaluation instrument.

"Both groups of students reported that the cooperative format increased their communication and social interaction skills with little negative effect in terms of problem student group members."

Obviously, replications of these studies need to be conducted, using similar classes as well as additional courses, students and faculty at a variety of colleges. Rigorous control groups should be used in the future, utilizing random assignment of students if possible, while employing the same professor, homeworks and tests for both treatment and control groups. Such control group comparisons would indicate the incremental value of cooperative learning in augmenting objective knowledge and interpersonal skills development.

Use of a large number of students could also lead to improvement of the evaluation survey instrument. With a sufficient number of respondents, factor analysis could be conducted in order to generate an instrument that parsimoniously measures the students' perceptions regarding the various effects of cooperative learning. Better measures of negative group behaviors seem to be needed. Indeed, focus groups composed of student representatives of cooperative learning classrooms and traditional lecture format classes might provide some insight into how to improve measures of effects and point to additional effects that were not measured in this investigation.

Although our studies indicate that students in general will prefer the cooperative learning environment over the traditional competitive

environment, the two studies suggest that there may be significant differences in perceptions and effects based on size of group, major, student level (e.g., sophomore vs. senior) and collegiate institution. Research on the composition of the small learning groups also needs to be conducted. For example, should the groups' members be homophilous or heterophilous in terms of gender, major, and/or academic achievement (i.e., GPA)? Group composition may increase or decrease the learning of some or all members of the groups.

Finally, research on why and how cooperative learning increases student learning interactions would provide invaluable insight to all educators. We hope that these preliminary investigations into the effects of cooperative learning in collegiate accounting classes serve as an impetus to colleagues, and results in the test-use of this powerful technique in a variety of business classes.

TABLE 1
STUDY 1 - PROPOSITION 1 RESULTS

ITEM	MEAN	S.D.	t*	p
I learned a lot in this class.	1.667	.617	8.37	.000
I spend more time studying for this class because of the group format.	2.267	1.033	2.75	.007
Being part of a group increased my learning in this class.	1.933	.799	5.17	.000
Because I was a group member, I paid more attention in class.	2.067	.799	4.52	.000
Because I was a group member, I studied more than I intended.	2.533	1.060	1.71	.053
I believe the use of groups in this class added a great deal to my learning experience.	1.800	.862	5.39	.000
I would have learned more in this class if the professor had lectured more.	3.067	1.100	.24	.404
I have learned more in this class because of the group format than I would have learned if it had been a lecture class.	2.200	1.265	2.45	.013
Because I was part of a group, I prepared more for this class than I would have working individually.	2.067	1.033	3.50	.002
I felt pressured to work because I was in a group.	2.467	.743	2.77	.007
I would like to see the group format used in other classes.	2.267	1.163	2.44	.013
I prefer the group learning format to the traditional lecture format.	2.267	1.486	1.91	.037
Overall I enjoyed this class more than I thought I would.	2.200	.862	3.59	.001

Note: In all Tables, all items, Likert scale agree-disagree statements (1 = strongly agree, 5 = strongly disagree).

* Absolute value of Student t scores reported in all tables.

TABLE 2

STUDY 1 - PROPOSITION 2 RESULTS

ITEM	MEAN	S.D.	t	p
Outside of this class I studied by myself most of the time.	2.138	1.87	2.83	.006
I enjoyed working in groups.	2.067	.884	4.09	.000
Working in groups is like working in the real world.	2.643	.842	1.59	.066
Working in groups helped me develop oral communications skills.	2.400	1.056	2.20	.021
I usually studied for tests with members of my group.	3.667	1.234	2.09	.026
Working in groups lowered my anxiety level.	2.800	.941	.82	.284
Explaining concepts to other group members helped me learn.	1.467	.640	9.28	.000
Participating in presentations helped improve my oral communications skills.	3.000	1.000	0.00	.498
I usually did my homework with members of my group.	3.600	1.242	1.87	.040
Being part of a group made me more committed to this class.	2.533	.915	1.98	.032
Being part of a group helped me to apply the material in more of a "hands-on" way.	2.133	1.060	3.16	.003
I got to know my classmates better in this class than in other classes.	1.867	.640	6.86	.000
Other group members frequently helped me learn/understand the material.	2.067	.799	4.52	.000
Working in a group helped me to better apply the lecture topics.	2.200	.941	3.29	.002
Having a "designated writer" increased the interaction between group members.	2.267	.961	2.95	.005
Working in groups increased my sense of control in this class.	2.267	.704	4.03	.001
The group format made this class more fun.	1.933	.704	5.87	.000
The group format made this a better class than I had originally expected it to be.	2.200	.862	3.59	.001

TABLE 3

STUDY 1 - PROPOSITION 3 RESULTS

ITEM	MEAN	S.D.	t	p
I am responsible for my own learning.	1.533	.640	8.88	.000
I feel that unprepared members were a problem in my groups.	3.000	1.195	0.00	.498
Knowing that I would be evaluated by my peers made me work harder.	2.400	1.056	2.20	.021
I found I could cover up a lack of preparation because I was a member of a group.	3.333	1.047	1.23	.119
I feel that dominating members were a problem in my groups.	3.533	1.125	1.83	.043
Some group members did most of the work while others did next to nothing.	3.33	1.047	1.23	.119
The peer evaluation form was necessary because some of our grade was based on group work.	2.400	1.242	1.87	.040

TABLE 4

STUDY 2 - PROPOSITION 1 RESULTS

ITEM	MEAN	S.D.	t	p
I learned a lot in this class.	1.600	.632	8.58	.000
I spend more time studying for this class because of the group format.	2.867	.834	.62	.227*
Being part of a group increased my learning in this class.	2.267	.961	2.95	.005
Because I was a group member, I paid more attention in class.	2.733	1.033	1.00	.168*
Because I was a group member, I studied more than I intended.	3.000	1.000	0.00	.500
I believe the use of groups in this class added a great deal to my learning experience.	2.067	1.033	3.50	.002
I would have learned more in this class if the professor had lectured more.	3.533	.516	4.00	.001
I have learned more in this class because of the group format than I would have learned if it had been a lecture class.	2.267	1.163	2.44	.013
Because I was part of a group, I prepared more for this class than I would have working individually.	2.667	1.345	.96	.322
I felt pressured to work because I was in a group.	2.933	1.163	.22	.411
I would like to see the group format used in other classes.	1.667	.724	7.13	.000*
I prefer the group learning format to the traditional lecture format.	2.133	1.060	3.17	.004
Overall I enjoyed this class more than I thought I would.	1.667	.816	6.33	.000*

*Indicates significant difference between Study 1 & Study 2 mean responses.

TABLE 5
STUDY 2 - PROPOSITION 2 RESULTS

ITEM	MEAN	S.D.	t	p
Outside of this class I studied by myself most of the time.	1.667	1.234	4.18	.001
I enjoyed working in groups.	1.733	.884	5.55	.000
Working in groups helped me develop oral communication skills.	1.933	.779	5.17	.000
I usually studied for tests with members of my group.	3.933	1.223	2.96	.005
Working in groups lowered my anxiety level.	2.800	1.146	.68	.258
Explaining concepts to other group members helped me learn.	1.600	.507	10.70	.000
Participating in presentations helped improve my oral communications skills.	4.867	.915	4.80	.000*
I usually did my homework with members of my group.	3.400	1.352	1.15	.136
Being part of a group made me more committed to this class.	2.333	1.047	2.47	.013
Being part of a group helped me to apply the material in more of a "hands-on" way.	2.467	1.356	1.52	.074
I got to know my classmates better in this class than in other classes.	1.667	.900	5.74	.000
Other group members frequently helped me learn/understand the material.	1.800	.862	5.39	.000
Working in a group helped me to better apply the lecture topics.	2.600	1.298	1.19	.126
Having a "designated writer" increased the interaction between group members.	2.400	1.352	1.72	.053
Working in groups increased my sense of control in this class.	2.600	1.183	1.31	.105
The group format made this class more fun.	2.000	.845	4.58	.001
The group format made this a better class than I had originally expected it to be.	2.067	.884	4.09	.001

* Indicates significant difference between Study 1 & Study 2 mean responses.

TABLE 6
STUDY 2 - PROPOSITION 3 RESULTS

ITEM	MEAN	S.D.	t	p
I am responsible for my own learning.	1.200	.561	12.43	.000
I feel that unprepared members were a problem in my groups.	3.467	1.407	1.29	.109
Knowing that I would be evaluated by my peers made me work harder.	2.533	.834	2.17	.023
I found I could cover up a lack of preparation because I was a member of a group.	3.733	.884	3.21	.003
I feel that dominating members were a problem in my groups.	3.800	.862	3.59	.002
Some group members did most of the work while others did next to nothing.	4.067	1.100	3.76	.001*
The peer evaluation form was necessary because some of our grade was based on group work.	2.000	.756	5.12	.000

*Indicates significant difference between Study 1 & Study 2 mean responses.

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