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THE IMPACT OF CURRENT TAX POLICY ON CEO STOCK OPTION COMPENSATION: A QUANTILE ANALYSIS

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ABSTRACT

The increase in stock option compensation has become controversial as disclosures emerge that executives have abused stock option compensation. The Omnibus Budget Reconciliation Act of 1993 gives stock options preferential tax treatment, allowing options to not be subject to the cap on corporate tax deductions for salaries exceeding $1 million. To examine whether this increases CEO stock option compensation, we use S&P's ExecuComp data from 1992-2000. We use quantile regressions to examine whether the position in the distribution affects behavior. Findings show that the salary cap has increased stock option compensation; strongest effects are at the bottom of the distribution.

INTRODUCTION

The increase in stock option grants during the 1990s is becoming increasingly controversial as disclosures emerge that senior executives of companies such as Enron Corp. and Global Crossing reaped millions of dollars in profit by exercising their stock options as the public held onto stock that became worthless. For example, Global Crossing reported a negative net income of $10,500,000, while they still issued the CEO, Mr. Annunziata, $182,000,000 worth of stock options. In addressing the corporate scandals, Senator Carl Levin recently suggested that stock option pay encourages firms and executives to push tax law to the limit. Our current tax code gives stock options preferential tax treatment: "Performance-based pay," such as stock options, are not subject to the limits or the cap on corporate income tax deductions for salaries exceeding $1 million.

In this paper, we examine if the cap on salary compensation reform has altered the mix of compensation that firms pay executives. Since companies may behave differently dependent on their position in the distribution, we then use a quantile regression technique.

STOCK OPTIONS TAX TREATMENT

Currently, a nonqualified stock option is taxed under Code Section 83, stating that an employer is allowed to deduct the full value of the employee's income from the exercise and sale of stock options. While companies can deduct stock options from their corporate taxes, salary is limited on the amount that it can be deducted from taxes. The Omnibus Budget Reconciliation Act of 1993 (OBRA 1993), Section 162(m) of the Internal Revenue Code (IRS par. 9001B, sec. 1.162), eliminated the deductibility of executive salary compensation in excess of $1 million paid to the top five highest-paid executive officers to a 1$ million cap each. However, “qualified performance-based pay” was exempt (IRS par. 9001B, sec. 1.162-7[e][1]).

While this supposedly constrains executive compensation, it may have just altered the mix of compensation towards “performance-based pay” since, contrary to salary and bonuses, stock options are generally not subject to the limits of Section 162(m).

LITERATURE REVIEW

Agency theorists (see Brookfield and Phillip, 2000, for a recent example) have addressed how stock options impact the principal-agent dilemma, while others (e.g., Sanders, 2001) examined whether the growing number of stock options impact firm performance. However, they all neglect to address whether current federal tax policy limiting tax deductible salary compensation alters the mix of executive compensation. Two studies that do examine if the million dollar cap has decreased the use of salary compensation by affected firms and increased their use of stock options compensation are Rose and Wolfram (2002) and Hall and Liebman (2000). Both studies find evidence that the salary cap has lowered the potential growth of CEO salaries, but they find differing results regarding if this cap has increased the use of stock options. While Rose and Wolfram find little support for an increase in performance-based pay, Hall and Liebman (2000) find support for the salary cap creating an increase in the use of stock option compensation. They suggest that most firms that reduced salaries from above the $1 million cap to below, cite that Section 162 (m) is the reason for such compensation adjustments. Hall and Liebman (1998) find that the median CEO receives 1.1 million in salary and that for executives earning in excess of $1 million, the growth rate in their salary between 1993 -1998 is zero.

ECONOMETRIC TECHNIQUE AND DATA

To empirically investigate if the salary cap has altered stock option pay, we regress the CEO compensation measures on the salary cap for affected firms. Specifically, we estimate the following equation:

$$\ln(StockOptio\ ns_i) = \alpha_0 + \alpha_1 affected_i + \alpha_2 affected_i * Cap + \sum_k \alpha_i x_{k.i} + \varepsilon_i$$

where $StockOptions_i$ is the natural logarithm of the Black-Scholes value that a CEO received in a particular year. The x_i are regressors to control for factors such as the overall performance of the stock market (we include the mean value of last year's S&P 500 index), firm performance (a firm's lagged market value and the return on assets), and the size of the company (we include one dummy variable each for companies which are S&P 500 companies or part of the S&P SmallCap, respectively).

Even after including these control variables, we may not be able to fully capture the factors, which determine how much stock option pay a CEO receives. Thus, we include a variable ($affected_i$) which takes on the value of one if a CEO, based on pre-cap salary, is predicted to would have received in excess of $1 million in salary had the salary cap not been enacted, zero otherwise. (Following Rose and Wolfram (2002), we construct predicted total compensation for the years after the 1994 cap by estimating an AR(1) model using data prior to 1994.) *Cap* is a dummy variable for the years that the $1 million dollar cap is in place. The $affected_i$ * *Cap* interaction term is used to capture the differential growth rate of this compensation after the cap is put into place.

However, it may very well be the case that the effects of the salary cap are not the same for all CEOs. In fact, we suspect that there are pronounced differences based on a CEO's position in the distribution of stock option compensation. Thus, we estimate the effects of the salary cap on CEOs' stock option compensation using a quantile regression technique. That is, we estimate the conditional median (rather than the conditional mean in an Ordinary Least Squares (OLS) regression) for various parts of the distribution of the dependent variable.

We collect annual compensation data from Standard and Poor's ExecuComp database from 1992 to 2000. Thus, we can examine the changes in tax law, which took place after the Section 162 (m) tax law change in 1993 that created a salary cap limit, favoring "performance-based pay" over salary from a tax perspective. One advantage of the ExecuComp database is its large size. It follows a total of 2,412 companies over time, which are or were a member of the S&P 1,500 (consisting of

the S&P 500, the S&P MidCap 400, or the S&P SmallCap 600). Since each company must provide information about the top five executives in each year, the overall number of records is substantial. After imposing some restrictions (most notably the restriction to CEOs as well as the exclusion of firms whose fiscal year does not end in December in order to properly account for any tax change effects and the exclusion of executives whose reported value of stock options granted in a certain year is missing), there are 6,062 individual-year observations that are included in our estimations. Summary statistics of these data are shown in Table 1.

Table 1
Summary Statistics of Variables Included in Estimations

Variable	Mean	Standard Deviation
Affected	0.424	0.494
S&P 500 index (lagged)	752.4	309.4
Market Value ($ million)	6,162.9	18,721.0
ROA	3.1	13.3
S&P500 firm	0.322	0.467
S&P SmallCap firm	0.201	0.401

RESULTS

Estimation results from the OLS regression of the stock option compensation equation are shown in Table 2.

Table 2
OLS Regression Results for Stock Option Compensation

Independent Variable	Estimate	Standard Error
Affected	-0.153	0.085
Affected*Cap	0.483**	0.083
S&P 500 index (lagged)	0.001**	0.000
Ln(Market Value ($ million))	0.367**	0.015
ROA	-0.004**	0.001
S&P500 firm	0.029	0.042
S&P SmallCap firm	-0.165**	0.045
Constant	-3.691**	0.101
No. of observations	6,062	
R-Squared	0.31	

Dependent variable is the natural logarithm of the Black-Scholes value of stock options.
** denotes statistical significance at the 1%-level.

The two variables of main interest show the following patterns: Before the salary cap went into effect, "affected" firms paid their CEOs approximately 15 percent less in stock options, *ceteris paribus*. After the cap went into effect, CEO stock option compensation was substantially higher in affected firms after controlling for a number of other factors. The average affected firm issued approximately 33 percent (48.3 percent minus 15.3 percent) more in stock options to their CEO than the unaffected firms. That is, in contrast to results found in Rose and Wolfram (2002), our results suggest a significant increase in the use of "performance-based compensation" for affected firms. Our results are consistent with those found in Hall and Liebman (2000).

Space considerations prohibit the discussion of the estimation results for the control variables. However, they seem quite reasonable and are typically highly statistically significant. A discussion is available from the authors upon request.

We now take a closer look at the variables of main interest in our study using a quantile analysis. As previously discussed, estimation via OLS may obscure some important differences in firm/CEO behavior. More specifically, firms at the bottom of the distribution may show different results from those around the median or at the top of the distribution. These issues can be addressed with the use of quantile regression. Estimates are presented in Table 3.

Table 3
Effect of the Salary Cap on Stock Option Compensation by Quantile

Quantile	Pre-Cap Effect on Stock Options (Affected Firms)	Post-Cap Effect on Stock Options (Affected Firms)	Pseudo R-Squared
1	-0.106	0.606	0.18
2	-0.065	0.493	0.19
3	-0.036	0.389	0.19
4	-0.027	0.343	0.20
5	-0.043	0.286	0.20
6	-0.240	0.223	0.19
7	-0.244	0.134	0.19
8	-0.214	0.115	0.18
9	-0.256	0.196	0.16

The estimates of the pre-cap effect on stock options for the first five quantiles are small in magnitude and not statistically significant at any conventional level. The results for the upper four quantiles are quite different: For that top part of the distribution, we find that affected firms (i.e., those whose predicted post-cap CEO salary is in excess of $1 million), on average, pay their CEOs approximately 21 to 26 percent less in stock options, all else equal. This may be due to the fact that before the salary cap was enacted, a larger share of CEO compensation was paid in the form of salary.

An even more interesting finding, in our opinion, emerges when the behavior of CEOs of affected firms in response to the enactment of the salary cap is examined. The full effect is captured by the sum of the estimates of the dummy variable for affected firms and the interaction term of that dummy with the salary cap term. The total impact is presented in column 3 of Table 3.

The full effect exhibits a very clear downward trend over almost the entire distribution. The largest effect is shown for CEOs in the bottom quantile. The combined effect is estimated to be 0.61, i.e., our results indicate that after the salary cap went into effect, the average CEO of an ”affected” firm received 61 percent more in stock options than a CEO at a firm that was not affected by the salary cap. The estimated effect is strictly monotonically declining over the entire distribution with the exception of the top quantile.

Again, space considerations prohibit the presentation of all results, especially in this context since we estimate a separate regression for each of the nine quantiles. All results are available from the authors upon request.

CONCLUSIONS AND POLICY IMPLICATIONS

There has been a tremendous increase in executive stock option compensation during the 1990s. During the same time period, a tax law change created a salary cap for tax deductions. Our analysis suggests a link between these two occurrences, i.e., the salary cap has increased the use of stock options as a form of executive compensation. This is especially true for companies and their

CEOs at the bottom of the distribution. While CEOs may not be representative for the general public, their response to current tax policy may be interesting in its own right, especially considering the magnitude of their overall incomes. Additionally, if it was the government's intention to limit executive compensation, our results indicate that such an effect was not achieved: Stock option compensation increased substantially after the salary cap went into effect.

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AN EMPIRICAL EVALUATION OF BANKRUPTCY PREDICTION MODELS FOR SMALL FIRMS: AN OVER-THE-COUNTER (OTC) MARKET EXPERIENCE

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ABSTRACT

Small businesses are the backbone of the U.S. economy, but are more vulnerable to business failure than their larger counterparts. In spite that the literature on the bankruptcy prediction models is rich and it demonstrates numerous strides made over the years since the pioneering research by Beaver (1966) and Altman (1968), for the most part, prior research has concentrated on the firm samples made up of the largest of the corporations traded on the New York Stock Exchange (NYSE) and/or the American Stock Exchange (AMSE). The objective of this study is to determine whether models that have been used successfully to predict bankruptcy for very large firms can be used effectively to predict bankruptcy for small firms. Specifically, the two successful bankruptcy prediction models, Ohlson's model (1980) and Shumway's model (2001), are selected to apply to a sample of small firms traded on the over-the-counter (OTC) market. While Ohlson's model relies strictly on accounting ratios, Shumway's model combines market measures with the accounting ratios. Both models are re-estimated with data from a most recent period in the 1990s, and are further validated by a classification test and a more rigorous prediction test to predict the bankruptcy probability of the holdout samples. The results indicate that both the classification accuracy and the prediction accuracy are impressive with these two models for predicting bankruptcy up to three years before their actual demise, while Shumway's model performs marginally better than Ohlson's model.

The distinguishing features of this study make strong attempts to overcome some of the glaring voids in the literature. First, this study addresses the issue of business failures specifically to the OTC traded small firms. Only firms with assets less than $130 million are considered in this investigation, and about 75 percent of the total sample firms had assets less than $50 million. Second, this paper analyzes data from a large sample of 316 matched OTC firms during the period of 1990-1998 to reflect the temporal nature of the data. Third, by using all the data, the financial, as well as, the market data, from a very recent and short period, the problem of pooling the data over long-term periods in the previous studies is mitigated. Fourth, the estimated models are externally validated by a prediction test up to 3 years prior to bankruptcy with the help of a holdout sample. Specifically, the bankruptcy prediction models estimated by using the data of 246 matched firms over the 1990-1996 period are utilized to predict failure for a group of 70 matched firms during 1997 and 1998.

THE BOOK-TO-MARKET EFFECT BEFORE AND AFTER THE MARKET DECLINE OF 2000

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ABSTRACT

Fama and French (1992) and others document and describe an extensive book-to-market (BEME) ratio effect in stock returns. Trecartin's (2000) results, however, question the pervasiveness of this finding across time periods. Thus, we reexamine the inter-temporal stability of the BEME effect by examining the months prior to and following the market decline of 2000. In general, we find that the BEME effect is much stronger during the bear market period, but it appears that much of the BEME effect during this period is driven by firms in the technology sectors.

INTRODUCTION

It is now commonly accepted that high book value of equity to market value of equity (BEME) portfolios outperform low BEME portfolios in stock-price return. Fama and French (1992) were the first to document this relationship, and since that time many articles have examined the persistence of this relationship across time (e.g., Davis 1994 and Ciccone 2003) and across international boundaries (Lakonishok 1991).

The finance literature is also concerned with explaining the dominance of high BEME portfolios since this result is contrary to the risk-return relationship forecasted by the traditional capital asset pricing model (CAPM). Fama and French (1992, 1993) attribute the BEME effect to a risk factor not captured by the CAPM. According to Tai (2003), BEME is a risk factor that varies across time. However, the literature also indicates that the BEME effect may be the result of other factors. Loughran (1997) suggests that the dominance of high BEME portfolios is due to the January effect, but Best, Best, and Yoder (2000) use tests of stochastic dominance to show that the BEME effect is not driven by the January effect. The BEME effect is also shown by Griffin and Lemmon (2002) to result from the mispricing of distressed firms.

Lakonishok, Shleifer, and Vishny (1994) and Haugen and Baker (1996) attribute the BEME effect to irrational investors and inefficient markets. If the BEME effect is indeed the result of irrationality, it is likely to change as market perceptions change. In this paper, we investigate further the inter-temporal persistence of the BEME effect. Trecartin (2000) shows that BEME is positively and significantly related to stock-price return in only 43% of monthly regressions from July 1963 to December 1997. Trecartin's (2000) results suggest that the use of BEME in forming short-term portfolios is not necessarily appropriate. We continue Tracartin's (2000) work by examining the use of the BEME in forming short-term portfolios leading up to and following the market downturn in the late spring and summer of 2000. Because aggregate stock returns during this period are heavily influenced by internet and technology oriented firms, we also investigate the use of a BEME strategy for firms outside of these market sectors during the bull and bear markets covered in our analysis.

DATA AND METHODOLOGY

We collect data for the firms used in this study using Research Insight and the Center for Research in Security Prices (CRSP) databases. Our analysis period includes July 1997 through December 2002. As in Fama and French (1992), the book value of equity is taken from the fiscal year-end of the year prior to portfolio formation. Using Trecartin's (2000) approach, we collect the market value of equity at the end of June in the year of portfolio formation and compound daily returns to compute monthly returns for each month from July of one year through June of the following year. In all cases in which we cannot match Research Insight data firms to CRSP data firms, we delete those observations. We then examine the monthly returns for 10 equally-sized (i.e., decile) portfolios ranging from a high to low BEME portfolios. Because we cannot match all firms across Research Insight and CRSP, our sample has various-sized portfolios across the sample period (ranging from a low of 181 firms per decile portfolio to a high of 257 firms per decile portfolio when all available firms are included in the sample).

To ascertain the impact of the recent bull and bear market on the BEME strategy, we break the sample into two distinct time periods–July 1997 through June 2000, and July 2000 through December 2002. Over these time periods (and in aggregate), we calculate the compounded monthly return on each of the decile BEME portfolios. We then compare the return on the lowest decile rank portfolio (labeled "High BEME" and which includes the firms with the highest BEME ratio) to the highest decile rank portfolio (labeled "Low BEME"). This comparison also facilitates the use of a difference in means t-test to determine whether any differences in portfolio returns are statistically significant.

Finally, the BEME effect as documented in previous studies implies that returns should increase monotonically from low BEME portfolios to high BEME portfolios. Because our statistical tests revolve around the "extreme" decile portfolios (high BEME versus low BEME), which may mask underlying variations in returns on the decile portfolios, we also ascertain which portfolio (among the ten deciles) has the highest return for the given month. Although we do not perform statistical tests on these returns, this examination allows us to determine the stability of the BEME effect across rank portfolios in addition to time-specific variations in the BEME effect.

For each of our statistical tests and time period comparisons, we report results in which all available firms are included and the results once technology-oriented firms are excluded. We consider firms with 3-digit SIC codes of 2830, 3570, 3660, 3670, 3690, 7370 and 4800-4890 to be high-tech firms. Thus, we can determine the impact of the "technology bubble" on the BEME effect. Our decile portfolio sizes range from 147 firms per portfolio to 198 firms per portfolio across time periods when we exclude technology firms.

RESULTS

Although we calculate returns on all decile portfolios and conduct statistical tests for each of the 66 months in our sample, we report only summarized data in the interest of space (month by month results can be obtained from the authors upon request). Our first analysis is included in Table 1, which lists the number of months in which the High BEME portfolio return is greater than the Low BEME portfolio and vice-versa. Again, to help us determine the impact of technology-oriented firms on the BEME effect over our analysis period, we report two sample results–"All" firms in Panel A of Table 1 and "Non-tech" firms in Panel B.

Table 1
Frequency of Returns on High BEME Portfolio versus Low BEME Portfolio

Panel A: All Firms

Time Period	High BEME>Low BEME	% of Months	Low BEME > High BEME	% of Months
07/97-12/02	43	65.2%	23	34.8%
07/97-06/00	18	50.0%	18	50.0%
07/00-12/02	25	83.3%	5	16.7%

Panel B: Non-tech Firms

Time Period	High BEME>Low BEME	% of Months	Low BEME > High BEME	% of Months
07/97-12/02	43	65.2%	23	34.8%
07/97-06/00	20	55.6%	16	44.4%
07/00-12/02	19	63.3%	11	36.7%

For all firms over the entire sample period, we find that in 43 of the 66 months (65.2%), the High BEME portfolio has a higher return than the Low BEME portfolio. The frequency for the non-tech sample is exactly the same over the entire sample period. Although this is greater than the frequency predicted by chance (50%), in real terms the frequency is small enough for us to begin to question the economic significance of the BEME effect. When we divide the sample into the pre- and post-market decline periods (July 1997-June 2000 and July 2000-December 2002), we find something striking in the all firms sample. The High BEME portfolio return exceeds the Low BEME portfolio return in exactly 50% of the months (and vice-versa) during the pre-market decline period–exactly as predicted by chance. In the post market decline period, the High BEME portfolio return is higher than the Low BEME return 83.3% of the months. Thus, there appears to be a shift in the BEME effect that occurs around the time of the market decline of 2000. This strong BEME effect, however, appears to be driven by technology-oriented firms as indicated in the sub-sample periods of Panel B. The relative frequencies for the non-tech firms are similar across time periods and are close to the full sample period relative frequencies.

To put these results in better perspective, and to shed greater light on the economic significance of our results, we identify those return differences (High BEME portfolio return minus Low BEME portfolio return) that are statistically significant. In Table 2, we report the number of occurrences in which these return differences are statistically different (using a 10% significance level). As indicated in Table 1, there are a number of occurrences in which the Low BEME portfolio has a higher return than the High BEME portfolio (contrary to expectations derived from previous studies). Thus, we divide the results in Table 2 into whether the return difference (High BEME - Low BEME) is positive (i.e., the return on the High BEME portfolio is highest) or negative. We also report the results for the pre- and post-market-decline periods.

Table 2
Frequency High BEME Return - Low BEME Return Is Statistically Significant

Panel A: All Firms

	Number of Months:			
Time Period	High-Low is Positive	% of Months	High-Low is Negative	% of Months
07/97-12/02	26	39.4%	8	12.1%
07/97-06/00	8	22.2%	7	19.4%
07/00-12/02	18	60.0%	1	3.3%

Panel B: Non-Tech Firms				
	Number of Months:			
Time Period	High-Low is Positive	% of Months	High-Low is Negative	% of Months
07/97-12/02	18	27.3%	3	4.5%
07/97-06/00	5	13.9%	2	5.6%
07/00-12/02	13	43.3%	1	3.3%

As shown for the entire sample period and all firms in Panel A, only 39.4% of all (66) months have a High BEME portfolio return that is statistically greater than the Low BEME portfolio return. Additionally, 12.1% of all months have a High BEME portfolio return that is statistically *lower* than the Low BEME portfolio return. Thus, our full sample findings appear to be consistent with Tracartin (2000). As the anecdotal evidence from Table 1 suggests, the BEME effect is stronger in the post-market decline period. During this period, 60% of all months have a High BEME return that is statistically greater than the Low BEME portfolio return, while only 1 month (3.3%) has a greater Low BEME return than High BEME return. Again, however, these results appear more pervasive for technology firms. As Panel B shows for the non-tech firms, only 43.3% of the post-market decline months have a High BEME portfolio return that is statistically greater than the Low BEME portfolio return. Thus, given the results in Tables 1 and 2, we cannot support the universality of the BEME effect. This effect appears to be concentrated in certain time periods and certain sectors.

Next, we report the number of times that a particular decile portfolio has the highest return in a given month. The frequencies (divided by all firms and non-technology firms only) for the entire sample time period appear in Table 3. Portfolio 1 represents the decile portfolio with the highest BEME firms and Portfolio 10 represents the portfolio with the lowest BEME firms. Although we provide no statistical tests on these frequencies, we should see a large frequency associated with Portfolio 1 and little or no frequencies among the other portfolios if the BEME effect described initially by Fama and French (1992) is pervasive.

Table 3
Number of Months in which Each Decile Portfolio Has Highest Return

	All Firms		Non-Tech Firms	
Portfolio	Frequency	% of Months	Frequency	% of Months
1	7	10.6%	13	19.7%
2	15	22.7%	8	12.1%
3	8	12.1%	6	9.1%
4	3	4.5%	6	9.1%
5	6	9.1%	9	9.1%
6	3	4.5%	2	3.0%
7	0	0.0%	1	1.5%
8	1	1.5%	1	1.5%
9	7	10.6%	10	15.2%
10	16	24.2%	10	15.2%

Surprisingly, for all firms, the most frequent portfolio with the highest return is the *lowest* BEME portfolio. In 16 months (24.2%) out of the entire sample period, this portfolio has the highest return. Further, although the two portfolios with the highest BEME have the higher returns 33.3% of the time, the two portfolios with the lowest BEME have the higher returns 34.2% of the time. The relative frequencies for the non-tech firms only are similar. The two highest BEME portfolios have the higher return 31.8% of the months, while the two lowest BEME portfolios have the higher

return 30.4% of the months during the full sample period. Thus, we must seriously question the extensiveness of the BEME effect as documented by previous studies.

Table 4
Number of Months in which Each Decile Portfolio Has Highest Return by Time Periods

Panel A: July 1997 - June 2000

	All Firms		Non-Tech Firms	
Portfolio	Frequency	% of Months	Frequency	% of Months
1	4	11.1%	11	30.6%
2	8	22.2%	4	11.1%
3	3	8.3%	3	8.3%
4	0	0.0%	0	0.0%
5	0	0.0%	0	0.0%
6	2	5.6%	1	2.8%
7	0	0.0%	1	2.8%
8	1	2.8%	1	2.8%
9	6	16.7%	10	27.8%
10	12	33.3%	5	13.9%

Panel B: July 2000 - December 2002

	All Firms		Non-Tech Firms	
Portfolio	Frequency	% of Months	Frequency	% of Months
1	3	10.0%	2	6.7%
2	7	23.3%	4	13.3%
3	5	16.7%	3	10.0%
4	3	10.0%	6	20.0%
5	6	20.0%	9	30.0%
6	1	3.3%	1	3.3%
7	0	0.0%	0	0.0%
8	0	0.0%	0	0.0%
9	1	3.3%	0	0.0%
10	4	13.3%	5	16.7%

Finally, to highlight the inter-temporal variation in the BEME effect, we divide the frequencies from Table 3 into our two sample periods–July 1997 - June 2000 and July 2000 - December 2002. These results are in Table 4. In Panel A, which includes frequencies for the pre-market-decline period, the relative frequencies are similar to, if not stronger than, the results from Table 3. The results from the post-market decline period in Panel B, however, reveal a pattern. As was evident from our previous evidence, it appears that the BEME effect becomes stronger in this latter period. The portfolios with the higher BEME (that is, portfolios 1-5), overwhelmingly have the higher returns during this period. Although this is true for all firms and for the non-tech firms, it is apparent that the results are stronger among the tech firms. Thus, we are left with our initial conclusion–the BEME effect is largely time and sector dependent.

CONCLUSIONS AND DIRECTIONS FOR FUTURE RESEARCH

Fama and French (1992) and others document and describe an extensive book-to-market (BEME) ratio effect in stock returns. Trecartin's (2000) results, however, question the pervasiveness of this finding across time periods. Thus, we reexamine the inter-temporal stability of the BEME effect by examining the months prior to and following the market decline of 2000. This time period allows us to contribute to the literature on the BEME effect in two ways.

First, we are able to determine the impact of the BEME effect in a bull and bear market. In general, we find that the BEME effect is much stronger during the bear market period. Second, because the bull market of the late 1990s was driven primarily by technology-oriented stocks, we are able to subdivide our sample to determine whether the tech sector has a large influence on the BEME effect. Here, we find that BEME effect is generally non-existent in the pre-market decline even among tech stocks. In the post-market decline, however, much of the BEME effect we document can be attributed to the tech firm sectors.

Thus, given our findings, we are left to question the extent of the BEME effect. Although the BEME ratio may be systematically related to the returns of some firms during certain time periods, it seems difficult to expect that a typical investor could consistently profit from forming portfolios on this basis.

We leave for future research two items unexplored in our analysis. First, are there systematic seasonalities in our findings? Although the results of Best, Best and Yoder (2000) would suggest otherwise, we find much different results than in that research. Second, although we do not report this finding previously in this paper, we note that there appears to be a "momentum" effect within the decile portfolios that we form. That is, when a particular decile portfolio has the highest return in a given month, that same rank portfolio tends to repeat as the highest return portfolio in subsequent months. Thus, there may be fruitful trading strategies based on a BEME and momentum effect.

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PROFESSOR WILLIAM A. PATON'S PROFESSIONAL CAREER: A PRELIMINARY STUDY

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ABSTRACT

William Andrew Paton (1889-1991), throughout his professional career, was an enthusiastic contributor to many facets of the accounting profession. Throughout the world, Paton was recognized as an eminent authority on accounting theory and one of the foremost leaders in accounting education. This paper is a preliminary study identifying Paton's contributions to the accounting profession and clarifying the positions assumed by Paton with respect to accounting thought and theory in the U.S.

INTRODUCTION

For more than 50 years, William Paton devoted his energies to the growth of accounting knowledge. During his distinguished career, he authored or co-authored more than a score of books and over one hundred articles. [See Appendix I & II for a partial listing.] He edited and was a principal contributor to the *Accountant's Handbook*, editions of 1932 and 1943, and the *Accounting Review*, 1926, 1927, and 1928. He held membership in the American Economic Association, the Mont Pelerin Society, the American Accounting Association, the American Institute of Certified Public Accountants, and other professional and honorary societies. Paton served as president, vice president, secretary-treasurer, and research director of the American Accounting Association. He was a member of the Committee on Accounting Procedure and the Special Committee on Development of Accounting Principles of the American Institute of Certified Public Accountants. Paton earned widespread recognition as a gifted and stimulating teacher who won the enduring respect and admiration of thousands of students. He earned an enviable reputation as articulate speaker, discerning consultant, forceful defender of logic, respected dissenter, and sharp critic.

The following topics will be considered for research: Paton's biography, philosophy, contributions to accounting education, contributions to professional societies, and nonaccounting activities.

During his lifetime, William Paton devoted his energies to virtually every facet of accounting. This study provides a broad overview of Paton's work.

GROWTH AND RECOGNITION

In December 1923, Henry Rand Hatfield (1924) read before the American Association of University Instructors of Accounting a paper entitled *An Historical Defense of Bookkeeping*. Conceived in an academic environment in which accounting was considered a brash outsider, the paper set forth Hatfield's arguments to justify accounting's place in the university curriculum. He noted that accounting needed respect--both self-respect and the respect of others. Hatfield listed

three elements, which, if not constituting proof, at least presumably establish respectability: 1) parentage and lineage, 2) the company one keeps, and 3) the services one renders to the community. Hatfield's paper, which now is a classic, was, in a small way, successful in helping to attract promising young men into the profession.

GROWTH AND RECOGNITION

Since 1923 the accounting profession has progressed a long way and won deserved recognition. The American Institute of Certified Public Accountants and the American Accounting Association have worked continuously to make the public aware of the services rendered by the profession. Such men as Littleton, Yamey, Chatfield, and Peragallo have pursued with painstaking attention the parentage and lineage of the profession. Yet a vital part of the profession's heritage as well as its future rests with "the company it keeps"--the people who have contributed to the development of the profession and those who will continue to share in its growth. The theories and concepts of accounting originated in the accumulation of ideas nd experiences of selected individuals, and the current body of accounting knowledge has been acquired through their efforts.

METHODOLOGY

Material for this study was obtained from the following sources: 1) selected materials published by William Paton from 1916 to the present, 2) minutes of committee meetings on which William Paton served, 3) interviews with William Paton, his professional associates, friends, and relatives, 4) interviews with accounting authorities who are cognizant
of Paton's contribution to the profession, and 5) personal letters, memoranda, lecture notes, speeches, and other unpublished materials.

The unpublished material was obtained from several sources. The library of the American Institute of Certified Public Accountants contains memoranda and minutes of various committee meetings, as well as certain published material. Although many of Professor Paton's personal papers were lost during moves at the University of Michigan, he was generous in making available those that remained. The American Accounting Association furnished some information, although its resources regarding early days of the association are limited.

Professor Paton, members of his family, colleagues, former students, and acquaintances graciously consented to interviews with the lead author. In addition, many people prominent in accounting education and business wrote the lead author in reply to his request for information.

The bias of this study is primarily historical, and the narrative, insofar as possible, will be presented in chronological order to show Paton's accomplishments in the accounting profession in proper perspective. Paton's personal life will be addressed, followed by an analysis of the Paton philosophy. Hopefully, this research will provide an insight into Paton's personality, for when the reader has some comprehension of this very complex man, his actions do not seem unusual--they become almost predictable.

Additional research will chronicle Paton's contributions to accounting education and professional societies. A paper on Paton's substantial contributions in nonaccounting areas will also be written.

As with any body of knowledge, thought and theory regarding accounting have evolved gradually over a period of time. Researchers cannot determine exactly any one person's contributions to this evolution, or even attribute a certain concept or thought to one individual. One person may obtain an idea from another, sometimes without even realizing it. Certainly Paton, who was always eager to find new solutions to problems, adopted many of his concepts from others. For instance, many persons associate Paton with the development of the entity theory in this country, but he certainly did not originate the idea. That he was a leader in attempting to state specifically

some of the basic assumptions or postulates of accounting does not mean that he originated them. For many years Paton advocated use of compound interest procedure in accounting for long-term debt, but he readily admits the influence exerted by Carman (1937a; 1937b), especially in regard to statement presentation of unaccumulated discount. In many other areas, one can discern the imprint of Paton's thought--treasury stock, goodwill, revenue recognition, and plant and asset accounting. Whether Paton originated these ideas is not important--he popularized them.

CONCLUSION

Paton has been called a theoretician, and indeed he was. He was criticized for not being practical. Yet Paton's life is a testimonial to the concept that a relationship exists between clear thinking and sound action. As Paton (1952) has commented, "Logic and expediency are seldom at odds."

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PIONEERING ACCOUNTANT AND PROFESSOR: THE LIFE OF WILLIAM A. PATON

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ABSTRACT

This paper discusses the life of an accounting pioneer--William A. Paton (1889-1991). During a long career as an accountant and professor, Paton achieved an international reputation as a controversial, dedicated, and brilliant scholar. As a result of his activities in private accounting practice, as well as his outstanding classroom teaching, he exerted a widespread influence on the emerging profession of accounting and was highly honored for his achievements.

INTRODUCTION

William A. Paton received an A.B. degree from the University of Michigan in 1915. He had actually completed academic requirements for the degree a semester or two earlier, but at that time the $10 diploma fee was too much for Paton's slender pocketbook (Taggart, 1964).

> *"After receiving the bachelor's degree, Paton lost no time in completing the requirements for the M.A. (1916) and the Ph.D. [in Economics] (1917). His doctoral dissertation dealt with the theory of accounts and in 1922, after some revision, was published by Ronald Press under the title Accounting Theory--With Special Reference to the Corporate Enterprise. This book has had such recognition as an accounting classic that to satisfy continuing demand, it was republished forty years later" (Taggart, 1964, p. x).*

THE EMERGING PROFESSIONAL

At the outbreak of World War I, William felt compelled to aid the war effort. In 1918 he and Mary moved to Washington, where he served as a trade expert and headed the section on trade certificates of the U.S. War Trade Board (Interview with William Paton, Jr., December 10, 1971). In 1919 he became Chief of the Special Assignment Section for the Income Tax Unit of the U.S. Treasury Department (Unpublished correspondence from William Paton to H.R. Hatfield, undated [1938]).

By 1919, William was already making his presence felt in the academic community. With Russell Stevenson, he had published *Principles of Accounting* and had written such articles as "Theory of the Double Entry System" for the *Journal of Accountancy* and "Significance and Treatment of Appreciation in Accounts" for the *Michigan Academy of Sciences*. In addition, he had authored at least six monographs for the War Trade Board (Memorandum from William Paton, 1971). Perhaps it was on the strength of this reputation that the University of Michigan in 1919 offered Paton an associate professorship.

PERSONS WHO INFLUENCED PATON

Paton's first formal course in accounting was taught by Russell Stevenson, a young instructor about William's own age, who was teaching his first class (Letter from Robert E. Stevenson to Howard Lawrence, December 1, 1971). There can be no doubt that Stevenson made a tremendous impression on Paton, who considers his former instructor his oldest living friend--a friendship dating from January 1912 and lasting more than 60 years (Letter from William A. Paton to Russell Stevenson, undated, received December 27, 1971).

Dr. David Friday also profoundly influenced Paton. Friday, one of the foremost teachers of accounting at the University of Michigan at the time, was actually in charge of the class taught by Stevenson. Friday lectured to all the accounting students once a week, and then they met in smaller sections. Stevenson instructed the section in which Paton was enrolled (Telephone Interview with William A. Paton, January 9, 1972). Friday was an economist--not an accountant--and had taught Paton such courses as Economic Theory. Friday instructed the accounting courses at the University of Michigan only because no one else was willing to undertake them (Taggart, 1964).

"The teacher to whom Paton owes the most," according to Taggart, "and who has always been his chief inspiration, was Fred M. Taylor, a kindly but exacting master of logic and an economist of the neoclassical school" (Taggart, 1964, p. x). Taylor had come to the University of Michigan from Albion College, where he had taught history (Telephone Interview with William A. Paton, January 9, 1972). He was a well-known economist at that time as a result of his publications--*Chapters on Money* (1906), *Principles of Economics* (Ronald Press, 1925), and a number of articles in such professional magazines as the *Journal of Political Economy*. Taylor never achieved worldwide recognition, however, perhaps partially because of his limited publication. His conservative evaluation of his own contribution to economic thinking, his passion for thoroughness, his devotion to teaching, and his high regard for the writings of his predecessors in the field, particularly in Austria and England, may have limited his own output (William A. Paton, 1971b).

Taylor must have been a magnificent teacher. Paton wrote of him:

> *"As a teacher Professor Taylor was truly outstanding. His main concern, always, was to provide a well organized, meaty, and sound body of subject matter for the student, but he also gave much attention to teaching methods, especially in his beginning course in principles. He took great care in preparing assignments, problem material, and examinations, and had no patience with the view that the in-charge professor should not be troubled by such prosaic chores. To an unusual degree he had the knack of telling his students what was what and at the same time stimulating them to express their understandings and raise questions. He also showed much skill in adjusting his teaching techniques to the level of attainment represented by those in a particular class. Thus there was a marked contrast between the rather rigid program of the basic course, and the exciting breadth of outlook encountered by students in his graduate seminars" (Paton, 1971b, p. 250).*

PERSONAL HONORS

During his lifetime, William Paton received virtually every honor that can be bestowed upon an accountant. He held membership in many Greek-letter honorary societies--Phi Beta Kappa, Phi Kappa Phi, Beta Gamma Sigma, and Beta Alpha Psi--and was a fellow of the American Academy of Arts and Sciences. He was named Dickinson Lecturer in Accounting at Harvard University in 1940 (Taggart, 1964). He served as trustee for the Foundation for Economic Education, Inc. and for the Earhart Foundation. His appointment to many of these positions resulted from his widespread reputation. Leonard Read has commented that Paton's selection to the Foundation for Economic Education was based primarily upon recommendation. He noted: "I was told by my friend, W.C. Mullendore, then Executive Vice President of Southern California Edison Company, about Bill Paton, what a remarkable person he was, and that I should try to interest him in becoming a Trustee of FEE (Foundation for Economic Education). I called on Bill at his University of

Michigan office. He consented and has been a faithful attendant at our meetings" (Letter from Leonard E. Read, December 1, 1971).

The faculty of the Department of Accounting at The Ohio State University appointed a nominating board of 45 members apportioned equally among accountants engaged in public accounting, industrial and governmental accounting, and educational accounting. According to Roberts, "The first board never actually met, but ballots were sent to each member and on the second ballot, George O. May, Robert H. Montgomery, and William A. Paton were elected as the first members of the Accounting Hall of Fame" (Roberts, 1971, p. 134). William Paton, never at a loss for words, recalled that "George O. May didn't attend but Bob Montgomery and I were on hand with our respective wives. It was a pleasant occasion and I recall suggesting--in my one minute acceptance--that now that the Hall was launched so auspiciously [that] great care should be exercised in adding names to the roll" (Roberts, 1971, p. 135).

Colleges and universities have also recognized William Paton's achievements. He has received honorary doctoral degrees from Lehigh University (Doctor of Letters), Eastern Michigan University (Doctor of Laws), Olivet College (Doctor of Economic Science), and Northwood Institute (Doctor of Laws) (Memorandum from William A. Paton, 1972). In 1947, in recognition of his distinguished achievements as teacher and scholar, Paton was appointed by the University of Michigan as Edwin Francis Gay University Professor of Accounting, one of 12 chairs designated by the Board of Regents to honor outstanding members of the faculty. When Paton retired from the University in 1959, the Regents adopted the following memoir for inclusion in the minutes of their meeting:

> *"WILLIAM ANDREW PATON. William Andrew Paton, whose teaching of accounting in the School of Business Administration has given him a reputation second to none in the nation, is retiring from the active faculty at the statutory age of seventy. Professor Paton received his bachelor's degree at the University in 1915, and his master's and doctor's degrees in successive years thereafter. He had served as Teaching Fellow in the Department of Economics of the College of Literature, Science, and the Arts while still an undergraduate; he rose quickly to the rank of Professor. When the School of Business Administration was officially instituted in 1924, his appointment was transferred to a professorship in that School. He was a visiting professor at the University of California in 1937-38, and Dickinson Lecturer at Harvard in 1940. His loyalty to his own University was such, nevertheless, as to deter him from accepting permanent appointments elsewhere. He was appointed Edwin Francis Gay University Professor in Accounting in 1947. His textbooks are authoritative in their field; his voice as consultant or expert witness in such areas as valuation, utility rates, and income measurement is definitive. Perhaps no other man in American academic life possesses his grasp of the theory and practice of accounting. For the esteem which he has brought to his School and his University, and the services, great and small, which he has faithfully rendered, the Regents express their profound gratitude. They confer upon him the title Professor Emeritus of Accounting and of Economics, and hope that he will long partake of the privileges attending that title" (Letter from Erick A. Walter to William A. Paton, September 28, 1959).*

RECOGNITION ACCORDED PATON BY HIS PEERS

Paton was always highly respected and revered by his fellow accountants. He served as president (1922), vice-president (1921), secretary-treasurer (1920), and research director or co-director with A.C. Littleton (1937 to 1939) of the American Accounting Association. He was founding editor of the *Accounting Review* and editor of the 1932 and 1943 editions of the *Accountants' Handbook*. Indeed, because many English-speaking foreigners used the *Handbook* in studying accounting, some persons contend that Paton is better known internationally than nationally because of his years as *Handbook* editor (Interview with Paul Garner, November 5, 1971). Paton served as a member of the American Institute of Certified Public Accountants Committee on Accounting Procedure from 1938 to 1950, and as a member of the Special Committee on Development of Accounting Principles during 1933-1934. Hatfield (1927) wrote of Paton, "... there

is perhaps, no other accountant who equals him in keenness of insight, careful analysis and penetrating interpretation."

CONCLUSION

In a short biography of William Paton, it is impossible to convey the dynamics of his freedom of expression, which so many have so often tried to analyze. He insisted on complete freedom to challenge any idea, including his own, and, therefore, he expressed himself absolutely honestly. Although others might disagree with him, he was not dismayed so long as he was completely honest with himself. His sole objective was to develop the proper reasoning to support his conclusions. He carefully analyzed the reasoning employed by those who disagreed with him in order to fortify his own position or to change it. If the objective was right, he would never hesitate to challenge the course he was following. Many persons found it a distinct pleasure to work with him, even though his intention was to solicit disagreement with his position. He asserted that honest exchanges leading to an understanding of disagreement would lay the foundation for a proper evaluation of his ultimate objective (Letter from Leonard P. Spacek, December 8, 1971).

William Paton lived in Ann Arbor, his home, for virtually all his adult life. He remained a prolific writer. During the 1970-71 school year, he published four articles in such periodicals as the *Journal of Accountancy*, *The GAP Review*, the *Michigan Business Review*, and *The Freeman*. In addition, he co-authored with his son William Paton Jr. a new textbook, *Assets--Accounting and Administration* (Memorandum from William Paton, 1972).

The fact that William Paton could still excite, still evoke disagreement, still make the accountant think about himself and his profession is evidenced by an article in the *Journal of Accountancy*, "Earmarks of a Profession--and the APB" (Paton, 1971a, pp. 37-45). In this article, Paton discussed the stifling effect exerted by the Accounting Principles Board on the development of the accounting profession. Once more Paton demonstrated the high esteem in which he held the men of accounting and his belief that accountants were honest, intelligent men who must be allowed to view each situation individually and choose the proper course of action. Many have disagreed with his assertions in this article, and the *Journal* has published at least two dissenting letters. William Paton was criticized previously, however, and was ultimately proved correct. Thinking ahead of his time was nothing new to him, and he knew that even those who disagreed with him gained a certain knowledge, and were forced to think and to analyze the opposing view. Paton died at age 101 on April 26, 1991 (The Ohio State University Fisher College of Business--William A. Paton (n.d.).

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A DISCUSSION OF RESULTS CONCERNING THE VERTICAL INTEGRATION-FIRM PERFORMANCE RELATIONSHIP

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ABSTRACT

This paper presents the primary points of discussion that relate to the observed effects of alternate types of vertical acquisitions on returns to shareholders and the consistency of these observations with previous research. The implications of the findings, limitations of the study, and areas for future research are also addressed.

INTRODUCTION

Although no strong support was found for any of the hypotheses, there is some evidence that moderating variables may be affecting the manner in which shareholders react to the announcement of a vertical acquisition. When analyzing the AARs and CARs of the entire sample, no significant returns were identified as going to the acquiring firm. However, when the sample was divided into smaller sub-samples, there was some evidence of significant returns. In the forward versus backward sub-sample, for example, there was weak evidence for higher returns going to firms engaged in forward rather than backward integration (although the difference between the mean CARs of the two groups was not significant). Likewise, when the sample was divided into related versus unrelated vertical acquisitions, returns to unrelated acquirers were shown to be significantly higher than returns to related acquirers.

DISCUSSION OF RESULTS

When analyzing the overall sample of firms, there was no evidence of abnormal returns going to the acquiring firms. This is consistent with the results of Chatterjee (1991), who also used the FTC database to analyze the returns to bidding firms engaged in vertical acquisitions. However, it should be noted that the SCARs of Chatterjee's sample were negative (loss of one percent to the acquiring firm) while the SCARs in this sample are positive. Although in both cases the SCARs were insignificant, the difference in sign indicates that removing potential biases from the sample may change the results of event-studies. In this sample potential biases arising from stock versus cash purchases, contested bids, opposed bids, small target size, and other acquisitions were all controlled. Chatterjee made no mention of such controls, possibly accounting for the difference in results.

Because future cash flows may be affected by specific attributes of a vertical acquisition, returns to acquiring firms may be non-observable when the sample is analyzed as a whole. Therefore, the sample was analyzed again, investigating differences in returns for forward versus backward integration and related versus unrelated vertical acquisitions.

CARs for the forward versus backward sub-sample indicated that returns to bidding firms are higher when the acquirer is moving toward the customer (forward or downstream integration).

On day -4 CARs for the acquiring firm were 0.007950 (t-stat = 1.634), significant at the 0.10 percent level. The cumulative gain to the acquiring firm on day -4 is, therefore, positive and significant. Differences between SCARs of the two sub-samples also indicate a higher return to acquirers integrating forward, rather than backward, although the statistical difference is insignificant.

Thus, there is some weak evidence that forward integration offers higher returns to bidding firms than does backward. Although researchers have analyzed the advantages associated with both forward and backward integration, little has been written which might indicate that one form of integration results in higher revenues, profits, or cash flows than does the other. However, for the time period studied, forward integration did offer one significant advantage over backward integration.

The prices of final and intermediate goods rose more than raw materials during the period 1962-1971 (20 percent, 21 percent, and 18 percent, respectively) and again in 1974-1977 (20 percent, 20 percent, and 15 percent), when a majority of these acquisitions took place (*Economic Report of the President*, 1991). Because of the higher costs of intermediate and finished goods during this period, forward integration might result in higher future earnings than backward integration.

SECOND DIVISION

A second division of the original sample was made to delineate between related and unrelated vertical acquisitions. As alluded to by Harrigan (1984), past classification of acquisitions into categories such as related or unrelated (Bettis, 1983) and single-business, dominant-vertical, constrained, linked, or unrelated (Rumelt, 1974) may not have been appropriate if the grouping were not mutually exclusive. To compensate for the fact that a vertical acquisition may also have characteristics of related or unrelated diversification, this investigation divided the sample into groups representing related and unrelated acquisitions.

The CARs and SCARs of these sub-samples do provide evidence that unrelated vertical acquisitions produce higher returns to acquiring firms than do related vertical acquisitions. All of the CARs for the related sub-sample were negative, with the CAR for day 3 significant at the 10 percent level (t = -1.317). On the other hand, all CARs for the unrelated sub-sample were positive, significant at the 10 percent level on day -4 (t = 1.491). More evidence of significant differences between the two groups is seen from an investigation of the SCARs and differences between the mean SCARs for the two sub-samples. The mean SCAR is 0.322 for the unrelated group and is -0.268 for the related group. The difference between the two is significant at the 0.10 percent level (t = 1.574).

REASONS FOR HIGHER RETURNS

There are several reasons why unrelated vertical acquisitions produce higher returns to the acquiring firm than do related vertical acquisitions. First, although synergistic combinations are normally seen as a benefit of related acquisitions, some authors (Chung, 1982; Michel & Shaked, 1984) have proposed that some synergy can be gained from the combination of two unrelated enterprises. These authors argue that the role of the general management functions (planning, organizing, leading, and controlling) in addition to functions normally centralized at top levels of the organization (research and development, finance, and legal) have increased in importance. Because these functions are not repeated unnecessarily when two firms are combined, in many cases the potential gains from operating a large, diversified firm are relatively higher than the associated costs (Copeland & Weston, 1988).

A second justification for unrelated mergers is a purely financial rationale, first proposed by Lewellen (1971). This argument states that "large firms have better access to the capital markets and also enjoy significant cost savings when securing their financing needs.... These cost savings

reflect, at least in part, the reduction in lenders' risk achieved through diversification" (Levy & Sarnat, 1970, p. 801). Because unrelated firms will have zero or negatively correlated returns, a combination of two debt-holding firms reduces the chance of default.

A final reason why unrelated mergers in this sample outperformed related mergers may be attributed to the prior performance of both subsets of firms. If investors judge decision quality of managers based upon their past successes (Morck et al., 1990), those acquirers who have performed well in the past will have higher returns than others. Through an additional analysis of the data in this sample, it was shown that after controlling for industry effects, the unrelated firms had outperformed related firms in the three years prior to the announced acquisition.

IMPLICATIONS

This research has several implications for both researchers and practitioners. First, for researchers, it is important to note that controlling for several potential biases (size of target firm, stock rather than cash, purchase, uncontested bids, unopposed bids, and other acquisitions made by the acquirer) did cause the results in this paper to differ from those found in Chatterjee (1991), who did not control for such biases. Therefore, future researchers should keep in mind that some or all of these factors should be controlled in an effort to avoid any bias in the data.

Secondly, this research suggests that past diversification studies which have categorized an acquisition into one of several mutually exclusive categories may have ignored the effects of moderating variables. In this study the category of vertical integration is modified to include firms which integrate in a related or unrelated manner. By doing so, this study suggests that a firm adopting a strategy of vertical integration may choose to integrate in either a related or unrelated manner. It was further shown that the type of integration chosen does act as a moderator in the diversification-shareholder return relationship.

For practitioners, this research extends previous studies which suggest that certain types of acquisitions may represent a strategic move for the acquiring firm, consistent with the maximization of shareholder wealth (Lubatkin, 1982). In particular, this research suggests that unrelated vertical acquisitions, when conducted by firms with a history of providing high returns to shareholders, provide significantly higher abnormal returns to shareholders than do related vertical acquisitions.

Although this research does have implications for researchers and practitioners alike, it does raise several questions that only additional research can answer. These unanswered concerns are discussed below as areas for future research.

FTC DATABASE

Three potential problems have been associated with the FTC classification scheme. First, Lubatkin (1982) states that the FTC categorizations do not always account for the "subtleness of the differences in products and markets" (p. 149). Because the FTC uses a product-count method of classification, the classification may ignore more complex relationships important in diversification research (Lubatkin, 1987). Secondly, the FTC has discontinued the merger series. Therefore, the latest acquisitions to be classified by the FTC are those occurring in 1979. Because the 1980s were a period of deregulation and *mergermania*, use of the FTC database may limit any conclusions the researcher draws to the period under study.

Finally, most studies utilizing the FTC database have equated actions taken by a firm with a strategy (Lubatkin, 1982). By using post-hoc observations as a proxy for strategy, researchers may be ignoring a firm's intended strategy. Again, Lubatkin suggests a case-method procedure whereby proxy statements are studied to determine the anticipated benefits from the merger and intended strategy is inferred from this more reliable source.

AREAS FOR FUTURE RESEARCH

This investigation raises several questions which could be addressed in future research. First, this research should be extended and the study duplicated using a more current data set. Because the FTC discontinued its merger series in 1979, this research cannot be generalized to acquisitions taking place past that date. A more extensive, current sample of acquisitions would help to extend the findings of this study. Secondly, it was found in this study that those firms announcing an unrelated vertical acquisition had higher prior performance than their respective industry average. Future research is needed to determine whether this is simply a characteristic of this sample, or if unrelated vertical integrators do tend to be better performers/implementors than those firms choosing to integrate in a related manner.

A third area for future investigation could focus upon the benefits to shareholders of integrating forward versus backward. Some weak support was found to indicate that forward integration provides higher abnormal returns to the acquirer.

CONCLUSION

More work needs to concentrate on the concept of related and unrelated vertical integration. In the past, these two strategies (related or unrelated diversification and vertical integration) were seen as separate, mutually exclusive alternatives. This research suggests that vertical acquisitions can be further classified into related or unrelated. .

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TYPES OF VERTICAL ACQUISITIONS AND RETURNS TO ACQUIRING FIRMS: A PRELIMINARY DISCUSSION

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ABSTRACT

Because vertical integration is popular in many industries, this type of diversification has been the focus of many academic research endeavors, especially in strategic management. There may be a number of reasons why equivocal conclusions have been drawn from previous research. In this study two potential reasons will be explored: (1) the impact of moderating variables and (2) the measure of firm performance. First, this investigation explores two moderators in the vertical integration-firm performance relationship: (1) whether the integration is forward or backward and (2) whether the acquisition is related or unrelated. Second, it is argued that by using market rather than accounting data to measure firm performance, a more timely view of firm performance can be gained.

INTRODUCTION

Although previous research has provided strategic managers with lists of advantages and disadvantages associated with the strategic option of vertical integration, it has also resulted in conflicting results regarding the vertical integration-firm performance relationship. For example, some studies (Rumelt, 1974) found that vertically integrated firms performed worse than any other type of diversified firm. However, other studies (Lubatkin, 1982; Harrigan, 1986) have indicated that vertical integration can lead to higher performance in some instances.

The event-study methodology, borrowed from the finance field, uses changes in shareholder wealth as a measure of firm performance. Despite the tremendous amount of research in the area of vertical integration, only a handful of researchers have studied vertical integration using event-study methodology. This research tests the impact of two moderators, forward versus backward integration, and related versus unrelated acquisitions, on returns to an acquiring firm's shareholders by utilizing the event-study methodology.

The Federal Trade Commission (FTC) series on mergers and acquisitions database classifies acquisitions into one of five categories, one of which is vertical integration. Shareholder reaction to these vertical acquisitions are then analyzed using the Center for Research on Security Prices (CRSP) data. Several variables are controlled for in this study including size of the target compared to the acquirer, other acquisitions made by the acquirer, whether the acquisition was contested and/or opposed, and whether the transaction was made in the form of stock versus cash.

Results of the overall sample indicate that no abnormal returns are accruing to the acquiring firm during the announcement of a vertical acquisition. When the sample is tested for moderating variables, there does seem to be some weak evidence that unrelated vertical acquisitions outperform related vertical acquisitions. However, whether the integration was forward or backward is not supported as a moderator.

VERTICAL INTEGRATION

Vertical integration can be defined as a form of interorganizational cooperation aimed at taking control of a firm's suppliers or customers. This strategic option is "one of the first diversification strategies firms consider as they progress from being single-business companies" (Harrigan, 1985, p. 397). Examples of organizations which have undertaken vertical integration include: beer manufacturers that purchase aluminum can manufacturing facilities; integrated oil firms that own crude oil fields, drilling rigs, pipelines, and refineries; and supermarket chains that produce and distribute many of the grocery products found on the shelves and own construction companies that build their new stores.

Vertical integration is often used as a vehicle for increasing margins because of the addition of value-added chains linked under one roof. An organization concerned with reducing the uncertainties associated with suppliers or customers may choose to reduce such risk by integrating either forward (becoming its own customer) or backward (supplying its own resources).

Vertical integration can be accomplished in one of two ways: (1) A firm may decide to expand internally, constructing facilities or distribution networks from the ground up, or (2) a firm may acquire or merge with either its supplier or customer. This paper will focus upon vertical integration accomplished through the latter strategy, acquisitions. Although vertical acquisitions have taken place throughout the 20th century, during the 1980s acquisitions increased in popularity for three reasons: (1) the Reagan administration established a relaxed posture toward mergers and acquisitions, (2) the once regulated industries of airlines, trucking, telecommunications, and shipping found mergers and acquisitions necessary to meet the challenges of competitive survival, and (3) managers felt stock prices of many viable targets were undervalued (Hodge & Anthony, 1988).

The next section briefly reviews vertical integration studies conducted by strategic management researchers. The focus then turns toward research in finance. Although finance researchers have yet to limit their database to only vertical acquisitions, much work has been done in the general area of acquisitions. The methodology used in these finance studies (i.e., event-study methodology) is proposed for use in this study. Therefore, a brief review of the event-study methodology is also included.

VERTICAL INTEGRATION FROM A STRATEGIC MANAGEMENT PERSPECTIVE

Strategy research in the 1950s through 1970s focused more upon vertical integration from an economic viewpoint. This is understandable since strategic management has its roots in economics (Porter, 1981). Work during this period took on either a traditional Industrial Organization Economics perspective (Bain, 1968) or, more likely, a transactions cost perspective (Coase, 1937; Williamson, 1971). Vertical integration, as studied from these viewpoints, benefits society by establishing a structure which decreases the overall costs associated with production of a final product. This cost reduction occurs via bypassing the market pricing mechanism, which can reduce transactions costs and in turn reduce the final price of a good.

As the field of strategic management grew to become more multi-disciplined, research on vertical integration changed as well. For example, Rumelt's (1974) work in the area of diversification began a reduction of research in the area of vertical integration. In his dissertation, Rumelt classified firm diversification into several categories: single business, related business, unrelated business, and dominant business. This final category, dominant business, was further divided into four sub-classifications, including dominant vertical, representing firms with high levels of vertical integration. From this classification scheme, Rumelt determined that firms following a dominant vertical strategy were consistent underperformers in such areas as sales growth, earnings growth, and earnings per share growth.

Seeing that the dominant vertical led to poor performance, researchers spent much time and energy studying the area of Rumelt's related versus unrelated diversification and focused relatively little attention on vertical integration and the benefits arising from such acquisitions (Harrigan, 1984). In fact, not until the mid-1980s, with the work of Harrigan and the Profit Impact of Market Share (PIMS) studies, was vertical integration once again viewed as a viable strategic option in certain situations.

POTENTIAL MODERATING VARIABLES

The different conclusions reached in the literature regarding the benefits of vertical integration may be due to the possible impact of moderating variables (Chatterjee, 1991). Two such variables are addressed in this investigation: (1) related versus unrelated acquisitions and (2) backward versus forward integration.

As stated earlier, much work in the area of strategic management in the 1980s focused upon related versus unrelated diversification, although no such distinction has been made for vertical integration. However, firms which vertically integrate may be acquiring unrelated or related businesses.

As a strategic option, vertical integration offers top managers a chance to lessen their reliance on suppliers (backward integration) or customers (forward integration). Strategists consider vertical integration a corporate-level growth strategy with the added benefit of reducing the uncertainty associated with the reliance upon another organization. However, no work has been conducted testing which type of integration, forward or backward, is more beneficial to firm performance. Therefore, this second moderating variable and hypothesis for testing is presented.

VERTICAL INTEGRATION AND EVENT-STUDY METHODOLOGY

In recent years scholars in strategic management have emphasized the need for an integrative approach to strategic management research (Bettis, 1983; Biggadike, 1981; Jemison, 1981; Porter, 1981). By borrowing and sharing theories across business disciplines, these writers hope the true complexity of strategic management will be reflected in future research endeavors. This study will provide a richer view of one particular strategic management concept, diversification through vertical integration, by combining work from strategic management and finance.

Event-study methodology attempts to determine the effect of a particular event on the discounted future cash flows of the firm. In so doing, this methodology compares changes in stock prices around the time of a particular event, in this case a vertical acquisition, with fluctuations in stock price for a "normal" period. Because stock prices reflect investor expectations of discounted future cash flows, an increase in a firm's stock price around the time of an announcement of a vertical acquisition indicates an expectation of increased cash flows in the future due to the acquisition. Likewise, a drop in stock price indicates anticipation of decreasing cash flows.

Several researchers argue that cash flows rather than earnings should be used to determine the value of a firm's stock even in those cases where a firm does not presently pay dividends. A firm's earnings can be either: (1) used to pay dividends or (2) reinvested in the firm. Normally, a policy of reinvestment is followed until the firm is no longer growing at a rate comparable to investments of similar risk in the market. At this point, normally during latter stages of the life cycle, dividends become more attractive to investors than reinvested earnings. Because it is assumed that all firms will eventually pay dividends, to discount future earnings would amount to double counting, since one would count retained earnings both when they are earned and when they are eventually paid out in dividends (Elton & Gruber, 1987).

The impact of strategic decisions upon firm performance, as measured by changes in discounted future cash flows and stock prices, can be tested through the use of event-study methodology. This technique has been used by several strategic management researchers including

Chatterjee (1986) and Singh and Montgomery (1987). However, only two researchers (Chatterjee, 1991 and Lubatkin, 1982, 1987) have looked specifically at the relationship between vertical integration and shareholder reaction.

Using the event-study methodology, Lubatkin (1982, 1987) found that shareholders do react favorably to the announcement of vertical integration, indicating an expectation for increased future cash flows. In fact, Lubatkin (1982) concluded that shareholders favor vertical integration over either horizontal, concentric, or conglomerate diversification. Slightly modifying the event-study methodology used by Lubatkin (1982), Chatterjee (1991) found conflicting results. He concluded that shareholders of acquiring firms lose an average of one percent return during the announcement of a vertical acquisition. These conflicting results reported by Lubatkin (1982) and Chatterjee (1991) could be due to the impact of moderating variables previously mentioned.

CONCLUSION

Because calls for more integrative research in the field of strategic management abound (Bettis, 1983), this study seeks to integrate work in the fields of strategic management and finance. Although researchers in finance have accomplished much in the area of acquisitions and their impact on stock prices, these researchers have treated all acquisitions as homogeneous events. Therefore, investigators are unclear as to shareholder reaction to specific types of acquisitions, such as those involving vertical integration. These conflicting strategy-related explorations have not distinguished between related and unrelated vertical acquisitions or forward versus backward integration.

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A DISCUSSION OF THE OUTSOURCING OF TAX RETURN PREPARATION- THE GOOD, THE BAD, AND THE UGLY (OR- IS IT REALLY SO BAD?)

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ABSTRACT

Without a doubt, among the hottest political and economic issues ongoing today is the notion of outsourcing of American jobs overseas. As if outsourcing alone is not a hot enough topic, the notion of outsourcing US citizens' tax returns to overseas preparers has raised even more questions and outcry. Concerns over privacy, security, disclosure, pricing, and disclosure to clients are just a few of the issues raised by this form of outsourcing. This paper attempts to present a balanced discussion of the issues and suggest possible and arguably reasonable compromises to the related concerns.

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A DAZZLING ARRAY OF CREDIT CARD FEES: EVIDENCE OF AN INDUSTRY IN TRANSITION

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ABSTRACT

With continuing pressures to show profits and with competition for customers becoming more intense, credit-card issuers are increasingly turning to higher fees rather than higher interest rates as a means for enhancing profitability. After all, it is easier to scatter a myriad of increasing fees than conspicuously raise basic interest rates.

In earlier years these companies might have turned to higher interest rates, but astute customers now have more comparative information and are resistant to higher rates. Other options for the lenders would have included an outreach to new categories of customers, but most of the subgroups of society have now been tapped by the industry.

In exploring the behavior of 50 representative credit-card fees, information is presented that not only shows an acceleration of fees and charges but also evidence that the industry is moving from a growth stage to a shakeout stage. The increasing fees may be a last hurrah for an industry that has had excessive profitability.

INTRODUCTION

In a well-documented article entitled "Fees! Fees! Fees!" we're reminded that "America used to be the land of the free. Now, it's the land of the fee" (Thornton, 2003). With methodical precision, fees from a variety of industries are explored along with their financial impact. But when it comes to expanding fees, no one does it better than the financial services industry. "Banks will get $30 billion this year from customers paying extra for bounced checks, using ATMs, (etc., and) … credit card issuers will rake in an estimated $20 billion in extra charges such as late-payment fees…" (Thornton, 2003).

One reason card issuers are the elite in using fees is because of the complexity of the process. Billings in many industries involve well-defined events that are easily understood and negotiated. But credit card processes are ongoing and usually involve many transactions, dates, and calculations, and billing statements contain inadequate information. So there is room for lenders to "maneuver among the complexities."

LITERATURE SEARCH

In studies relating to the credit-card industry, the majority relate to interest rates, and few relate directly to the setting of fees. However, the interest-rate studies do provide indirect value in understanding the forces at work. One significant study in the American Economic Review showed that consumers seem willing to pay higher fees in the credit-card industry because they don't fully account for the high probability that they may actually have to pay the high fees (Ausubel, 1991).

A later study documented abnormally high profits in the credit-card industry because customers rationally avoid both search costs and switch costs of other financing possibilities and are largely unresponsive to fee changes (Calem and Mester, 1995). A third study showed that credit cards, even with high fees, are a low-cost method of financing transactions and arranging short-term loans (Brito and Hartley, 1995). But the academic literature is sparse because the fee phenomenon is relatively recent.

CREDIT CARD FEES TO THE FOREFRONT OF THE INDUSTRY

The reason credit-card fees are a hot topic is because of a confluence of major forces. Interest rates were high four years ago with the federal funds rate at 6.54%, the prime rate at 9.5%, and credit-card rates around 20% on average. As rates started falling in December of 2000, the cost of funds for card issuers declined because of 15 Federal Reserve rate reductions. However, the interest rates that card issuers were able to charge their customers remained stable, so the profits of card providers increased significantly.

As the rates in other interest-rate markets remained low through 2002 and 2003, the interest rates in the credit-card market stubbornly inched downward which squeezed profits. And with few segments of society left to turn to for growth, the credit-card providers began focusing more on fees to maintain and enhance profits. Now, in 2004, we have seen the official rates starting to increase. This upward trend in the cost of funds will squeeze profits even further, so more emphasis will be placed on increasing fees.

THE STUDY

With the credit card industry at a crossroads and with an increasing emphasis on the charging of fees, the purpose of the study was (1) to identify what credit-card fees are being charged and how these compare to previous years, (2) to evaluate the amount of these fees and how they compare to previous years, (3) to form an opinion about the likelihood that these fees will be applied to customers and how this probability compares to previous years, (4) to search for clues about the impact that these fees are having on profitability, and (5) to use all of this information to determine whether the credit-card industry is moving from a growth stage to a shakeout or maturity stage.

The purposes were accomplished by obtaining information from (1) business publications, (2) academic journals, (3) credit-card statements, (4) interviews with bank employees, and (5) advertising flyers received from national credit-card marketers. As to the flyers, over 1,000 have been saved since 1996 from the national marketers, and samples were used from 1998, 2001, and 2004 to identify three-year-interval changes.

THE FINDINGS

Using a wide sampling of advertising flyers, a list of 50 fee charges (and accompanying rates) was assembled, and these are shown in Exhibit 1. It is important to note that the number of fees and charges has increased over time from about 7.5 fee-charge categories per flyer in 1998 to about 15 categories of fee charges and rates contained in each of the advertising flyers received in 2004.

As to the question of whether these fees have been increasing in amount, a variety of tests and observations were applied to the five most prominent fees. For the late payment fees, the samples of advertising flyers from 1998 show that the fees never

Exhibit 1
A Sampling of 50 Fees Charged by Credit Card Issuers

A. Fees for getting started:	B. Ongoing fixed fees:
Credit review fee	Annual fee
Account set-up fee	Monthly participation fee
Enrollment fee	Payment protection fee
Membership fee	Payment protection rate
Program fee	Unauthorized usage protection fee
Initial card fee	Additional card fee

C. Main fees:	D. Main rates:
Unpaid balance fee (min. charge)	Unpaid balance rate (several levels)
New purchases fee	New purchases rate (several levels)
Interchange fee (fin'l. intermediaries)	Interchange rate
Cash advance fee	Cash advance rate
Balance transfer fee	Balance transfer rate
Foreign currency transfer fee	Foreign currency transfer rate
Special purchases fee (gaming chips, etc.)	Special purchases rate
E. Processing fees:	F. Communication fees:
Minimum finance charge	Copying fee
Foreign fee (use of others' ATMs)	Autodraft fee
Service of account fee	Internet access fee
Automatic payment fee	Voice response fee
Payment by phone fee	Mailed statement fee
Stop payment fee	Express delivery fee
G. Fees for account management:	H. Penalty charges:
Research fee	Late payment fee (several levels)
Credit limit increase fee	Over credit limit fee (several levels)
Overdraft advance fee	Returned check fee
Overdraft advance rate	Lost card fee
Closed account fee	Arbitration fees
Closed account rate	Legal fees

exceeded $25 and were often less. The samples from 2004 show that it has become almost universal to use a three-tier approach with a typical arrangement calling for a penalty of $15 for balances up to $100, $25 on balances of $101 to $1,000, and $35 on balances of $1,000 and greater. Some run as high as $19, $29, and $39 respectively, so the fees have increased in this category.

As to the over-credit-limit fees, the samples from 1998 never exceeded $25 and were often less. In the samples from 2004, almost all the fees have gone up to $35 with a handful increasing to $39 per incident. As to the returned check fee, the typical charge was $25 in 1998, and the payment is now more typically $29.

In the case of fees for balance transfers, there is almost no evidence that such fees existed five or six years ago. In the 2004 samples, a 3% rate is the standard, and there are some companies beginning to charge $10 per transaction (or 3%, whichever is greater). The fees being charged for cash advances averaged about $2.94 in 1998 or 3% whichever was greater. In 2004 the cash advance fees are all either $5 or $10 (with the average being about $6.50), and the percentage rate continues almost rigidly at 3%.

CREDIT-CARD PROFITS AND THE EFFECT OF FEES ON THESE PROFITS

Prior to 1980 there were few profits being made in the credit-card industry because it had not yet been fully computerized. From 1980 until well into 2002 the credit-card business was extremely profitable. The 50 largest issuers earned about 3 to 5 times the ordinary rate of return for the banking industry. This was largely true because of increasing efficiencies and the interest rate gap between high interest charges to consumers and low interest costs to the card issuers. Within the last two years interest rate charges have been inching down and interest-rate costs have been inching up. Consequently, card providers have had to turn to increasing fees to maintain profits.

There is evidence that an acceleration is happening both in the number of fees being charged and in the level of these fees, and the increases are largely offsetting the squeeze taking place in interest rates. So the profitability is still largely there, but this "watershed" shift is really evidence of a life-cycle change for the industry.

EVIDENCES OF A LIFE-CYCLE SHIFT IN THE CREDIT-CARD INDUSTRY

General business theory usually makes reference to at least four major stages in the life cycle of each industry (introduction, growth, maturity, and decline). Some lists put a shakeout stage between the growth and maturity stages. The current cycle is measured by customer saturation, sales growth, profitability, degree of competition, product options, promotional costs, etc.

These and other characteristics were evaluated and the findings show there is a movement toward the maturity stage, but it is not yet fully there because the number of card providers remains about the same, credit-card sales are continuing to increase (although more slowly), credit-card profits still exceed the average profits of other banking services, and there are still significant opportunities overseas.

The conclusion of the study is that the industry is moving from its growth stage to a shakeout stage, and a summary of the life-cycle findings is shown in Exhibit 2:

SUMMARY AND CONCLUSIONS

(a) As measured informally in advertising flyers, the number of fees being charged by the industry has approximately doubled in the last six years with an average of about 7½ fees mentioned in each flyer in 1998 to about 15 fees per flyer in 2004.

(b) "Late-payment fees" and "over-credit-limit fees" have increased from an average of less than $25 in 1998 to "probably" over $30 at present. Credit-card issuers have adopted more complicated mathematical formulas and the data is harder to compare.

Exhibit 2
Characteristics of the Industry Life Cycle
(With an emphasis on the credit-card industry)

Indicators:	Growth Stage:	Shakeout Stage:
Credit-card customers	Rapidly increasing	Saturation
Credit-card sales	Fast-growing	Slower growing
Interest rate behavior	Very inelastic	Inelastic, but less so
Interest rate levels (regular)	High	Declining slightly
Interest rate levels (penalty)	Very high	Remaining high
Fees and other charges	Average	Increasing in number and level
Profits (Innovators)	Big profits	Profits becoming more normal
Profits (Generally)	Rising then leveling off	Leveling off, declining for some
Competitors (Number)	Increasing	Some decline with mergers
Competitive options	Many	Fewer
Competition	Increasing	Intensifying
Product quality	Increasing	Maintaining to improving
Product variations	Increasing	Some increasing
"Awareness" advertising	Heavy	Average
Specific promotional costs	Average per unit	Increasing per unit

(c) In reference to the more complicated formulas, it was almost universal in 1998 to advertise one "late-payment fee" and one "over-credit-limit fee," but it is now almost universal for companies to apply a scale with higher fees for higher credit-card balances.

(d) Although there is much said about grace periods being shortened to increase the likelihood of late payments, evidence was not found to support this theory. Virtually 100% of the samples from both 1998 and 2004 showed grace periods about the same.

(e) "Returned check fees" have almost universally remained a single fee (as opposed to a scale of fees), and the amount of these charges has increased from approximately $25 per returned check in 1998 to about $29 per returned check in 2004.

(f) "Balance transfer fees" was basically a non-existent phenomenon in 1998, but with credit-card holders now "jumping around" to take advantage of "zero-interest grace periods" companies are regularly charging balance transfer fees that average $5 to $10 per transfer or 3% of the transfer amount, whichever is greater.

(g) "Cash advance fees" have remained very stable at almost exactly 3%, but the dollar amount has increased from approximately $2.94 in 1998 to about $6.50 in 2004.

(h) In broad terms, the credit-card industry was not generally profitable before 1980. Since 1980 it has been highly profitable, but an increase in the number and level of fees is what has kept it profitable in the last couple of years.

(i) The accelerating fee charges are not just a passing trend, but a long-term, strategic necessity for maintaining profits in an industry that is crowded and competitive.

(j) Evidence suggests that the industry is moving out of the growth stage of its life cycle and into a significant shakeout stage (but not yet into a maturity stage).

REFERENCES AVAILABLE UPON REQUEST

THE DEVELOPMENT OF A MODEL EXPLAINING RETURNS TO ACQUIRING FIRMS: VERTICAL INTEGRATION AND EVENT-STUDY METHODOLOGY

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ABSTRACT

This paper describes how a sample was gathered concerning the types of vertical acquisitions and returns to acquiring firms. The data used meet several criteria, each of which is discussed in this paper. The event-study methodology is also discussed, along with its origins, purpose, and applications. The concept of abnormal return and the method of calculating an abnormal return are also described.

INTRODUCTION

The database used for this paper is the FTC database employed by both Lubatkin (1987) and Chatterjee (1991). The FTC database classifies firms in the process of diversifying by categorizing merger types. It includes mergers that took place during the years 1948-1979, excluding those targets with an asset value of less than $10 million. The database classifies mergers into five types: (a) horizontal, two firms producing similar products in the same geographic region; (b) market-concentric, firms producing similar products in different geographic regions; (c) product-concentric, firms with noncompeting products which share marketing or production similarities; (d) conglomerate, firms with dissimilar products and markets; or (e) vertical, firms with a buyer-seller relationship.

CENTER FOR RESEARCH IN SECURITY PRICES

For data retrieval purposes, in order to be included in this paper, the acquiring firm had to be included in the Center for Research in Security Prices (CRSP) database. The CRSP tapes contain daily stock returns adjusted for dividends and stock splits for all stocks traded on either the New York or American Stock Exchanges.

Use of daily stock returns has several advantages over the monthly returns method used by previous researchers (c.f. Lubatkin, 1987). First, the use of daily stock returns allows the researcher to focus more attention on one isolated event or tactic (Lubatkin & Shrieves, 1986), in this case a vertical merger. Secondly, daily returns reduce bias caused by extraneous events (Brown & Warner, 1985). Seventy-two firms were listed in the FTC database and the CRSP file.

STOCK PURCHASE

Several researchers (Kroll et al., 1992; Myers & Majluf, 1984) have suggested limiting an acquisition sample to those with similar method of payment. This controls for any differences in shareholder reaction arising due to cash versus stock (or combination of these two) modes of

payment. In most instances, the FTC database identified the mode of payment as cash, equity, or a combination. This sample used only those acquisitions with stock as the mode of payment.

UNCONTESTED BIDS

A contested bid is one where several firms are bidding to take over a potential target. Roll (1986) comments that such bidding wars can result in intensified bidding for target shares, causing higher-priced bids. That is, what is created is hubris, the Greek word for "animal spirits." The hubris hypothesis suggests that managers may overevaluate potential acquisition candidates, transferring virtually all takeover gains to the target shareholders. Because contested bids tend to drive up the final price paid for the target, thereby increasing the potential for hubris, Roll suggests limiting samples to those with uncontested bids. Information regarding any competing bids was gathered from *The Wall Street Journal Index.*

UNOPPOSED BIDS

If management or shareholders attempt to block the acquisition, costs associated with such a transaction will increase (Kroll et al., 1992). Therefore, the sample was limited to those firms whose takeover was unopposed. This information was gathered from *The Wall Street Journal Index*.

FORWARD VERSUS BACKWARD INTEGRATION

To determine if the integration was forward or backward, several sources were used. First, as reported by Davis and Duhaime (1992), SIC codes can be used to identify between-stage vertical integration. The example provided by these authors is of a firm with an SIC code of 2020 (manufacturing) and 5143 (service). This firm has integrated forward because the firm produces (2020) and sells (5143) wholesale dairy products. Six of the 33 acquisitions were classified as between-stage and determined to be backward or forward from SIC codes.

Davis and Duhaime (1992) warned, however, that within-stage integration is harder to pinpoint as either backward or forward. They suggested that company and product descriptions might have to be gathered to determine the type of integration pursued. To obtain these descriptions, the original article in *The Wall Street Journal* which announced the acquisition was examined to determine if the acquisition was reported as backward or forward or if that relationship can be established from the information given. This was a very valuable source for all but three acquisitions. One of these remaining acquisitions was classified using *Moody's Handbook of Common Stocks*, which lists the major supplying and buying industries for the companies covered. Not enough information could be gathered about the remaining two acquisitions, so these were eliminated from the sample when conducting tests of the second hypothesis.

METHODS

The standard event-study methodology was first developed in the finance literature by Fama, Fisher, Jensen and Roll (1969). Since that time researchers have used this procedure to test market reaction to such events as changes in accounting procedures (Kaplan & Roll, 1972), corporate divestiture (Montgomery, Thomas & Kamath, 1984), management turnover through deaths (Worrell, Davidson, Chandy & Garrison, 1986), and executive succession (Reinganum, 1985). The following paragraphs provide both a general overview and a more specific presentation of the event-study methodology.

GENERAL INFORMATION ON EVENT-STUDY METHODOLOGY

The market value of a firm represents the sum of all discounted future net cash flows. Therefore, the market price of a firm depends on the expected stream of future earnings, discounted at an appropriate discount rate. Any event which changes either the expected stream of future earnings or the rate at which those earnings are discounted will affect the market value of that firm. For example, management may enter into an acquisition that causes the firm to become more vertically integrated. If investors believe that this acquisition will lead to higher earnings or lower risk in the future, the market value of the firm should increase at the time of such an announcement. Strategic decisions affecting long-run profitability should be reflected in short-run changes in the market value of the firm.

The key assumption underlying the event-study method is capital market efficiency (Bromiley, Govekar & Marcus, 1988). This assumption suggests that stock prices reflect all publicly available information. In the extreme form of this efficient market hypothesis, stock prices adjust instantaneously to any new information. Although research has not fully supported the strong form of this hypothesis, most empirical work indicates prices adjust rapidly to new information (Reinganum, 1985).

If the stock market does indeed possess informational efficiency as many studies suggest, then the impact of any new information on the future prospects of the firm will be fully reflected in a change in price of that firm's security. The event-study methodology can be used only if the news is unanticipated by the market (Bromiley et al., 1988). If the new information is seen as beneficial to the firm, then the stock price will increase. On the other hand, bad news for the firm will lead to a decrease in the price of the stock. News which investors foresee as having an inconsequential effect on the prospects of the firm will not affect the price of the security. Furthermore, Fama (1970) suggests that this assessment will be unbiased and rational.

By assessing the behavior of stock prices around the day a news event is announced, the event-study method attempts to determine how a strategic decision affects stock price. In this manner, researchers can measure the market's reaction to and assessment of a news event.

SPECIFICS OF THE EVENT-STUDY METHODOLOGY

In order to correctly estimate market reaction to an event, a researcher must determine how a stock would have behaved without the event (normal return) and compare that to the price changes caused by the event (abnormal return). There are several techniques for estimating abnormal returns, including the market-adjusted return used in this paper (Brown & Warner, 1985).

For the purposes of this paper, the actual return was defined as a change in stock price divided by its initial price. Abnormal returns were calculated by taking the differences between the actual return calculated and the predicted or normal return calculated. The calculation of a normal return accounts for the movement of the market (represented in this paper by the S&P 500), eliminating the misrepresentation of a market-wide change in stock price as abnormal to one particular security.

Abnormal returns associated with each vertical acquisition were aligned according to event-date time rather than calendar time. In this paper, time $t = 0$ represents the day the announcement was made (the day before the announcement appeared in *The Wall Street Journal*). Day $t = -1$ is the business day preceding the announcement, day $t = -2$ represents two business days before the news of a vertical acquisition. Similarly, day $t = +1$ is the business day after the announcement. The impact of vertical acquisitions across companies was computed by taking an average of the abnormal returns for the event date.

Because information may either *leak out* before the announcement date or slowly be assimilated after the announcement, cumulative stock fluctuations several days before and after the announcement are also of interest. The cumulative abnormal return (CAR) is calculated by

summing the average abnormal returns for the period under investigation. In this paper, CARs are calculated for event date -5 to +5.

To test the significance of the CARs for each of the 11 days from -5 to +5, a procedure conducted by Brown and Warner (1985) was utilized. The test statistic in this instance is simply the CAR to its estimated standard deviation.

CONCLUSION

As a final test of significance, Dodd and Warner (1983) suggested using average standardized cumulative abnormal returns (SCAR). This procedure has also been used by Davis (1990) and Chatterjee (1991). For each security a SCAR for any interval $(d_{2i}-d_{1i}+1)$ is then calculated. To test the significance of these SCARs, a Z score is then computed for the sample of N firms. Finally, to test the hypotheses, the sample was divided into sub-samples based upon the criterion applicable to each hypothesis. As suggested by Davis (1990), the SCARs were used to conduct a two-sample t-test to test for a difference between CARs.

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Academy of Creativity and Innovation

UTILIZING CONCEPT MATRICES IN MANAGEMENT INFORMATION SYSTEMS INSTRUCTION

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ABSTRACT

The purpose of this study was twofold. One, to experiment in the classroom with different note taking methods that hopefully would allow students to better synthesize the material presented in an introductory management information systems course. And two, to reinvigorate the instructor after teaching the introductory management information systems course for about twenty years. Students in two sections of an introductory management information systems course received instructions on using mind mapping, concept matrices, and adding notes to power point lectures. Then each class voted as to their preferred method of note taking. One section selected adding notes to power point lectures and the other section selected concept matrices. The students were given pre and post tests over the course content. The results of this small exploratory study showed minimal impact from the change in instruction methodology. Anecdotally, the students liked learning about the different approaches and used them in other settings.

INTRODUCTION

This study began when the author was involved in a reading group sponsored for faculty development. The group read Maryellen Weimer's book: *Learner-Centered Teaching*. In a discussion on developing independent learners, the idea of using concept maps and concept matrices to help the learner categorize content for better understanding was briefly mentioned (p. 172). This sparked the author's interest and curiosity. This led to research on concept maps and matrices, which evolved into an exploratory study using two sections of an introductory management information systems (MIS) course. These classes are given in a computer lab where each student is at a workstation. It can be frustrating teaching in this environment when you know that many of the students are checking email, playing games, surfing the Internet or doing other work. This is not a unique situation to introductory MIS courses. In John Schwartz's article, "Professors Vie With Web for Class's Attention" in *The New York Times*, (2003) he states that "professors say the technology poses a growing challenge for them: retaining their students' attention." Professor Mallek at American University said "As a professor if you are not productively engaging them, they have other opportunities" (Schwartz, 2003). Therefore, finding an activity that required the students to use the computer during lectures would be beneficial and hopefully less frustrating to the instructor.

Given the resources available in the computer lab, research was done to see what kinds of teaching strategies could be incorporated into the introductory MIS class. The author found the following approaches would be viable and could be done with the software currently available to the students. These approaches were concept maps (Visio), concept matrices (MS Word), flowcharting (Visio), and adding notes to power point presentations (MS Power Point). As tempting as it would be to have the students do flowcharts in this course, the author decided that it would not be as attractive as the other approaches.

What is a concept map? A concept map is a visual model of a topic. It will graphically show through the use of nodes and links how the various categories or characteristics relate to each other without a formalized structure. Nancy Romance and Michael Vitale (1999) looked at the research on the application of concept mappings. One finding from the use of concept maps in the sciences included a consistent correlation between the quality of the concept map and other course

assessments. They also noted the weakness of the time required to develop concept maps and that for some students this was not an attractive technique.

For the first introduction to concept maps the author explained what concept maps were and how to draw them. The author felt that having the students learn Visio before completing their first concept map would waste time, since the concept map would be lost as the students focused on learning Visio.

Concept matrices, while similar to concept maps, use a table structure. Maryellen Weimer (2002) defined the matrices as "a grid with defining characteristics across one axis and categories on the other (p. 174)." Jyostsna Kinnard (2003) in her article describes a "HyperDim Research Grid." This grid is a "non-linear, multi-dimensional tool that can be used as an electronic notepad for brainstorming, as a centralized repository of ideas for group projects; or as a medium to link concepts, lend perspective, and help students understand historical trends (p. 3)." Her grid represents four quadrants. She used "features, impact, opportunities, and trends (p. 3)" in her IT courses. This grid is a tool to help students organize the concepts and how they are related. Other references to concept matrices were for mathematical, engineering or project management and didn't specifically relate to this use of a matrix. The author decided to approach the development of a concept matrix in class using MS Word. Initially, the students in the introductory MIS course are more familiar with MS Word. Since the author stresses applications, not just identification of terms, the following column headings were used: concepts, categories, characteristics, applications.

The author has traditionally taught this course using a MS Power Point presentation covering the chapter concepts. Many students have printed out the power point presentation and take notes on the hard copy. Other students felt they could print the presentation out any time, so they were free to do other things in class. To give the students an activity to do while the lecture was going on, the students were taught how to add notes to the power point presentation.

EXPLORATORY STUDY

The author felt that there were three viable teaching strategies to engage the students during the lectures. It was not possible, initially, to deviate from the lecture format since that was the expectation of the students and other faculty members. During the Spring 2003 semester the author decided to try an experiment. This experiment involved teaching both sections of the introductory MIS course how to do concept maps and concept matrices, and add notes to power point presentations.

The semester begin by the author explaining to the students the various teaching approaches in general and the format for the study. If the students wanted to participate in the study, they could take the pre-test at the end of class, day two. As an incentive if the student took the pre-test they would earn five bonus points. Five bonus points were also given at the end of the semester for taking the post-test. The course grading schema used 800 points so the 10 bonus points would not adversely inflate the grades for the course.

The first approach taught was taking notes using power point. This was done first since it was the most familiar approach for the students and would get them comfortable using the computers in the lab. The second approach presented was the concept matrix. Again, chapter 1 was covered. The students were given the basic template with the concepts, categories and characteristics completed by the instructor. The student then added the applications for each characteristic. These were in the student's words to give the concepts personal meaning. The third approach taught was the concept map. Since Visio was not a software tool that most of the students were familiar with, the first concept map was done on paper using colored pencils, if the students wanted to use them. The students were then shown how to take their paper maps and put them into Visio. This was very slow and the students were frustrated many times. On hindsight, using Visio should have waited until the decision was made on what teaching strategy was to be used in each section.

The next action required the students to participate. They had to vote, electronically, on which approach the class wanted to take for the remainder of the semester. After the votes were completed each section decided to use a different approach. Section 6 chose the concept matrices approach (27 out of 36) and section 7 chose adding notes to power point (23 out of 34).

The instructor did lecture differently for each section. For section 7, power point slides were used and keep the instructor on topic. For section 6, initially a concept matrix was used with the concepts, categories, and characteristics given the students. Neither the power point notes nor the concept matrices were collected by the instructor.

Towards the end of the semester the instructor was reading about teaching approaches and that no one approach works for every students. Many researchers are tying teaching approaches to student learning styles (Sutliff & Baldwin, 2001; Wilson & Cole, 1996, BizEd, 2003). Students were asked to go to two web sites and determine their learning styles using the Myers Briggs scale (www.typefocus.com) and the DVC four learning styles (www.metamath.com/lsweb/fourls.htm). The Myers Briggs scale brought back four dimensions, this study only used the introvert or extrovert dimension. The DVC four learning styles looked at visual, auditory, kinesthetic and tactile dimensions.

The pre and post tests were identical. The test was made up of 30 multiple choice questions from the instructors' test bank. The test covered all the material to be covered during the semester. Students were assured that at the beginning of the semester they were not expected to know the answers.

RESULTS

The study looked a many different data items for analysis: the pre-test, post-test, and difference scores, the students' age on May 1, 2003, gender, and the students learning style – introvert or extrovert and visual, auditory, kinesthetic, tactile or balanced. In addition the students' grades on exams and course assignments were input to see if there was a correlation between the teaching approach and individual grades on assignments and exams. The classes began with 36 students in section 6 (matrix) and 34 students in section 7 (ppt). Twenty-one students from section 6 (matrix) completed the pre and post tests, while only sixteen students from section 7 (ppt) completed the pre and post tests. These were the only participants used in the statistical analysis. Twenty-four of the participants were female and thirteen were male. The student ages ranges from 19 to 43. Thirty of the participants were under 28 years old. Ten students were 23 years old.

Using cross tabs and chi-square analysis there was no difference between the sections by gender, age, pre-test, post-test or grade. In addition there was no difference between the sections by learning style for either the DVC four learning style scale or the Myers Briggs scale for introvert or extrovert. And there was no difference between the DVC four learning style scale and the Myers Briggs by gender. Additionally, there was no significant differences between the sections for the grading components or the total points earned. Therefore, we can conclude that the sections were homogeneous.

There was a marginally significant difference in the post-test score by gender. Female students did better than male students (16.7 vs. 14.3). The women's score had a significant improvement between the pre-test and post-test (14.25 to 16.7) whereas the men's score dropped but it was not significant. The women in section 6's (matrix) score improved from 14.4 to 16.5 and the women in section 7's (ppt) score improved from 14 to 17. The score for the pre-test, post-test, and difference is the number answered correctly. For example, 14.4 means that the average was 14.4 questions answered correctly. The men in section 7 (ppt) improved from 15.1 to 16.7. Introverted students tended to have higher pretest scores in section 6 (matrix) than the extroverts ($p = .10$). Introverts earned more points on the pre-test and for the difference score ($p = .10$). In section 6 (matrix) kinesthetic and tactile had marginally higher post-test scores. Auditory, visual,

and those students that were balanced between the four dimensions marginally scored lower on the post-test.

LIMITATIONS

There are several limitations of this exploratory study. The first one is that student grades were not affected by the teaching approach. This could be good from the students and instructors perspective, since this would suggest that instructors can try different teaching approaches and not adversely affect the student's final grade. On the other side, the author felt that this just demonstrated that course assessments are not truly assessing the level of concept mastery by the students. It does not prove that they truly know the material and can build on it in future courses.

The other limitation of the study is the number of participants and the lack of a section using the concept maps. The author has been doing the same approach for several semesters but has not had the luxury of having two sections of the introductory MIS course since the Spring 2003 semester. The students have been allowed to do any of the approaches; however, Visio has not been taught.

Other student comments sent to the instructor from the study group via email acknowledged that trying new teaching approaches is appreciated by some of the students. For example, ED stated "I'm thankful that a teacher would care enough to try something new in the classroom." JD sent "I didn't like the mind maps but I was talking about them to my boss. She has a son with learning problems and she thought this might help him. She asked if you have any references, so she can learn more about mind mapping." And JB commented "I liked the mind maps but maybe it was just the colored pencils. Anyway I wanted to let you know I will be doing these on my own. Can I borrow some of your colored pencils?"

CONCLUSIONS

This is an exploratory study. The author undertook this study for two reasons: to evaluate different teaching approaches and to re-energize the instructor. From the instructor's perspective this really did require a new approach, openness to student decision making and control over the course, and to really look at the introductory management information systems material. The instructor's bad habits showed up and some were caught by the students in the section using the concept matrices. This study did not overwhelming convince the author or other colleagues that changing our teaching approach will improve the students' learning of the material. Then again, it showed that what we do in the classroom may not positively affect the students but it didn't negatively affect them either. About the same number of students from the two introductory sections went on to the next course in the MIS sequence, Database Management, as usually do.

The feedback from students indicated that they were pleased to try something new. No negative comments were sent to the instructor either through email or through the student evaluations. In asking other colleagues, they did not hear negative comments about the experiment. Would the author recommend other instructors try this: YES without reservation. But be aware it is more time consuming and risky for the instructor.

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ENTREPRENEURSHIP, CREATIVE DESTRUCTION, AND TECHNOLOGICAL PROGRESS

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ABSTRACT

The paper examines one of the many channels of endogenous technological progress. Technology growth is usually the result of intentional and costly effort, and a significant amount of new innovation is driven by entrepreneurs who seek to introduce new products and new methods in order to earn profit.

INTRODUCTION

Innovation and the application of new ideas are usually the result of intentional and costly effort. As (Schmookler's, 1966) classic study of innovation in several U.S. industries found that, invariably, inventions and discoveries were the result of profit-seeking behavior rather than independent intellectual inquiry. More recent research has confirmed Smookler's findings; see for example, (OECD, 1997; Thompson, 2001; The World Bank, 2002).

When innovation has direct costs, technological progress becomes more like an investment that requires up-front costs in order to achieve expected future gains. Models that describe the process of innovation must therefore identify the *incentives* that induce people to incur the up-front costs of innovation. This makes models that assume perfect competition particularly awkward; when the costs of production exactly add up to the competitive price of a good, there is nothing left over to cover the up-front costs of research and development activities.

The most popular models of technological progress assume that innovation is driven by entrepreneurs who seek to introduce new products and new methods in order to earn a profit. These models drop the usual assumption of perfect competition and instead assume that innovators gain market power that permits them to charge prices above their marginal production costs. These types of models of innovation under imperfect competition are often referred to as Schumpeterian models, in honor of the twentieth century economist Joseph Schumpeter.

THE CREATIVE DESTRUCTION HYPOTHESIS

The creative destruction hypothesis was initially developed by Joseph Schumpeter (Schumpeter, 1912; Schumpeter, 1934). Schumpeter saw an ever-changing economy in which each innovation sets in motion activities that cause further innovations. He described the capitalist economy as a "perennial gale of creative destruction" in which each firm sought to gain an advantage in the marketplace through innovation. That is, each innovation was pursued because it held the possibility of generating higher profit for the innovating firm. Such *creative* activity also *destroyed* the monopoly power that its competitors had gained by means of their earlier innovations. Each innovator's gain is, therefore, only temporary because the creative innovation of its competitors will, sooner or later, destroy its hard-earned market power. This continual creation and destruction prevents permanent monopolies from developing, and in the process, society enjoys continuous technological progress (Lewer and Van den Berg, 2004).

THE ROLE OF THE ENTREPRENEUR

Central to Schumpeter's process of creative destruction is the entrepreneur, the person who initiates the process of innovation. The entrepreneur is the one who recognizes and grasps the opportunities for introducing a new product. Schumpeter attached great importance to the *social climate* within which the entrepreneur had to operate. If the rate of technological progress of an economy depends on how aggressively entrepreneurs innovate, the incentives and barriers they face are critical to the process of economic growth. Among the critical institutions are society's attitude toward business success, the prestige of business activity, how well the education system prepared potential entrepreneurs, and how much freedom "mavericks" have to pursue their ambitions (Lewer and Van den Berg, 2004).

CONCLUSION

Economists have modeled technological progress in two fundamentally-different ways. The earlier models assumed that technological progress is an unintentional by-product, an externality, of some other activity. Most of the more recent models have recognized that most new knowledge is created by intentionally applying scarce and, therefore costly, resources to innovative activities. After recognizing that it takes costly resources to create knowledge, ideas, and technology, the development of several other useful models of endogenous research and development activity can be created. By modeling technological progress to be the result of intentional efforts to create new ideas, better products, more efficient production processes, etc., policy makers are better advised to focus on how to stimulate such activities.

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OVERVIEW ON HAVING A WEBSITE AND ONLINE SELLING: DATA FROM A NATIONAL SAMPLE OF U.S. SMALL BUSINESS FIRMS

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ABSTRACT

This paper presents a significant part of the picture on the current use of technology and website by small businesses. It utilizes data from a national sample of 752 U.S. small business firms. Previous research studies on this dataset have described the overall usage of the Internet by small firms (Mohan-Neill 2004a), the computer and Internet usage by small business and their correlation with owner's gender and education (Mohan-Neill 2004b). Differences in Internet usage by industry sector have been analyzed and reported (Mohan-Neill 2004c), and an initial analysis of the interaction between owner's gender, industry sector and Internet usage has also been reported (2004d). A more detailed analysis of the correlation between online environmental scanning activity with firm's size, industry sector and firm's sales growth is currently under review for journal publication (Mohan-Neill 2004e). The current paper focuses on the firm's decision to have a website and its use of the website for selling goods and services over the Internet.

McCollum (1998) argued that doing business on the Internet has become a competitive necessity for many small businesses. In virtually all industries, large corporations and government agencies are telling suppliers to trade with them online or risk losing their business (McCollum 1998). Research show that small firms use the Internet for a variety of online business activities (Mohan-Neill 2004a, Mohan-Neill 2004e). Mehling (1998) reported that small businesses were the slowest sector to embrace E-commerce. The purpose of this study to continue building on the big picture of technology and website usage by small businesses, by adding another significant building block, which focuses on the small firm's decision to have or not have a website.

This paper addresses issues concerning the decision to have a website and to conduct online selling activity by firms. It presents an overview of the frequency distribution of websites in small firms, and the frequency of online selling by these firms. It also explores why some firms with a website do not use it to sell goods and services over the Internet, and why firms without websites do not currently have a site. Finally, it explores the expectations of firms without a website, concerning the future development of a website for the business? One cannot over-exaggerate the importance of this area of research. The Internet bubble has burst, and much of the hype is over, but we are nonetheless face with technological change, which have revolutionized the competitive marketplace, and even small businesses cannot ignore the opportunities and threats, which comes with the Internet.

The advantages of a fairly substantial national random sample of small firms can only enhance the quality and significance of the findings. Researchers who have struggled with small convenience samples over the years will have a keen appreciation for this characteristic of the study.

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CHILDCARE IN THE LATE 1990s AND BEYOND

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ABSTRACT

There is no doubt that childcare in this country is less than ideal. There are many tradeoffs and compromises made every day by families that enable both parents to work while maintaining adequate childcare. Childcare appears to be a greater problem than it was 10 years ago. Parents are generally more concerned about the quality of childcare than either the availability or cost. This paper discusses some of the problems of childcare in the late 1990s.

INTRODUCTION

Increasingly, the debate on childcare is about two separate, but equally important, issues. The first issue is a straightforward debate concerning quality of childcare. The second, and more difficult, issue is defining whether it is appropriate to subsidize daycare and not subsidize in- home care by a parent. This is a small part of the overall debate on the suitability of daycare versus in-home care by a parent.

On January 7, 1998, former President Clinton proposed that approximately $20 billion be spent over the next five years on childcare outside of the family home. This would include "$7.5 billion over five years to double the number of children receiving child care subsidies to more than two million by the year 2003. The initiative also increases tax credits for childcare for three million families and provides tax credits to businesses that provide child care services to their employees. To improve early learning, the initiative includes $3 billion over five years to establish an Early Learning Fund that helps local communities improve the quality and safety of childcare for children ages zero to five" (Anonymous, 1999).

LITERATURE REVIEW

A six-year study released by Education Secretary Richard Riley on June 8, 1999 revealed that top-notch childcare can help children do well in school, but children attending low-quality childcare centers have poorer language and math skills. Small wonder that public school students have such disparaging scores. Environmental and socioeconomic factors basically dictate the type of childcare available. A challenge exists to bridge gaps between the types of services delivered to these children and the ideal types of services that will lead to high scores on standardized tests. The education study also suggested that good childcare made the biggest difference in attitudes toward learning for children who were poor or whose mothers were not well-educated.

Morris (1999) argues that most childcare in the U.S. today is mediocre or worse and that this mediocrity is a result of supply and demand conditions in the market for childcare. In a series of studies, it was found that only one in seven centers provides good care and a level of quality that promotes healthy development, and that the quality of childcare increases as the competitive nature of the market increases. High quality centers were usually those with higher adult to child ratios,

better-educated teachers, higher staff wages, more experienced and more involved administrators, and lower staff turnover. The answer: better licensing/evaluation, better training, and bolder accreditation initiatives. Noteworthy statistics include the following:

- Six out of every 10 mothers are in the labor force.
- There are approximately 3 million children (of ~9.1 million) under age six, in female headed households, with the mother in the labor force.
- Approximately one in three preschoolers (of ~11 million preschool children) are cared for in organized childcare facilities.
- Most childcare facilities fail to meet minimum recommended quality standards.
- There are no consistent state childcare regulations.
- Good quality childcare made the most difference for children who were poor or whose mothers were less educated than other children's mothers. [(Specifically, Peisner-Feinberg, study at the University of North Carolina, all others, Facts on Working Women, 2001)]

Ardelt et al. (1995) studied 429 inner city families (African-American and European) relative to parenting and the effects of economic pressure. Both low income and unstable work/income enhance the risk of emotional distress and beliefs of parental effectiveness by increasing economic pressure. These issues are especially true among African-American families, single-parent households, and conflicted marriages because these issues magnify such effects by undermining parent well-being. Compared with Caucasian parents, the sense of parental efficacy of African-American parents is more predictive of child management strategies that both enhance developmental opportunities for children and minimize behavioral risks. Ceballo et al. (1996) and Bryant et al. (1996) imply from their research that African-American single mothers will have better social adjustment and more positive parenting when given supportive and involved child care-giving.

Higher quality childcare for very young children (newborn-3) was consistently related to high levels of cognitive and language development (Anonymous, 1997a). Studies have raised concern about the quality of care:

1. A four state study of quality childcare centers found only one in seven (14%) were rated as good quality (Anonymous, 1995a).
2. The quality of services provided by most centers was rated barely adequate (Anonymous, 1989).
3. Many children living in poverty receive childcare that, at best, does not support their optimal development and, at worst, may compromise their health and safety (Anonymous, 1995b).

WHAT WORKS TO IMPROVE THE QUALITY OF CHILDCARE

Based on the evolving modern family with fewer stay-at-home mothers, there have to be some mechanisms to ensure parents are aware of choosing quality childcare and making good choices to enhance the development of their children. According to the Child Care Bulletin, employers in Lee County, Alabama have taken proactive initiatives to improve the quality of childcare in the area (Anonymous, 1997, March-April). Initiatives include funds for training for childcare centers working towards accreditation. Parent directed initiatives include:

- Brochures, newsletters, and work place seminars on topics such as indicators of quality child care.
- A media campaign of advertising by newspaper, public service announcements, cable television, and billboards.
- Brief videos for use in places where parents may spend time waiting in a lobby, such as in public agencies and medical offices.

- Development of inexpensive placemats with messages about quality childcare for use in family type restaurants.

SUBSIDIZED CHILDCARE/DAYCARE

The main mechanism for the proposal to subsidize childcare/daycare is to increase funding for childcare block grants to states. This will increase the amount of childcare available to the poor. While this is a noble goal, is the intent of the government to provide quality childcare or daycare? In a larger sense, is the government subsidizing, to some extent, out-of-wedlock births and single mothers? Is government doing this by artificially by lowering the cost of daycare while it should be creating tax policy that guide the population toward in-home care by a parent, in a two-parent environment? Assume that a non-family member provides daycare and a family member provides childcare. If more money is made available for the subsidized daycare, thus lowering the cost of daycare, then the incentive is to utilize daycare as the childcare of choice. This also would have the unintended consequence of creating an anti-homecare bias. Indeed, there is already a bias present as the first $5000 of childcare is tax deductible, while the stay-at-home parent not only loses the income, but receives no tax incentive.

At present, there is no government-subsidized incentive for full-time, in-home care by a parent. There are, however, at least two Republican proposals that would give tax cuts of either $500 or $900 per child. These tax cuts could be termed "significant;" however, one could not imagine these small amounts being an incentive to abandon work and become a full-time caregiver.

THE FAMILY MODEL TODAY

The traditional American family model has been, until the last thirty years, one where the father leaves the home to work at a wage-paying job while the mother works inside the home at a non-wage paying job. The mother would care for the children, nurturing and teaching them. As society changed, there came to be societal pressure on women that moved them to seek employment outside of the home. This led to decisions about childcare that usually did not involve care by a family member. "According to the National Center for Education Statistics, in 1995 there were approximately 21 million infants, toddlers, and preschool children under the age of six in the U.S.; more than 12.9 million (61.43%) of these children were in child care" (Anonymous, 1997 September/October). This is not to say that these children are in full-time daycare, but rather that they spend some amount of time in daycare.

The decision about how children will be cared for is a highly personal as well as political problem. If one decides to forego a second income in favor of parental childcare, one must accept a lesser standard of living. This decision would be viewed in light of the assumption that this is a better model. There are, however, a number of problems with this. If both parents are educated and motivated individuals who desire to work and can earn substantial incomes, then one parent will have to make the emotionally charged decision on which equally fulfilling career to abandon. In this scenario, the implicit assumption is the single working spouse can meet all the material needs of the family.

What about the households that are unable to maintain a suitable standard of living from a single working spouse? These families may not have the luxury of one parent providing in- home care. Families that have incomes less than $14,400 who paid for childcare and had children under age 5 spent 25% of their income on childcare (Anonymous, 1997 September-October). This clearly leaves the family under the federal poverty level. This in turn could lead to a decision to no longer work and turn to government subsidies for TANF support. If people choose to abandon self reliance, then this clearly violates the intent of the proposal, which is to aid families so that they may work.

The different incentives that the government is considering are not large enough to make a meaningful difference in the decision concerning childcare/daycare. Any tax credit large enough to be meaningful is impossible because of fiscal considerations. The federal government cannot afford to give a $10,000 or greater subsidy to each family that wants to have in-home care by a parent. The Republican proposals top out at a $900 dollar tax credit, which is probably not enough money to change anyone's mind.

What are the long-range effects of little or no parental guidance? West (1998) cites a book, A Tribe Apart: A Journey into the Heart of American Adolescence by Patricia Hersch, which tells the tale of early adolescence to the mid-teen years in Reston, Virginia. These children had little or no parental supervision. Their parents leave for work in the morning and return at night, seemingly never to insert themselves into their children's lives. The children, emulating their parents to some degree, drift through their hedonistic and amoral lives without being given the boundaries and values to judge right from wrong. These children freely use illegal drugs, participate in criminal activity, and suffer the consequences without any moral compass to guide them (West, 1998).

Obviously, this is not the outcome that is desired when addressing the issues of childcare in the U.S. Ideally, most Americans would like for all children to internalize the mores and values that their parents believe, not what the government would mandate. This learning process will not take place in federal childcare centers, but rather in the family home.

CONCLUSION

Is it possible to legislate this outcome? Probably not. How then does society deal with this issue and produce an acceptable outcome? Parents must take responsibility for the raising of their children. If consumers are able to find daycare that will teach their children in an appropriate manner, then the consumer makes an individual choice as to place their children there. The more likely decision is that the family must make sacrifices. The additional income of one parent may be a casualty of the overriding need to raise children in a way that parents, not the government, deem correct.

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A FURTHER LOOK AT COMPUTER USE BY THE SELF-EMPLOYED IN METROPOLITAN AND NON-METROPOLITAN AREAS

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ABSTRACT

There is little question that computers and the internet are changing the way people in our society conduct business as both suppliers and buyers. While rural businesses may have the most to gain from the new marketplace opened up by communications technology, people in non-metropolitan areas frequently have lower levels of accessibility, which could lead to less use of these tools and place them at a competitive disadvantage. This study builds upon previous research on the topic by analyzing data from the March 2003 Supplement to the Current Population Survey. Respondents' answers to questions regarding computer and internet use were compared by sex and location. Overall, several differences were found between the responses of self-employed metropolitan and non-metropolitan men, while self-employed women in these locations gave similar answers.

INTRODUCTION

The advent of powerful communication technology is changing the competitive landscape. Physical location loses its importance when purchasing and selling over the internet. Through the use of web pages, even the smallest and most remote businesses can reach a global market and compete with larger companies (Haynes, Becherer & Helms, 1998; Hormozi, Harding & Bose, 1998). Considering the limitations of the local market—for both acquiring supplies and marketing to buyers--rural business owners are likely to have the most to gain or lose from the broader world offered by online transactions.

In addition to internet, technology such as word processors, spreadsheets and databases can help businesses in all areas become more efficient and competitive. This is increasingly important for small companies as large discount department stores entering rural areas, as well as non-store shopping options, have created significant competition for small business (Frazier & Niehm, 2004; Hormozi et al., 1998). Those companies that fail to take advantage of these tools are likely to be left behind.

Given the economic disadvantages historically attributed to rural areas, it is important to determine whether self-employed people in non-metropolitan are embracing technology, and possibly bridging the gap, or continuing with their old ways, thus creating even greater disparities. This study examines computer use by metropolitan and non-metropolitan business owners to determine if those in rural areas are keeping up with their non-rural counterparts. Data were obtained from the March 2003 Supplement to the Current Population Survey. Usage patterns by people in different were compared for similarities and differences. After a brief review of the literature on rural businesses, the results of this study are presented and analyzed. According to U.S. Census (2004), the terms rural and non-metropolitan are not exact synonyms, but for the purposes of this study, the words will be used interchangeably.

RURAL ECONOMIES

MacKensie (1992, p. 92) has stated that "rural areas are seen by many as being on the fringe rather than a part of the mainstream of both the economy and society." This is very likely to be true because non-metropolitan areas have historically lagged behind urban areas in their economic development. Lower populations have led not only to smaller markets, but also to decreased chances to obtain capital and support services as well as less-developed electronic and transportation infrastructures (Fendley & Christenson, 1989; Kale, 1989; MacKenzie, 1992; Mueller, 1988; Osborne, 1987; Small Business Administration [SBA], 2001; Tigges & Green, 1994; Trucker & Lockart, 1989).

Electronic infrastructure in rural areas often lags behind that of metropolitan areas. For example, internet access may be restricted to dial-up service. Although dial-up internet access is slow and possibly inconvenient, it allows anyone with a standard telephone to log onto the internet to seek information and post a web site if desired, providing more opportunities for non-metropolitan business owners. Such technology has allowed business owners to reach a broader market than their sparsely populated areas.

The individual small business owner is usually the key decision maker for his or her company, meaning that person is responsible for the adoption of information technology (Raymond & Blili, 1997; Thong, 1999). This person's strategic orientation is likely to be related to the use of information and communications technology as the business owner seeks to develop and improve relationships with business partners and gain a competitive advantage (Raymond & Blili, 1997). With its potential to allow rural business owners to expand their markets and compete better within their local markets, the computers and theinternet are increasingly important to business owners. This study examines this issue by comparing metropolitan and non-metropolitan business owners' responses to questions regarding their use of technology. The following sections present the methodology of this study followed by the results and analysis.

METHODOLOGY AND RESULTS

Date were retrieved from the March 2003 Supplement to the Current Population Survey. Only people who were employed at the time of the survey are included in this study. A total of 2,094 self-employed men were included in study, with 1,568 of them living in metropolitan areas. For self-employed women, 924 of the 1,270 in the study lived in metropolitan areas. Frequencies and percentages of people of different occupations using computers at work for particular tasks using computers are shown in Tables 1 and 2. Results of chi-squared tests are shown for those activities in which there were significant differences (at the p=.05 level) in the proportions of metropolitan and non-metropolitan respondents doing those activities. It should be noted that chi-squared test results refer to metropolitan and non-metropolitan men or metropolitan and non-metropolitan women as these groups' answers were analyzed separately.

Table 1
Frequencies and percentages of self-employed people using computers at work

	Men				Women			
Activity	MSA		Non-MSA		MSA		Non-MSA	
Word processing	1172	74.7%	357	67.9%	741	80.2%	275	79.0%
Chi=9.447 p=.002								
Graphics or design	609	38.8%	195	37.0%	389	42.1%	138	40.0%
Spreadsheets/databases	1093	69.7%	344	65.4%	547	59.2%	207	59.8%
Calendar/scheduling	837	53.4%	238	45.3%	383	41.5%	126	36.4%
Chi=10.429 p=.001								
Email/internet	1343	85.7%	423	80.4%	737	79.8%	264	76.3%
Chi=8.162 p=.004								

Table 2
Frequencies and percentages of self-employed people using the internet

	Men				Women			
	MSA		Non-MSA		MSA		Non-MSA	
Use the internet to search for product information	1325	84.5%	456	86.7%	785	85.0%	297	85.8%
bought a product online within the last year	960	61.2%	306	58.2%	577	62.5%	212	61.3%
using dial-up for internet access	1167	74.4%	459	87.3%	708	76.6%	306	88.4%
Chi=37.356 p=.000					Chi=21.888 p=.000			

ANALYSIS AND CONCLUSIONS

Analysis of these results suggests there are some differences between in the computer and internet use of self-employed men in metropolitan and non-metropolitan areas, but not of women. This suggests that sex is a crucial variable in examining the problem of the digital divide. An important area for future research will be the underlying reasons why self-employed women have similar usage rates regardless of location, but men do not.

The finding that non-metropolitan people were more likely to have only dial-up access was expected given the lower levels of technological infrastructure in rural areas. This could place non-metropolitan businesses at a disadvantage, although these results suggest that self-employed people in rural areas are as likely as their non-rural counterparts to use the internet to buy products online.

One answer to this problem may be to create incentives for communications companies, thereby reducing the higher costs inherent in serving less populated areas. Some politicians have sought to even the playing field by requiring companies to serve rural areas. Several pieces of legislation such as the Broadband Internet Access Act have been introduced to congress in an attempt to encourage communications companies to serve rural or underserved subscribers (Cantos, Fine, Porcelli & Selby, 2001). However, these have yet to be passed.

This study has examined the computer use of self-employed men and women in metropolitan and non-metropolitan locations. Information and communications technology has become an important part of work, as evidenced by the proportions of people who engage in computer-related activities at work. Overall, the differences in usage rates appear to be greatest among men in metropolitan and non-metropolitan areas. Women's usage rates vary less according to geography among the self-employed.

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20th CENTURY ACCOUNTANT AND ECONOMIST: THE PHILOSOPHY OF W.A. PATON

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ABSTRACT

William A. Paton (1898-1991), one of the outstanding financial economists of the 20th century, devised a complex yet easily understood philosophy based on his complete mastery of accounting theory and his broad knowledge and understanding of business and financial matters. The Paton philosophy requires logical and orderly thought. Since Paton is both economist and accountant, his accounting theory sometimes relies on support from his economic theory.

INTRODUCTION

Paton's philosophy, as interpreted by Spacek (1971), is always to build. He regards accounting as a communications system similar to a military communications system, wherein facts of the front line are relayed to persons in the hinterlands so that they may properly judge what is going on and what course of action should be followed. Paton considers accounting as a system to be used in improving man's economy over the forces of nature, such as laziness, bias, and politics, which hinder progress. According to Spacek (1971), "His philosophy was that the truth could overcome all of the negative forces of nature and accomplish in our economy what man has been struggling for ever since his existence." In short, Paton's philosophy is "based on a strong sense of honesty and ethics" (Letter from Leonard Spacek, December 8, 1971).

THE PRACTICAL APPROACH TO ACCOUNTING

Most accountants today consider accounting to be a utilitarian art. Pronouncements of various committees of the American Institute of Certified Public Accountants certainly imply the practical approach. In almost all cases, these pronouncements have not taken a conceptual approach; rather, they have been devised to put out brush fires--to solve immediate problems. According to this approach, theory is largely a rational justification and an explanation of practice. According to Salmonson (1969), the approach is similar to that used by authorities to establish speed limits on various streets and highways after they have observed the speeds at which traffic moves under specified conditions. Such an approach "often leads to the assertion, 'if it is not good practice, it is not good theory'" (p. 2).

The practical approach offers several advantages, especially in view of the fact that the accounting function is valuable to society only if it provides useful information--the primary objective of the practical approach. On the other hand, a major disadvantage of the practical approach is that "a completely unstructured body of propositions results, primarily because it does not require a clear statement of objectives.... The formulation of a theory of accounting without an explicit statement of objectives seems impossible" (Salmonson, 1969, p. 4).

THE PATON APPROACH

Paton's approach combined many ideas. The ethical approach certainly exerted a strong influence on Paton (Letter from Maurice S. Hahn, January 11, 1972), and he always believed that theory must serve the accountant and not enslave him in an unworkable, impractical framework.

Primarily, however, Paton adopted the postulational approach to accounting standards. Although some accountants consider this approach to be a relatively new method, it certainly is not a recent innovation. Deinzer (1965) pointed out that even though a meaning can be denoted by various symbols, and the terms *postulates*, *principles*, *axioms*, and *assumptions* have sometimes been used interchangeably, the term *postulate* as applied to accounting is not new. In Chapter 20 of *Accounting Theory*, Paton used the term *postulates of accounting* to identify what were later referred to as "underlying concepts." He specifically mentioned the concepts of business entity, going concern, stability of the monetary unit, the accrual or attachment of costs, the representative status of the balance sheet for indicating current financial condition, and the notion that assets are independent and equal summations. Paton clearly identified a postulate as an assumption upon which operational procedures and interpretations of significance are based. The postulates were to be accepted tentatively, subject to testing for their suitability as means to "the end in view" (Deinzer, 1965, pp. 108-109). Paton stated in *Accounting Theory*: "few, if any, of the postulates can be completely demonstrated" (Paton, 1922, p. 472).

Paton's postulational approach has been widely accepted in some of the more important areas of accounting. Paul Grady, author of *Accounting Research Study No. 7*, remarked that Paton and Littleton, in *An Introduction to Corporate Accounting Standards*, presented the "first comprehensive exposition of concepts in accounting literature." Published in 1940 by the American Accounting Association, this monograph discussed seven of the basic concepts used in Grady's study. Grady remarked that Paton discussed a "lesser number of concepts... in an accounting textbook written some twenty years earlier" (Grady, 1965, p. 23).

In June 1921, Paton's article entitled "Assumptions of the Accountant" appeared in *Administration* (Paton, 1921). This article, with only slight changes in wording, reappeared as the last chapter of *Accounting Theory*, published in 1922. Essentially, this book constituted a reworking of Paton's doctoral dissertation, which he wrote during 1916 and 1917. Taggart has remarked: "Paton's formal acquaintance with accounting began no earlier than 1912. The acquisition, in less than five years, of the amazing sophistication which characterizes this summarization of the logical basis of the accountant's work is surely Paton's greatest accomplishment" (Taggart, 1964, p. 122).

BASIC ASSUMPTIONS OF THE ACCOUNTANT

Paton's first assumption was that the specific situation constitutes a distinct entity. Paton considered the specific business enterprise to be the unit of organization with which the accountant is chiefly concerned. "Accordingly," he wrote, "it is convenient for the accountant to assume that this enterprise or business situation has a distinct existence, that it constitutes a real institution through which flows a stream of values and in the operation of which several, perhaps many, individuals have a part" (Paton, 1921, p. 788).

Paton's second assumption was that the business entity is continuous--it is a going concern. The going-concern postulate had achieved its greatest recognition in England in the form of statements presented and in the failure to take depreciation in railroads and utilities. George O. May also considered the going-concern concept to be a major postulate and a great influence on accounting procedures. He stated that the base stock method of inventory valuation, which created LIFO, was a natural result of this postulate (May, 1948).

Paton's going-concern concept was largely one of convenience. No one, he said, is in a position to predict with certainty the future of a specific business. The strength of the going-concern

concept was that it was entirely reasonable. Certainly the going-concern is a more nearly normal entity than a seriously embarrassed or insolvent business. The accountant must base accounting principles and procedures on the going-concern concept, because it would be entirely unreasonable to set up conditions of insolvency as a background in determining present values, effective liabilities, etc.

In his third postulate, Paton became more specific and technical. He considered here the assumption that in every business enterprise an equation exists between the total of the properties and the total of the representations of ownership, proprietary and other elements combined; the assumption, in other words, that the total of the assets of every business is equal to the total of the liabilities.

Paton's fourth postulate assumed that a statement of assets and liabilities in dollars and cents is a complete representation of the financial condition of the enterprise on the date of the statement. Paton realized that this assumption could be demonstrated, but it also could well be disproved. The balance sheet, Paton believed, "has very definite limitations under the most favorable circumstances" (Paton, 1921, p. 793). Future costs, earnings, and losses of a business enterprise are largely indeterminate, and yet the realities of the present values do depend on the future for proper validation.

Perhaps the most serious limitation of the balance sheet is the accountant's fifth assumption that the value or significance of the measuring unit, the dollar, remains unchanged.

As mentioned previously, Paton held that this assumption was not sound (Paton, 1921, p. 785). As early as 1920, Paton published articles dealing with the problem of the unstable and untrustworthy index of the balance sheet. Accordingly, Paton recognized that comparisons of unadjusted accounting statements prepared at different periods are always more or less unsatisfactory and can be positively misleading (Paton, 1920a). Other accountants also recognized the limitations of this fifth assumption.

Several of Paton's assumptions concerned the subject of cost and value. The first of these was that "cost gives actual value for purposes of initial statement" (Paton, 1921, p. 796). Paton was of the opinion that this premise was one of the most important underlying technical accounting. The necessity for this assumption was plain. Cost is the only definite fact available when a property is purchased. An entire chapter of *An Introduction to Corporate Accounting Standards* is devoted to this one subject. Chapter three begins with a definition of cost: "Broadly defined, cost is the amount of bargained-price of goods or services received or of securities issued in transactions between independent parties" (Paton & Littleton, 1940, p. 24).

Regarding the validity of the assumption, Paton recognized that there exists no complete and clear-cut physical connection between cost items and product on which the accountant can base his premise. A dollar's worth of gold in a watchcase may be worth intrinsically somewhere near a dollar. But the value of the steel recoverable from even a new automobile would be much less than the value of the materials used by the manufacturer in fabricating the car.

Paton's eighth assumption was that "costs accrue but income appears only in terms of specific transactions, notably the sale" (Paton, 1921, p. 802). The accountant is concerned with determining a proper test for revenue--a proper occasion upon which to recognize the flow of earnings. Paton thought this occurred at a particular time--when cash is collected from the customer, at the point of legal sale, upon completion of production, or the accumulation of costs incurred.

The fact that the depreciation of fixed assets is uniformly continuous is an interesting and important subsidiary assumption which Paton made his ninth assumption. At the time Paton was describing his assumptions, the only widely used method of apportioning depreciation involved the assumption that the values of fixed properties expire continuously and uniformly. The "straight line" method of apportionment was the technical expression for this assumption. Even though the assumption may not now be considered as valid as it once was, some of Paton's discussion still remains valuable. First, asked Paton, should depreciation be assumed to be a function of physical product? That is, shall each item, pound, or other unit of product be charged with so much fixed

asset cost? Evidently, no definite physical connection could be traced on this basis. Yet the assets are acquired because their services are deemed to be necessary in turning out product.

Paton's tenth assumption was that losses extinguish proprietorship in the order of its currency. Thus, expirations are commonly charged first against gross earnings or the otherwise net earnings for the period. In the second place, they are charged against accumulated profits, and they are charged against the accounts showing original investment only as a last resort. In other words, losses are assumed not to have any effect upon original investment until the entire amount of accumulated profit has been absorbed (Paton, 1921). Paton granted that this was pure assumption. In general, the funds of an enterprise are so inextricably merged that no objective of losses to net income earned surplus or investment is feasible. Nevertheless, in view of the very nature of business finance and operation, including the modern emphasis upon continuity, it seems thoroughly reasonable to assume that the capital fund--the amount invested--is residual with respect to absorption of losses. Paton and Littleton felt that the purpose of placing current net in front of earned surplus to take the shock of net losses was less clear, "but the practice can be defended as an accounting standard which checks the tendency of management to report losses by the backdoor route. It thus fosters a clear cut accounting for income" (Paton & Littleton, 1940, p. 104).

Paton's last original assumption was that inventory is always composed of the units most recently acquired (Paton, 1921). He recognized that this assumption was not based on literal fact but could find its justification in sound economics. He pointed out that the Bureau of Internal Revenue endorsed at that time the first-in, first-out method in regard to the buying and selling of securities.

CONCLUSION

Without question, Paton's analysis of the assumptions of the accountant was historic and far ahead of its time. In 1961, Maurice Moonitz, Director of Accounting Research of the American Institute of Certified Public Accountants, published the first accounting research study entitled *The basic postulates of accounting* (Moonitz, 1961). The similarities between these concepts, written 40 years apart, testify to Paton's forward thinking. The concepts of entities, unit of measure, continuity, and stability of unit regarding which Moonitz wrote bear an amazing similarity to Paton's assumptions.

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ESTIMATING PRODUCTIVITY IN LATIN AMERICA: 1970-1980

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ABSTRACT

The purpose of this article is to examine productivity growth for nine Latin American countries during the turbulent period of the 1970's. Using neoclassical growth theory and applying the Malmquist index of (Fare et al., 1994), estimation of productivity growth and its components are identified for each country.

INTRODUCTION

Productivity is defined as the efficiency with which inputs are transformed into output in the production process (Van den Berg, 2001). Despite the fact the "Solow residual" is based on solid economic theory, difficulty remains in estimating and evaluating total factor productivity (Solow, 1957; and Mankiw, Romer, and Weil, 1992).

Contemporary researchers now prefer using non-parametric methods to quantify productivity. Due to its accuracy and ease of estimation, the Malmquist index has now become the most popular way to estimate residuals. It allows for the decomposition of productivity change into efficiency and technology (Fare *et al.*, 1994). This article applies the Malmquist index for the purpose of determining the sources and differences in productivity growth for nine Latin American countries during the lost decade of the 1970's.

THE MALMQUIST PRODUCTIVITY INDEX

The initial theory behind the output-based Malmquist productivity index comes from (Caves *et al.*, 1982) who apply distance functions of output and inputs to capture quantifiable estimates of productivity growth. (Fare *et al.*, 1989; Fare *et al.*, 1992) decompose the Malmquist index of productivity change into two parts: changes in relative efficiency and changes in technology over time. This is shown below,

(1) $M_0 = \Delta E + \Delta T$,

where delta E is the change in efficiency and delta T is the change in technology.

DATA AND RESULTS

This paper is concerned with productivity growth in a sample of nine Latin American countries from 1970-1980. Countries include: Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, and Venezuela. This paper model stems from the neoclassical Cobb-Douglas production function,

(2) $Y = F^t L^{\alpha} K^{1-\alpha}$,

where Y is real gross domestic product (GDP), F is the Solow residual or total factor productivity, L is the labor force, K is the capital stock, and α and $(1-\alpha)$ are the relative income shares of income

going to labor and capital, respectively. The IMF International Financial Statistics 2003 Yearbook is the source for all data.

One of the significant findings from the estimation is that during the years 1972-1973, the two components of the Malmquist move in opposite directions. Efficiency change decreased and technical efficiency rose causing total factor productivity to be slightly higher in 1974. Another significant result from the estimates is that efficiency change tends to be a positive contributor to total factor productivity change in the selected Latin American countries and technical change tends to be a negative contributor. What is the impact of the result? It suggests that the productivity gains due to such things as learning-by-doing, technological diffusion, and other short run adjustments are substantial for these countries. Another meaningful result is the mean of total factor productivity growth (Malmquist index, M_0) is less than one for the eleven year period. Only two countries had a Malmquist index greater than one: Ecuador and Colombia. The other countries found their overall productivity declined away from potential.

CONCLUSION

The purpose of this paper is to estimate productivity growth and its components using the distance based Malmquist index. This non-parametric approach constructs a best practice frontier, and allows for the decomposition of technology into two measures: technical change (the innovation effect) and efficiency change (the catching-up effect). Two significant results were found in this study. Efficiency change tends to be a positive contributor to total factor productivity change, but technical change tends to be a negative contributor for the nine Latin American countries. Also, the mean of total factor productivity growth is less than one for the eleven year period suggesting that the amount of output returned for a given amount of input decreased during the "lost decade." This article points to the lack of overall domestic innovation as a partial explanation as to why the 1970's were a slow growth period for many Latin American countries.

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ON THE EFFECT OF DOMINANT RELIGION ON TRADE

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ABSTRACT

The purpose of this paper is to empirically test the impact of dominant religion on international trade flows. Religion, especially prior to the reformation, has often looked down upon accumulation and commerce. Does this past bias translate into any influence today? Using an extended gravity model of trade for 81 countries in 1998, the results show that countries which have a dominant religion (i.e. at least three-fourths of the native population adhering to one common belief system) trade less with others. Specifically, the results indicate that dominant religion significantly reduces trade by nearly 16 percent.

INTRODUCTION

Economists have only recently begun to focus again on the economics of religion. Religion has not faded after the scientific, industrial, or information revolutions. In fact, there has been a recent resurgence of religion, for example, the rise of Islamic Fundamentalism in Asia and the Middle East, evangelicalism in the United States and Latin America, and orthodoxy in Eastern Europe. (Iannaccone, 1998) finds that 96 percent of Americans believe in "the existence of God" and states that, "Studies of religion promise to enhance economics at several levels: generating information about a neglected area of "nonmarket" behavior...exploring how religion (and, by extension, morals and culture) affect economic attitudes and activities of individuals, groups, and societies" (Iannaccone, p. 1465).

This study focuses on one potential aspect of religion, and that is how it impacts international exchange and commerce. The results indicate that dominant religion is negatively related to the volume of international trade.

THE GRAVITY MODEL SPECIFICATION OF BILATERAL TRADE

To examine the extent in which dominant religion influences trading patterns, one must hold constant all other natural economic determinants. The gravity model has been extensively applied and widely accepted as the preferred systematic framework for measuring "natural" trade patterns based on economic size (i.e. mass) and geographic distance between economies, see, for example, (McCallum, 1995; Frankel and Romer, 1999; Freund, 2000; Frankel and Rose, 2002).

In a standard gravity equation, trade between a pair of countries is a negative function of the distance between the countries and a positive function of their combined GDPs. The underlying "gravitational" relationship is:

$$(1) \qquad TRADE_{ij} = f(GDP_i GDP_j / DIST_{ij}),$$

where TRADE is total value of bilateral trade between countries i and j, GDP is the respective Gross Domestic Product in millions of U.S. dollars, and DIST is straight-line distance (in kilometers) between the economic centers of country i and j. Taking the logs of both sides yields:

$$(2) \qquad trade_{ij} = a_0 + a_1(gdp_i gdp_j) + a_2 dist_{ij} + u_{ij.}$$

Including additional geographically, ethnolinguistic, and economic variables to equation (2) is common in the literature. The baseline equation for this paper is:

(3) $trade_{ij} = a_0 + a_1(gdp_i gdp_j) + a_2(pop_i\ pop_j) + a_3 dist_{ij} + a_4 CONT_{ij} + a_5 LANG_{ij} + a_6 LINK_{ij} + a_7 FTA_{ij} + u_{ij}$,

where $pop_i pop_j$ is the log of the product of the populations in country i and j, CONT, LANG, LINK, and FTA are dummy variables which take the value 1 for pairs of countries which have a contiguous border, common language, common colonial linkage, and common free trade area agreement, respectively.

To estimate the impact of dominant religion on trade, an additional dummy variable (DOM) which takes the value 1 if a country has a belief system where that at least 75% of the population professes to adhere to one of the major religions (i.e. Catholic, Protestant, Orthodox, Muslim, Hindu, Buddhist, Confucius, and Judaism). The model does not differentiate between the world religions, but simply test if a dominant national religion impacts a countries trading volume by itself. The model is:

(4) $trade_{ij} = a_0 + a_1(gdp_i gdp_j) + a_2(pop_i\ pop_j) + a_3 dist_{ij} + a_4 CONT_{ij} + a_5 LANG_{ij} + a_6 LINK_{ij} + a_7 FTA_{ij} + a_8 DOM_{ij} + u_{ij}$,

If dominant religion has a negative effect on trade than the coefficient on DOM should be negative, and vice versa.

ESTIMATION AND FINDINGS

This paper uses the scaled OLS technique of (Eichengreen and Irwin, 1995), which yields similar to results of Tobit while maintaining the double log form. Here the dependent variable is expressed as $\log(1 + trade_{ij})$. The results indicate that geographic distance and economic size matter for bilateral trade across the 81 country sample for the year 1998. For example, the coefficient on distance is -0.655, suggesting that for every 10 percent increase in distance, bilateral trade is reduced by 6.54 percent. Dominant religion (DOM) is found to dampen trade among the 81 countries. The statistically significant coefficient on REL is -0.177, suggesting that, *ceteris paribus*, countries with a dominant religion trade on average 16 percent ($e^{-0.177}-1 = -0.162$) less than those countries without a dominant religion. These results suggest that economies which are secular and/or have diversity in their religious systems will, on average, trade more than those countries with a national or near universal religion. In addition, countries with a dominant religion may be less open to global trade, especially in those countries that do not share the same belief system. Many religious systems have ethical standards against accumulation and avarice. History has shown that religious leaders often detested the merchant traders for selling a good at a much higher price in one place than what it was bought for in another. This historical bias against commerce and trading has been shown to influence current trading patterns (Rauch, 1999; Freund, 2000). Countries which were late in opening up to trade or to a regional trading bloc are having to develop their own "trade routes" today. This takes time, however.

CONCLUSION

At the end of his survey on economics and religion, (Iannacone, 1998) concluded that: "People's religious affiliation or degree of religiosity seems not to influence their attitudes concerning capitalism, socialism, income distribution, private property, free trade, and government regulation" (Iannaccone, p. 1477). The statistical results suggest that dominant religion has predominantly negative institutional effects on international trade. This paper and its results are

only a starting point. Much more research is necessary before the role of religion in the global economy can be completely understood.

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CHINESE CURRENCY: TO APPRECIATE OR NOT TO APPRECIATE-THAT'S THE QUESTION

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ABSTRACT

Over the past few months there has been heated discussion about the issue of China's currency revaluation. There are generally two positions in this currency dispute. American politicians, scholars, and business people, particularly those in manufacturing industry are accusing China of deliberately and severely undervaluing its currency, blaming the low value of the Chinese RMB for US job losses, trade deficits, and other economic problems, and pressing the Chinese government to abandon artificial manipulation of foreign exchange rate system and allow RMB to appreciate. To force China to raise the value of RMB, American government has threatened to inflict trade sanctions against a series of products imported from China, e.g. TV sets, textile products, furniture, etc if RMB's value remains unchanged. It has sought allies from other governments through G-7 meeting and other high-ranking bilateral talks. Japan is the most active in responding to America's call for the revaluation of RMB. Moreover, US Treasury Secretary John Snow visited China in September 2003 specifically to discuss the Chinese currency issues.

The US governmental efforts to press China to appreciate RMB seem to be futile. Chinese politicians, economists, and business people are taking the opposite view. Chinese central governmental officials have reiterated that China would not appreciate RMB in the near future. When Chinese Premier Wen Jiabao visited Washington in late November 2003, he again stressed the need for Chinese currency to maintain its stability. The Chinese currency revaluation issue has sparked international controversy. To appreciate or not to appreciate, that's a big problem.

This paper discusses the pros and cons of appreciating Chinese currency. Governmental stances and views of economists and businessmen both for and against the RMB appreciation are discussed, followed by the analysis of the fundamental motives of American and Japanese government and industrialists for pressing China to revaluate RMB. After that will be a brief discussion and analysis of what should done about RMB's value. This paper concludes that it is not in the interest of China to appreciate RMB at the moment or in the near future. Before China succeeds in systematic structural reforms and its economy gets strong enough to withstand risks of RMB appreciation, it should and will maintain the current RMB-dollar exchange rate.

VERTICAL ACQUISITION AND RETURNS TO ACQUIRING FIRMS: EMPIRICAL RESULTS

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ABSTRACT

This paper discusses the results of a statistical analysis conducted on a sample studying how a firm may acquire or merge with either its supplier or customer. In particular, the paper focuses upon the results of three hypotheses.

INTRODUCTION

As suggested by Morck, Shleifer and Vishny (1990), if a company has been performing poorly compared to its industry average, shareholders may react negatively to the announcement of an acquisition. Managers who have made bad decisions for shareholders in the past may continue to do so. In addition, they may enter an acquisition simply as a way to assure survival of the firm or as an attempt to find a business they might be good at managing (Morck et al., 1990). The results of the three hypotheses are discussed below.

RESULTS OF HYPOTHESES 1 & 2

Hypothesis 1 reads--Ho1: Cumulative abnormal returns five days prior and subsequent to the announcement of a vertical acquisition will not differ significantly from zero.

Table 1 reports the results from testing of this hypothesis. As can be seen from the Z-scores for the average abnormal returns (AAR) and the t-statistics for the cumulative average abnormal returns (CAR), there appears to be no significant reaction during the event period. A visual display of the AARs and CAARs in Figures 1 and 2 also reveal no unusual movement in returns during the event period. All returns tend to fluctuate around zero, as would be expected under *normal* conditions.

When the returns were standardized (SCARs), again no significantly abnormal activity was detected for the event period. The average SCAR was 0.030053, with a Z-score of 0.172--obviously insignificant. Given these statistical results, the above hypothesis cannot be rejected. It appears that when the sample is evaluated as a whole, no significant gains are accumulated by the acquiring firm. Investors are not reacting significantly to the announcement of vertical acquisitions.

One reason significant results are not being seen could be that two potential moderating variables are not being accounted for when the sample is evaluated as a whole. Therefore, the effect of these contingency variables is causing an otherwise significant reaction to be offset. To test for this possibility, Hypotheses 2 and 3 will be examined.

The second hypothesis to be tested involves separating the sample into forward and backward integration. Hypothesis 2 reads--Ho2: Forward or backward acquisitions are associated with insignificant differences in their cumulative abnormal returns five days prior and subsequent to their announcement.

Table 2 gives an initial indication that there may be some differences between returns to acquirers taking part in forward rather than backward integration. Looking at the CARs for forward integration, all are positive with the exception of day 2. On the other hand, the CARs for backward integration indicate negative returns for 10 of the 11 days.

Although only one of the CAARs is significant (day -4 for the forward sub-sample of firms is significant at the 0.10 level), Table 2 does provide some weak support for forward integration providing higher return to bidders than backward integration. The cumulative average abnormal returns are consistently higher for forward integration than for backward integration.

TABLE 1

AVERAGE ABNORMAL RETURNS AND CUMULATIVE AVERAGE OF ENTIRE ABNORMAL RETURNS FOR THE SAMPLE

Event Date	AAR	Z-Score	CAR	t-stat
-5	-0.00068	-0.22821	-0.00068	-0.22821
-4	0.00363	1.21790	0.00295	0.69982
-3	-0.00169	-0.56809	0.00157	0.24341
-2	0.00021	0.06990	0.00126	0.24575
-1	-0.00226	-0.75879	-0.00080	-0.11954
0	-0.00088	-0.29718	-0.00168	-0.23045
1	0.00074	0.24882	-0.00094	-0.119 31
2	-0.00196	-0.65812	-.002903	-0.34428
3	-0.00120	-0.40438	-0.00411	-0.45939
4	0.00467	1.56481	0.00056	0.05902
5	-0.00172	-0.57938	-0.0011701	-0.11842

Average AAR = 0.000007
Standard Error = 0.002981

TABLE 2

CUMULATIVE AVERAGE ABNORMAL RETURNS FOR BACKWARD AND FORWARD INTEGRATION

Event Date	Backward AR	t-stat	Forward CAR	t-stat
-5	-0.00472	-0.98850	0.002913	0.846795
-4	-0.00123	-0.18291	0.007950	1.634077*
-3	-0.00031	-0.03769	0.667248	0.667248
-2	0.002S3	-0.27491	0.002238	0.325364
-1	-0.00008	-0.00792	0.000249	0.032388
0	-0.00238	-0.20421	0.001056	0.125336
1	-0.00056	-0.04480	0.000699	0.076888
2	-0.00349	-0.25888	-0.00017	-0.017910
3	-0.00900	-0.62831	0.00211	0.204030
4	-0.00099	-0.06606	0.00577	0.530676
5	-0.00494	-0.31198	0.006988	0.612509

* Significant at the 0.10 level

A final test of this hypothesis was conducted by analyzing the SCARs for the two groups. Again, the SCARs indicate that forward integration provides a higher return (SCAR equals 0.031; Z = 0.10756) to acquiring firms than does backward integration (SCAR equals 0.0155; Z = 0.0679). However, the difference between the two means was not significant (t = 0.03764). Therefore, Hypothesis 2 cannot be rejected.

The differences in price changes among raw, intermediate, and final goods during the period under study could explain why forward integration provided higher SCARs than did backward. During the period 1962-1971 and again during 1974-1977, the prices of intermediate goods and final goods rose (20 percent for both types of goods during the two separate periods) more than the price of raw materials (18 percent and 15 percent for the two periods), suggesting that forward integration provided increased profit margins over backward integration during these two periods (*Economic Report to the President*, 1991). Since a majority of the acquisitions under study occurred during this time period, this information may help explain why forward integration provided higher abnormal returns to the bidding firm than did backward integration.

It should be noted that although the CAARs for the backward integration group of firms are consistently negative, the average SCAR is positive. Dodd & Warner (1983) warned that this might occur if most cumulative residuals are of a certain sign, but a few outliers of the opposite sign exist.

RESULTS OF HYPOTHESIS 3

Hypotheses 3a and 3b also call for dividing the sample into two sub-samples. These hypotheses test for differences in returns between related and unrelated vertical acquisitions.

Ho3a: Related vertical acquisitions are associated with insignificant cumulative abnormal returns five days prior and subsequent to the announcement.
Ho3b: Unrelated vertical acquisitions are associated with insignificant cumulative abnormal returns five days prior and subsequent to the announcement.

Table 3 shows evidence that Hypothesis 3b should be rejected. In fact, there is evidence that unrelated vertical acquisitions present the bidding firm with higher returns than related acquisitions. Several of the CAARs are significant at the 0.10 level; however, in every case the CAARs for the unrelated sub-sample are positive, while they are negative for the related sub-sample. This provides further support for investors preferring unrelated acquisitions to those that are related.

A review of SCARs for the two sub-samples provides support for unrelated acquisitions providing higher returns than related acquisitions. The average SCAR for the related firms is 0.268 with a Z-score of -1.105. The average SCAR is 0.322 for the unrelated group of firms, with a Z-score of 1.240188. The t-statistic which tests the difference between the mean SCARs for the two groups is 1.574, significant at the 0.10 level. These results are particularly impressive given the small sample sizes.

Because the results of Hypothesis 3 were counter to expectations, further explanation is needed. There have been several other studies which have found that unrelated acquisitions provide higher returns to shareholders than do related acquisitions (Elgers & Clark, 1980; Michel & Snaked, 1984). This paper offers a further explanation for the above findings: prior performance of the acquiring firm.

Shareholders may react more favorably to an acquisition made by a firm that has performed well in the past. Shareholders will have more faith in these managers' decisions because of past success.

In order to test for this possible explanation, 391 competitors were identified using the SIC codes obtained from the CRSP database. A maximum of ten competitors per industry was used in the sample as suggested by Morck, Shleifer and Vishny (1990). Shareholder returns for a three-year period ending on December 31 of the year prior to the acquisition were obtained from CRSP for

both the firms in the sample and their identified competitors. From these returns, a geometric near return was calculated for each firm and for an equally weighted portfolio of industry competitors. The difference between the return for each firm and the return for the portfolio of firms was then calculated.

On average, the unrelated firms had superior performance versus the related firms. Therefore, one reason unrelated vertical acquisitions are associated with higher returns could be that unrelated firms in this sample have performed better than their industry averages in the past. Managers of this group of firms have been successful in strategy formulation and implementation in the past and, therefore, shareholders place more confidence in this group of successful managers, expecting higher future cash flows from the announced acquisition.

TABLE 3
CUMULATIVE AVERAGE ABNORMAL RETURNS FOR RELATED AND UNRELATED ACQUISITIONS

Event Date	Related CAR	t-stat	Unrelated CAR	t-stat
-5	-0.00409	-1.05517	0.003948	0.871273
-4	-0.0 0191	-0.34994	0.009559	1.491383*
-3	-0.00389	-0.58065	0.008255	1.051572
-2	-0.00266	-0.34343	0.007068	0.779771
-1	-0.00754	-0.86977	0.008356	0.824494
0	-0.01040	-1.09534	0.010151	0.914420
1	-0.00864	-0.84286	0.009516	0.793609
2	-0.01288	-1.17470	0.010640	0.830060
3	-0.01532	-1.31707*	0.011107	0.816885
4	-0.00914	-0.74546	0.013716	0.957024

* Significant at the 0.10 level

CONCLUSION

Overall, the results seem to support the fact that moderating variables may be working to offset the reactions investors have to vertical acquisitions. Specifically, there is weak support for the conclusion that returns to bidders improve if the acquisition is forward and unrelated.

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INTERNET USAGE IN THE ACADEMIC ENVIRONMENT: THE TECHNOLOGY ACCEPTANCE MODEL PERSPECTIVE

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ABSTRACT

This study examined the impacts of perceived ease of use (PEOU), perceived usefulness (PU), and perceived Internet content (PIC) on students' usage of the Internet. Additionally, it investigated the impacts of these variables on usage of the Internet as moderated by gender, educational background, income, computer users' classification, and self-reported measure of computer knowledge. We modified the original technology acceptance model (TAM) and created a theoretical model to better understand the hypothesized relationships. To validate the research model, we collected data from 170 students at a regional Midwestern university. The results showed that PEOU and PU, but not PIC, were significant factors in influencing usage of the Internet. Additionally, gender was the only significant moderator. PEOU affected usage of the Internet more strongly for female students than it did for male students.

WILLIAM A. PATON'S CONTRIBUTIONS TO ACCOUNTING EDUCATION

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ABSTRACT

Many early attempts to teach accounting at the university level resulted directly from state C.P.A. laws. Educators who taught in universities and colleges, however, moved ahead of the educational provisions of these laws. The development of a university curriculum in accounting paralleled that of programs in enterprise management and economics, business law and finance, money and credit, statistical methodology, and business and technical writing. William A. Paton's (1889-1991) knowledge of accounting and the University of Michigan's program in accounting developed together. This paper reviews some of Paton's contributions to accounting education.

INTRODUCTION

The development of accounting education was, perhaps, the most important single professional objective in Paton's life. Paton treated his students fairly and courteously and felt an overwhelming sense of responsibility for them. The accounting profession owes its high level of development and its prestige to educators such as Paton and their high aims for advanced education in accounting (Littleton, 1953).

As early as 1920, Paton spoke and wrote regarding the aims and scope of accounting education. In a paper prepared for the fifth annual meeting of the American Association of University Instructors in Accounting, he listed four possible areas of specialized graduate study involving accounting: 1) accounting systems for special branches of industry, 2) corporate finance and the history of a particular enterprise or group of enterprises, 3) statistical research concerning corporate profits and surplus, including costs for different lines, turnover statistics, and the effects of changing price levels on apparent profits, and 4) accounting theory. Paton pointed out a number of areas wherein research on both accounting theory and procedure was weak. As an example, he cited the subject of valuation, an area badly in need of factual study and theoretical research (Paton, 1921).

ACCOUNTING IN THE COLLEGE CURRICULUM

Paton used three criteria to demonstrate the suitability of accounting as a university level subject. They were: 1) Is the subject matter important and of fundamental and general interest? 2) Does the subject matter include knowledge which an individual would not automatically acquire from a lifetime of everyday experience? 3) Is the subject matter sufficiently recondite and difficult to escape understanding from casual conduct? (Paton, 1923, p. 70).

Paton felt that economics and accounting, especially economics, fared well when these tests were applied. On the other hand, Paton, never a starry-eyed dreamer, recognized serious and

legitimate grounds for criticizing university level instruction in business. The weaknesses he mentioned in 1922, as well as in later years, included a lack of good textbooks, an emphasis upon superficial aspects, and a scramble after practical trivialities rather than concentration upon fundamentals.

Henry Rand Hatfield, one of the most distinguished accountants of the early 20th century, was in Paton's audience, and he heard Paton's explanation of the need for further research in accounting and Paton's defense of accounting as a suitable university subject. A year later, in 1923, Hatfield delivered perhaps his most famous address, "An Historical Defense of Bookkeeping" (Hatfield, 1924).

Paton was always favorably inclined toward a professional school of accountancy (Interview with Herbert Taggart, October 20, 1971), and he referred to this belief in suggesting a possible solution to the problem. He believed, as did Paul Grady (Letter from Paul Grady, January 8, 1972), that part of the reason accounting does not enjoy the prestige of a profession such as law, which is fully comparable, is because it did not evolve in terms of "schools of accounting." Paton felt that the prestige of accounting could be enhanced if industrial and public accountants would cooperate in a strong campaign toward achieving this objective. The Paton Center of Accounting at the University of Michigan strives toward achieving Paton's objective. Certainly Michigan seems to be the type of school that Paton visualized as ideal for improving the image of accounting education.

CONTINUING EDUCATION

The educational background of the first accounting practitioners was minimal, to say the least. A 1926 study sponsored by the Institute's committee for placements revealed that 240 persons admitted to membership from 1917 to 1925 had not even graduated from high school, while 278 were high school graduates. Of the 179 college graduates, 57 were from New York University, 12 from Harvard University, 10 from the University of Wisconsin, and the other 100 from other colleges and universities throughout the country. Of those educated outside the U.S., 91 were not high school graduates, 71 had graduated from high school, and 15 were college graduates. According to Carey, "only 22 percent of the members admitted during the ten-year period had a degree from a recognized college" (Carey, 1969, p. 270).

Clearly, a need existed for "catch-up" education for C.P.A.s. The Institute's first venture into continuing education was a refresher course for servicemen returning to the profession after World War II. Thomas W. Leland, a professor of accounting at Texas A & M College, had taken a leave of absence to become the Institute's full-time education director. He was chosen to edit the textbook for the course. Individual portions of the book were written by prominent members of the profession recognized as experts on the various topics (Carey, 1970). Among the contributors to *Contemporary Accounting, a Refresher Course for Public Accountants*, released in 1945, were such well known professionals as George O. May, Eric Kohler, Percival Brundage, Walter Staub, Carman Blough, William Werntz, Hiram Scovill, Maurice Peloubet, Maurice H. Stans, Eric Camman, Marquis Eaton, J. K. Lasser, and William Paton. When the first printing, consisting of 9,600 copies, was almost immediately exhausted, a second printing was undertaken (Carey, 1970).

PATON'S TEACHING

The first accounting courses offered at the University of Michigan were taught in the department of economics. The accounting department evolved slowly, but by 1929, 30 to 40 hours of accounting were offered by five or six instructors. Students did not usually begin concentration in accounting until their second or third year, when elementary courses were offered for accounting majors. Study during the fourth and fifth years was devoted to specialized and professional courses. The MBA degree was awarded after a candidate had successfully completed five years of college work (Paton, 1929).

Paton was always willing to expose his students to opposing points of view. In the classroom he expressed his own views strongly (Interview with Stephen Zeff, November 12, 1971), but he never forced his ideas upon the students. He would usually present the view opposing his own, then follow through with his personal convictions (Interview with Carl Devine, December 10, 1971).

Paton never interjected his strong personal and political philosophy into a course, and even students who held views strongly opposed to his were never ill at ease in his presence. While he has most often been described as a Jeffersonian Democrat, strongly opposed to Roosevelt's New Deal policies, the day following the Truman-Dewey presidential election he confined himself to a single obliquely political remark: "Miserable day, isn't it?" (Interview with William Paton, Jr., December 10, 1971).

PATON'S TEXTBOOKS

A mere cataloging of Paton's books and articles creates amazement that one man could produce so much. The material he wrote or co-authored has "added greatly to the structure of accounting theory" (Letter from Paul Grady, January 8, 1972). His thinking was always interesting and ahead of his time. An example is afforded by *Essentials of Accounting*, published in 1938, which "included many accounting concepts that were quite radical in their day and have generally been accepted by the profession today as being valid" (Letter from Maurice S. Hahn, January 11, 1972).

Although Paton's textbooks have been generally well received and praised by educators and reviewers alike, they are not widely used. Paton's books are not only difficult for both student and teacher, but they also contain material which some persons find objectionable, since Paton sometimes espouses a view that is not generally accepted. As John B. Canning has remarked regarding at least one Paton text, a scrupulous instructor finds it awkward to take exception to a textbook he has required students to buy, regardless of the merits of the book (Canning, 1942). Perhaps this last point accounts for the few uncomplimentary reviews Paton's books have received. Some reviewers have characterized Professor Paton's books as "a trifle tedious" (Yntema, 1925b). Others have suggested that the innocent minds of accounting students should not be exposed to such books as *Principles of Accounting*. "We venture to doubt," said a reviewer in the July 1919 issue of the *Journal of Accountancy*, "if the average college student would get from it such grounding in theory and practice, especially practice, as would enable him to pass the American Institute of Accountants' examination" (Taggart, 1964, p. 20).

PATON'S USE OF CASES

One of Paton's innovative contributions to accounting education was his use of the case method in teaching accounting. Some persons have commented that Paton has not been accorded proper credit for his development of cases (Interview with Carl Devine, December 10, 1971). He developed his cases many years ago and utilized the knowledge gleaned from his years with the war trade board, the federal income tax unit, and his experiences with public utilities. Paton's cases differ somewhat from those used at the Harvard Business School in that he employed cases primarily to prove a point, whereas the cases developed at Harvard provide for a number of alternatives (Interview with Stephen Zeff, November 12, 1971). Paton's cases were actually combined with a problem book and usually issued in a problem and casebook accompanying one of his textbooks (Interview with Paul Garner, November 5, 1971). The cases were similar to a long problem with a hypothetical background. At Harvard, cases are utilized primarily to stimulate discussion between students. Paton, however, spent considerable class time in explaining his cases and their practical implications (Interview with Herbert Miller, December 3, 1971). Certainly many educators have found these cases to be most helpful in introducing students to a problem situation.

CONCLUSION

No doubt can exist that William Paton tremendously enhanced the prestige of Michigan's accounting department. Through his writings, his speeches, his offices in professional societies, and even his testifying before various courts, he brought fame to the university. His students, as well as prominent men of accounting who were attracted to the university because of Paton, contributed to the advancement of the department.

All elements of this situation, however, were not completely favorable. At one time, 11 men held full professorships in accounting at the University of Michigan. Certainly one might question if such a concentration became a little top-heavy. With so many senior professors in the department, it became very difficult for new members of the staff to earn promotions. In fact, it became necessary for someone to retire or leave before younger professors could be promoted. One could also speculate whether other departments in the school of business suffered because the accounting department was so strong and had so many full professors. The situation might have been somewhat altered if the University of Michigan had a professional school of accountancy.

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A REVIEW OF PROFESSOR WILLIAM A. PATON'S ACTIVITIES OUTSIDE OF ACCOUNTING

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ABSTRACT

William A. Paton (1889-1991) was an extraordinary accounting professor and theorist at the University of Michigan for over 50 years. This paper discusses some of Paton's interests outside of accounting. Like most men of wisdom, Paton had a number of other interests, including economics, management, philosophy, and politics.

INTRODUCTION

Paton's second interest was always economics. As a person who was always vitally interested in maintaining a free enterprise system, he took advantage of his special position and knowledge as an accountant to explain the operations of private business enterprises. He battled what he termed economic fallacies and misrepresentations. He maintained that it was particularly important that the accountant, the educator, the manager, and the politician understand the nature of cost records and the relationships, or lack of relationships, between costs, prices, and profits. Paton felt Americans should fear both monopoly and governmental interference, because both can lead to collectivism. Paton thought that the accountant, by explaining the operation of the free enterprise system, could help to check movements toward this undesirable goal (Paton, 1948).

PATON THE ECONOMIST

Paton listed five economic fallacies that he worked to overcome in both his personal and professional life: 1) prosperity can be secured by maintaining a shortage of economic goods, 2) efficiency in output should be restricted in order to create more jobs, 3) economic security can be obtained for all merely by the paying out of government funds, 4) under wartime illusions, people can live on their wartime savings without producing, and 5) a government can continually capitalize deficits (Paton, 1945).

One of Paton's writings in economics was *Shirtsleeve Economics: A Common Sense Survey*, which he wrote to present the "facts of life" regarding economics in everyday, understandable terms and to make truth and accuracy in this field palatable to the average citizen. Paton wrote: "The central proposition of the book is very simple: We can't consume any more than we produce and only through increased production is a higher standard of living possible." Paton thought that this proposition had an important corollary: "We must be everlastingly on our guard to check those influences and developments that tend to limit and discourage production" (Paton, 1952, p. v). Among them is "social legislation," which emphasizes diversion only, without considering what happens to output. Paton thought that "this proposition is almost axiomatic, but it has, nevertheless, been generally neglected in recent years" (Paton, 1952, p. v). In *Shirtsleeve Economics: A Common*

Sense Survey, Paton restated it as a basic consideration throughout all phases of economic inquiry and activity.

In this text, Paton took the stand that private enterprise is responsible for the unprecedentedly high level of productivity and welfare achieved in this country. If we abandon this system it will be impossible for us to maintain our present position, much less improve it. Paton saw an abundance of historical evidence to demonstrate that the alternative to private enterprise--totalitarianism or socialism--is bound to result finally in complete regimentation of the individual and a declining rather than an increasing standard of living (Paton, 1952).

ACCOUNTING AS AN AID TO MANAGEMENT

Paton has always maintained that one of the basic purposes of accounting is to aid management. With this idea in mind, Paton attempted to analyze many common business problems. For instance, he was concerned with the underlying factors and measurements that affect make-or-buy decisions. In 1965, at the request of Senator Philip A. Hart, chairman of the subcommittee on antitrust and monopoly of the committee on the judiciary of the U.S. Senate, Paton presented his views on this controversial subject. In his statement, Paton declared: "The first step in developing an understanding of the make-or-buy problem is to recognize that decision-making in this area is a part of the overall package of management policies and determinations" (Paton, 1966a, p. 7).

The urge for business to grow, to expand operations, is currently widespread. Paton explained: "Growth may be achieved either by 1) increasing the output and sales of the line or lines in which an enterprise is already engaged or by 2) moving into new (or related) fields and thus broaden the scope of operations--that is, by diversifying" (Paton, 1966a, p. 7).

Although Paton maintained that accounting should serve management, he realized that if it is to serve ably, it must be free to serve. In his opinion, the freedom to serve was being obstructed by the development of arbitrary and rigid government rules and controls, and the unreasonable and restrictive conventions and fetishes that have been a millstone around the accountant's neck for years, particularly in the field of public accounting (Paton, 1946).

Paton found especially objectionable the fallacious ideas of management that: 1) some costs are peculiarly under managerial control while other types of cost are entirely outside the pale and hence should not be viewed as true operating costs, 2) some costs are superior to others in economic potency and accountability suppression of resources and premature absorption of costs are desirable practices, and 3) use of hindsight and consequent revision and correction are improper (Paton, 1946). Paton did not believe that accountants performed their full measure in serving management. Accountants have chosen to ignore such matters as price level changes and, thus, have seriously overstated profits. Many managers now have their accountants prepare supplemental statements containing the information management personnel need in reaching decisions. Clearly then, public accountants are not providing all the information management needs. If the accounting profession does not remedy the situation, the credibility and acceptability of accounting statements may well be questioned.

COMMENTS ON STOCK OPTIONS

For years Paton was interested in the subject of proprietors' and managers' salaries and the various phases of capital stock. As early as 1919, Paton began expressing his views in this area, primarily from an accounting viewpoint. In 1963, however, Paton wrote an analysis of stock options, which is of significant interest to businesses and their executives. This written analysis was only incidentally concerned with the accounting aspects of these options. Paton saw the underlying problem in arranging the terms of stock-option grants as "that of ascertaining the proper levels of compensation for the grades of managerial talent represented by the persons to whom such grants are being made" (Paton, 1963, p. 21). No precise market quotations are available for a certain type

of managerial skill or for a specific package of skills represented by a particular person. In the "area of executive functions, there is no bargaining agent in a position to insist on a particular salary scale for all administrators of a major class, regardless of individual differences" (Paton, 1963, p. 22).

Paton's analysis of stock options included techniques for renegotiating plans in the event an executive is retained past the original contract period. In addition, Paton thoroughly evaluated the various reasons why a company wished to utilize stock options. Finally, Paton did not, of course, ignore the accounting aspects of stock options.

POLITICAL INVOLVEMENT

Paton served five years as an elected councilman on the Ann Arbor, Michigan city council. Paton was a member of the council during the Great Depression of the 1930s, and he had a great deal of first-hand experience with relief work. Paton was known to be a staunch Jeffersonian Democrat and was strongly opposed to the New Deal. He firmly believed in people paying their own way and in a society that rewards productivity. Yet as a councilman, Paton recognized the fact that a person was not the master of his own destiny. For many years prior to Paton's joining the council, the city government had encountered no problems of any consequence regarding the poor. [Paton remarked that "the 'poor' commissioner would dole out a few hundred dollars where he thought it would do the most good politically" (Paton, 1952, p. 59).] Help for the needy had been provided on a voluntary basis by individuals and private agencies. When unemployment became widespread, the city government became involved to a considerable degree in relief spending--several hundred thousand dollars of local tax money (a substantial part of the total budget) was expended annually for relief. According to Paton, this situation occurred before the idea developed that state and federal governments should shoulder the burden. He recalled that the city ran a "commissary" and developed rules and machinery for taking care of the local unemployed. Paton hoped that he and the other councilmen accomplished something worthwhile (Paton, 1952).

Paton's tenure as a city councilman did not represent his only interest in politics. He served on numerous committees and commissions for the federal government and for the state of Michigan, and as expert witness for committees of Congress and state commissions. His expert advice was sought by schools, universities, and various branches of state governments (Letter from John Arch White, November 30, 1971).

In his writings, Paton expounded his political philosophy. As early as 1934, he criticized the growing demand for the construction of municipal utility plants. The arguments for public ownership, he declared, were based on false assumptions and data that broke down under careful examination. For example, the assumption that unbridled exploitation constitutes the only alternative to governmental ownership was unwarranted. Rate regulation was relatively successful. Municipal ownership was no mysterious source of superior economic efficiency and service. Government has no monopoly on human talent. Regarding the matter of rates, the fact that taxes take between one-third and one-sixth of the total receipts of privately owned utilities was frequently overlooked (Paton, 1934).

Paton eventually referred to the U.S. as a "disaster area." His justification for referring to the entire country in this way, he remarks:

> *"... is not to be found in regional variations and difficulties nor in aid and handout programs as such. The disaster which has befallen us is the change in attitudes. The decline in willingness to assume responsibility and take the initiative, at individual and family levels; the increasing feeling of helplessness and accompanying eagerness to cast our burdens on the state; the failure to remember--despite the American experience of which the astonishing results are still right before our eyes--that the road to prosperity for all is a climate that encourages the talented, the innovators, and the enterprisers, and thus produces a surge of creative energy and drive that stimulates even the laggards to try to hang on to the fast moving coattails of the hustlers: these are the changes that have brought us to the very brink. And there are few signs on the horizons that we will wake up in time to avoid going over the cliff into full-fledged socialism" (Paton, 1967, pp. 26-27).*

In Paton's opinion, a belief in the superiority of government operation over that of typical private organizations is surely one of the most unjustified of all the familiar delusions from which we are suffering. Experience with the military service alone, said Paton, should be sufficient to cure anybody--even the most gullible--of such a conviction (Paton, 1972).

Paton always admired high-level performance and topflight workmanship in all lines of endeavor, including the lowliest pursuits. Early in his life, he developed guidelines to help him contend with both routine affairs and special problems. Efficiency and equity are the two basic concepts that were most useful to him. He referred to them as his twin E's. In his estimation, efficiency represents production raised to a higher power. In relation to the individual, efficiency refers to both quality and quantity of personal accomplishment. In a broader sense, efficiency means overall utilization of manpower and other resources in a superior manner, with the goal of maximizing the flow of goods from the economic pipeline. Paton was concerned about how conducive the atmosphere of America is to efficiency. He noted that recent trends seem to endanger this greatest of American traits (Paton, 1970).

Paton's second basic guideline, equity, is a more elusive concept, and hence more widely misinterpreted, than the standard of efficiency. Paton related equity to fairness, yet he was careful not to load the concept with sentimentality--turning it into an emotional lodestar. Equity is not softness, said Paton.

CONCLUSION

In summarizing his observations about life in general, Paton remarked:

> *"Two points pertaining to individual conduct may be stressed in conclusion. First, the most satisfying feature of a lifetime on Mother Earth is a sense of accomplishment. This becomes very plain as we grow older. And although most of us never achieve pinnacle performance in anything, it's fun to keep trying. Second, looking back on the journey provides an especially good feeling if one can recall few if at any times when he behaved unfairly. The best way to run the race, for sure, is to rely on one's own power and speed, and not get in the runner's way, in the drive to hit the tape first."*
> *"The E's, like the 'ayes,' still have it" (Paton, 1970, p. 121).*

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A REVIEW AND ANALYSIS OF E-BUSINESS EDUCATION: A LOOK AT U.S. COLLEGES AND UNIVERSITIES

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ABSTRACT

The overall research objectives of this paper were to explore the prevalence of E-business programs in a broad, representative sample of U.S. institutions of higher education, and to provide an overview of E-business education in this sample. It also examines the correlation between industry sponsorship and the location of schools (metro versus non-metro). A stratified sample of 139 schools was drawn from U.S. News and World Report.

GUIDEPOSTS FOR THE DEVELOPMENT OF QUALITY CHILDCARE/DAYCARE

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ABSTRACT

The issue of childcare quality is one facing many American families today. The role of government in solving this problem is the subject of heated debate. How can government aid those families in need while balancing the incentives of labor force participation and in-home parental childcare? The solutions are many and varied, but they leave little to be desired. An increase in funding for government programs improves quality but also encourages increased labor participation of those who might otherwise remain at home to care for their children. If government does not aid deficient pre-school programs, those who have no choice but to work are left with low-quality programs which could possibly harm the future school performance of their children and have a negative impact on future generations.

INTRODUCTION

There is no doubt that childcare in this country is less than ideal. Finding quality daycare, especially for low-income parents and children, is a major dilemma in the U.S. (Jaeger, 2000). Mocan (1995) states that the average daycare is below a level considered "good" by professional educators. Furthermore, there is a link between quality childcare and education in child development (Mocan, 1995). However, this connection leaves out the home situation of the child. According to a study of 100 daycare centers in the spring of 1993, the quality of daycare is tied into child development, and it would cost $0.13 per hour per child to improve the average daycare from mediocre to "good" (Mocan, 1995).

Jaeger (2000) states there is little political or social support for the changes necessary to improve the quality of daycare. This leads to the questions: do low-wage workers have to settle for low-quality childcare? Are working families to expect their children will not develop as fully as their wealthier counterparts? When is government intervention appropriate and necessary? Can the market correct this potentially devastating flaw in our education system? In addition, is it appropriate to subsidize daycare and not subsidize in-home care by a parent? This is a small part of the overall debate about the suitability of daycare versus in-home care by a parent.

STATISTICS

Since 1970, the labor force participation rate of married women with young children has doubled (Michalopoulos, Robins & Garfinkel, 1992). According to Department of Labor statistics, three-fifths of married women with children under the age of six and one-half of married women with children under the age of one are participating in the labor market (Anonymous, 2000). According to a 1992 Department of Commerce study, women in poverty spend 21 percent of their

income on childcare (Mocan, 1995). "According to the National Center for Education Statistics, in 1995 there were approximately 21 million infants, toddlers, and pre-school children under the age of six in the United States; more than 12.9 million of them (61.43 percent) were in childcare" (Anonymous, 1997). This is not to say these children are in full time daycare, but rather that they spend some amount of time in daycare.

TRAINING REQUIREMENTS FOR CAREGIVERS

Training and continuing education are required of daycare workers in most states, but, according to Jaeger (2000), the convenience and timing of training sessions is a problem for workers. To promote a high quality system for childcare provider development, Jaeger (2000) suggests an increase in the visibility and accessibility of professional resources to providers for training purposes.

THE COLLABORATIVE

The Philadelphia Childhood Collaborative is a three-year experiment investigating the benefits of increasing professional resources to providers where they live or work (Jaeger, 2000). To achieve this, the organization used neighborhood resource rooms, training, and traveling teachers to supply childcare providers with the education they needed to fulfill the state-required minimum of six hours of annual continuing education. Approximately 2500 providers in the Philadelphia area used the services, and more than half used the services more than once. Of those surveyed, 60 percent said they benefited from the service. However, over the eight-month evaluation period, the quality of care was unchanged (Jaeger, 2000).

Although this solution helps solve the problem of convenience and time constraints on the providers, it does not solve the problem of lack of quality. Those seeking training to improve their skills will usually be concerned about the quality of care they are providing. It is those providers who do not seek training, but do only what is required of them, who are of the most concern when considering quality of care. The government can do little to regulate emotions, and few programs can change a person's outlook on life. It is only the parents and the owners of the daycare facilities who can prevent the uncaring provider from taking care of children.

SUBSIDIES--THE CLINTON PROPOSAL

On January 7, 1998, President Clinton proposed the allocation of approximately $20 billion over the next five years to childcare outside of the family home. This would include $7.5 billion over five years to double the number of children receiving childcare subsidies to more than two million by the year 2003. The initiative also increased tax credits for childcare for three million families and provides tax credits to businesses which offered childcare services to their employees. To improve early learning, the initiative included $3 billion over five years to establish an Early Learning Fund which would help local communities improve the quality and safety of childcare for children ages zero to five (Anonymous, 2000, Clinton's proposal).

The main mechanism for this proposal is to increase funding for childcare block grants to states. This would increase the amount of childcare available to the poor. While this is a noble goal, is it the intent of the government to provide quality childcare or daycare? In a larger sense, is the government subsidizing, to some extent, out-of-wedlock births and single mothers?

THE OMNIBUS BUDGET RECONCILIATION ACT AND OTHER FEDERAL EDUCATION PROGRAMS

The Omnibus Budget Reconciliation Act of 1990 included a childcare and development bloc grant to states. This bloc grant included $750 million in 1991 increasing to $925 million in 1993, 75 percent of which went directly to subsidize expenditures on childcare for low-income families (Berger, 1992).

Each year, the federal government provides about $4.6 billion for pre-school education and $4.4 billion in bloc grants, such as the Childcare Development Fund. The pre-school education programs for low-income children include Head Start, Even Start, and Title I. The Department of Health and Human Services oversees Head Start and The Department of Education oversees Even Start. Both of these programs focus upon preparing children for primary school. Title I funds, which are traditionally used to support economically disadvantaged elementary and secondary students, often subsidize pre-school programs as well. State governments provide $2 billion annually to support pre-school programs (Shaul, 2000). The associate director for Education, Workforce, and Income Security Issues testified before a Senate committee that the effectiveness of Head Start, Even Start, and Title I programs is unknown because of lack of information (Shaul, 2000).

SUBSIDIES TO PROVIDERS

Berger and Black (1992) studied the effects of Louisville's 4C (Community Coordinated ChildCare) and Kentucky's Title XX Purchase of Care. Both of these programs provide subsidies to daycare facilities (up to $50 per week per child) depending on the income levels of individual families. The parent must work a minimum of 20 hours per week. Berger and Black (1992) found that in both cases, single mothers were more likely to enter the labor force and be more satisfied with childcare when they received these subsidies. Most households cannot pay the true cost of childcare, resulting in low pay for childcare workers (Jaeger, 2000). The low incomes of caregivers and providers causes high turnover in their employment (Chang & Sterne, 2000). There is little to no research available concerning the effects of subsidies on childcare workers as they relate to quality of care, but basic economic theory states that as incomes rise in a profession, there will be an increase in the supply of workers in that profession. With an increase in the supply of willing workers, daycare centers can pick and choose from a larger pool of potential employees and as a result, increase their chances of hiring quality workers.

EFFECTS OF SUBSIDIES

According to Berger and Black (1992), subsidies appear to increase parental satisfaction concerning childcare. Michalopoulos, Robins, and Garfinkel (1992) state that subsidies only help those who use the money to purchase slightly higher quality market care over free care. If more money is made available for subsidized daycare, thus lowering the cost of daycare, then the incentive is to utilize daycare as the childcare of choice. This would have the unintended consequence of creating an anti-home care bias. Indeed, there is already a bias present as the first $5000 of childcare is tax deductible, while the stay-at-home parent not only loses the income, but receives no tax incentive. In contrast, according to Blau (1988), subsidies for childcare do not encourage labor force participation. Blau (1988) notes that in a tight labor market, employer subsidized childcare may entice mothers into the labor force.

PROBLEMS WITH TAX INCENTIVES

The decision about how children will be cared for is a highly personal as well as political problem. If one decides to forego a second income in favor of parental childcare, one must accept a diminished standard of living. This decision would be viewed in light of the assumption that this is the better model. There are, however, a number of problems with this. If both parents are educated and motivated individuals who desire to work and can earn substantial incomes, then one parent will have to make the emotionally charged decision on which equally fulfilling career to abandon. In this scenario, the implicit assumption is that the single working spouse can meet all the material needs of the family.

What about the households which are unable to maintain a suitable standard of living from a single working spouse? These families may not have the luxury of one parent providing in-home care. Families that have incomes less than $14,400, paid for childcare, and had children under the age of five spent 25 percent of their income on childcare (Mocan, 1995). This clearly leaves the family under the federal poverty level. This, in turn, could lead to a decision to no longer work and turn to government subsidies for familiar support. If people choose to abandon self-reliance, this violates the intent of the proposal, which is to aid families so they can work.

CONCLUSION

The availability of alternative forms of childcare affect cost (Chipty, 1995). Where there are many forms of alternative care, the consumer can choose the best and most cost-effective means of childcare. The decision of a woman to work does not automatically mean she is in the market for childcare. Sometimes, friends or family members provide care at little or no cost (Blau, 1988). Not everyone has access to all of the alternatives.

In every culture the family is the primary agent responsible for the care and nurturing of a child. Family background is an important indicator of the success or failure of a child (Willis, 1987). It is difficult to understand why a parent would not do everything possible to ensure that the best interests of the child are protected. These are value judgments, which are impossible to legislate. But people operate from incentives. They will continue behavior for which they are rewarded and refrain from behavior for which they are punished. According to Steuerle (1990), increasing funds to programs like Head Start have better results in improving quality than increases in childcare allowances. The ideal situation is for one parent to stay at home with the children until they are ready to start primary school. Although the government cannot subsidize low-income families for wages lost by staying at home, they can encourage parents to stay at home by expanding tax credits to parental care and not penalizing marriage with the tax code.

Is it possible to legislate this outcome? Probably not. How then are we, as a society, able to deal with this issue and produce an acceptable outcome? Members of society must individually, as parents, take responsibility for the raising of their children.

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ABSENTEEISM AND ACADEMIC PERFORMANCE IN AN INTRODUCTION TO BUSINESS COURSE

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ABSTRACT

The relationship between absenteeism and academic performance was investigated among 172 students enrolled in an Introduction to Business course. The students who were absent from class on the random days attendance was taken performed significantly lower on subsequent tests. In addition, the total number of days absent from class was negatively correlated with performance on a comprehensive final exam. Finally, the number of days absent was found to be the second most important factor after GPA, in predicting student performance on the final exam.

INTRODUCTION

In a traditional university setting, class meetings are the primary means of delivering educational services. However, as almost anyone who has ever taught a large section of an introductory course can confirm, student attendance at these meetings is far from perfect. As educators, we want our students to attend class. We enjoy teaching and interacting with students and work hard to make our classes worthy of the students' time and energy. We know who our best students are because they attend class regularly, but we often have a hard time putting a face to the names of the students that fail. Based on this anecdotal evidence, we assume that students who attend class regularly benefit from the lectures, films, and learning activities designed to facilitate their acquisition of knowledge. Conversely, we assume that excessive absences from class results in poor academic performance. These assumptions, however, are not based on empirical evidence.

To encourage class attendance, we have always spent part of the first class meeting telling our students that it is important for them to attend class, that they will learn more if they attend class, and that students who attend class regularly generally earn higher grades for the course and vice versa. Unfortunately, when we searched the literature for empirical evidence to back up our claims, we failed to find any studies specifically examining the relationship between students' absenteeism during an Introduction to Business course and their subsequent performance on exams. Moreover, studies over the past fifteen years that have examined the relationship between absenteeism and academic achievement in related fields such as economics, finance, and operations management have produced different, sometimes contradictory, results. Several studies have linked class absences with lower grades (e.g., Brocato, 1989; Park & Kerr, 1990; Durden & Ellis, 1995; 2003; Marburger, 2001). In contrast, Browne et al. (1991) found students who studied on their own did just well as on the Test of Understanding College Economics (TUCE) as students that attended a typically structured Microeconomic course and Peters, Kethley & Bullington (2002) found that class attendance did not affect students' exam performance in an introductory operations management course. The research findings on the relationship between mandatory attendance policies and academic achievement are also equivocal. While Chan, Shum, and Wright (1997) found that a mandatory attendance policy did not improve performance in a Principles of Finance course, Lai and

Chan (2000) found it boosted an average student's performance by 6.7% in a Principles of Microeconomics course.

After reviewing the literature, we began to question our assumptions about attendance and academic performance. Like many university professors who teach large, introductory courses, we had no attendance policy. After all, taking attendance in large classes is difficult and time consuming. Moreover, we prefer to treat our students as adults who are responsible for their choices and attending class is one of those choices.

We began to wonder, however, if our laissez faire approach to attendance was actually encouraging students to miss class. Although we told our students on the first day of class that attendance was important, we kept our comments relatively brief and only repeated them after reporting the results of tests. Attendance was sometimes poor, suggesting that many students did not believe our claims about its importance.

Thus, this study set out to answer three important questions as they related to our Introduction to Business course. First, what was the extent of absenteeism? Second, how much, if any, does absenteeism affect student learning? Finally, in light of our research findings as they relate to answering the first two questions, should we make any changes to our course policies to combat absenteeism?

METHOD

The subjects were 172 undergraduate students enrolled in a large section of Introduction to Business at a medium-size, state university located in the upper Midwest. An equal number of men and women were enrolled in the course. A review of university records revealed that 70 students were classified as freshman, 80 as sophomores, 15 as juniors, and 7 as seniors. In terms of their major, forty-five of the students had declared business majors (30 in Business Administration, 6 in Marketing, 5 in Accounting, and 1 each in Economics, Finance, Human Resources Management, and Management Information Systems). Seventy-one students were non-business majors. The three most popular non-business majors for students enrolled in the course were Education (15 students), Mass Communication (13 students) and Nursing (eight students). A further 56 students enrolled in the course had yet to declare a major. Table 1 presents an academic profile of the subjects based on their high school (percentile) rankings, ACT scores, grade point averages (GPA), number of credit hours attempted, number of credit hours completed, and current credit hours (i.e., course load).

The course was taught over a 15-week semester in the spring of 2003. The teaching methods included lectures, video case presentations, and large-class discussions. At the first meeting of the class, the instructor stressed that class attendance was an important component of the educational environment and that students were expected to be present for each class session. It was further explained to the students that attendance would be randomly checked throughout the semester; however, no incentives were offered for class attendance nor were students penalized for not attending class. Thus, while class attendance was monitored, it was neither rewarded nor punished.

The assessment activities in the course included four individual case write-ups (approximately 500 words in length), four tests consisting of 50 multiple-choice questions, and a comprehensive final examination consisting of 100 multiple-choice questions. Each case write-up accounted for five percent of a student's overall grade for the course and students were required to complete a minimum of two case write-ups. Each test accounted for 10 percent of a student's overall grade for the course and students were required to sit a minimum of three tests. For students exceeding the minimum assessment requirements, only the scores greater than their final exam score were included in the calculation of their overall grade for the course. Thus, the final exam was weighted at 40-60 percent of a student's overall grade for the course.

All the questions on the tests and final exam came directly from a test bank written by the authors of the textbook, which was required reading for the course. Thus, a student who had never

attended class and relied exclusively on the textbook to prepare for the tests could have answered all the questions correctly.

Using an unannounced random schedule, class attendance was recorded at four points during the semester, once prior to each test. On the days attendance was taken, a sign-up sheet was circulated on which students were required to print their name and student number as well as sign their name. A head count was also taken to insure that no one signed in for a student who was absent.

RESULTS

Of the 172 students who enrolled in the course, 21 withdrew and three did not sit the final exam, yielding an overall retention rate of 86.05 percent. The overall class average for the course was 76.51 percent, with a high of 94.85 percent, a low of 31.50 percent, and a standard deviation of 10.88. The distribution of grades was as follows: A – 11 (7%); B – 57 (39%); C – 45 (30%); D – 20 (14%); F – 14 (11%). The overall pass rate for the course was 89.86 percent.

Table 2 presents the absenteeism rates recorded on the four random days that class attendance was taken. The percentage of the students absent on the days attendance was taken ranged from a high of 35.98 percent to a low of 30.60 percent, with an overall weighted average of 32.49 percent. However, class attendance did improve as the semester went on. Table 1 also presents the absenteeism rates by gender, which shows that male students where far more likely than female students to be absent from class.

Students' scores on Tests 1-4 were classified into two groups based on whether they were present in class the unannounced random day attendance was taken prior to each test. We used *t*-tests to test for the differences in the mean test scores for those students present and absent. The results of these *t* tests are presented in Table 3. Clearly, the students present in class outperformed the students absent from class on each test. An examination of the range of scores also reveals that no students who were absent from class on the random day attendance was taken scored 90 percent or above (the cutoff for a grade of A) on the subsequent test. Thus, class attendance appears to be a necessary condition for scoring an A on a test in this course. Furthermore, a student's total number of absences was negatively correlated with his or her final exam score ($r = -.47$, $p<.0001$).

To assess the impact of absenteeism relative to other factors that may explain a student's final exam performance, we developed a regression model that incorporated the following factors: High School Rank, ACT score, GPA, Credit Hours Attempted, Credit Hours Earned, Current Credit Hours, Case Count, Test Count, Gender, Absent Overall and Major (Business versus non-business). Unfortunately, the student records accessed for this study had 25 missing values for high school rank and 15 missing values for ACT score, so missing values for these variables were inputted using regression on each other along with GPA. The initial regression model parameter estimates are presented in Table 4. A cursory look at Table 4 suggests that GPA, number of absences, ACT, and high school rank are the significant explanatory variables.

Using stepwise model selection methods, we arrived at the following parsimonious model predicting final exam performance.

E(Final Exam | GPA, ACT, H.S. Rank, Absent Count) =

46.24 + 9.85*(GPA) + .744*(ACT) - .104*(H.S. Rank) – 1.85*(Absent Count)

(<.0001) (.0018) (.0116) (.0014)

N = 148 R^2 = .614 adj-R^2 = .603 (p-values in parentheses)

Here we can see that a student's GPA, Absent Count, ACT score, and High School Rank explain 61.4 percent of the variation in their final exam score. The partial correlations of the covariates are presented in Table 5. These partial correlations indicate that the number of days absent from class is the second most important factor after GPA in predicting student performance on the final exam.

DISCUSSION

In this study, we set out to answer three questions with regard to our Introduction to Business course: What was the extent of absenteeism? How much, if any, does absenteeism affect student learning? And considering the answers to the first two questions, should we make any changes to our course policies to combat absenteeism?

Concerning the first question, on a typical class day roughly one-third of the students enrolled in the course were not in class. This figure is comparable to the rate of absenteeism reported by Romer (1993) in economics courses and leads to the same conclusion – "absenteeism is rampant" (p 173). In regard to the second question, we found a very strong statistical relationship between absenteeism and academic performance. Specifically, the students who were absent from class on the random days attendance was taken performed significantly lower on subsequent tests. In addition, the total number of days absent from class was negatively correlated with student performance on the comprehensive final exam. Finally, after GPA, the number of days absent was the second most important factor in predicting student performance on the final exam.

Faced with similar research findings regarding the relationship between absenteeism and academic performance, Romer (1993) suggested experimenting with making class attendance mandatory. We caution against such an approach. Mandatory attendance policies, which impose an academic penalty for failure to attend class regularly, may have some unintended consequences. For example, the quality of classroom decorum may decline, due to the presence of resentful and disinterested students. As Stephenson (1994) notes, "a captive audience is not an ideal learning environment" (p.307).

Approaching the problem of student absenteeism from an organizational behavior modification perspective (Luthans & Kreitner, 1985), we offer the following suggestions based on a functional analysis of the antecedents and consequences of the desired behavior – class attendance:

1. To establish the proper antecedents, at the first class meeting students should be informed of the empirical relationship between class attendance and academic performance.
2. Applying the business axiom, "What gets measured gets done," we recommend instructors take attendance at the beginning of every class session. Fortunately, there are a of variety interactive student response systems on the market today (e.g., EduCue, eInstruction, and TurningPoint) that make the task of taking attendance, even in large classes, a relatively quick and simple exercise.
3. Instructors should consider awarding bonus points for class attendance to positively reinforce the desired behavior. Beaulieu (1985), for example, found attendance rates of students enrolled in a sophomore-level, undergraduate management course were higher for those experiencing positive consequences versus those experiencing negative consequences, although the difference was not statistically significant.
4. Instructors may also want to consider giving short quizzes at the end of every class session. Again, this is relatively easy to accomplish with an interactive student response system. Such in-class assessments serve to reinforce the day's lesson as well as class attendance. To eliminate the element of compulsion, alternative homework assignments should be made available for students needing to make up any quizzes they missed due to an absence. .

5. Finally, we recommend instructors maintain records on class attendance and provide feedback to students on their behavior. For example, when reporting test results, also report correlation between attendance and test performance to reinforce the message that students who attend class regularly generally perform better on tests than those who do not.

Tables and references are available upon request.

AN EXAMINATION OF THE EFFECT OF A CODE OF CONDUCT ON BUSINESS STUDENTS' PERSPECTIVES REGARDING ACADEMIC FRAUD

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ABSTRACT

The purpose of this study is to examine the ethics education program of a military academy for potential enhancement of accounting ethics programs. The military academy emphasizes the core values of its honor code that are similar to the American Institute of Certified Public Accountants' (AICPA) Code of Professional Conduct. Using a survey describing two situations of academic fraud, the ethical perceptions of business students at the military academy are compared to those of accounting students at a control university to determine if there are any measurable differences attributable to the academy's ethics program.

This study found that military academy students were significantly more likely than the control group to perceive academic behavior as unethical when it directly violated their core values, but were not more likely to perceive academic behavior as unethical when it did not violate their core values. These results indicate that the ethics education program at the military academy may have been useful in aligning students' ethical perceptions with their code of conduct. This implies that ethics education in accounting programs may want to emulate aspects of the academy's ethics program, most notably emphasizing the accounting profession's code of conduct to accounting students.

Academy of Family Business

COLLEGE EDUCATION FUNDING: MAXIMIZING FAMILY TAX SAVINGS AND FINANCIAL AID

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ABSTRACT

For 2003-2004, the average college tuition rose to $19,170 at a four-year private school (up 6six percent from last year), $4,694 at four-year public institutions (up 14.1 percent from last year), and $1,905 at two-year schools (up 13.8 percent from last year). With the average cost of a college education at public and private institutions estimated to rise to $60,000 and $200,000, respectively, by the year 2007, the need for financial planning for college is more critical than ever.

While changes and additions to the Internal Revenue Code have fulfilled Congress' intention to "maximize tax benefits for education and provide greater choices for taxpayers in determining which tax benefits are most appropriate for them" (H.R. Conference Report), "the mere number and perplexing intricacies of these benefits make it extremely difficult for taxpayers to choose and interpret the ideal option" (June 2004 testimony of former IRS Commissioner Fred Goldberg). Regulations issued in 2003 and 2004 have clarified some issues in the education credit and student loan deduction areas and action by Congress on the reauthorization of the Higher Education Act of 1965 is expected to answer questions about the treatment of qualified tuition plans. However, the interaction of the various education incentives such as qualified tuition plans, Coverdell education savings accounts, and the Hope and Lifetime Learning credits continues to make planning to maximize tax benefits an extremely complex undertaking.

Further complicating the overall planning process is the impact of various funding alternatives and tax incentives on eligibility for federal financial aid. Last year a record $90 billion in financial aid, an increase of more than 11.5 percent from the prior year, was awarded to students at both private (75 percent of the students) and public institutions (60 percent of the students) institutions. For 2004, $105 billion is expected to be awarded. Thus, a basic understanding of the financial aid process is an essential component to effective planning for the college years. All of the pieces of this complex puzzle will be explored in the paragraphs that follow.

SOUTH PARKWAY EAST KIDDIE LEARNING CENTERS: AN OVERVIEW OF THE TRAINING AND DEVELOPMENT OF PERSONNEL

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ABSTRACT

An explicit 1997 law established the Work Incentive Program that mandated TANF (Temporary Assistance for Needy Families) receiptor mothers participate in job training or work programs and created enormous problems for TANF mothers. Although almost all research indicates the social and environmental necessity of offering quality childcare to this sector, the movement toward the training and development of quality programs has been slow and tedious. The South Parkway East Kiddie Learning Centers, a privately held corporation, provides innovative and unique services for the preschool and after-school child, offering those mothers needing to participate in job training or work programs the opportunity to do so. Training and development of personnel is of utmost importance when dealing with children in their formative years. This paper comments on The South Parkway East Kiddie Learning Centers' training and development program.

INTRODUCTION

It is a known fact that several million children enter preschool levels throughout the United States each year, and a large proportion of them are children of the inner city and/or minorities. Quality daycare/childcare or preschool systems are being developed and implemented in order to ease this transition. Three goals should be kept in mind for this development and implementation:

- All children should have access to high quality and developmentally appropriate preschool programs that will help prepare them for school.
- Every parent, regardless of the constraints on them, should participate in this effort.
- Children should receive the nutrition, physical activity experiences, and health care needed to arrive at schools with healthy minds and bodies, and to maintain the mental alertness necessary to be prepared to learn (Anonymous, 1998).

In order to get a better understanding of the interrelationships of the childcare system in general and inner city issues in Memphis in particular, the authors met with Reginald Peyton, founder of The Peyton Company and owner/operator of The South Parkway East Kiddie Learning Centers, on February 8th 2002 in order to discuss the Centers' training and development process. Four areas of concern were discussed: childcare quality, curriculum, nutrition, and safety. Peyton believes that good quality daycare can make the most difference for children who are poor or whose mothers are less educated than other children's mothers. According to Peyton, training and

development is paramount for personnel in providing good quality daycare/childcare; an investment in children is an investment in our future.

ORGANIZATION

Peyton and his training director deliver training to five teachers and their assistants. Neither was familiar with any particular textbook theory; however, both are highly educated and skilled trainers/educators familiar with training techniques and the importance of education in training. It is evident that good training programs tend to improve child daycare quality. With the advent of the Federal Childcare and Development Block Grants in 1991, states have implemented initiatives that range from loans to childcare programs to large-scale training systems, to promote program quality in the childcare system (Peyton, 2002). Allowable projects are in five areas: resources and referral activities, training, licensing improvement, staff salaries, and child daycare loans. Many states have used this funding to establish and implement training systems (Morgan et al. 1993). Fiene (1995) argues that the implementation of Childcare and Early Childhood Development training systems within the state of Pennsylvania from 1991 to 1995 improved the quality practices in daycare facilities and that this practice could be transferred to other state systems. Focus groups were used to establish feedback from trainees, providers, agencies, and trainers on improving the state's existing system in order to achieve their goal of a seamless early childcare and educational professional development system by establishing one statewide training contractor where previously there were eight; thus, training has been shown to dramatically improve quality in daycare/childcare delivery (Fiene, 1995).

The South Parkway East Kiddie Learning Centers were founded in 1996, focusing on developing children academically, instilling strong character, building self-esteem, and teaching self-respect for others. Teachers come to the Centers already trained in early childhood education theory; the Centers' training is practical in its application.

OTHER FEDERAL EDUCATION PROGRAMS

Each year, the federal government provides about $4.6 billion dollars for preschool education and $4.4 billion dollars in block grants, such as the Childcare Development Fund. The preschool education programs for low-income children include Head Start, Even Start, and Title I. The Department of Health and Human Services oversees Head Start. The Department of Education oversees Even Start. Both of these programs focus upon preparing children for primary school. Title I funds, which are traditionally used to support economically disadvantaged elementary and secondary students, are often used to subsidize preschool programs. State governments provide $2 billion dollars annually to support preschool programs. The overall effectiveness of Head Start, Even Start, and Title I programs is unknown because of a lack of data.

SUBSIDIES

According to Berger & Black (1992), subsidies appear to increase parental satisfaction concerning childcare. Oftentimes, subsidies only help those who use the money to purchase slightly higher-quality market care over free care. If the money is made available for subsidized daycare--thus lowering the cost of daycare--then the incentive is to utilize daycare as the childcare of choice. This would have the secondary effect of creating an anti-home care bias. Indeed, there is already a bias present as the first $5000 dollars of public childcare is tax deductible, while the stay-at-home parent not only loses the income, but receives no tax incentives. In contrast, according to Blau & Robins (1988), subsidies for childcare do not encourage labor force participation.

CONTINUITY

According to Peyton, training is an on-going affair, due to the anticipation of turnover. Frequent teacher turnover has a dramatic effect on children's development skills. Essa (1999) found a strong correlation between continuity--a three-year span of same caregiver interaction in a childcare environment--and higher developmental skills. Morris (1999) argues that most childcare in the United States today is mediocre or worse and that this mediocrity is a result of supply and demand. In a series of studies, it was found that only one in seven centers provided good care, defined as a level of quality that promotes healthy development. In addition, research indicates that the quality of childcare increases as the competitive nature of the market increases. High quality centers were usually those with higher adult to child ratios, better- educated teachers, and higher staff wages, among other items. What is the answer? Peyton states that better licensing/evaluation, constant training of the best teachers, and stronger accreditation initiatives could be the answer.

Gormley (1999) argues that the only answer to the quality dilemma is federal and state intervention in the form of shared regulatory standard setting. He further argues that quality, affordability, and availability go hand-in-hand and regulation must take these attributes into account. Peyton agrees that the costs for the attainment are high; thus his standards for training and wages offered are higher than those of surrounding daycare businesses in Memphis. Morris (1999) indicates that many of the data show that the cost of mediocre childcare is much higher in more critical areas, such as child development. The overriding value of the studies discussed in Morris' article seems to indicate that both providers and parents need more information about how to produce and identify quality in childcare.

CURRICULUM

Dodge (1995) argues that achieving quality childcare systems demands a thorough evaluation and implementation of well-thought-out and planned childcare curriculum. Quality programs are based on an understanding of child development, and on a recognition that each child is an individual with unique needs, interests, and learning styles. At Peyton's centers, children's safety and health are of paramount importance and are never compromised. The physical environment of quality programs is well organized and filled with a variety of age-appropriate and culturally relevant materials. In reference to quality programs, relationships between staff members at the Centers and families are positive and supportive, and the staff receives ongoing training and support. Some of the highest-priority curriculum needs for a quality program are social competence, emotional growth, cognitive challenge, and physical development (Peyton, 2002). Four caveats for training quality childcare-learner teachers were discussed during the interview:

1. Citing Maslow (1955). Children must feel safe and secure and have their physical needs met in order to learn.
2. Citing Piaget (1952). Children construct knowledge. Learning is making connections, applying what one has learned and experienced to a new situation, and constructing meanings that may or may not be "correct."
3. Citing Peyton (2002). Children learn through social interaction. Learning for children is a social event.
4. Citing Peyton (2002). Children learn through play. Real learning is "play learning."

NUTRITION

Levy and Cooper (1999) show extensive research that indicates that young children with full and entertaining nutrition education programs exhibit better eating habits. At The South Parkway East Kiddie Learning Centers, preschool teachers receive extensive training in nutrition and are

certified by the state. Peyton states that preschool children are an excellent audience due to their readiness to learn and potential for change. Their natural curiosity in food and their bodies can lead to the formulation of lifelong good eating habits, preferences, and attitudes. Teaching young children to eat five or more servings of fruits and vegetables a day will help to establish healthy eating/nutrition for a lifetime (Peyton, 2002). Mendez et el. (1999) argue that their data indicate that poor nutrition in the early developmental years has an adverse affect on cognitive development.

SAFETY

As discussed in the previous sections, the director and/or the administrator can deal with most of the safety concerns for child daycare with an aggressive training/evaluation plan. Facilities should be aggressively monitored for standards by governmental agencies at all levels. The majority of studies reviewed for this paper indicate that it is sometimes not the hazards that cause the problems. Some of the safety concerns uncovered by the studies show that clothing, playground surfacing/maintenance, window blinds, soft bedding, no safety gates, and faulty cribs/toys are common safety hazards in daycare centers. (See www.cpsc.gov for elaboration on the safety issues for daycare centers.)

CONCLUSIONS

For all intensive purposes, The South Parkway East Kiddie Learning Centers appear to be the state of the art in both their training of teachers and the delivery of childcare. Peyton offered a few fundamental training actions that can be taken to enhance the competitive aspects of childcare:

- Have some conversations with your target audience; they have training wants and needs. Ask them if they know what the organization has to offer.
- By targeting training needs, you will enhance delivery of quality programs.
- Be aware of changes in the political/social-training environment and adjust the program accordingly.
- Enhance your programs, test them, evaluate them, and continue to do better (Peyton, 2002).

Obviously, training for quality childcare/daycare involves the melding of several major constituents in the system. When these constituents are in balance, highly competitive quality daycare can be delivered. Although difficult, future research should be undertaken to examine the effects of these variables in a more formal research context.

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THE TREND TOWARD CHILD PROVIDER CARE IN THE 21st CENTURY

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ABSTRACT

This paper discusses the trend toward child provider care in place of stay-at-home mothers. This trend presents a challenge in areas of certain learning and social skill development. To this end, effective quality childcare and preschool systems must be developed and implemented.

INTRODUCTION

According to the National Center for Education Statistics, in 1995 there were about 21 million infants, toddlers, and preschool children under the age of six in the U.S., and more than 12.9 million of these children were in childcare. Furthermore, 45 percent of children under age one were in childcare on a regular basis. Providing creative, stimulating, and progressive learning environments is the challenge facing society. Quality pre-school care is a major dilemma facing the American family. Table 1 provides information about the care of young children.

Table 1
Primary Child Care Arrangements Used by Families with Employed Mothers for Preschoolers: 1993*

Type of Care	Percentage
Mother	6 %
Father	16%
Others	1%
Grandparents	17%
Other Relatives	9%
Family Child Care (non-relatives)	21%
Centers	30%

These statistics point to the high occurrence of children in more institutionalized childcare provider settings (Anonymous, 1996). The figures for center-based childcare have increased due to the welfare to work initiative. It is also a known fact that about four million children enter kindergarten throughout the U.S. each year, and a large proportion of them are children of the inner city and/or minorities.

According to the Annie E. Casey Foundation in the Model Programs and Policies, the single most overriding concern for parents as they search for childcare is safety. Many parents simply assume that all childcare programs are regulated and that basic safeguards and quality standards will protect their children from harm. According to this same article, legally there are approximately 40 percent of early care and education programs that are exempt from state regulations.

Under the direction of the Child Care and Development Fund, states are encouraged to provide to families served with state supported subsidies a single integrated childcare system. To this end, many states have engaged in the development of initiatives to address childcare needs of families served. At the local level, communities need accurate information on which to base their efforts. According to the Child Care Bulletin, communities should develop responses to childcare needs of the local communities served (Anonymous, 1997, January/February).
Three goals should be kept in mind for this development and implementation of higher quality childcare programs (see Anonymous, 1998):

- All children should have access to high quality and developmentally appropriate preschool programs that will help prepare them for school.
- Every parent, regardless of the constraints on them, should participate in this effort.
- Children should receive the nutrition, physical activity experiences, and health care needed to arrive at schools with healthy minds and bodies, and to maintain the mental alertness necessary to be prepared to learn.

LITERATURE REVIEW

A six-year study released by Education Secretary Richard Riley on June 8,1999 revealed that top notch childcare can help children do well in school, but children attending low-quality childcare centers have poorer language and math skills. Small wonder that public school students have such disparaging scores. Environmental and socioeconomic factors basically dictate the type of childcare available. A challenge exists to bridge gaps in the types of services delivered to these children and the ideal types of services that will lead to high scores on standardized tests. This study also suggested that good childcare made the biggest difference for children who were poor, or whose mothers were not well-educated.

Morris (1999) argues that most childcare in the U.S. today is mediocre or worse and that this mediocrity is a result of supply and demand conditions in the market for childcare. In a series of studies, it was found that only one in seven centers provided good care and a level of quality that promotes healthy development, and that the quality of childcare increases as the competitive nature of the market increases. High quality centers were usually those with higher adult to child ratios, better-educated teachers, higher staff wages, more experienced and more involved administrators, and lower staff turnover. The answer--better licensing/evaluation, better training, and bolder accreditation initiatives. Noteworthy statistics include the following:

1. Six out of every 10 mothers are in the labor force.
2. There are approximately 3 million children (of ~9.1 million) under age six, in female headed households, with the mother in the labor force.
3. Approximately one in three (30%) preschoolers (of ~11 million preschool children) are cared for in organized childcare facilities.
4. Most childcare facilities fail to meet minimum recommended quality standards.
5. There are no consistent state childcare regulations.
6. Good quality childcare made the most difference for children who were poor or whose mothers were less educated than other children's mothers. [(Specifically, Peisner-Feinberg, study at the University of North Carolina, all others, Facts on Working Women, 2001)]

Ardelt et al. (1995) studied 429 inner city families (African-American and European) relative to parenting and the effects of economic pressure. Both low income and unstable work/income enhance the risk of emotional distress and beliefs of parental effectiveness by increasing economic pressure. These issues are especially true among African-American families, single-parent households, and conflicted marriages because these issues magnify such effects by undermining

parent well-being. Compared with Caucasian parents, the sense of parental efficacy of African-American parents is more predictive of child management strategies that enhance developmental opportunities for children and minimize behavioral risks. Ceballo et al. (1996) and Bryant et al. (1996) imply from their research that African-American single mothers will have better social adjustment and more positive parenting when given supportive and involved child care-giving.

Higher quality childcare for very young children (newborn-3) was consistently related to high levels of cognitive and language development (Anonymous, 1997b). Studies have raised concern about the quality of care:

- A four state study of quality childcare centers found only one in seven (14%) were rated as good quality (Anonymous, 1995).
- The quality of services provided by most centers was rated barely adequate (Anonymous, 1989).
- Many children living in poverty receive child care that, at best, does not support their optimal development and, at worst, may compromise their health and safety (Anonymous, 1995b).

WHAT WORKS TO IMPROVE THE QUALITY OF CHILDCARE

Based on the evolving modern family with fewer stay-at-home mothers, there has to be some mechanisms to insure parents are aware of choosing quality childcare and making good choices to enhance the development of their children. According to the Child Care Bulletin, employers in Lee County, Alabama have taken proactive initiatives to improve the quality of childcare in the area (Anonymous, 1997, March-April). Initiatives include funds for training for childcare centers working towards accreditation. Parent directed initiatives include:

- Brochures, newsletters, and work place seminars on topics such as indicators of quality child care.
- A media campaign of advertising by newspaper, public service announcements, cable television and billboards.
- Brief videos for use in places where parents may spend time waiting in a lobby, such as in public agencies and medical offices.
- Development of inexpensive placemats with messages about quality childcare for use in family type restaurants.

A few facts concerning the quality childcare environment that can be goals for development into childcare cultures:

- Children who receive warm and sensitive caregiving are more likely to trust caregivers, to enter school ready and eager to learn and to get along well with other children. To ensure that childcare settings nurture children, protect their health and safety, and prepare them for later school success--better-qualified staff are essential (Anonymous, 1994).
- Smaller group sizes, higher teacher/ratios and higher staff wages result in quality childcare (Anonymous, 1997c).
- Any childcare setting will benefit from a health consultant…to advise on potential infectious diseases, explain symptoms and treatments to families.

The quality of childcare is dependent on the interaction of the individual staff member and the child. This conference also proposed that the lower the quality, the more affordable and plentiful the service. The higher the quality, the better the children will be served. This conference revealed the following issues concerning the quality of service:

- Licensing rules must be comprehensive, well-written, and measurable.
- There must be a measurement tool designed to standardize the application and the interpretation of the rules.

- There must be a licensing weighting system designed to assess the relative risk to clients if the rule is not met.
- At least one year of data on rule violations for individual facilities. These data will determine which rules are the indicators or predictors of high compliance.

CHILD CARE WORKER'S STAFFING ISSUES

Startling facts about staff issues that were addressed by a study commissioned by The Center for the Child Care Workforce in April 1998 included the high turnover of staff. Nearly one-third of all childcare workers were replaced on their jobs and only 32 percent had been in their center for five years or more. With such high employee and staff turnover, training for staff is an ongoing ritual.

Frequent teacher turnover has a dramatic effect on developmental skills. Essa (1999) found a strong correlation between continuity--a three-year span of same caregiver interaction in a childcare environment--and higher developmental skill levels.

CONCLUSION

The availability of alternative forms of childcare affect cost (Chipty, 1995). Where there are many forms of alternative care, the consumer can choose the best and most cost-effective means of childcare. The decision of a woman to work does not automatically mean she is in that market for childcare. Sometimes, friends or family members provide care at little or no cost (Blau, 1988). Not everyone has access to all of the alternatives. The more likely decision is the family unit must make sacrifices.

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Academy of Health Care Management

THE JOINT COMMISSION ON ACCREDITATION OF HEALTH CARE ORGANIZATIONS' SENTINEL EVENTS POLICY

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ABSTRACT

This article looks at the Joint Commission on Accreditation of Healthcare Organizations' (JCAHO) sentinel event policy which is designed to improve the quality of health care in the United States. A brief history of the JCAHO is included as well as a history of "incident reporting" in general. A discussion of the background of medical errors including information from the Institute on Medicine's landmark report is the basis for the increasing emphasis on medical errors and the sentinel events policy is one of the tools used in health care organizations to combat medical errors. A sentinel event is defined by the JCAHO as "an unexpected occurrence involving death or serious physical or psychological injury, or the risk thereof". Following the identification of a sentinel event, a root cause analysis must be completed which is a process for identifying the processes or problems that resulted in an adverse event or incident. Identification and reporting of sentinel events with the subsequent root cause analyses allows organizations to implement guidelines and policies to reduce the numbers of adverse effects occurring in hospitals and other health care facilities.

The reporting of sentinel events to the JCAHO provides the data for the sentinel event database which provides data that can be used in the prevention of sentinel events by identifying causes of events, trend data, location or settings of events and outcomes.
The JCAHO's Sentinel Event Alert newsletter disseminates information and lessons learned from actual incidents. The National Patient Safety Goals (NPSGs) were introduced in 2002 and are based upon the data gathered about sentinel events. Healthcare facilities must be in compliance with the recommendations and requirements of the NPSGs in order to meet accreditation standards.

Academy of Information and Management Sciences

USING MANAGEMENT SCIENCE TO EXPERIMENTALLY AND THEORETICALLY EVALUATE A PRODUCT: A REVIEW OF PERFORMANCE CHARACTERISTICS

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ABSTRACT

The performance characteristics of a poppet valve are experimentally and theoretically evaluated in this paper. The pressure drop across the valve and the flow forces exerted on the valve at different opening/closing positions were also measured. In addition, the experimental and theoretical analysis of this study is discussed.

INTRODUCTION

In-line poppet valves are designed such that the flow passes through an annular space surrounding the poppet. Once the valve is closed, the pressure of the fluid, which in part is responsible for closing the valve, keeps it tight and sealed. In these valves sharp contractions and sudden expansions, which are the main cause of the flow losses, are eliminated. The low pressure drop is one of the attractive features of these valves. In addition, these valves are also known for their quick response to opening or closing signals and for their tight sealing.

When high pressures and flow rates are involved, the valve closing should take place in a controlled manner to eliminate water hammer effects. Otherwise, it may cause severe damage to the valve and connecting piping systems. In addition, valve poppet and valve housings must be designed and manufactured such that they can withstand very high axial forces produced during the closing process. These factors contribute significantly to the high cost of construction of these valves and thereby limit their use to high technology applications such as aerospace technology.

POPPET VALVE MODEL DESCRIPTION

Prior to the design and modification of a water loop, the water loop facilities at the National Institute of Science and Technology (NIST) were used by Linde (1990) for some preliminary testing. To use the valve model at NIST facilities, it was necessary to scale down the size of the model by a factor of 0.55. It consists of five major parts, namely, valve poppet, valve housing tube, valve housing parts, valve support structure, and valve flanges. The base model poppet valve consists of three parts, and they are made of black Delrin plastic. These parts include two conical sections and a cylindrical section that fits between the upstream and downstream conical sections of the poppet valve. There are three grooves made at 120 degrees apart in the cylindrical section of the valve. The grooves allow the poppet to be moved upstream and downstream of the valve

housing section, which makes it possible to study the flow over the valve at different positions between the fully open position and fully closed position.

The poppet valve is fixed to the valve section tube by screws using a three-leg star shaped support that fits inside the poppet valve. The support arms extend through the grooves of the cylindrical section of the valve and are screwed to the tube wall of the valve test section. The test section is made of clear plexiglass tubing with 6.35 mm (1/4 inch) wall thickness and 157 mm (6.18 inch) inside diameter.

The upstream and downstream inner housing parts of the valve are also made of clear plexiglass and are fitted in the valve tube housing and fixed to the wall by screws. Two flanges are mounted on the inner housing parts of the valve. These flanges are made of aluminum with an outside diameter of 228.6 mm (9 inch), inside diameter of 101.6 mm (4 inch), and length of 25.4 mm (1 inch). The flanges fit to American standard PVC flanges for four inch piping.

RESULTS

The experimental and theoretical analysis of this study led to the following conclusions:

- The pressure loss coefficient across the valve is a function of a Reynolds number. For the case under study, it was shown that the pressure loss coefficient decreases for flows with the Reynolds number less than approximately $2.5 \bullet 10^5$. For flows with a higher Reynolds number, the pressure loss coefficient remains relatively constant.

- By changing the upstream housing, a pressure drop of 10 to 20 percent could be achieved, while a pressure drop of 53 percent or more can be achieved if the upstream housing and the upstream cone are changed simultaneously. In addition, it was shown that the pressure loss coefficient is very sensitive to the position of the valve poppet in the valve section.

- The pressure drop across the valve can be predicted by using simple analytical methods, such as the control volume momentum analysis, in conjunction with estimation of flow losses for standard flow patterns. The predicted results were in agreement with the measured results.

- The velocity profile becomes fully developed at approximately four pipe diameters downstream of the valve section. If the pressure is measured at distances less than four pipe diameters downstream of the test section, then the predicted pressure loss coefficient across the valve is larger than its actual value.

- The proposed method to reduce the downstream cone flow separation is ineffective.

- The flow force acting on the front cone of the valve poppet is relatively small and can be accurately predicted by using a simple potential flow code.

- The flow force acting on the valve poppet increases significantly during closing of the valve. When poppet cone #1 was replaced with poppet cone #3, the flow force acting on the valve poppet was reduced approximately by a factor of two.

- Finally, it was seen that the area around the valve seat which becomes the smallest cross-sectional flow area when the valve closes has a significant influence on the pressure loss across the valve as well as the flow force exerted on the valve poppet.

CONCLUSION

The findings of this study represent a number of research results which can be applied immediately to improve valve designs. However, this investigation showed several research areas that should be addressed.

1. The flow field distortion in valves due to linear scaling should be investigated.

2. The effect of a Reynolds number on the pressure loss coefficient should be further investigated.

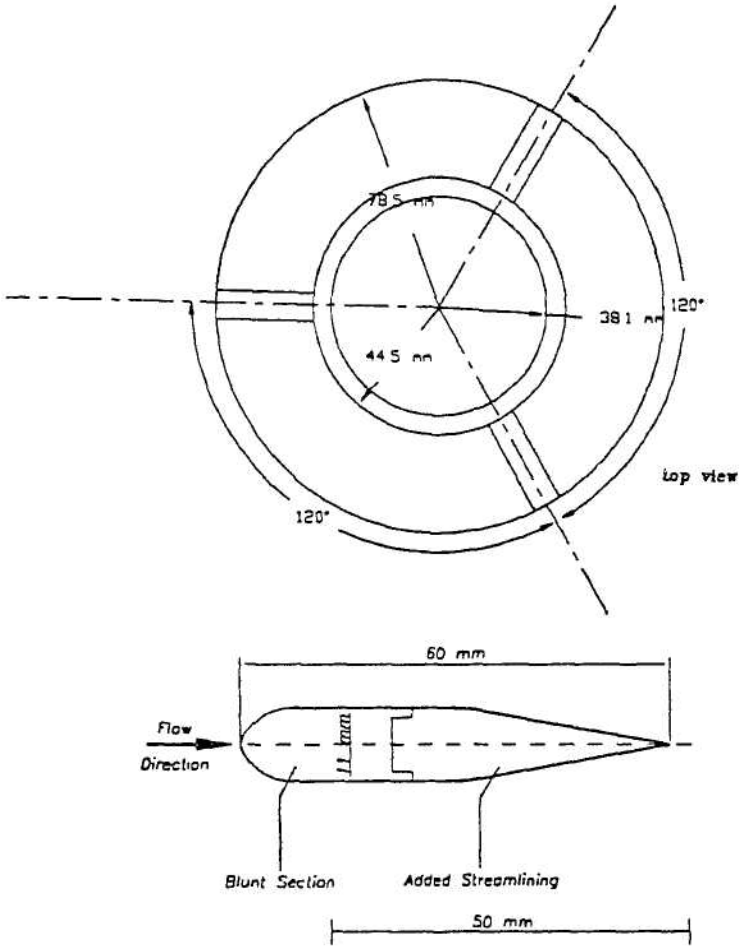
3. Experiments should be conducted to investigate the flow field upstream and downstream of the valve separately to find their effects on the overall valve performance.

4. A mathematical model should be developed to allow analysis of flow field downstream of the valve.

5. A mathematical model should be developed to study the flow instability in the valve section.

APPENDIX

Although all the drawings were made to scale, the dimensions for the poppet valve components and their modifications were not given in the paper. two of these drawings--a valve poppet support (top view and side view)--are presented below with the necessary dimensions for illustrative purposes.



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A STUDY OF FLOW FORCE: A DISCUSSION OF THE SIGNIFICANT RESULTS FROM A SERIES OF TESTS PERFORMED ON AN INDUSTRIAL PRODUCT

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ABSTRACT

A series of tests were performed on several valve cone shapes in combination with various housing contour geometries in order to determine their effect on the overall pressure loss coefficient. In general, flow field observation and intuitive reasoning of how to eliminate flow separations guided the design process. The work done for this paper yielded a number of significant results. The results are of particular importance to the valve designer for the development of improved valves and to the valve user in formulating his selection criteria.

INTRODUCTION

The major findings of this study can be summarized as follows.

- The dependence of the pressure loss as a function of a Reynolds number was shown.
- The influence of the housing and upstream cone on the pressure drop were investigated.
- The accuracy with which the pressure drop can be predicted by using simple analytical methods, such as the control volume momentum analysis in conjunction with estimation of flow losses for standard flow patterns, was studied.
- The influence of the development of the velocity profile downstream of the valve section on pressure loss coefficient was shown.
- The method to omit the flow separation on the downstream cone was shown to be ineffective in the pressure loss reduction.
- The flow forces acting on the front cone of the valve poppet were accurately predicted by using a simple potential flow code.
- The exponential rise of the forces during closing of the valve was shown.
- The importance of the downstream area near the valve seat, which becomes the smallest cross-sectional flow area when the valve closes, was shown. These findings are discussed in the order presented above.

DEPENDENCE OF THE PRESSURE DROP ON A REYNOLDS NUMBER

Most fluid mechanic references or commercial test data give little or no information about the pressure drop as a function of a Reynolds number. The pressure loss factors are customarily given as constants irrespective of a Reynolds number. This investigation showed a clear relationship between the pressure loss coefficient and Reynolds number for the type of valve investigated here.

The plots of the pressure loss coefficient vs. velocity for different valve configurations were calculated. A review of these plots reveals that the pressure loss coefficient across the valve decreases as the flow velocity increases, and it appears to remain relatively constant at the higher Reynolds number. This behavior was observed for all valve configurations tested at the fully open position, and it reflects the relations between the pressure loss coefficient and a Reynolds number.

THE INFLUENCE OF THE HOUSING AND UPSTREAM CONE ON THE PRESSURE DROP

The effect of upstream valve housing contours on pressure drop across the valve was investigated by the design of four upstream housing contours in addition to the one supplied by the valve manufacturer. Selected test results using different valve housings in combination with poppet cone #1 were studied. This figure shows that the pressure loss coefficient has its lowest value for the particular combination of poppet cone #1, H_2. This upstream housing contour was designed such that it produces a gradual expansion in the flow area from the inlet of the test section. This design seems to reduce the relatively large flow separation region.

In addition, the influence of the upstream housings used in conjunction with different poppet cone shapes on the pressure drop was investigated. For this purpose two new poppet cones were designed (poppet cone #2 and poppet cone #3). Poppet cone #3 showed lower pressure drop as compared to poppet cone #2. This design has streamlined body and also eliminates the separation region. Due to design features and promising results obtained by using poppet cone #3, most of the tests were done using this cone shape in combination with the different upstream housings. When this was done, it was found that the lowest pressure drop is obtained when poppet cone #3, H2 valve configuration is tested at the fully open position. This test result gives a pressure loss coefficient approximately equal to 0.72 (approximately 12 percent reduction in pressure drop compared with the base model design). A new upstream housing, housing contour #5, was then designed specifically to produce a gradual increase in the flow area of 20 percent when used in combination with poppet cone #3. The test results for this case show approximately a 10 percent reduction in the pressure loss coefficient as compared with the similar results of the base model design.

To further reduce the pressure drop, it was decided to study the influence of the position of the valve poppet in the valve section by increasing the valve stroke length. The poppet cone #3 combined with upstream housing contour #5 was used to study this effect. First, the valve poppet was moved 8.4 mm and 16 mm upstream of its fully open position. This figure suggests a significant change in the pressure drop for the above mentioned valve positions. It is seen that when the valve poppet is moved 8.4 mm in an upstream direction, the pressure loss coefficient drops to 0.55, and when the valve poppet is moved 16 mm upstream, an increase in pressure drop is observed. This suggests the existence of an optimum position for a valve poppet which gives lowest pressure drop within the above limits.

To obtain this optimum position of the valve poppet, a series of experiments was performed in which the valve poppet position was changed in smaller intervals (about 5 mm). These figures show that when the valve poppet is moved 10.5 mm upstream of its original position, the pressure loss coefficient drops to its lowest value, so far, of 0.44.

Additional investigation of the pressure loss was continued by positioning the valve poppet at 10.5 mm upstream (its optimum position) and moving the upstream housing contour further upstream. It was found that when upstream housing is moved 10 mm, the pressure loss coefficient reduces to 0.42. Furthermore, the same valve model configuration was tested with a single leg valve support structure and the experiments were repeated several times. The results show more reduction in the pressure loss due to the effects of the support structure on the flow field. This gives the lowest pressure loss coefficient of 0.37 obtained during this investigation.

In summary, it was found that by changing the upstream housing, a 10 to 20 percent drop in the pressure loss coefficient could be achieved. By changing simultaneously the upstream housing and the upstream cone, a 53 percent or more drop in the pressure loss can be achieved.

ACCURACY

The simple control volume momentum analysis approach was used to estimate pressure loss coefficient across the poppet valve. The pressure loss coefficient obtained through this analysis is 0.53. The measured pressure loss coefficients for fully developed flow field over the valve poppet configurations investigated here varied from 0.82 to 0.42. By looking at an average value between these two extreme values, this simple approach gives a pressure loss coefficient that is within 15 percent of average measured values. Considering the complex nature of the flow field in the valve, the estimation of pressure loss coefficient is sufficiently accurate to guide the valve designer in his initial design.

THE INEFFECTIVENESS OF THE INTENDED METHODS TO DECREASE THE FLOW SEPARATION ON THE DOWNSTREAM CONE IN PRESSURE LOSS REDUCTION

During this study, an attempt was made to decrease the flow separation on the downstream cone. For this purpose a set of flow straighteners was designed to be mounted on the downstream cone of the valve poppet. The flow straighteners were designed to follow the flow streamlines and direct the flow in such a way to reduce the separation in the wake region behind the valve cone. It was seen that the flow straighteners produced larger overall pressure loss. This increase in pressure loss may be caused by the drag of additional surface area in the flow field or by the flow area reduction near the valve seat.

THE ACCURATE PREDICTION OF THE FLOW FORCES ON THE FRONT CONE OF THE VALVE POPPET BY USING A SIMPLE POTENTIAL FLOW CODE

The potential flow code gave an accurate prediction of the flow forces acting on the front cone of the valve poppet. The magnitude of this force was relatively small as compared to the total force acting on the valve poppet. This indicates that most of the force acting on the valve poppet is due to flow behavior downstream of the valve poppet. In addition, as expected, potential flow code predicted lower forces acting on the front cone of the streamlined poppet cone as compared to the base model design poppet cone.

THE EXPONENTIAL RISE OF THE FORCES DURING CLOSING OF THE VALVE

Knowledge of the forces exerted on the valve poppet is extremely important to a valve designer. It is particularly of interest to know the variation of these forces during valve opening or closing. The measurements of the drag force for two valve models at several partially open positions and different flow velocities were calculated. Both of these measurements show clearly that the drag force is directly proportional to the square of the velocity. Also, it is seen that the drag force increases exponentially as the valve poppet is moved to partially closed positions.

A more careful inspection shows that the data are more scattered when the valve poppet is moved 10 mm downstream from its fully open position. This particular test was repeated several times and the scatters were obtained. It seems that there exists an instability in the flow field when the valve poppet is at this position. This requires further investigation. Furthermore, the drag measurement for poppet cone #3, H_1 is approximately half of the measured values for poppet cone #1, H_1, while the only difference between the two models is the poppet cone. However, the pressure

forces exerted on the front cone of these two valve poppets were calculated and do not account for the big difference in the total force experienced by these two models. This leads to the conclusion that significant changes occur in the flow field downstream of the valve seat.

THE DOWNSTREAM AREA

The downstream area (that is, the area around the valve seat that becomes the smallest cross-sectional flow area when the valve closes) is an important area for discussion. The variation of smallest flow area downstream of the valve near or at the valve seat as a function of valve closing position was studied. Also, the drag coefficients at several partially open positions of the valve were studied. Comparison of these two figures shows that the smallest flow area downstream of the valve has a significant influence on the drag coefficient, i.e., the drag coefficient increases exponentially as the valve poppet is moved toward the fully closed position.

ERROR ESTIMATE

In most experimental works, maximum care is taken to make accurate measurements of the parameters involved. However, this does not eliminate all the errors associated with the instrumentation and human involvement, but only reduces these errors to some extent. Therefore, there is a need to account for the overall effects of unavoidable errors on the measured quantities. These errors are due to equipments used for instrumentation and to human involvement. Instrumentation errors are usually given by the manufacturers, and human errors are of random nature and would have to be estimated.

The data acquisition system used for the measurements taken during this investigation was fully automated. This minimizes the human error in most of the measurements. Basically three quantities, pressure, velocity, and force, were measured during this study. The measurements of pressure and velocity were taken by two identical pressure transducers with an accuracy of ±0.7%. The outputs of the pressure transducers were amplified through the amplifier with an accuracy of ±0.05% and fed into the computer through an A/D convenor board (described in section 2.3) with an accuracy of ±0.01%. The pressure loss coefficient and the average velocity were then calculated. In addition, once the drag force was measured by the designed load cell, the drag coefficient was calculated. The overall error associated with these quantities is discussed here.

ESTIMATION OF ERROR IN CALCULATION OF DRAG COEFFICIENT

To find the error in drag coefficient, first the error associated with the measurement of drag force is estimated. The design load cell was calibrated by using a scale with the accuracy of ±1 gram. The load cell has a resolution of one Newton. Therefore, the uncertainty in the reading of the scale becomes ±1%. Also, there is uncertainty associated with the linearity of the calibration line, which is ±0.1%. Therefore, the overall uncertainty in determination of drag force becomes:

(1) $$\varepsilon_{F_D} = \pm\sqrt{1^2 + 0.1^2} = \pm 1\%$$

Since drag coefficient is directly proportional to drag force and inversely proportional to the average flow velocity squared and diameter of the poppet cone squared, the following equation is developed to estimate the error in calculation of drag coefficient.

2. $$\varepsilon_{C_D} = \pm\sqrt{(\varepsilon_{F_D})^2 + (2\varepsilon_{\bar{V}})^2 + (2\varepsilon_{dia.})^2}$$

where $å_{dia.}$ is the uncertainty associated with measurement of the poppet cone diameter and is equal to $\pm\left(\frac{1}{1\frac{1}{4}6}\right)100 = \pm 0.86\%$. Substituting the numerical values into the appropriate equation, the total error in calculation of drag coefficient becomes:

(3) $$\varepsilon_{C_D} = \pm\sqrt{1^2 + [2(2.5)]^2 + [2(0.86)]^2} = \pm 5.4\%$$

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APPLIED MANAGEMENT SCIENCE: AN EXAMPLE OF INDUSTRIAL APPLICATION

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ABSTRACT

This paper provides a fluid dynamic investigation of a commercial in-line poppet valve. Pressure losses across the valve and drag forces experienced by the valve poppet were measured using an approximately 1/2 scale model. The water was used as the flowing medium. To find a valve design with minimum pressure loss, new valve models were designed and tested. A major focus of this paper is on the experimental determination of the pressure drop across a poppet valve and the measurement of the flow force on the poppet cone.

INTRODUCTION

Valves which control the flow of liquid fuel (hydrogen) and the oxidizing agent in a rocket engine are called main feed valves. The most often used type of feed valve is the so- called in-line poppet valve. The pressure drop across the feed valve must be kept as low as possible to avoid cavitation, which may cause interruption of the proper amount of fuel flow. In addition, a controllable motion of the valve poppet during opening/closing of the valve is required to prevent the possibility of a water hammer.

In many industrial applications dealing with fluid flow, valves play a very important role. They are used as flow controllers, pressure regulators, throttling devices, or reverse flow preventers. The primary use of valves is controlling the flow of fluids such as water, natural gas, liquid fuel, steam, and corrosive and toxic liquids and gases.

The type of valve used is determined by the nature of its intended application. In many cases, the fluid flow characteristics of valves such as pressure loss, water hammer, flow force, and cavitation as well as sealing, and an opening/closing mechanism are important in design consideration. Due to existence of the wide variety of valves and their wide range of applications, it would be difficult to give an overall view of all these valves. However, a brief description of the major valve types is presented here.

GLOBE VALVE

Globe valves are made of a disc that is lowered to fit on the seat in the closed position and is lifted off the seat in the open position. In this type of valve the flow bends and as soon as the disc is lifted, the flow of fluid starts. The globe valve gives tight shut off and is especially suitable for throttling processes. These valves can be used as closing and opening devices provided that the high pressure loss through the valve is acceptable. Also, globe valves are suitable for cases in which opening and closing of the valve is more frequent since the moving distance of the disc between the open and closed position is very short.

BALL VALVE

A ball valve uses a hollow spherical ball, fitted in a simple housing by two resilient sealing rings. The valve is opened or closed by rotating the ball 90 degrees through the valve housing. These valves feature low pressure drop at fully open position, low leakage, and rapid opening. However, the wear of the valve seat and body due to particles trapped between them during opening and closing of the valve and throttling process are disadvantages of this type of valves. These valves are most commonly used as opening and closing devices. They are also used for moderate throttling, flow diversion, and cryogenic fluids (Warring, 1982).

BUTTERFLY VALVE

A butterfly valve uses a thin rotating disc as a closing device. A 90-degree rotation is required to make it fully opened or closed. Since the disc is relatively thin and is in the direction parallel to the flow in fully open position, it introduces little disturbance and resistance to the flow. These types of valves are normally single flanged or double flanged (lug valve) and can be mounted easily between pipe flanges via bolts. They need a little more space than the flange of the pipe. The low cost, lightweight, easy installation and easy operation of butterfly valves have made them popular and attractive in industry.

GATE VALVE

Gate valves consist of a disc or wedge that can be raised to open and lowered to close the valve. The gate valves are designed to be either fully open, in which case they produce little resistance to the flow, or fully closed. In most cases a large force is required to operate these valves and they cannot be used in a partially open position. These valves are used extensively in the pumping industry and are available in a variety of sizes.

CHECK VALVE

Check valves are used to prevent fluid flow in the reverse direction. The valve consists of a hinged disc. The fluid flow in one direction causes the disc to swing and lift the value from the seat, therefore permitting the flow to pass through the valve. However, the flow in the other direction pushes the disc against the seat and closes the valve. These valves introduce a large resistance and turbulence in the flow field in the open position due to the swinging nature of the disc in the flow field.

PRESSURE RELIEF VALVE

The function of this type of valve is to release the pressure in a pressurizer (i.e. pressure vessels, pressurized water reactors, etc.). When the valve is subjected to abnormal operating conditions, which cause the pressure acting on the valve to rise above a pre-set pressure limit, the valve is opened, and after the excessive pressure is relieved the valve is closed. The opening/closing of the valve can take place via a pilot-operated relief system or a spring system. In the former case, a pressure sensing element is used to activate the opening/closing force mechanism and in the latter case, the internal pressure must overcome the spring force and any external pressure force acting on the valve for opening of the valve.

POPPET VALVE

In-line poppet valves are designed such that the flow passes through an annular space surrounding the poppet. Once the valve is closed, the pressure of the fluid, which in part is responsible for closing the valve, keeps it tight and sealed. In these valves sharp contractions and sudden expansions, which are the main cause of the flow losses, are eliminated. The low pressure drop is one of the attractive features of these valves. In addition, these valves are also known for their quick response to opening or closing signal and for their tight sealing.

When high pressures and flow rates are involved, the valve closing should take place in a controlled manner to eliminate water hammer effects. Otherwise, it may cause severe damage to the valve and connecting piping systems. In addition, valve poppet and valve housings must be designed and manufactured such that they can withstand very high axial forces produced during the closing process. These factors contribute significantly to the high cost of construction of these valves and thereby limits their use to high technology applications such as aerospace technology.

LITERATURE REVIEW

The analysis of fluid flow through a valve is essential for determination of valve characteristics such as maximum flow, pressure loss, and stability. Performance evaluation of valves generally involves solution of momentum and energy equations where flow separation, turbulence, and cavitation coexist. The complexity of the internal flow field and irregular geometries of valves make the theoretical analysis of the flow field associated with the valves extremely difficult. For these reasons, most analysts look at the overall effects of internal flow through the valves and rely extensively on experimental results and observations or semi-empirical relations. Nevertheless, for some simple cases, theoretical treatment of the flow field, using simplified models, can be found in the literature.

Extensive research and study have been done on flow through nozzles, diffusers, and sharp edge orifices. But very few studies address the flow field analysis through valves. An experimental investigation of pressure and velocity distribution in safety valves is given by Sallet et al. (n.d.). Sallet (1984) also discusses some thermal hydraulic characteristics and analysis of flow through valves for nuclear applications. In addition, Firth et al. (1954) present an experimental investigation of special control valves in hydraulic machinery. They used a special design of the poppet valve for completely different design requirements.

After reviewing available references, it was found that Lyons (1975a, 1975b), Warring (1982), and Zappe (1978) provide extensive description, including design and performance data, for most commonly used valves. Common parameters used to express performance characteristics of a valve are pressure loss coefficient æ and flow coefficient A_v defined by:

(1)

$$A_v = Q\left(\frac{\rho}{\Delta P}\right)^{1/2}$$

(2)

$$\zeta = \frac{\Delta P}{\frac{1}{2}\rho \overline{V}^2}$$

where

$\overline{V}$ = flow velocity (m/s)
ÄP = pressure loss (Pa.)

ñ = density of the fluid (kg/ml)
Q = flow rate (m^3/s)

Pressure loss coefficients at the fully open position for a number of commonly used valves are given by Zappe (1978). These values are given in Table 1. Also, pressure loss coefficients at several partially open/closed positions for a ball valve, a butterfly valve, and a gate valve are given by Bohl (1986). These values are shown in Table 2. Bohl also gives the variation of the pressure loss coefficient as a function of Reynolds' number for a number of valves.

It is also common practice to express the flow losses through a valve by using the K-factor method. K is defined by:

(3)

$$h_l = K\frac{\overline{V}^2}{2}$$

Also, K is sometimes expressed in terms of a friction factor and an equivalent length of a pipe of the same diameter as the valve restriction. Thus, K can be defined as:

(4)

$$K = f\left(\frac{L}{d_L}\right)$$

where
h_1 = flow losses through the valve

$\overline{V}$ = average velocity through a restriction
f = friction factor
L = equivalent length of a straight pipe for valve restriction
The K-factor and equivalent length for some standard valves are given in Lyons (1975a, 1975b). Among the cited references, no previous work regarding the type of poppet valve under investigation was found.

PROBLEM STATEMENT

The principal valve in a liquid fuel rocket system is the main feed valve. This valve, which is an in-line poppet valve, monitors (turns on/off) the fuel, liquid oxygen, and liquid hydrogen, in the rocket engine. For such an application, it is important to keep the pressure drop to a minimum to avoid cavitation. Also, when the valve opens or closes, it is important that this process takes place in such a controlled manner as to prevent water hammer. Therefore, knowledge of the forces exerted on the valve poppet or by the valve poppet is important in the design process. Table 3 provides a review of the nomenclature. Modifications to the valve housing and valve poppet are to be made in order to minimize the pressure drop across a poppet valve.

CONCLUSION

The results of this research can be summarized as follows: 1. It was shown that an optimal choice of valve housing contours and valve poppet shapes can decrease the pressure loss coefficient

by more than 50 percent (typically from ζ= 0.82 to ζ =0.37). 2. It was found that the pressure loss coefficient is strongly dependent on the Reynolds number up to Reynolds numbers of approximately less than $2.5 \cdot 10^5$. 3. It was shown that the pressure drop across the valve can be predicted by using simple analytical methods such as the control volume momentum analysis in conjunction with estimation of flow losses for standard flow patterns. 4. It was shown that the drag force acting on the front part of the valve poppet is relatively small and can be accurately predicted by a simple potential flow code. 5. It was found that the flow force experienced by the valve poppet increases exponentially during closing of the valve. 6. It was seen that the area around the valve seat which becomes the smallest area during the valve closing has a significant influence on the pressure loss across the valve and dominates the total flow force exerted on the entire valve poppet.

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MATHEMATICAL MODELING IN MANAGEMENT SCIENCE: THE CASE OF INDUSTRIAL VALUES AND VISCOSITY

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ABSTRACT

It is well established that potential flow will accurately predict the drag force acting on streamlined bodies of valves where there is no flow separation involved. Therefore, we used potential flow theory to calculate the drag experienced by the front part of the valve poppet. The influence of different upstream valve poppet shapes on the total drag of the valve poppet were also investigated. To accomplish this, the related potential flow governing differential equations were solved numerically as described in this paper.

INTRODUCTION

In many fluid flow problems, the flow field is divided into two separate regions: a region called the boundary layer where the viscosity effects are significant, comprising a very thin layer close to the solid boundary, and a region where the viscosity effects are negligible. The viscous effects can be neglected outside of the boundary layer when the boundary layer thickness is relatively small. The flow in which the viscosity is set equal to zero is called inviscid or potential flow. The assumption of potential flow, where applicable, introduces considerable simplifications in the flow analysis.

NUMERICAL SOLUTION

The finite difference technique was used to solve the partial differential equations involved in the potential flow analysis of the flow field over the poppet valve. Solutions of the partial differential equations require specified boundary conditions, and the accuracy of the solutions strongly depends on the implementation of the boundary conditions. This does not cause any difficulty when the solid boundaries of flow field are made of little or no curvature. However, when the flow field consists of a complex or irregular geometry body shape, the finite difference analysis becomes tedious and cumbersome. To overcome this difficulty, a numerically generated body fitted-coordinate system was used (Anderson, Tannehill & Pletcher, 1984; Thames, Thompson, Mastin & Walker, 1977; Thompson, Thames & Mastin, 1974, 1977). This method transforms the curves from the physical domain into a rectangular computational domain. This technique is remarkably attractive since the boundary conditions are exactly satisfied for many physical problems. Transformation from the physical plane to the computational plane, as suggested by Thompson (1977), was accomplished through the use of Laplace's or Poisson's equations. The distribution of the interior grid points, as given by Thompson (1977), were obtained by solving:

(1) $\hat{i}_{xx} + \hat{i}_{yy} = P(\hat{i}, ç)$

(2) $ç_{xx} + ç_{yy} = Q(\hat{i}, ç)$

where (î, ç) are the coordinates of the grid points in the computational plane and P and Q are terms which control the spacing of the interior grids. Terms P and Q were assumed to be zero for this analysis. Transformation of equations (1) and (2) from the physical plane to the computational plane yields:

Equations (2) and (3) were discretized by using the central finite difference scheme, and then the Gauss-Seidel method with over-relaxation factor of 1.25 was used to numerically generate the grids for a given valve geometry and the flow field. The finite difference equations for internal nodes were written based on the general grid representation.

Equations (3) and (4) give the coordinates of the internal grid points in the physical domain of the flow field.

$$x_{i,j} = \frac{(A_1 + A_3 - A_2)}{2(\alpha + \gamma)} \qquad (3)$$

$$y_{i,j} = \frac{(B_1 + B_3 - B_2)}{2(\alpha + \gamma)} \qquad (4)$$

The next step after completing the task of grid generation was writing the partial differential equations and the algebraic equations representing the flow field. The design of the poppet valve and its housings indicated that flow was axisymmetric. For incompressible axisymmetric flow, the continuity equation as given by Vallentine (1959) is:

$$\frac{\partial}{\partial x}\left(\frac{1}{\omega}\frac{\partial \psi}{\partial x}\right) + \frac{\partial}{\partial \omega}\left(\frac{1}{\omega}\frac{\partial \psi}{\partial \omega}\right) = 0 \qquad (5)$$

Equation (6) was solved numerically to obtain the stream functions for internal grids subject to the following boundary conditions. Boundary condition for stream function ø: the stream function for nodes on the south boundary was set to be ø =0 and for the nodes on the north boundary was set to be ø=Q (the volume flow rate).

$$\psi_{i,j} = \frac{D_1 + D_2 + D_3 + D_4 + D_5 - D_6}{D_7} \qquad (6)$$

The boundary conditions upstream of the test section (grids on the west boundary nodes) for the stream function were given by:

$$\psi_{i,1} = \frac{Q}{N-1} \qquad (7)$$

and the east boundary condition for the stream function was:

$$\Psi_{i,M} = \frac{Q}{N-1} \qquad (8)$$

where N and M are the total number of grids on the east/west and north/south boundaries respectively.

Equations (9) and (10) were solved numerically to obtain the velocity field over the poppet valve in the test section. It is important to realize that the potential flow equations are expected to predict the flow field over the front part of the poppet valve cone. Once the velocity field was obtained, the momentum equation along with continuity and Bernoulli equations were used to predict the drag force experienced by the front part of the poppet cone at fully open position with different upstream velocities.

$$u_{x(i,j)} = \frac{1}{y_{i,j}}\left[\xi_y \frac{\Psi_{i,j+1} - \Psi_{i,j-1}}{2\Delta\xi} + \eta_y \frac{\Psi_{i+1,j} - \Psi_{i-1,j}}{2\Delta\eta}\right] \qquad (9)$$

$$u_{y(i,j)} = -\frac{1}{y_{i,j}}\left[\xi_x \frac{\Psi_{i,j+1} - \Psi_{i,j-1}}{2\Delta\xi} + \eta_x \frac{\Psi_{i+1,j} - \Psi_{i-1,j}}{2\Delta\eta}\right] \qquad (10)$$

CALCULATION OF DRAG FORCE ON THE FRONT PART OF THE POPPET CONE

As expected, potential flow theory can give a relatively accurate prediction of the flow field over the front pan of the poppet cone. Therefore, the pressure force over the front part of the poppet cone was calculated by using the developed potential flow code, and the results were compared with measurements made by Linde and Florian (1990).

The drag for the front part of the poppet cone was calculated by integrating the pressure over its area. For this purpose an element of area was selected. Since the velocity field was known from the computer code, the Bernoulli equation was used to find the pressure distribution over the front part of the poppet cone. Applying the Bernoulli equation along a streamline between point 1 and point i of the selected area element results in:

$$\frac{P_1}{\rho} + \frac{V_1^2}{2} = \frac{P_i}{\rho} + \frac{V_i^2}{2} \qquad (11)$$

where P_1 and V_1 are static pressure and average velocity upstream of the test section respectively, and P_i and V_i refer to static pressure and velocity of an arbitrary point i on an element of area of the poppet cone. Solving this equation for P_i results in:

$$P_i = P_1 + \frac{\rho V_1^2}{2}\left[1 - \left(\frac{V_i}{V_1}\right)^2\right] \qquad (12)$$

A similar equation written along a streamline between point 1 and point (i+1) on this element area is:

$$P_{i+1} = P_1 + \frac{\rho V_1^2}{2}\left[1 - \left(\frac{V_{i+1}}{V_1}\right)^2\right] \qquad (13)$$

Then, the average pressure acting on this element of area becomes:

$$P_{avg} = \left(\frac{P_i + P_{i+1}}{2} \right) = P_1 + \frac{\rho V_1^2}{4} \left[2 - \left(\frac{V_i}{V_1} \right)^2 - \left(\frac{V_{i+1}}{V_1} \right)^2 \right] \qquad (14)$$

The area of this element was calculated by:

$$A_i = (y_{i+1} - y_i) \cdot \pi \cdot s \qquad (15)$$

where the pressure force acting on the element of area is:

$$F_i = A_i P_{avg} \qquad (16)$$

The total pressure force acting on the front part of the poppet cone was determined by integrating the forces acting on all the differential elements of areas comprising this part.

CONCLUSION

This force was calculated for different flow velocities, and the calculated results for poppet cone #1, H_1 and poppet cone #3, and H_1 poppet valve configuration are given in Table 1. These results are also plotted in Figure 1. As expected, the pressure force calculated for the streamlined poppet cone (poppet cone #3) was shown to be smaller than the pressure force calculated for the base model design (poppet cone #1). In addition, the calculated pressure forces have the same order of magnitude as the ones measured by Linde and Florian (1990). The measurements made by Linde and Florian were rather involved and difficult. On the other hand, the potential flow code is relatively easier.

Table 1. Flow force acting on the front cone of the valve poppet obtained from integration of pressure distribution on the front part of poppet cone and the pressure measurements by Linde and Florian (1990)

Poppet Cone #1, H_1		Poppet Cone #3, H_1		Poppet Cone #1, H_1 (Linde)	
Velocity (m/s)	Cal. Pressure Force (N)	Velocity (m/s)	Cal. Pressure Force (N)	Velocity (m/s)	Cal. Pressure Force (N)
0.87	0.07	0.51	0.02	0.94	0.79
1.11	0.12	0.80	0.04	1.12	0.35
1.51	0.22	1.09	0.08	1.31	1.03
1.67	0.26	1.48	0.15	1.49	0.69
1.99	0.37	1.64	0.18	1.68	0.48
2.20	0.46	2.00	0.27	1.87	0.97
2.50	0.59	2.18	0.32		
2.68	0.68	2.64	0.47		
2.98	0.84	3.01	0.6		

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A PRELIMINARY DESIGN OF AN EXPERIMENTAL SETUP: USING A DEVELOPED QUICK *BASIC* PROGRAM

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ABSTRACT

The design of any experimental set up and the type of transducers adopted to measure the desired physical parameters are important considerations. The validity of the test data depends on the successful completion of this process. In order to minimize the errors associated with any measurement, selected transducers must have proper resolution, sensitivity, frequency response and linearity and, of course, they must satisfy budget constraints. Therefore, before the design of any test facility and selection of transducers, the physical quantities that have to be measured must be identified. This study measures the drag force experienced by the valve poppet along with the static pressure drop across the valve, as well as the velocity profile upstream and downstream of the valve section.

INTRODUCTION

A Pitot-Static tube, a piezometer ring, and strain gage based pressure transducers are used to measure velocity and static pressure difference. A load cell equipped with electrical resistance strain gages is designed and used to measure the drag force, and a linear displacement transducer is designed to construct the velocity profile downstream of the valve section.

The experiments related to this investigation were conducted in a two-phase flow laboratory. The experimental setup consists of three major parts:

- Modification of water tunnel
- Design of poppet valve models and valve housings
- Design of the data acquisition system.

The following sections provide a detailed description of the test facility and the associated transducers.

DESCRIPTION OF THE TEST FACILITY (WATER TUNNEL)

The test assembly consists of the following components:

1. A large stainless steel tank (6 m^3) which is used as water supply tank and is located outside of the laboratory.

2. A 1.9 m long stainless steel horizontal pipe welded to the bottom of the tank via a weldneck flange.

3. A 10.16 cm OD ball valve mounted 197 cm upstream of the test section is used to cut off the flow of the water into the test assembly.

4. A 197 cm plexiglass pipe with 10.16 cm ID followed by a 33 cm long test section.

5. A butterfly valve mounted 90 cm downstream of the test section, which is used to control the flow rate.

6. A sump tank used to collect the discharged water and for pumping it back to the water supply tank.

7. A 4-in diameter PVC pipe followed by a 3 hp pump with a rated capacity of 300 GPM, which is used to return the water from the sump tank to the supply tank.

DESIGN AND CONSTRUCTION OF THE POPPET VALVE MODEL

To study the flow over the poppet valve, a scaled down model was constructed using specification and dimensions supplied by the valve manufacturer. The constructed test model offers the following features:

- The valve position can be varied along its housing. This allows the study of fluid flow over the poppet valve for different positions ranging from fully open to fully closed positions.

- The model is equipped with pressure taps at the valve boundary and its housing. This permits the static pressure measurements over the surface of the poppet valve and inner boundary of the valve section.

- The installation and removal of the valve during the test can be accomplished easily and quickly.

- The fluid flow through the valve section can be observed and visualized.

POPPET VALVE MODEL DESCRIPTION

Prior to the design and modification of a water loop, the water loop facilities at the National Institute of Science and Technology (NIST) were used by Linde (1990) for some preliminary testing. To use the valve model at NIST facilities, it was necessary to scale down the size of the model by a factor of 0.55. It consists of five major parts, namely, valve poppet, valve housing tube, valve housing parts, valve support structure, and valve flanges. The base model poppet valve consists of three parts, and they are made of black Delrin plastic. These parts include two conical sections and a cylindrical section that fits between the upstream and downstream conical sections of the poppet valve. There are three grooves made at 120 degrees apart in the cylindrical section of the valve. The grooves allow the poppet to be moved upstream and downstream of the valve housing section, and this is necessary to study the flow over the valve at different positions between the fully open position and fully closed position.

The poppet valve is fixed to the valve section tube by screws using a three-leg star shaped support that fits inside the poppet valve. The support arms extend through the grooves of the cylindrical section of the valve and are screwed to the tube wall of the valve test section. The test section is made of clear plexiglass tubing with 6.35 mm (1/4 in) wall thickness and 157 mm (6.18 in) inside diameter.

The upstream and downstream inner housing parts of the valve are also made of clear plexiglass and are fitted in the valve tube housing and fixed to the wall by screws. Two flanges are mounted on the inner housing parts of the valve. These flanges are made of aluminum with the outside diameter of 228.6 mm (9 in), inside diameter of 101.6 mm (4 in), and length of 25.4 mm (1 in). The flanges fit to American standard PVC flanges for 4 inch piping.

AUTOMATED DATA ACQUISITION SYSTEM

Manual data collection and analysis is slow, tedious, and susceptible to considerable errors. With the developments in personal computer hardware coupled with the availability of graphics-based software packages, it is possible to set up an affordable computer-assisted data collection and analysis system. This automated approach offers much greater speed, more reliable data collection, better data analysis, and an easier way of presenting the test results. A 286-based data acquisition system is set up and used. The system consists of a 286 personal computer equipped with an add-on Analog to Digital (A/D) converter board (6b Series Utility from Analog Devices, Inc.). This board, which provides the interface between the computer and analog or digital world, has four differential analog input channels. The amplified output of the pressure transducers and force transducer are fed into the analog input channels of the board and read by the computer. Lab Tech Notebook Package is utilized to set the necessary data acquisition parameters and write the collected data into an ASCII file.

The A/D convertor board mentioned above was replaced by a ìC DAS-16G board from MetraByte corporation. The new board, which uses one of the expansion slots of the personal computer, has a sampling rate of 7000 per second and software selectable amplification gains of 1, 10, 100, and 500. Each analog input channel can be programmed independently to have its own amplification gain. The A/D module of the board has a 12-bit resolution, which allows the measurement of voltage fluctuations as low as 0.005 micro volt. Without any amplification the board offers a resolution of 2.4 mvolts. (voltage range/2^{12}=10/4096=0.0024)

CONCLUSION

Various functions of the board and data collection and analysis phases of the testing are performed through using a developed quick *BASIC* program. The DAS-16G board is used for measurement of pressure losses across the valve, drag force experienced by the valve poppet, and velocity profiles downstream of the valve section.

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MEASUREMENTS OF PRESSURE, VELOCITY, AND DRAG ACROSS A TEST SECTION: USING MANAGEMENT SCIENCE FOR PROBLEM SOLVING

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ABSTRACT

Experiments were performed to measure the flow force on a valve poppet at different opening/closing positions. These experiments were performed for different flow velocities, and in each case, the velocity was measured by a Pitot-Static tube. The procedures to perform these experiments are discussed in this paper.

INTRODUCTION

The pressure drop across a poppet valve plays a very important role in the valve design, particularly when the valve is used to control the fuel line of a rocket engine. Also, the forces experienced by the valve poppet are equally important in such a design. To investigate these phenomenoa, a series of experiments were designed to measure the pressure drop across the valve for various valve poppet models used in combination with different upstream housing contours and the valve downstream housing contour. Also, some experiments were designed to study the development of velocity profile downstream of the valve on the pressure loss coefficient.

PRESSURE MEASUREMENTS

Pressure is defined as the average force per unit area. To measure the pressure, a sensing element is used to transduce the pressure into an equivalent displacement, strain, or some other physical quantities that can be easily measured. One of the most popular techniques of measuring pressure is through the use of electrical resistance strain gages. A flexing member converts the input pressure into strain (or elongation), and the induced strain can be readily measured by utilizing strain gages.

In the strain gage-based differential pressure transducer used for the present investigation (Bell & Howell Type 4-451-0100), a thin cantilever beam, equipped with four active strain gages, acts as a sensing element. The strain gages, configured in a four active-arm wheatstone bridge, were energized by a 10-volt DC power supply. The output voltage was amplified by a strain gage conditioner and amplifier system (2100 system) from Measurements Group, Inc., and fed into an A/D converter board interfaced to a personal computer. The gages provide temperature compensation. The transducers were calibrated by using two differential water and air manometers designed for this purpose. The transducers' response to input pressure signals is linear. The calibration process was repeated several times during the time of experiments, and no significant change in the response of the pressure transducers was observed.

Two pressure transducers were used in this study. The first one was intended to measure the static pressure drop across the test section, while the second one, which receives its fluidic signal from a Pitot-Static tube, was employed to measure the maximum velocity upstream of the test section.

Since there might be pressure variation around the periphery of the test tube, resulting in an erroneous static pressure measurement, the piezometer ring concept was adopted here. Pressure signals from four pressure taps mounted around the circumference of the tube were averaged before input into the pressure transducer. This tends to minimize the error caused by any pressure variation. Also, to take into account the variation of the water level in the supply tank during a test run, a least-squares curve fitting approach in conjunction with a time averaging scheme was employed to minimize this fluctuation.

The voltage readings of pressure transducers corresponding to the pressure drop data read by the data acquisition system were converted to its equivalent pressure change in mm of water by using the calibration chart. Then the pressure drop across the test section was converted to N/m^2 by the equation:

$$\Delta P = \rho g \Delta h \qquad (1)$$

where p is the density of the liquid water (kg/m^3), g is the gravitational acceleration (m/s^2), and Ä*h* is the pressure drop across the valve in meters of water.

VELOCITY MEASUREMENTS

To measure the flow velocity, a pressure tap drilled 104 cm upstream of the valve test section. A Pitot-Static tube was mounted at this location and was placed at the center of the pipe. The Pitot-Static tube measured the dynamic pressure, which is the difference between the stagnation and static pressure. The dynamic pressure at the center of the pipe was measured with a differential pressure transducer and also with a differential pressure manometer. In addition, a thermometer was used to measure the temperature of the water, which would be used in obtaining the density of the water. The following equations were used to calculate the maximum flow velocity from the measurements as described above.

$$\Delta P = \rho g \Delta h \quad (1)$$

$$P_o = P_{static} + \frac{1}{2}\rho U_{max}^2 \quad (2)$$

Equations 1 and 2 are solved for the maximum velocity upstream of the test section.

$$U_{max} = \sqrt{2g\Delta h} \quad (3)$$

where p is the density of the liquid (kg/m^3), g is the gravitational acceleration (m/s^2), Ä*h* is the deflection of the manometer (m), P_o is the stagnation pressure (Pa.), P_{static} is the static pressure (Pa.), $\frac{1}{2}\rho U_{max}^2$ is the dynamic pressure (Pa.), and U_{max} is the maximum velocity at the center of the pipe upstream of the test section (m/s).

It is desirable to calculate the average velocity that was used to determine pressure loss coefficient and drag coefficient. To find the average velocity, the form of velocity profile which is dependent on the Reynolds number must be known.

Since the velocity profile in a smooth pipe is only a function of the Reynolds number, the knowledge of the Reynolds number should permit the calculation of average velocity (Schlichting, 1979). The Reynolds number is defined by:

$$Re = \frac{\overline{V}D}{\nu} \quad (4)$$

where Re is Reynolds number, V is the average velocity, and v is the kinematic viscosity of the fluid. The range of the Reynolds number for the tests performed varied from 1×10^5 to 4×10^5. In this range, the velocity profile for turbulent flow in smooth pipes follows the 1/7 power law given by:

$$\frac{u}{U_{max}} = \left(1 - \frac{r}{R}\right)^{1/n} \quad (5)$$

where r is the radial distance measured from the center of the pipe and u is the velocity at location r, U_{max} is the maximum velocity (center-line velocity), and n = 7 (Schlichting, 1979). The average velocity is calculated from the following equation.

$$\overline{V} = U_{max}\left[\frac{2n^2}{(n+1)(2n+1)}\right] \quad (6)$$

For n = 7, equation 6 becomes:

$$\overline{V} = 0.817U_{max} \quad (6a)$$

Equation 6a was used to calculate the average velocity in all of the velocity measurements upstream of the test section. However, the velocity profile upstream of the text section was constructed to verify the validity of equation 6a. Also, several velocity profiles downstream of the valve were measured to study the effect of the development of velocity profiles on the pressure loss coefficient.

The construction of the velocity profile required the measurement of Pitot-Satic tube displacement from the pipe wall. The displacement transducer used to accomplish this task was a simple linear potentiameter that was designed and fabricated in the lab. It takes advantage of the principle that the resistance of a conductor is a linear function of its length. A regulated power supply energized a copper wire with a known resistance, R. The induced current, I, can be readily calculated through the application of Ohm's Law. A slider, rigidly connected to the Pitot-Static tube, moves along the conductor and causes a change in the resistance of the portion of conductor bounded between the tube wall and the slider. It consequently produces an output voltage which is directly proportional to the displacement. The output voltage of the linear potentiameter was then fed to the computer through one of the analog channels of the iCDAS-16G board and there it was converted to its equivalent displacement by using a built-in calibration curve.

DRAG MEASUREMENTS

To measure the resisting force experienced by the poppet valve, a force transducer was designed, fabricated, tested, and used. The design specifications for this transducer are:

- It should have the resolution of at least 1 Newton.

- It should have a linear response.
- It must be reliable and stable.
- It must be capable of operating within water.

The design process of the force measuring device consists of two pans: design optimization of the sensing element and determination of optimal location on the sensing element for mounting the strain gages. In order to satisfy the design specifications and constraints, two commercially available packages were used. The first package is *I-DEAS* (Integrated Design Engineering Analysis System), which has been developed and marketed by SDRC of Milford, Ohio. The second one is a general purpose finite element program called *ANSYS* developed by Swanson Analysis System, Inc.

Using shell elements, the finite element model of the sensing element was created in the *I-DEAS* in parametric form. The design parameters were width and height of the spokes' cross section, and the material was aluminum. Boundary conditions were imposed and a 300 N force in the direction of flow was applied. The finite element model was solved and the results were postprocessed. The optimum design was a sensing element whose spokes have a 5 x 5 mm cross section. This design reflected a compromise between resolution, sensitivity, and maximum capacity.

Although the contour plot of bending stresses obtained from the analysis of the shell model of the sensor gave the optimal locations for installing the strain gages, a 3-D beam model of the sensor was also created by the *ANSYS* program. This model was solved and the resulting stresses are compared against their shell model counterparts. The results from the two models were in close agreement. The best location for mounting the strain gages would be either on the ends of each spoke (near the cylindrical wall) or close to the center of the ring. Two of the gages were mounted on the front face of the element while the other two were bonded symmetrically on the back of the spokes. When the front gages were in tension, the rear ones would undergo a compression. This state of stress permitted us to use the gages in a 4-active arm bridge configuration, yielding maximum sensitivity.

CALIBRATION OF FORCE TRANSDUCER

To predict the voltage output of the load cell, the following modeling was employed. From the finite element analysis of the sensor element, it was found that the average strain at the gage location is:

$$\varepsilon_{avg} = K \cdot F \quad (7)$$

where K is the proportionality constant and F is the force.

For a 4-active arm bridge, on the other hand, the output voltage is related to the induced strain through:

$$V_{output} = V_{input} \cdot GF \cdot \varepsilon_{avg} \quad (8)$$

V_{input}=5 volts (constant)

where:

GF= Gage Factor of the stain gage (2.09)

Solving equations 6 and 7 results in:

$$V_{output} = V_{input} \cdot GF \cdot K \cdot F \quad (8)$$

Since V_{input} GF, and K are constant, equation 8 proves that the designed load cell transducer is a linear device. However, the response of the load cell to axial force is in the form of an electrical signal (volts), and it has to be converted to the units of force (N). Therefore, it was necessary to calibrate the load cell. The calibration was performed by applying some known forces in the axial direction to the load cell. The output voltage was measured using the iCDAS-16G data acquisition board from MetroByte Company interfaced with the 286 computer in the lab. Data was taken at the rate of 20 Hz., and the mean value of 10 consecutively collected data points was recorded in a data file. Also, simultaneously the output signal was displayed on the computer monitor.

CONCLUSION

A quick visual examination of the displayed signal revealed that the force transducer had a quick response to the applied force. The results are plotted and presented. As expected, the response of the force transducer is linear.

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AN APPLICATION OF MANAGEMENT SCIENCE CONCERNING AN APPROXIMATE METHOD FOR PREDICTION

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ABSTRACT

In the first part of this paper, the overall pressure losses which occur across a valve are estimated by accounting for pressure losses due to all the individual components which comprise the valve assembly. In the second part of this paper, the control volume approach is used to obtain an approximate expression that gives the drag coefficient for flow over the poppet valve in terms of pressure losses.

INTRODUCTION

Determination of the pressure loss across the valve and the force acting on the valve poppet are crucial in the design process. It is particularly of interest to be able to predict the forces acting on the valve poppet during closing of the valve. Due to the complex nature of the flow field, it is extremely difficult and/or costly to accurately predict such forces. In addition, measurements of these forces are extremely involved and cumbersome. Since the measurement of the pressure losses which occur across the valve are relatively simple, it is desirable to find a rather simple expression which relates the forces exerted on the valve to the pressure losses which occur across the valve.

DETERMINATION OF PRESSURE LOSS COEFFICIENT

The overall pressure loss coefficient for flow over the poppet valve can be approximated by calculating the pressure loss due to each of the valve components and then adding them. The control volume formulation was used to estimate the pressure loss contributed by the individual components making up the valve. These losses are present due to the expansion of the flow upstream of the test section, the contraction downstream of the test section, the drag of the support structure, and the drag of the valve poppet. The expressions for each of these losses are obtained in the following sections.

DETERMINATION OF PRESSURE LOSS DUE TO UPSTREAM VALVE HOUSING EXPANSION

Calculation of the pressure loss coefficient due to the gradual expansion in conical sections is generally obtained by experiment. However, to get an estimate of such flow losses, flow loss through a sudden expansion is presented here.

The integral form of momentum equation as given in (1) is applied to this control volume.

$$\Sigma \vec{F} = \vec{F}_B + \vec{F}_S = \frac{\partial}{\partial t}\int_{c.v.} \rho \vec{V} dV + \int_{c.s.} \vec{V}\rho\vec{V} \cdot d\vec{A} \quad (1)$$

where $\vec{F}_B$ and $\vec{F}_s$ are the body and surface forces acting on the control volume respectively, $\frac{\partial}{\partial t}\int_{c.v.} \rho \vec{V} dV$ is the rate of change of momentum within the control volume, and $\int_{c.s.} \vec{V}\rho\vec{V} \bullet d\vec{A}$ is the net efflux of momentum across the control volume. Flow is assumed to be steady, incompressible, and frictionless with uniform velocities at the inlet and exit of the control volume. In addition, the influence of the valve poppet is neglected and there is no body force in the axial direction. Using the aforementioned assumptions, equation 1 applied in the axial direction (x-direction) of the control volume reduces to:

$$P_1 A_1' - P_1' A_1' = \rho A_1 V_1 (V_1' - V_1) \quad (2)$$

$$\zeta_{exp} = \left(1 - \frac{A_1}{A_1'}\right)^2 \quad (3)$$

Equation 3 was used to approximate the pressure loss coefficient caused by the upstream housing contour of the valve assembly. Substitution of the numerical values in this equation gives:

$$\zeta_{exp.} = 0.34 \quad (3a)$$

DETERMINATION OF PRESSURE LOSS CAUSED BY POPPET CONE

A similar approach as given for estimation of the pressure loss coefficient due to the support structure can be used here. Therefore, the pressure loss coefficient due to the poppet cone becomes:

$$\zeta_{popp} = C_{D\,popp.}\left(\frac{A_{popp.}}{A}\right) \quad (4)$$

Equation 4 shows that the pressure loss coefficient due to the poppet cone is a function of the drag coefficient for the poppet cone. Therefore, without the knowledge of the drag coefficient, it can not be determined directly. However, the experimentally determined drag coefficient, due to this type of shape, is approximately equal to 0.05, as given by Hoerner (1965). Substituting numerical values into equation 4 results in:

$$\zeta_{popp.} = 0.05\left[\frac{0.116^2}{0.157^2}\right] = 0.03$$

DETERMINATION OF TOTAL PRESSURE LOSS ACROSS THE VALVE

The total pressure loss is represented by the æ$_{total}$, which is the summation of all the losses due to the individual components making up the valve and is given by:

$$\zeta_{total} = \zeta_{exp.} + \zeta_{sup.} + \zeta_{popp.} + \zeta_{cont.} \quad (5)$$

Substituting the numerical values obtained for the corresponding loss coefficients in equation 5 results in:

$$\zeta_{total} = 0.34 + 0.10 + 0.03 + 0.06 = 0.53$$

Although the derivation of the terms in equation 5 was based on oversimplified assumptions, the predicted overall pressure loss coefficient for poppet cone #1, H_1 and poppet cone #3, H_1 valve assembly are approximately 65 percent and 75 percent of the measured values respectively.

As is seen, the pressure loss coefficient for the poppet cone is a function of the drag coefficient that can be used to calculate the forces experienced by the poppet cone. Since the measurements of the pressure losses are usually easier than the measurements of the drag coefficient, it is desirable to find a relation that predicts the drag force in terms of the pressure loss coefficient. Therefore, a procedure was developed to predict the drag coefficient during the valve closing process and is presented in the next section.

DETERMINATION OF DRAG COEFFICIENT DURING VALVE CLOSING

To calculate the drag coefficient, the drag force as well as the incoming flow velocity must be known. The presence of the drag force is due to viscous effects and pressure distribution over the body in the moving fluid. In this analysis, viscous effects were neglected and the drag due to the pressure distribution was taken into consideration. To evaluate this force, control volume approach was used. The integral form of the momentum equation was applied to a control volume. Appropriate assumptions were then made to simplify it. In addition, continuity and energy equations along with the momentum equation were used simultaneously to calculate the drag force.

The integral form of momentum equation applied to a control volume is given in (6):

$$\sum \vec{F} = \vec{F}_B + \vec{F}_S = \frac{\partial}{\partial t}\int_{c.v.} \rho \vec{V} dV + \int_{c.s.} \vec{V} \rho \vec{V} \cdot d\vec{A} \quad (6)$$

where $\vec{F}_B$ and $\vec{F}_s$ are the body and surface forces acting on the control volume respectively, $\frac{\partial}{\partial t}\int_{c.v.} \rho \vec{V} dV$ is the rate of change of momentum within the control volume, and $\int_{c.s.} \vec{V} \rho \vec{V} \bullet d\vec{A}$ is the net efflux of momentum across the control volume. Since the drag is only in axial direction, equation 6 can be applied in this direction. Also, the flow was assumed to be steady, incompressible, and frictionless with uniform velocities at the inlet and exit of the control volume. In addition, there was no body force in axial direction. Using the stated assumptions, equation 1 applied in the axial direction (x-direction) of the control volume reduces to:

$$A_1 P_1 - A_2 P_2 + R_x + (F_u)_x - (F_d)_x = 0 \quad (7)$$

where P_1 and P_2 are static pressures at sections 1 and 2 respectively, $(F_u)_x$ and $(F_d)_x$ are the forces exerted on the control volume by upstream and downstream housing contours respectively, and R_x is the force exerted to the control volume by the poppet cone.

Since the areas at the inlet and exit of the control volume are the same, setting A_1 and A_2 equal to A, equation 7 becomes:

$$A(P_1 - P_2) + R_x + (F_u)_x - (F_d)_x = 0 \quad (8)$$

$$|F_d|_x = \left(\frac{P_2 + P_2'}{2}\right)(A_{H'2} - A_2)$$

Next, the continuity equation and conservation of energy are applied between 1 and 1' respectively.

$$V_1 A_1 = V_1' A_1' \quad (9)$$

$$P_1 + \rho\frac{V_1^2}{2} = P_1' + \rho\frac{V_1'^2}{2} + K_{exp}\rho\frac{V_1^2}{2} \quad (10)$$

Then, equations 9 and 10 are combined and solved for P_1:

$$P_1' = P_1 + \rho\frac{V_1^2}{2}\left[1 - \left(\frac{A_1}{A_1'}\right)^2 - K_{exp}\right] \quad (11)$$

Continuity and energy equations are written between 2 and 2' and are combined in a similar way to give:

$$P_2' = P_2 + \rho\frac{V_2^2}{2}\left[1 - \left(\frac{A_1}{A_2'}\right)^2 - K_{cont}\right] \quad (12)$$

where K_{exp} and K_{cont} in the above equations are the flow coefficients due to the expansion upstream and the contraction downstream of the valve respectively. To find an expression for the forces exerted on the control volume by the upstream and the downstream valve housing contours, it was assumed that pressure varies linearly with the changes in area. Therefore, the following equations could be written.

$$|F_u|_x = \left(\frac{P_1 + P_1'}{2}\right)(A_{H'1} - A_1) \quad (13)$$

(14)

where $A_{H'1} - A_1$ and $A_{H'2} - A_2$ are projected areas of the upstream and the downstream housing contours in the valve axial direction respectively.

Equation (15) is solved for drag coefficient, C_D, which is given by:

$$\zeta = \frac{(P_1 - P_2)}{\frac{1}{2}\rho V_1^2} \quad (15)$$

Equation 15 was used to estimate the drag coefficient for flow over the valve poppet at the fully open position and at several partially open positions. The numerical values for terms in this equation are given below:

$$A = \frac{\pi}{4}(10.16)^2 = 81.07 \text{ cm}^2$$

Substituting values into equation 15 yields:

$$C_D = 1.065\zeta - 0.01 \quad (15a)$$

Equation 15a was used to calculate the drag coefficient for different velocities when the base model design valve was in its fully open position. The results obtained from the experimental measurements and the results obtained by using the above equation show a very close agreement (the maximum of seven percent deviation) between the calculated results and the measured results.

Inspection of equation 15 reveals that, during closing of the valve, the area downstream near the valve seat becomes a dominant factor in evaluation of the term in the bracket. The flow area is normalized with respect to the smallest flow area ($A_0 = 74.10$ cm^2) at the fully open position and the opening valve position is normalized with respect to the valve stroke length ($L_0 = 4.1$ cm). The measured drag coefficients are at the average flow velocity of 1 m/s.

CONCLUSION

Equation 15 was developed to predict the drag coefficient for the valve at the fully open position. However, when it was used to calculate the drag coefficient at the different valve opening positions, it was found that the predicted values from this equation are within 20 percent of the measured values. This is true for valve poppet positions between the fully open position and the half-open position of the valve except when the valve is positioned at 10 mm downstream (approximately 75 percent open).

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STABILITY ANALYSIS FOR DEA MODELS: AN EMPIRICAL EXAMPLE

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ABSTRACT

This paper provides a framework for finding stable Data Envelopment Analysis (DEA) efficiency classifications. The approach is innovative in (1) assigning DEA efficiency classifications of efficient (E), inefficient (IE), or unstable (US) based upon cluster analysis of sensitivity scores and (2) comparing different analytical approaches, such as the Cobb-Douglas Production Function and ratio analysis, to DEA. A case study with 36 Jordanian hospitals illustrates the methodology. The DEA hospital classifications are robust with respect to input-output variable selections and surprisingly stable across reference sets for different years. However, differences between constant-return-to-scale (CCR) and variable-return-to-scale (BCC) DEA models suggest the importance of initial model formulation. Cobb-Douglas efficiency shows considerable agreement with DEA in this case. Ratio analysis has a bias for finding units efficient relative to the other methods.

THE COMPARISON OF GA-VRPTC WITH OTHER METHODS: SOLVING THE VRPTC

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ABSTRACT

This paper presents the comparison of Genetic Algorithms constructed to solve Time Constrained Vehicle Routing Problems (GA-VRPTC) with other methods of solving the VRPTC in terms of solution quality and efficiency of execution as measured by CPU time. Computational results of this comparison are reported and a detailed statistical analysis of the results is conducted.

INTRODUCTION

This paper consists of developing a genetic algorithm to solve the VRPTC (GA-VRPTC) building on the insight gained during the development and computational evaluation of genetic algorithm-traveling salesman problem (GA-TSP). We begin with a discussion of the preliminary testing and the tuning of GA-VRPTC to achieve the best possible results in terms of solution quality.

Test problem selection for the computational analysis of GA-VRPTC and the complete computational evaluation of GA-VRPTC are presented. Next, a non-parametric statistical test, the Friedman test, is used to analyze the results of this evaluation to determine the effect of small, medium, or large GA population sizes on the solution quality obtained. This paper concludes with a statistical comparison of the results obtained by GA-VRPTC with the results previously recorded using several traditional algorithms on a suite of 14 test problems. These test problems are presented in Christofides, Mingozzi and Toth (1979). Observations are made and the paper ends with a summarization and conclusions of this computational evaluation of GA-VRPTC.

GA-VRPTC PRELIMINARY TESTING

The primary difference in the code for GA-TSP and the code for the initial version of GA-VRPTC lies in the evaluation function. The GA-VRPTC evaluation function partitions each chromosome into a set of tours based on vehicle capacity limits, calculates the distance for each route, and re-partitions the chromosome as necessary to comply with the time constraints of the problem. No violations of problem constraints are allowed and the fitness of each chromosome is the total distance traveled to service the set of customers in the VRPTC.

For preliminary testing, problem *vrpncl* was randomly selected from the VRPTC test library. This problem requires that routes be generated to 50 cities from a depot using vehicles with a capacity of 160. There are no delivery/drop time considerations and no time limits for each route. This problem is also the first problem solved in Christofides, Mingozzi and Toth (1979). After running the first preliminary test, we found that the results obtained by GA-VRPTC on this problem were two to three times worse in terms of solution quality than the results obtained by any of the traditional algorithms solved and presented in Christofides, Mingozzi and Toth (1979).

CROSSOVER FUNCTIONS

The initial attempt to improve the solution quality of GA-VRPTC was to evaluate the results obtained when each of the viable crossover operators for order-based problems using path encoding was utilized as the crossover operator. Each of these variations was tested on the test problem, *vrpncl*. While not meeting our expectations, orderl crossover still produced the best results. In addition to evaluating different crossover functions, the probability of crossover being applied during the generation of new chromosomes was varied and evaluated. The probability of crossover was varied from .5 to 1.0 in increments of .05. One hundred percent crossover appears to give superior results in most cases. Each of these tests were conducted with small, medium, and large population sizes. In all cases the choice of orderl crossover and 100 percent mutation was confirmed.

DEVELOPMENT OF IMPROVEMENT OPERATORS

The performance in terms of solution quality of GA-VRPTC, as initially developed, was two to three times worse than the results obtained by more traditional algorithms (Christofides, Mingozzi and Toth, 1979). While a pure GA or hybrid GA using a space filling curve (SFC) to generate an initial GA population was capable of finding optimum solutions to TSP, it appears that this approach is not adequate for solving the more complex VRPTC. Further testing and analysis found that, to achieve some degree of success in solving the VRPTC, the inclusion of an improvement function was required.

R_OPT IMPROVEMENT

In an attempt to address the problem at hand, an r_opt improvement function was developed for use in GA-VRPTC. In this test *r* was selected to be two; consequently, the r_opt function is a 2_opt. The r_opt improvement function re-orders the paths of the individual tours created by loading vehicles and ensuring compliance with the vehicle capacity as well as time/distance constraints. Within each tour, each city was inserted in every other position and the tour was evaluated to see if it was shorter. If it was shorter, this became the new tour. The process continues until each combination has been tried. This approach guarantees that each tour generated would be as short as possible. It does not guarantee that the overall VRPTC distance is as short as possible, as we do not insert each city in other tours.

The first application of the r_opt improvement function was as a post-hoc process to improve the quality of the solution found by the standard GA-VRPTC. This approach provided good results, but the results obtained still did not approach those previously obtained with traditional heuristics.

The r_opt improvement function was used in place of the crossover function. This approach did not prove viable, as it forced the GA to prematurely converge. Next, the improvement function was used in place of the mutation function. This approach provided improvements in performance that allowed GA-VRPTC to compare quite well in terms of solution quality with the results presented in Christofides, Mingozzi and Toth (1979). The probability of applying the r_opt function was varied from .05 to 1.0. The best results were obtained with a value of .15.

TEST BED PROBLEMS

The problems selected for use in the GA-VRPTC evaluation were obtained from the ORLibrary presented in Beasley (1990) and accessible on the Internet by anonymous ftp at mscmga.ms.ic.ac.uk. These test problems are representative of a cross section of several real- world problems selected from the literature. These same problems were solved in Christofides, Mingozzi and Toth (1979) by a group of traditional operations research algorithms for solving the VRPTC.

Our intent is to compare the results obtained by GA-VRPTC with those presented in Christofides, Mingozzi and Toth (1979).

TEST EXECUTION

There remains some ambiguity as to which GA population size tends to give the best results in terms of solution quality. In the GA-TSP evaluation, we found that often the best results were obtained with smaller population sizes. For the GA-VRPTC test, GA-VRPTC was executed using a small GA population size of 100, a medium GA population size of 200, and a large GA population size of 500.

The GA-VRPTC test was conducted on a network of Sun Sparcstation 10-30 machines. Each machine was configured with 64mb of main memory. All machines shared a common NFS mounted drive for problem data and results. The Sun workstations were running the Solaris 2.3 operating system. All code was compiled using the GNU gcc 2.58 C compiler.

The test was conducted using the Genetic Algorithm Testing System (GATS). GA-VRPTC was used to solve five replications of the 14 test problems using small, medium, and large GA population sizes. A total of 210 problems were solved by the three GA-VPRTC configurations. As each problem was solved, the results in terms of solution quality and CPU time were recorded by GATS in a run log. In the run log, the solution value, CPU time required to solve the problem, the time of the execution, and the number of generations it took to converge or reach the maximum number of generations allowed was recorded.

At the end of the computational stage of the experiment, the results recorded in the log files were re-coded for analysis by the SPSS statistical analysis package. SPSS was used to conduct the statistical analysis presented later in this paper.

INITIAL REVIEW OF COMPUTATIONAL RESULTS

The CPU times presented in Christofides, Mingozzi and Toth (1979) were based on solving these problems using a CDC 6600. These entries have been translated to equivalent CPU times on a Sun Sparcstation 10-30 using conversion factors found in Dongarra (1994).

The Sun Sparc 10-30 was reported to have an Mflop rating of 9.3 on the *LINPACK* benchmark, and the CDC 6600 reported an Mflop rating of *AS.* The *LINPACK* benchmark is a CPU intensive benchmark that is similar in nature to computing solutions to the VRPTC. CPU times are translated from CDC 6600 to Sun Sparc 10-30 by multiplying the CDC 6600 time by a translation factor of .0515. The GA-VRPTC column shows the mean solution value over five replications of each specified VRPTC. CPU Time is the mean solution time on a Sun Sparcstation 10-30. By observing the CPU time in this column, it can be seen that the CPU time used by GA-VRPTC is several orders of magnitude greater than the CPU time used by the more traditional algorithms.

Observation A_{init} : The primary reason for the vast difference in the amount of CPU time required to solve the VRPTC using traditional algorithms and the GA-based approach is that in the GA approach, an entire population of potential solutions is being evolved to solve the problem at hand. This inherent parallelism will make this type of algorithm very adaptable to using the parallel computers available today. Some preliminary research is being conducted in this area. It may be the focus of future GA research.

Observation B_{init} : By observing the solution quality, we can see that the solution quality obtained by GA-VRPTC is very consistent with the responses obtained using traditional VRPTC algorithms. In most cases the results obtained by GA-VRPTC are within a few percent of the best available and in the worse cases, it is no more than a few percent worse than the poorest performing traditional algorithm.

STATISTICAL ANALYSIS OF RESULTS

Golden and Skiscim (1986) suggest a number of statistical tests to evaluate the performance of competing algorithms. They suggest the Wilcoxon signed rank test and the Friedman test as the preferred approaches. The Wilcoxon signed rank test is used to compare the performance of two algorithms, while the Friedman test is an extension that permits the comparison of more than two algorithms.

The current requirement is to compare the results obtained using GA-VRPTC for solving 14 VRPTCs with the results obtained using five traditional VRPTC algorithms to solve these same problems. The results obtained using traditional VRPTC algorithms are presented in Christofides, Mingozzi and Toth (1979). Only summary data is presented on the performance of the traditional algorithms in this paper.

Our primary intent is to rank the performance of GA-VRPTC in terms of solution quality with the other algorithms presented. Golden and Skiscim (1986) suggest the use of the Friedman test. In this analysis we test the hypothesis that each treatment or algorithm used to solve each of the selected VRPTCs produces equivalent results.

The Friedman test ranks *k* variables from one to *k* for each case, calculates the mean rank for each variable over all the cases, and then calculates a test statistic with approximately a chi-square distribution.

OBSERVATIONS

Observation A: Performance in terms of solution quality of GA-VRPTC provides superior results to algorithms A and B and worse than algorithms D, E, and C. These results seem to indicate that the GA has the potential to provide good solutions to these problems that are within the range of the best research algorithms.

Observation B: When solving more complex problems such as the VRPTC, the inclusion of an r_opt improvement function in place of the mutation operator appears to enhance the results.

Observation C: The results in terms of CPU utilization required much improvement. Currently, there are several orders of magnitude difference between traditional VRPTC algorithms and GA-VRPTC. While additional performance improvement may be obtained by additional tuning, it is doubtful that GA-VRPTC will approach the performance in terms of CPU utilization of the traditional VRPTC algorithms. The best hope for improving the CPU times of GAs may lie in the use of parallel computing architectures.

CONCLUSION

It appears that a hybrid GA approach for solving the VRPTC is viable. The results obtained in this study compare favorably in terms of solution quality with traditional algorithms for solving the VRPTC. Much work remains to be done in terms of reducing the amount of CPU time required to solve these problems.

The approach taken in this paper differs from that taken in previous studies, most notably those conducted by Thangiah, Vinayagamoorthy and Gubbi (1993). This study used a GA to solve the VRPTC completely. In Thangiah, Vinayagamoorthy and Gubbi (1993), a GA was used solely to perform clustering of the cities to be serviced, and the balance of the VRPTC was solved using traditional approaches. This study shows that the GA can be used to solve the VRPTC completely.

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THE DEVELOPMENT OF GENETIC ALGORITHMS USED IN SOLVING THE VEHICLE ROUTING PROBLEM WITH TIME CONSTRAINTS (VRPTC)

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ABSTRACT

This paper explores the potential of genetic algorithms (GA) to solve order-based problems, with particular emphasis on solving the traveling salesman problem (TSP) and the time constrained vehicle routing problem (VRPTC). As a result of a thorough review of the literature, several issues related to developing GAs to solve ordering problems are uncovered. An in-depth, empirically valid computational study using an a priori statistical design is conducted to determine the best combination of parameter settings and design decisions to use when building GAs to solve ordering problems. This test was conducted using the GA Testing System (GATS) developed as part of this effort. A suite of real-world problems selected from literature and the TSPlib 1.2 were solved with 144 different GAs designed to solve the GA-TSP, also developed as part of this paper.

INTRODUCTION

This paper explores the development of GAs to solve order-based problems. The specific problem of interest is the VRPTC. This problem requires finding the minimum cost to service a set of customers from a depot. Each customer has a particular demand/load and each tour must be completed within a specified period of time using a set of capacity constrained vehicles. In addition to the time required for travel from the depot to each customer on the tour, a drop or delivery time may be specified. The TSP objective is to find a minimum cost Hamiltonian tour of all the nodes in the TSP. These problems share the property of being easy to define and difficult to solve.

More than 5,000 problems were solved by GA-TSP during this study. The results of the GA-TSP test were used to develop a GA to solve the GA-VRPTC. To evaluate GA-VRPTC, a set of VRPTCs were solved and the results were compared with the results obtained when solving the same set of problems using traditional algorithms. We find that GA-VRPTC performs well in terms of solution quality; however, the amount of CPU time required to solve these problems exceeded that used by traditional methods by several orders of magnitude. After reporting and analyzing the results of the GA-VRPTC test, suggestions for further improvements and extensions are made.

EARLY PHASE

After a review of the literature, emphasis is placed on heuristics to solve the VRPTC and the TSP. The problem characteristics of the VRPTC and the TSP were reviewed. Traditional methods for solving these problems were examined. Next, potential AI-based solution methods such as Simulated Annealing (SA), Neural Networks (NN), Tabu Search (TS), and GA were explored. The two most promising AI approaches appear to be GA and TS. As GA was selected as the subject of

this paper, an in-depth review of previously published attempts at applying GA to the TSP and VRPTC was conducted. We find that a fair amount of effort has been expended on applying the GA to solve the TSP, while little previous work has been based on applying GA to the VRPTC.

It was decided to conduct this study in two phases. The object of Phase I is to develop a GA for solving the TSP (GA-TSP). When GA-TSP was developed, the insight gained would be used to develop a GA for solving the more complex VRPTC (GA-VRPTC) in Phase II. The GA-VRPTC developed is compared in terms of solution quality and CPU time utilization with traditional VRPTC.

The process of reviewing the application of GA for solving the TSP uncovered several areas of conflict in the literature. This conflict relates to determining the best possible configuration and design parameters for developing a GA for solving the TSP. The areas of conflict begin with determining the best problem representation. The effect of initialization of a GA population with good solutions to the problem was disputed, as was appropriate GA population size. Which evolution strategy, generational or steady state, is the superior strategy for order-based problems is another source of conflict. The use of elitist or non-elitist strategy is still debated. One of the largest areas of conflict revolves around which crossover operators are most productive in order-based GA.

In light of the conflict evident in the literature, a comprehensive evaluation of each of these areas of conflict was conducted in Phase I of this study to help determine which initial configuration and design parameters will provide superior performance when developing a GA to solve ordering problems. This test involved developing 144 different GAs to solve the TSP. The 144 different GAs include all possible combinations of the conflicting design or configuration parameters.

Another shortcoming in the area of GA research was addressed--lack of *a priori* statistical experimental plans for computational comparative study of alternative GAs to solve the TSP and VRPTC. An empirically valid statistical experimental plan was developed for GA-TSP. Each of the GA developed to solve the TSP was used to solve five replications of the TSP test bed problems representing the entire population of TSP. These problems varied in size and dispersement.

Phase II of this study builds on the knowledge and insight gained during Phase I. The best configuration and design parameters identified in the GA-TSP evaluation were used to initially develop the GA to solve VRPTC (GA-VRPTC). The original design developed in this study intended that the only difference in the code used in the best GA-TSP configuration and GA-VRPTC would be in the evaluation function. The GA-VRPTC evaluation function must partition the chromosome to be evaluated into tours based on time and vehicle capacity constraints and sum the distance of each tour as the chromosome fitness function.

During the preliminary testing conducted on GA-VRPTC, it was determined that the performance of GA-VRPTC, as designed, was not meeting our expectations in terms of solution quality. The average performance of GA-VRPTC was two to three times worse than the results obtained by the traditional VRPTC algorithms on the sample problem.

Based on our initial results with GA-VRPTC, it was decided to pursue a higher level of hybridization for this algorithm. Several tour improvement functions were coded, integrated with GA-VRPTC, and evaluated. The improvement functions developed were an r_opt function, an Or_opt function, a SFC function, and an inversion function.

Initially, the improvement function was embedded as a post-hoc process to improve the result obtained by GA-VRPTC. This approach did not provide adequate improvement. Using an improvement function as a crossover operator was tried unsuccessfully. This approach forces premature convergence. Finally, the improvement operator was tried in place of the mutation operator. This approach provided the best results. Further evaluation showed that the r_opt where r = 2, or 2_opt, provided the best results.

Three versions of GA-VRPTC were used to solve the 14 test bed problems. The only difference between these versions was the GA population size. The results of this test were evaluated and it was found that there was no significant difference between the medium and large GA population size on solution quality.

The results obtained by GA-VRPTC compared favorably in terms of solution quality with the traditional VRPTC. GA-VRPTC performed better than two of the traditional algorithms and worse than three in terms of solution quality. In terms of CPU utilization, GA-VRPTC was several magnitudes worse than the traditional algorithms.

STATISTICALLY VALID RESEARCH DESIGN

In the field of GA research, seldom is a statistically valid research design developed and executed. In this research, the design and implementation of an *a priori* statistical design for an in-depth computational comparison among heuristic alternatives was developed to evaluate the effect of each of the configuration and design issues uncovered by our review of the research. This study was developed to evaluate both the solution quality and the amount of CPU time required to obtain a solution.

DEVELOPMENT OF A PORTABLE GA TESTING SYSTEM (GATS)

After the experiment was designed for testing the GAs and configuration issues, a testing system, GATS, was developed to conduct the test. The testing system selected problems for testing, configured GAs to solve them, scheduled the tests, and recorded the results. After the results were obtained, they were reported and transformed for statistical analysis. For the GA-TSP test, 144 alternative GAs were developed. These GAs were used to solve 5,184 TSPs during the analysis and over (14)(5) = 70 VRPTCs in addition to the countless problems solved during the preliminary analysis and tuning of the VRPTC. These problems are representative of real-world problems, and this testing system could also be used to solve other real-world problems.

NEW MINIMUM FOR TSP PROBLEM FOUND

The problems used for conducting the GA-TSP test were selected from the TSPlib 1.2, which was generated at Oak Ridge Laboratories for conducting research on order-based problems and GA literature. For one of the problems, Oliver's 30-city problem, presented in Whitley, Starkweather and Fuquay (1989), a new minimum solution was found using the following configuration parameters, random GA population generation, GA population size 500, generational evolutionary strategy, elitist replacement strategy, and orderl crossover. The previous minimum was 424. The new minimum found was 423. A description of these results is given in the next section.

BEST INITIAL CONFIGURATION FOR ORDER-BASED PROBLEMS

The GA-TSP test provided the following initial design and configuration parameters for developing GAs for solving order based problems:

GA Population Creation	Initialize 50% with a good initial solution
GA Population Size	Large Population 200 +
GA Evolution Strategy	Steady State
GA Population Replacement	Elitist Strategy
GA Crossover	Asexual or Order1 Crossover

These initial configuration options were tested in the GA-VRPTC test and still proved to deliver the best results.

EVALUATION OF GA-VRPTC

A test was designed and a GA was developed to evaluate GA performance on the more complex VRPTC. Two interesting results are obtained in this analysis. The first is that the embedding of an improvement function in place of the traditional mutation function is required to obtain reasonable results. By embedding a 2_opt heuristic in the GA to solve the VRPTC, results comparable in terms of solution quality with the traditional VRPTC algorithms were obtained. These results seem to suggest that as the problems to be solved become more complex, the value of hybridization increases. For the relatively simple TSP, the GA alone performed very well.

The approach taken in this study differs from that taken in previous studies, most notably those conducted by Thangiah, Vinayagamoorthy and Gubbi (1993). This study used the GA to solve the VRPTC completely. In Thangiah, Vinayagamoorthy and Gubbi (1993), the GA was used solely for developing clustering, and the balance of the VRPTC was solved using traditional approaches.

A further difference is the evaluation of GA performance against known algorithms on real-world problems. Thangiah's study used randomly generated problems to evaluate his implementation and simply presented his results. This does not give the reader adequate means to compare the performance in terms of effectiveness or efficiency with other approaches for solving the same problems. Additionally, even though the CPU utilization was excessive, it should be reported to give the reader a means of comparing the relative efficiency of various algorithms. This was also omitted in most previous studies of GA. The results obtained in this study prove that a more traditional GA approach can successfully solve the VRPTC.

RESEARCH LIMITATIONS

There is a lack of statistically valid results reported in the GA field. Traditionally, only simple results in terms of solution quality are reported. The CPU time required to obtain the solution is rarely reported. This limits the ability to conduct comparative analysis with previous research. Hopefully, this study will start a trend toward developing statistically valid studies and analysis.

CONCLUSION

The GA appears to be a very good meta search strategy. Future areas of research will lie in the development of hybrid algorithms. A proposal for developing hybrids based on GA and TS is suggested in Glover, Kelly and Laguna (1993). The results obtained in this study suggest that hybridization becomes more valuable as the problems being addressed become more complex.

The serial GA uses an excessive amount of CPU time to reach a solution. This approach appears to lend itself to parallel implementations. Several approaches toward parallel implementation may be pursued. For instance, an entire population may be involved at once. Another approach is to use a steady state approach and have all available processors evolve a population simultaneously.

The most profitable future area of research in the field of GA appears to be in the development of hybrid GAs and parallel implementations of GAs. Perhaps these two areas can be combined.

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DESIGN AND IMPLEMENTATION OF ALTERNATIVE GENETIC ALGORITHM HEURISTICS

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ABSTRACT

This paper presents the design and development of alternative genetic algorithm (GA) based heuristics specifically designed to solve the traveling salesman problem (GA-TSP) and the development of GA-VRPTC to solve the vehicle routing problem with time constraints. The third and final section of this paper discusses the design and development of a portable GA test system (GATS).

INTRODUCTION

In our review of the literature, we found that there is a strong linkage between heuristics designed to solve the VRPTC and heuristics designed to solve the TSP. Often a TSP heuristic is embedded in the VRPTC heuristic.

The original intent of this paper was to develop a heuristic to solve the VRPTC. Following our review of the literature, it was decided to conduct this study in two phases. Phase I will develop several GA-TSP heuristics and evaluate their performance. The results of this evaluation and the insight gained from developing GA-TSP will be used in Phase II of this study. Phase II will develop GA-VRPTC and evaluate its performance in terms of effectiveness and efficiency. This will be accomplished by solving a set of VRPTC previously solved using traditional algorithms and comparing GA-VRPTC's performance with the performance of the more traditional algorithms.

PHASE I--GA-TSP ALGORITHM DESIGNS

In reviewing the literature, we find that there are several areas of conflict regarding the best approach for developing a GA to solve ordering problems such as the TSP and VRPTC. In an effort to resolve some of these conflicts and to identify the best parameters and design decisions for developing the most effective GA to solve the TSP, the decision was made to develop a GA that would easily allow the testing of various configurations.

In reviewing available GA code, we examined the LibGa package. This is the only code we found that has the capability of using both generational and steady state population evolution strategy. The most commonly utilized GA test bed, GENESIS, utilizes only generational population evolutionary strategy. The other system that commonly utilizes code for developing GA for ordering systems, GENITOR (Whitley, 1988), is restricted to steady state population evolutionary strategy. LibGa was chosen as the starting point for our GA development. Further information about this package can be found in Corcoran and Wainwright (1993).

GA-TSP was developed by modifying some of the code found in LibGA and combining this code with many new code modules developed specifically for this study. The GA was developed

using the GNU gcc 2.58 compiler on a free UNIX system, Linux. All code was written or rewritten in ANSI compliant C language. One of the basic design criteria for this code is that the GA developed be dynamically configurable. That is, when another variation of a GA is required, it should be easily reconfigured without recoding and recompiling. User configuration parameters for the GA are entered into a GA configuration file and used by GA-TSP to dynamically reconfigure itself.

TSP data files are generated by the GA Test System (GATS) developed for this study and discussed later in this paper. GATS is capable of reading standard TSPlib files and translating them to the GA-TSP format. GATS also allows the entry of problem files using a spreadsheet or flat file format.

As GA-TSP uses a full $N * N$ matrix for distance calculations, it is possible to solve both symmetric or asymmetric TSPs using alternative GAs presented in this study. For symmetric TSPs, the distance is calculated once for each X and Y location and the results are placed in the complementary location. The default distance calculation is for Euclidean distances. For non-Euclidean distances, a distance table may be loaded into GA-TSP.

Several data transformation options are included in GA-TSP. One option forces all locations in the problem file to be remapped in the interval 0 to 1. It was hypothesized that this might be useful when comparing results obtained on problems of vastly differing scales. An option that forces chromosomes to always begin at location 1 was included. The reason for this option is to allow the GA to take advantage of good building blocks or high potential sequences in generating new chromosomes. For the TSP, the sequence 123 gives the same result as the sequence 231. For the GA these sequences are not seen as the same.

A chromosome can be built using various encodings. For purposes of this application, a chromosome is simply a vector of any data types. The data types can be integers, characters, double precision numbers, or any intrinsic or user defined data type allowed by the C programming language.

Crossover functions that support the path encoding chosen for this study, as well as the rate of applying crossover, have been coded and may be selected. Several mutation functions that support path encoding have also been coded. The rate that the mutation function is applied is also configurable.

The GA objective must also be selected. This is used to determine if the highest fitness chromosome or the lowest fitness chromosome is best. The use of elitist replacement strategy is also selectable. Elitist strategy, used only in combination with generational evolutionary strategy, ensures that the best of the current generation is included in the next generation. Several user selectable reports are available. Log and summary files are always generated to capture the final results in terms of solution value and CPU time. Additional reports include logging the results of every generation or logging every tenth generation. Plot files of the final solution that can be displayed by *gnuplot* can also be generated.

The evaluation function for the TSP calculates the fitness of each chromosome to be evaluated by summing the distance between each adjacent pair of cities in the tour and adding the distance back to the first point or city. This evaluation function is very fast.

GA-TSP MEMORY REQUIREMENTS

The memory requirements for GA-TSP are primarily determined by the number of cities in the TSP and the size of the initial GA population. The base memory requirement includes approximately 250KB. Table 1 shows GA-TSP memory requirements.

TABLE 1
GA-TSP MEMORY REQUIREMENTS

Let B := base memory requirement - approximately 250 KB;
Let N := the number of cities in the TSP;
Let P := the number of chromosomes in the GA population;

For Steady State evolutionary strategy:

Approx _Memory _Requirement := B + (N * N * sizeof(double)) + (N * P * sizeof(double));
For Generational evolutionary strategy:
Approx_Memory_Requirement := B + (N * N * sizeof(double)) + 2(N * P * sizeof(double));

PHASE II--GA-VRPTC ALGORITHM DESIGN

GA-VRPTC is developed as an extension of GA-TSP. The primary difference in the code is seen in the evaluation function. The evaluation function is seen in Step 5 of the GA-TSP algorithm. This section will discuss the GA-VRPTC evaluation function. Following this discussion, some possibilities for integrating improvement functions will be examined.

The literature shows two basic approaches for developing heuristics for solving the VRPTC. One approach begins by clustering locations and then developing routes that service each of the clusters. The other method finds a route that can service all of the locations and then partitions the route into clusters that satisfy the constraints of vehicle capacity and route distance/time. These two approaches are respectively referenced as *cluster first* and *route first* approaches for solving the VRPTC.

In GA-VRPTC, we solve the entire problem incrementally. In the evaluation function, genes are partitioned into tours based on the problem constraints. The distance of each tour is determined and summed to calculate the fitness of the chromosome being evaluated. As the GA converges, the chromosomes with the minimum fitness value will be the most desirable and the population will converge to these values. The only other study published that uses GA to solve the VRPTC used the cluster first method. Thangiah, Vinavagamoorthy and Gubbi (1993) used a GA to partition the locations to be serviced into clusters and then used a traditional TSP algorithm to develop routings.

It is hypothesized that the primary difference between the GA-TSP and GA-VRPTC will be the fitness evaluation function. The codes for the VRPTC and the TSP use the same chromosome representation. The chromosome representation is simply the sequence of the cities to be visited. For the VRPTC, the evaluation function partitions the path into clusters that comply with the criteria of maximum vehicle loads and time constraints. The total distance traveled by all tours in the VRPTC is assigned to the chromosome as its fitness value.

The city data structure for GA-VRPTC differs from that used for GA-TSP by the addition of the demand to be moved to each city. It could easily be modified to include a unique drop time for each site or both drop-off and pick-up demand.

If the pure GA approach does not give the results desired, several improvement operators may be developed and included in GA-VRPTC. One use of improvement operators seen in traditional algorithms is the use of an r-opt or Or-opt improvement function to improve the final solution obtained by the primary algorithm. This approach may be explored. Other options are the use of improvement operators in place of traditional crossover or mutation functions.

DEVELOPMENT OF A PORTABLE GA TESTING SYSTEM (GATS)

One of the tasks required to perform this research is the development of a portable testing system to allow us to ensure that each of the tests is consistently performed. GATS supports the three phases of test execution. Initially it provides support for test problem generation either interactively or through transformation of test library files into appropriate input to the test execution phase. In the test execution phase, GATS provides scheduling for multiple concurrent tests running on a TCP/IP network of UNIX machines. During the testing phase, GATS provides several other services as outlined below. As each test is concluded, the data gathered is used to generate a series of reports and optionally a file that can be used to plot the final solution.

GATS was developed on a Pentium PC running the Linux 1.0 Unix operating system. The code was compiled using the GCC 2.58 compiler and debugged using the GNU debugger GDB. To ensure portability and maintainability, GATS is developed in fully ANSI compliant C code. All code that was included for use in GATS was upgraded to current ANSI standards. Aside from testing and debugging, all tests of GA configurations were conducted on a network of Sun Sparkstation 10-30s running Solaris 1.2. The GCC 2.58 compiler was also utilized on the Sun workstations when the GATS code was moved to that environment.

GATS allows the execution of multiple problems using dynamic configuration options to allow the execution of multiple GAs configured as required to test parameters and design decisions. Controlling the number of repetitions of each test in an automatic manner and reporting both summary and individual results is a primary function of GATS. The system allows an *operator-less* environment once the series of tests to be conducted is configured. When a large number of tests are required to be conducted, this facility has proven invaluable. For the GA-TSP experiment, over 4,300 problems needed to be solved for each run. This would have been nearly impossible without tools to support this effort. Other extensions include the capture of the CPU time required to solve each problem. Automatic limits to the number of generations the GA was allowed to execute were also introduced. Extensive reporting capabilities were added, including the ability to generate plot files of the final solution and the optimal solution if known.

One of the primary objectives of the GATS design was to develop a platform in which it would be possible to execute a large number of GAs to solve a set of representative problems and to record the results for further analysis in the most expeditious manner possible. To execute a large experiment such as this one, a lot of drudgery is involved in running programs, collecting the results, reinitializing, analyzing data files etc. GATS uses a script that schedules the full set of programs to be executed, ensures the integrity of the data files required, and ensures that any errors are correctly logged.

Several features support this concept. By allowing the passing of command line parameters to the main program, a driver script can initiate the process in an operator-less environment. This feature allows the scheduling of programs for execution on a large network of machines instead of a single machine. This feature proved very useful in this experiment. Automatic determination of program initialization files and the generation of unique output file names is another feature of GATS. An option to normalize problem data in a range from 0 to 1 is included to assist in comparison of performance when solving different problems.

For each problem selected for execution, an automatic limit in terms of the number of generations a problem will be allowed to execute is calculated. This limit is based on a heuristic that appears to allow the most opportunity for convergence without undue waste of computer resources on a problem that does not converge. The maximum number of generations a problem is allowed to execute is calculated according to the number of cities. For generational evolutionary control, the process concludes here. For steady state evolutionary control, the maximum number of generations is increased by a factor calculated by dividing the maximum generations by two.

A routine that implements a version of the SFC heuristic to solve the TSP was coded for use in creating seeded or initialized populations. This heuristic provides a good initial solution for a

TSP in very little time. Our experience is that most problems were solved by SFC in less than .05 seconds. More information on space filling curves can be found in Bartholdi III and Platzman (1988).

CONCLUSION

This paper provides an overview of the design and implementation of the GAs developed to solve the TSP (GA-TSP) and VRPTC (GA-VRPTC) for this study. Additionally, the GATS was developed to support the testing required in this study. All of these applications were developed using GNU GCC 2.58 on a free UNIX system, Linux 1.0, running on a Pentium-based PC. The GAs developed to solve the TSP and VRPTC integrated code from LibGA as well as code developed specifically for this study. Both the GATS and the GAs developed for this study have proven robust and extensible.

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COMPUTATIONAL RESULTS AND STATISTICAL ANALYSIS OF THE DEVELOPMENT OF A GENETIC ALGORITHM FOR SOLVING THE TRAVELING SALESMAN PROBLEM

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ABSTRACT

This paper presents the results obtained by executing an experimental research design concerning the traveling salesman problem (TSP). Following the discussion describing the execution of the experiment and the computational results obtained, a statistical analysis of the results is presented. Observations are recorded and conclusions are drawn to help determine the best set of configuration and design parameters to be used when developing a genetic algorithm (GA) to solve ordering problems such as the TSP.

INTRODUCTION

The experimental research design was conducted using the Genetic Algorithm Testing System (GATS). For each of the 144 different GA configurations presented in the experimental design, a GA was developed and used for testing by the GATS. Five repetitions of each of the six selected TSPs were solved by each of the 144 GAs developed. The test was conducted on a network of Sun Sparcstation 10-30 computers. Each GA/test combination was randomly assigned to one of the Sun workstations on the network for execution. At the end of the computational stage of the experiment, the results recorded in the log files were re-coded for use by the SPSS statistical analysis package. This package was used to conduct the statistical analysis presented in this paper.

STATISTICAL ANALYSIS OF RESULTS

The analysis phase of an experimental design includes the application of analytical procedures (usually statistical), the establishment of hypotheses and procedures for evaluating hypotheses, and the statement of conclusions. This section presents applications of statistical methods to analyze the computational results obtained by the execution of the GA-TSP experiment. Due to the large number of cells we are working with and the complexity of what we are trying to accomplish, we will be analyzing only the main effects and any valid two-way interactions found in the results obtained. Even if higher levels of interaction are found, they will be ignored due to the difficulty in interpreting them. We begin our analysis by determining if there are any two-way interactions. If there are, we will try to explain them prior to analyzing any main effects.

ANALYSIS OF VARIANCE

The main goal of this paper is to determine which combination of levels of the five factors selected for analysis tend to give the best results in terms of solution quality and efficiency as measured by CPU time in seconds required to achieve a solution. We will be using Analysis of Variance (ANOVA). This statistical method provides information for simultaneously testing whether there is a statistically significant difference between the results obtained with every combination of levels of the five factors selected for analysis. In addition to testing whether the main effects of each factor produce significant results, we will be using ANOVA to determine if the interaction of any factors provides a significant effect. Based on our experimental design, we can test the significance of any treatment combination solution quality or efficiency by analyzing the variance between their respective means.

To test for significant difference between means, ANOVA breaks the variation in the data into two components: the variation between the means and the variation within the data. In its simplest form, the variation between the means is computed by squaring the difference between each mean and the grand mean, multiplying these squared deviations by the number of items making up the mean, and summing the weighted squared deviations. The second component of variation, the variation within the data, may be computed by squaring the deviations of each item of data from its own mean for each of the given sets of means and then summing these squared deviations. Each of these two components is divided by its respective degrees of freedom.

The results consist of two estimates of the population variance. If the variance between means is approximately equal to the variance within the data and the ratio of the variance between means to the variance within the data equals one, then the variation between means is said to be non-significant. If the variation between the means is much greater than the variation within the data, there is significant difference in the means because the variation is not explained by the variation in the data. The variation ratio is computed by Equation 1 below.

Equation 1

$$F = \frac{S_1^2}{S_2^2}$$

where:

S_1^2: variance among the treatment means.

S_2^2: variance within the data.

To determine if the difference between the means measured by the F test is significant, the value obtained using Equation 1 is compared with a table of theoretical F distributions. This table is readily available in most statistics books. The F distribution is skewed differently for the number of degrees of freedom in the numerator and denominator. The degrees of freedom in the numerator are usually equal to the number of means to be compared minus one.

The degrees of freedom for the denominator are the number of data points to be compared minus the number of groups. The calculated F value is significant if the calculated value exceeds the theoretical value obtained from the table of F distribution. When a significant F value is found, we may infer that there is, at a minimum, a statistically significant difference between the smallest and largest mean compared. There may be many more differences between the means that may be uncovered by post-hoc analysis. A post-hoc test must be conducted to determine which means are significantly different from each other.

There are several valid post-hoc or follow-up techniques generally available for use in this design. The follow-up method used in this paper is the Scheffe method. Kennedy and Bush (1985) state that "Scheffe is the most flexible, robust and conservative method" of post-hoc procedures. Another follow-up procedure commonly used is the Tukey HSD test. The Scheffe method can be thought of as a method that converts the t ratio approach to individual comparisons to the F ratio approach.

STATISTICAL ANALYSIS: SOLUTION QUALITY

An ANOVA test was used to evaluate the computational results in terms of solution values obtained by running the GA-TSP test. The statistics software package SPSS (SPSS Inc., 1988) was used to carry out the analysis. In addition to each main factor being significant, all two-way interactions between factors were significant at .001 except problem five replacement strategy by crossover. As significant main effects and interactions were found during this phase of the analysis, we can reject all the null hypotheses that these factors make no difference on the solution quality found.

When performing statistical analysis, if an interaction between factors is found, analysis of the effects of any interaction should be examined prior to studying the main effects of the factors involved. As we have found two-way interactions and all main factors are significant, we can infer that the variation seen in the dependent variable is not caused by random chance. It is, in fact, due to the interaction between the factors. Based on these results, we can reject the null hypotheses that there are no differences in the solution values. By examining these tables, it can be seen that all two-way interactions are significant with the exception of the interaction between GA replacement strategy and crossover for problem five. Problem five is representative of a large clustered TSP.

Statistical analysis using ANOVA has the ability to determine that a factor is significant, but it does not show which levels are different when more than two means or levels are involved. For this type of analysis, a post-hoc statistical analysis must be performed. In this case the follow-up test selected was Scheffe's test. Scheffe's test was used primarily due to its robustness.

OBSERVATIONS: SOLUTION QUALITY

Observation A_{soln}: For all problem types, creating an initial GA population consisting of 50 percent good solutions and 50 percent random solutions to the TSP tends to give superior results over randomly creating the entire population.

Observation B_{soln}: For all problems, the use of an initialized population and a large GA population size produces significantly better results than other combinations of GA population initialization and size. For all problems this interaction was significant at the .001 level.

Observation C_{soln}: A population initialized with 50 percent good initial solutions and the balance randomly generated always gives superior results. When combined with an evolutionary strategy, the majority of problems favor a generational approach. Problem one, representing the small size clustered dispersement, shows significantly better results using a steady state evolutionary strategy. When examining problem four, representing a medium size problem with even dispersement, the interaction between population creation strategy and evolutionary strategy was not significant.

Observation D_{soln}: The combination of an initialized population and an elitist replacement strategy produces significantly better results for all problems.

Observation E_{soln}: The combination of an initialized GA population and asexual crossover produces superior results. In all cases this combination showed significantly better results.

Observation F_{soln}: The effect of size and population evolutionary strategy for problems 1, 4, 5, and 6 shows that the combination of a large population size and a steady state evolutionary strategy is significantly better. For problem 3 the combination of a medium population and a

generational evolution strategy is significantly better. For problem 2 the combination of a medium population size and a steady state evolutionary strategy is significantly better.

Observation G_{soln}: An initialized population using asexual crossover always produces significantly better results.

Observation H_{soln}: For all problems, we see that the combinations of a large population and steady state evolutionary strategy produce superior results.

Observation I_{soln}: The combination of a large population size and an elitist population replacement strategy produces significantly superior results.

Observation J_{soln}: When examining the interaction between size and crossover strategy, we see somewhat conflicting results. In all the previous interactions a large population size was one of the components that ensured superior results.

Observation K_{soln}: An elitist replacement strategy with a generational population evolutionary strategy always produces significantly better results.

Observation L_{soln}: The combination of asexual crossover and a steady state strategy produces significantly superior results in all cases. For problem 6, the use of asexual and orderl crossover produces the same results.

Observation M_{soln}: The combination of an elitist replacement strategy and order1 crossover produces the best results. For problems 2, 3, 5, and 6, an elitist replacement strategy, when combined with an asexual crossover, produces significant results. In problem 1, this same combination produces significant results, but these results are not significantly better than those found with an elitist replacement strategy and orderl crossover. In problem 4, the combination of an elitist replacement strategy and orderl crossover provides superior results.

Observation N_{soln}: There does not appear to be any difference in the best GA configuration to solve medium and large size problems with either clustered or dispersed cities. The best results for these problem sizes and class is configuration c126. The c126 configuration uses an initialized GA population, a large population size, a generational evolutionary strategy, an elitist replacement strategy, and asexual crossover.

CONCLUSIONS: SOLUTION QUALITY

Based on the observations described in the previous section, we can draw the following conclusions regarding the best configuration to ensure superior solution quality when designing a GA to solve the TSP. This paper confirms the generally held belief that GA population size matters and that larger populations tend to give better results. However, this concept is not an absolute truth. If the relationship between crossover and size is examined for all problems tested, a medium size population is generally superior.

A solution to problem 1 of 424.7 was found using the c144 configuration consisting of an initialized population, a large population size, a steady state evolutionary strategy, an elitist replacement approach, and an asexual crossover function. The analysis of the two-way interaction of all factors seems to support this configuration as significantly better than the others. The solution of 424.7 is within one unit of the best solution reported of 423.95 and 99.8 percent of the best value so far. This same configuration provides good results for the other problems tested, though none approach the results seen on problem 1.

CONCLUSION

One of the purposes of this paper was to determine the impact of each of the five configuration or design parameters identified by our review of literature on GAs to solve ordering problems. These factors are *GA Population Initialization*, *GA Population Size*, *GA Evolutionary Strategy*, *GA Replacement Strategy*, and *GA Crossover Strategy*. The impact of each of these factors and the interaction between them up to a two-way interaction was analyzed. This analysis was

conducted by building 144 different GAs to solve the TSP. Two separate analyses were performed, one which focused on the effect these factors have on Solution Quality and the other which focused on the effect these factors have on CPU Time.

By examining the results, it can be seen that the worst solution in terms of solution quality is always found with the minimum CPU time; however, the best solution quality never takes the most CPU time. This suggests that a heuristic approach toward integrating the need for quality and speed may be used to integrate the results obtained by this experiment. It appears that to get the best mix of solution quality and performance, one may want to start with an initial configuration consisting of a GA population initialized with a good solution to the problem at hand, and use a steady state GA population evolutionary strategy, and an elitist population replacement strategy. The size of the GA population and the selection of the crossover function appear to be the two areas of greatest divergence. One might try a medium and large population size coupled with either asexual or cycle crossover. Crossover appears to be a rather weak factor based on the results of this experiment. In many cases there was no significant difference between groups ranging from two to five different crossover selections.

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RESEARCH ISSUES AND METHODOLOGY CONCERNING THE DESIGN, DEVELOPMENT, AND EVALUATION OF A GENETIC ALGORITHM HEURISTIC

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ABSTRACT

This paper discusses the research issues and methodology utilized to conduct the design, development and evaluation of the genetic algorithm (GA) heuristic. We will outline the research issues and methodology for the testing and evaluation of the issues where conflict exists in the literature. These issues include: GA population evolutionary strategy, GA population size, the use of GA population initialization or seeding, and the effectiveness of various crossover operators.

INTRODUCTION

This research is conducted in two phases. The first phase evaluates the areas of conflict in terms of configuration and design parameters uncovered during the review of the genetic algorithm GA literature. A GA to solve the traveling salesman problem (GA-TSP) was developed and used to evaluate these issues. This evaluation is conducted using *a priori* computational statistical design. This approach examines the GA performance when solving relatively simple TSP and extends these results to solve the more complex time constrained vehicle routing problem (VRPTC). The results obtained in first phase are used to develop a GA to solve the VRPTC (GA-VRPTC). In the second phase, we compare the results obtained by GA-VRPTC with other methods of solving the VRPTC. Real world problems obtained from the literature are used to evaluate the performance of GA-VRPTC. Again, this comparison is based on a statistically correct design and analysis. Comparison is made not only in terms of solution quality but also the efficiency of the solution as measured in CPU time. To facilitate this effort, the genetic algorithm testing system (GATS) was developed to conduct the evaluation of the research questions.

The best approach for comparing two algorithms in terms of solution quality and efficiency is to execute the computer codes in the same environment. As this is not feasible in all cases, we may have to take other approaches for comparison. Some of the comparisons with other approaches are made by running the same test problems as other studies found in the literature and comparing our results in terms of solution quality. One of the most common limitations found in our review of the GA literature is the almost total lack of execution times reported.

RESEARCH GOALS AND OBJECTIVES

The primary focus of this research is to evaluate GA based solutions to order based problems. Particular emphasis is placed on developing and evaluating GA based solutions to the

TSP and VRPTC. This is a rather new area of research as the successful development of GA to solve ordering problems is a recent development. There have been only a few attempts to solve the VRPTC with a GA. Most of the prior research in developing GA to solve sequencing problems centers on attempts to solve the TSP. The design GA-VRPTC will combine the best features found in previous research with new concepts in an attempt to develop the most effective and efficient heuristic possible for solving the VRPTC.

GA-VRPTC is developed in an evolutionary fashion. From the review of the literature, we identified several areas relating to the design of GA to solve order based problems, where there is no consensus as to the best design or configuration parameters. Each of these issues is evaluated during the design process for this GA. As each design decision is made, it is incorporated into the GA being developed.

Each one of the design issues that require testing are evaluated using GA-TSP and GATS to solve problems from the literature as well as problems selected from the standard TSP library, (TSPLib 1.2) maintained by Gerhard Reinelt of the Universitaet Heidelberg in Germany and available from the Internet. Each design issue is evaluated using selected TSP. This will also allow us to compare our findings with those from the literature as most of the GA development relating to ordering problems was evaluated using the TSP.

RESEARCH QUESTIONS

The Phase I research questions in this paper center around exploring the design issues that must be considered in order to develop a GA-VRPTC. From the literature, we find that there is disagreement as to the most appropriate methods to deal with the areas that must be addressed in the design stage when developing the GA. Based on the review of literature, a list of research questions was developed. Each of these research questions is evaluated in terms of their impact on the solution quality and computational efficiency when solving both the TSP and VRPTC.

Phase II research questions are related to how well GA-VRPTC developed using the results obtained in Phase I of this study compares against other GA based and non-GA based heuristics in solving the VRPTC. This analysis is conducted using a statistically valid research design and GATS, the portable testing system developed in this study. The emphasis of this phase will be on comparing performance in terms of solution quality and efficiency as measured by CPU time between different heuristics to solve the VRPTC.

GA PROBLEM REPRESENTATION

Based on our review of the literature, it appears that the most important task in developing a GA is to find a representation (genotype) that will record the important features required to solve the problem at hand. Our representation for the VRPTC will consist of a chromosome that contains a list of customer numbers. The customer numbers will be an index into a data structure containing customer specific information such as location, demand required, service time constraints, drop time, etc. Another structure required to solve this problem is an inventory of the vehicles available, their cost, capacity, and speed. The fitness function will evaluate the chromosome using these auxiliary structures. As was stated in earlier studies, virtually any representation that is reasonable will perform well if the evolutionary operators-- crossover, mutation, and fitness evaluation know how to interpret it. The goal then is to devise a flexible, extensible, and compact encoding scheme. This scheme meets this criterion since it is compact--only the index into an array containing further information is contained in the genotype as well as summary information. This representation scheme is flexible and extensible as additional information can be added to the data structure without disturbing the genotype.

GA POPULATION EVOLUTION

Based on the literature review, it appears that a steady state type of evolutionary strategy may be best for solving ordering problems. Whitley's (1988) GENITOR was often used for solving order-based problems. Replacement policy will be evaluated using exponential replacement and least fit replacement as seen in Syswerda & Palmucci (1991). When using the crossover function to generate a child, the child must be more fit than the parents for it to enter the population. When a child generated by any other evolutionary function is less fit than the least fit in the population, it may not enter the population. This may be called an ultra-elitest strategy. The strategy outlined above is compared to a simple generational approach using the same replacement strategy. The result of this comparison guides us as to which evolutionary strategy is most effective for the simple TSP as well as the VRPTC.

PHASES OF THIS RESEARCH

Phase I focuses on determining the best configuration and design parameters to use when building a new GA based heuristic to solve the TSP and VRPTC. The new heuristic is developed by evaluating each of the design issues uncovered in the review of the literature. Several GA implementations were coded and compared using a statistical experimental design and analysis. Phase II concentrates on comparing the GA-VRPTC heuristic developed in this study with other methods of solving the VRPTC. Again, this comparison will be conducted using statistical experimental design and analysis. The performance in terms of solution quality and efficiency as stated in CPU time will be compared with other implementations presented in the literature.

A PORTABLE COMPUTATIONAL TESTING SYSTEM (GATS)

In each phase of this research, we are required to generate and analyze a vast number of test problems. Hence, a portable testing system is required. This testing system generates a set of test problems based on the problem parameters input by the user, saves the problem data, executes the solution methods to be compared, and saves the results for further analysis.

METHOD 1-N

Various methods of solving the VRPTC are evaluated. In Phase I of this study, GATS will be used to conduct the evaluations outlined earlier in this paper using GA-TSP to evaluate the design decisions required to develop a GA to solve order based problems. In this case the methods to be compared will be variations of GA-TSP. In Phase II of this study, the results obtained by solving a set of 14 test problems with GA-VRPTC, developed using the information gathered in Phase 1, will be compared with the results found by five traditional VRPTC algorithms. The results obtained by the five traditional algorithms is presented in Christofides, Mingozzi & Toth (1979).

STATISTICAL EXPERIMENTAL DESIGN AND ANALYSIS

One area that is often neglected in the area of mathematical programming in general and GA research in particular is the use of valid statistical procedures to evaluate experimental results. This has been confirmed in the review of the literature where very few valid experimental designs and statistical analysis was found. Several other studies support this finding as well (Amini, 1989; Amini & Racer, 1994). Experimental design and statistical analysis form the foundation for valid scientific exploration. During Phase I of this study, each of the research questions stated would be tested and evaluated in a statistically valid manner. Phase II will require a second experimental

design and analysis with the objective of comparing the GA developed in this study with other methods of solving the VRPTC.

Experimental design is the process of planning an experiment so that relevant data will be collected. The design is a complete procedure which provides the methodology of collecting data in a way that permits objective analysis leading to valid inferences.

THE EXPERIMENT

A valid experimental design begins with a statement of the problem to be solved and proceeds by generating a set of hypotheses to be tested and a concise statement of how they will be evaluated. In Phase I of this study the objective is to determine the optimal design parameters for developing a GA heuristic for solving the TSP. These results will be used to design and build the GA to solve VRPTC (GA-VRPTC). The initial task performed in this phase is to translate the design issues into valid hypotheses to be tested.

The next step in designing the experiment involves selecting the response variable to be measured. For Phase I a selected set of TSP and VRP problems will be generated. The response variables measured in this case will be both solution quality and the amount of CPU time required to solve the problem.

In Phase I, the factors to be manipulated are easily derived from the problem statement or hypothesis being tested. For each factor to be tested, a GA will be coded that utilizes the specific factor. For example, to test whether steady state or generational population evolution is superior for solving TSP and VRPTC problems, two GA will be developed. One will use steady state population evolution, the other will use generational population evolution. In all other aspects they will be identical. Other experimental factors include test problem classes and size, etc.

THE DESIGN

Three main principles are involved in experimental design: *replication*, *randomization*, and *error control*. Replication is required to determine if the identical results are obtained when running the same test under the same conditions and to determine the amount of error variance. Experimental design may be divided into systematic and randomized designs. In randomized designs, treatments are assigned partially or completely to the experimental units. Some examples of common randomized designs are *completely randomized*, *randomized complete block*, *latin square*, and *split plot*. This type of experiment tends to support a crossed or split plot experimental design. This decision will be made as we progress further in this study. The same fundamental design should be appropriate for Phase I when we will be comparing variations on a GA heuristic method and for Phase II when we will be comparing the results of the GA developed in Phase I with other methods of solving a the VRPTC.

CONCLUSION

This paper consists of two major phases. The goal of Phase I is to evaluate the GA parameter and design conflicts found in our review of GA literature and to use the findings of this phase to develop a GA for solving the VRPTC (GA-VRPTC). The purpose of Phase II is to evaluate the performance of GA-VRPTC against other methods of solving the VRPTC. This paper outlines the research goals and objectives and proposes a set of research questions related to design decisions that are required to develop a GA to solve the VRPTC. Next, a description of the portable GA Testing System (GATS) developed as part of this study was presented. In Phase I of this study, GATS is used to conduct the analysis required to select the best option for each of the research questions.

In Phase II of this study, GATS is used to evaluate the GA-VRPTC heuristic against other approaches for solving the VRPTC. The best approach for comparing two algorithms in terms of solution quality and efficiency is to execute the computer codes in the same environment. As this is not feasible in all cases, we have to take other approaches for comparison. Comparisons with other approaches is made by running the same test problems as other studies found in the literature and comparing our results in terms of solution quality and efficiency as measured by CPU time.

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THE GA-TSP EVALUATION OF THE GA CONFIGURATION AND DESIGN ISSUES: A STATISTICAL EXPERIMENTAL DESIGN

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ABSTRACT

This paper develops a detailed statistical design for conducting the GA-TSP evaluation of the genetic algorithm (GA) configuration and design issues. Included is a discussion of the statistical procedures used for initial analysis and post-hoc analysis of both solution quality and efficiency as measured by CPU time.

INTRODUCTION

This paper begins with a review of the terms and concepts required in developing an experimental design for an empirical study. The primary purpose of this study is to examine the effect that each level of all selected parameters or the design decision used in developing a GA to solve order-based problems, specifically the TSP, will have on the efficiency and solution quality obtained when using the GA to solve a set of real-world problems. When solving these problems, effectiveness is measured in terms of solution quality, and efficiency is measured in the amount of CPU time required to obtain the solution.

EXPERIMENTAL DESIGN: THEORETICAL CONCEPTS

In addition to examining the individual effect a given parameter has on the outcome, we will be exploring the interaction between parameter settings and the effect this interaction (if it exists) has on effectiveness and efficiency. One outcome of this experiment is to identify the configuration parameters or design decisions with the highest potential when initially developing a GA to solve the traveling salesman problem (TSP) or vehicle routing problem with time constraints (VRPTC).

Due to the complexity and size of this study, it is doubtful that any one set of configuration parameters will prove superior under all conditions. There is always a tradeoff between a set of parameters that will lead to the best solution and the amount of computing time that is available to solve a given problem. In some cases, it may be reasonable to settle for a slightly poorer solution quality if there are substantial savings in the amount of CPU time required to achieve it. Unfortunately, this type of tradeoff cannot be made using statistical analysis. A heuristic approach must be used to select the best set of parameter and design decisions for developing a GA to solve ordering problems. Based on the data and analysis presented in this paper, it may be possible for an individual to make informed decisions and select the best parameter set and design decisions required to solve the specific problem at hand.

We begin analyzing the results obtained in this experiment by looking at the solution quality and CPU time obtained using separate models for statistical analysis, as there is no known method to consider both performance measures simultaneously.

In this paper, our GA-based heuristic for solving the VRPTC (GA-VRPTC) is based on the TSP implementation (GA-TSP) used in this experiment. The only real difference between GA-VRPTC and GA-TSP is in the chromosome evaluation function specific to the problem being solved. As this code is developed in a modular fashion, the replacement of the evaluation function code turns the TSP application into a VRPTC application. Consequently, the results obtained in this portion of the paper apply directly to our VRPTC implementation.

EXPERIMENTAL DESIGN: MEANING, PURPOSES, AND PRINCIPLES

The primary purpose of designing an experiment is to ensure that relevant data is collected for later analysis. An experimental design is the complete stepwise procedure for collecting the data required to make a valid inference about the problem. In addition to providing a method for collecting the maximum amount of data on the problem under study, the design should be as simple and efficient as possible. The experimental design should reflect a balance between effectiveness and efficiency to ensure the successful execution of the experiment. It is generally conceded that "the experimental approach possesses the greatest potential for generating and refining new knowledge; ... the well conceived, designed and executed experiment constitutes the *ideal of science*" (Kennedy & Bush, 1985, p. 1).

In the following discussion we use the terms *treatments* or *experimental manipulation*, *independent variables* or *experimental units*, and *experimental error*. Treatments are the particular set of conditions imposed on an experimental unit within the framework of the experimental design. Independent variables are those variables directly manipulated by the treatment.

In the context of this particular experiment, a treatment is the setting of a specific combination of GA parameters and design decisions to pre-defined levels and then the use of the resulting GA to solve a set of representative TSPs. The *experimental unit* is the unit to which a single treatment is applied for a single replication. In this paper, the experimental unit is the randomly selected representative TSP to be solved by each GA developed using the selected parameters and design decisions. Each of the TSPs used in this paper is representative of a specific class of TSPs. The selection of the test problems used in this experiment is discussed later.

Experimental error is the failure of two experimental units that receive the same treatment to obtain the same results. This particular error may reflect experimentation, observation, or measurement error, or the combined does define effects of all extraneous factors.

Three main principles of experimental design are *replication*, *randomization*, and *error control*. *Replication* is the repetition of the basic treatment combinations. If a treatment combination is allotted to n experimental units in an experiment, it is replicated n times. If each of the treatment combinations in a design is replicated n times, the design is said to have n replications. Replication is necessary to increase the accuracy of estimates of the treatment effects. It also provides an estimate of the error variance, which is a function of the differences among observations from experimental units under identical treatment combinations. The more replications the better, as far as precision of estimates is concerned. The number of replications is typically limited by the availability of resources for the experiment. The number of replications used for each cell or combination of parameters in this experiment was limited to five. This limit was primarily due to the limited availability of time and computing resources. We tested 144 GAs on six problems representative of the TSP in general. This involved configuring 144 GAs and using them to solve 5,184 TSPs. Sensitivity of statistical methods for drawing inferences depends on the number of replications. Therefore, the number of replications used is based on the permissible expenditure and the required degree of precision.

The second main principle of experimental design is *randomization*. After the treatments and experimental units are decided, the treatments are allotted to the experimental units at random to avoid any type of personal or subject bias that may be conscious or unconscious. This helps to ensure the validity of the results. It also helps to validate a wide variety of statistical procedures, even when the basic assumptions of the procedures are not met. Depending on the nature of the experiment and the experimental units, there are a variety of experimental designs. Each design has its own rules for randomization.

The third principle of experimental design is *local control* or *error control*. Error control refers to dividing the treatment combinations into suitable groups or blocks for allotment of experimental units so that the treatment effects can be estimated more precisely.

The consideration in regard to the choice of number of replications and randomization procedure is to make possible a valid test of significance among treatments. Local control makes any test of significance more sensitive in testing different hypotheses, or it can make the test procedure more powerful by reducing the chance of *Type II error*.

FACTORS, EFFECTS, AND INTERACTIONS

An experiment in which we simultaneously manipulate more than one independent variable is called a factorial experiment. The central idea is to articulate the multiple independent variables in a balanced arrangement such that all combinations of variable arrangements are present (Kennedy & Bush, 1983, p. 17). In designing a factorial experiment, each independent variable is referred to as a factor. In this paper, *Population Initialization Strategy*, *Population Size*, *Population Replacement Strategy*, *Population Evolutionary Strategy*, and *Crossover Strategy* are all independent variables or factors that are manipulated as part of the experiment. In the discussion that follows, capital italicized letters are used to refer to factors, and combinations of lower-case italicized letters and numerical subscripts are used to denote treatments.

Experimental designs involve the study of the effect of a single factor or a level or combination of factors on the dependent or response variable. Effects are classified as *simple effects*, *main effects*, and *interactions*. Assume an experimental design which involves two factors, *A* and *B*, where each factor has two levels denoted by a_1a_2 and b_1b_2. The treatment combinations might be a_1b_1, a_1b_2, and a_2b_2. The four differences, a_1 - a_2 at each level of *B* and b_1 - b_2 at each level of *A*, are termed *simple effects*. Mathematically, main effects are shown in Equations 1 and 2.

$$\text{Main effect } (A) = \frac{1}{2}\left[\left(a_2b_2 - a_1b_2\right) + \left(a_2b_1 - a_1b_1\right)\right]$$

$$= \overline{Y}_{2.} - \overline{Y}_{1.} \qquad (1)$$

$$\text{Main effect } (B) = \frac{1}{2}\left[\left(a_2b_2 - a_2b_1\right) + \left(a_1b_2 - a_1b_1\right)\right]$$

$$= \overline{Y}_{2.} - \overline{Y}_{1.} \qquad (2)$$

$\overline{Y}_{1.}, \overline{Y}_{2.}, \overline{Y}_{.1}, \overline{Y}_{.2}$ are means. Main effects are computed on a per-unit basis. Equations 1 and 2 are easily extended to experiments with more factors and levels. When simple effects for a factor differ by more than can be attributed to chance, the differential response is termed an interaction of the two factors. The relation is a symmetric one; that is, the interaction of *A* with *B* is shown in Equation 3.

$$Interaction\ (AB) = \frac{1}{2}\left[\left(a_2b_2 - a_1b_2\right) - \left(a_2b_1 - a_1b_1\right)\right]$$

$$= \frac{1}{2}\left(\overline{Y}_{22} - \overline{Y}_{12} - \overline{Y}_{21} + \overline{Y}_{11}\right) \quad (3)$$

The value one-half is used so that interaction, like the main effects, is on a per-unit basis. The main effect of a factor is defined as a measure of the change in a dependent variable caused by a change in the level of an independent variable averaged over all levels of all other factors. Interaction is an additional effect due to the combined influence of two or more factors.

AN EXPERIMENTAL DESIGN FOR EVALUATING GA-TSP

This section extends the previous discussion by developing an experiment to study various GA implementations using the Genetic Algorithm Testing System (GATS). The experiment, design implementation, and analysis phases are discussed.

The main goal of this experiment is to study the effect that each of the design decisions or parameters, identified in the GA literature, has on the effectiveness and efficiency of our GA implementation when solving selected TSPs. The TSP selected represents three classes of size and within each size, two classes of dispersement. A small, medium, and large number of cities in the TSP represent the size classification. Within each size category two problems were randomly selected from those representative of TSPs with an even distribution of cities and those with a clustered distribution of cities.

Two response variables are collected for each problem solved. These are the solution and the CPU time required to obtain a solution. CPU time is the central processing time required to solve the problem excluding input/output processing time. CPU time is measured using the ANSI C function clock() which returns the number of CPU ticks from the beginning of the program. This function is initially called after the I/O processing is completed and again after the problem is solved. The difference between these two readings is divided by the macro CLOCKS_PER_SECOND and reported as the CPU time required to solve the problem.

The factors to be studied in this experiment are: *population initialization*, *population size*, *population evolution*, *population replacement*, and *crossover function*. These factors were selected based on a review of GA literature for solving TSPs and VRPs. Two other factors were identified in the literature review but are not included in this experiment. The first is representation. It was decided to utilize a *path* representation of the TSP in this GA. Path representation lists the sequence of cities that must be visited. Other potential representations are edge-combination and matrix representations. The selection of the problem representation limited the selection of crossover functions. Only crossover functions that operate effectively on path representations were chosen for inclusion in this paper.

The mutation function was also eliminated from inclusion as one of the factors to be evaluated. Two types of mutation operators are typically used in conjunction with path representation. These are the swapping of two allele values and the reversing of the chromosome. When evaluating the goodness of a TSP solution, we sum the total distance covered from start to the finish of the tour. For our purposes, it makes no difference if the tour is traversed in forward or reverse order. For this reason, it was decided to only use the swap mutation operator.

Taking the output of one algorithm and using it as the input to another is one of the more common methods of linking algorithms. In this experiment, a very fast TSP algorithm, the space filling curve (SFC), is used to develop an initial good solution to the problem and the GA is used to refine it. This approach is analogous to the concept of post-processing GA solutions. The known

good solutions used for initialization were generated by a SFC heuristic written for this implementation to solve the TSP being used for the evaluation. More information on SFC and their application to the TSP can be found in Bartholdi III and Platzman (1988).

CONCLUSION

This experimental design was developed to explore an area that has not been examined previously in GA research on order-based problems such as the TSP and VRPTC. The execution of this design required several hundred hours of CPU time using a network of Sun Sparc 10 - 30 workstations. Approximately 4,320 GA-TSP executions were required to complete this experiment. The primary purpose for running this experiment was to determine which parameter settings and design decisions might be most useful to select when implementing a GA to solve the TSP or VRPTC. Again, in our case this is a necessary first step, and all results obtained in this experiment are directly applied to the development of a GA to solve the VRPTC (GA-VRPTC). In fact, the only difference between the GA developed for solving the TSP and the GA for solving the VRPTC is contained in one procedure or function--the evaluation function. As in any good design, we have striven to maintain a balance between the available resources and the task at hand.

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THE CASE OF A SELECTED CARPET MANUFACTURER: THE DEVELOPMENT OF A MODEL FOR PRODUCTION SCHEDULING

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ABSTRACT

This paper is concerned with the development of a process model of the yarn preparation division of a selected carpet manufacturer. The model developed represents the characteristics of yarn processing and scheduling employed by the textile mill.

INTRODUCTION

Carpet manufacturing could logically be broken down into two major processing divisions: yarn preparation and weaving. Although problems of production scheduling existed in both divisions, there was a general feeling that the scheduling of individual yarn colors through the yarn preparation division presented the most intriguing and complex problems. Management also felt that scheduling problems of the weaving division were less crucial than scheduling problems associated with the preparation of yarn. This difference was primarily due to the need for scheduling and controlling a great number of individual colors in yarn processing, in contrast to the fewer number of assembled colors to schedule in the weaving division. This contention was partially substantiated by the fact that a *high* percentage of orders that reached the yarn storage area on schedule did complete the subsequent processing stages on schedule, i.e., setting, weaving, and finishing.

Traditional methods of carpet production have assumed away certain production scheduling problems. For example, problems of economic order quantities (E.O.Q.) have been obviated by the stated policy of producing just the amount of yarn needed for each order. The only exception to this policy was related to a very few colors (five or six) that were required for several different orders. Larger batches were processed for those few colors and stored in the finished yarn storage area. Even for those few colors, however, batch size determination was not systematically analyzed.

A MODEL REPRESENTATION OF YARN PROCESSING AND SCHEDULING CHARACTERISTICS

Before the weaving process can begin, all colors that comprise an order must be gathered and assembled. Storage is normally required at this point (prior to weaving), since colors for a given order cannot, and do not, become finally assembled until all colors for a given order are available. When the last color for an order is received, all colors for that order may be drawn from storage, assembled onto a *loom spool*, and woven.

Consider a single order with three colors. Figure 1 illustrates, on a Gantt type chart, a feasible processing scheme. In this case, all colors begin processing at the same time, are processed for the same length of time, and are received in storage at the same time. Such an occurrence could, theoretically, reduce the necessary storage time for the colors on order to zero.

FIGURE 1
POSSIBLE YARN PROCESSING ACTIVITY FOR THREE COLORS

Color Number	*Processing Time*	*Starting Time*	*Receiving Time*
123		*2*	*11*
329		*2*	*11*
015		*2*	*11*

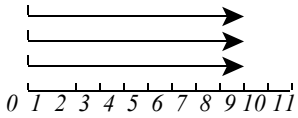


Figure 2 illustrates a modification of this situation to include variable processing times for the different colors, and Figure 3 approximates the actual case.

FIGURE 2
POSSIBLE YARN PROCESSING ACTIVITY FOR THREE COLORS BEGINNING PROCESSING AT DIFFERENT TIMES

Color Number	*Processing Time*	*Starting Time*	*Receiving Time*
123		*5*	*11*
329		*3*	*11*
015		*7*	*11*

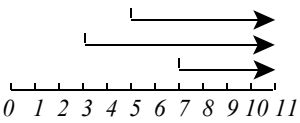
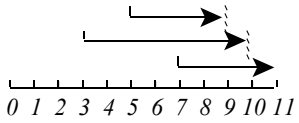


FIGURE 3
POSSIBLE YARN PROCESSING ACTIVITY FOR THREE COLORS BEGINNING PROCESSING AT DIFFERENT TIMES AND COMPLETING AT DIFFERENT TIMES

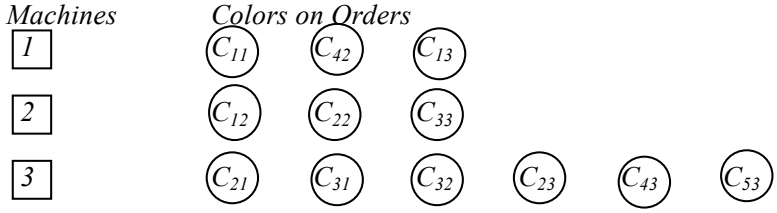
Color Number	*Processing Time*	*Starting Time*	*Receiving Time*
123		*5*	*9*
329		*3*	*10*
015		*7*	*11*



Colors do not begin processing at the same time due to the different machine loads and variable processing times, nor do they complete processing at the same time because of the same factors and/or other occurrences, such as delays, machine breakdowns, color rejections, and differences in worker productivity.

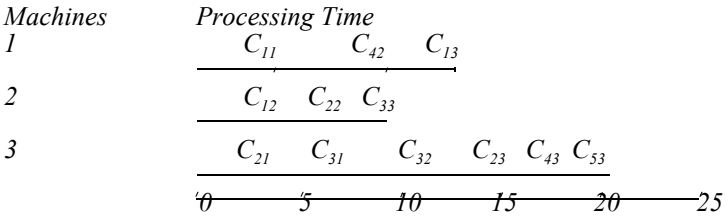
The usual characteristic of batch type processing is the development of waiting lines of items, or batches, to be processed prior to the start of production and between processing departments. When the mill receives an order, it is broken down into its specified yarn colors, assigned a schedule date, and issued to the processing departments. As orders are issued into processing, the items, i.e., colors, form queues within the initial processing department, prior to processing, and within subsequent departments as processing proceeds.

FIGURE 4
TWELVE YARN COLORS ASSIGNED TO THREE DYE MACHINES BY THE WEIGHT OF EACH COLOR AND MACHINE CAPACITY



Assuming a deterministic processing time (measured in general time units) and simultaneous machine availability at time 0, Figure 5 illustrates the results of the previous alignment of Figure 4.

FIGURE 5
ORDER ALIGNMENTS AND SCHEDULED PROCESSING TIMES OF TWELVE COLORS ON THREE MACHINES



Referring to Figure 5, Order Number 1 completes processing at time 7, when color C_{31} is finished. Order Number 2 is completed at time 11, when color C_{32} completes processing, and Order Number 3 is completed at time 20, when color C_{53} is finished. If an order cannot be released for further processing until all colors for that order are available, the times of 7, 11, and 20 represent the releasing times for Order Number 1, 2, and 3 respectively. As orders are released and issued for further processing, the weight of the accumulated inventory decreases at that point in time by the sum of the weights of all colors for that order.

Figure 5 illustrates a predetermined assignment of 12 colors to three machines. The assignment of each color is based on its weight and is assigned to a particular size machine. After the colors have been assigned to their respective machines, the total number of assignments can be determined by calculating the product of within-group (i.e., machine group) permutations. For the example of Figure 5, the colors assigned to machines can be permuted as follows:

(3!) (3!) (6!)

or 25,920. With the added restrictions that all colors on a given *Dyehouse Order* assigned to a given dye machine must be processed consecutively, the possible number of permutations is greatly reduced. In this instance, colors for a given *Dyehouse Order* that are scheduled for the same dye machine are considered as a unit, rather than separate elements. Accordingly, the number of possible sequences would be:

(3!) (2!) (3!)

or 72.

An additional restriction may reduce the set of observed sequences even further. If all colors for any given *Dyehouse Order* are assigned to their proper machines before the colors on the next *Dyehouse Order* are assigned, the number of possible sequences is reduced to:

(3!)

or 6. Thus, the number of sequences is the permutation of the number of *Dyehouse Orders* on hand, since the sequence is determined on an order-by-order basis rather than a color-by-color basis. This

would be analogous to selecting one order from a group of *Dyehouse Orders*, assigning all colors on that order to their respective dye machine (according to the weight of each color and the weight that each dye machine can accommodate), and then removing that selected *Dyehouse Order* from the group of *Dyehouse Orders*. If this selection process were repeated until all *Dyehouse Orders* had been assigned, one processing sequence, such as that illustrated in Figure 5, would be obtained. All possible permutations of n orders, assigned in this fashion, would be n! Figure 6 enumerates the 3! case, showing all possible order alignments.

Relative to each possible case illustrated in Figure 6, there are *Order Releasing Times*. For example, in Case Number 1 of Figure 6, Order Number 1 is released for further processing at time 7, the time when the last color (color C_{31} on machine 3) on Order Number 1 is scheduled for completion. The next order (Order Number 2) will be released when the last color on that order is scheduled for completion (color C_{32} on machine 3). The last order to be released is Order Number 3. This would occur at time 20 when color C_{53} is scheduled for completion. The schedule order releasing times for the first case may then be given as:

Dyehouse Order Number	Scheduled Releasing Times
1	7
2	11
3	20

As the colors for any given *Dyehouse Order* are completed in the yarn processing division, they are held in a finished yarn storage area that uncouples the yarn division from the weaving division. When the last color on any given *Dyehouse Order* is received into the finished yarn storage area, that *Dyehouse Order* may be released for further processing, thus decreasing the total pounds of all yarn held in storage by the total poundage on the *Dyehouse Order*.

Relative to each possible machine alignment, as illustrated in the six cases of Figures 6 and 7, there is an associated *Order Releasing Time* and a variable finished yarn inventory level over the scheduled time period. The average level of finished yarn inventory, in pounds, is based on the rate of input of colors into finished yarn inventory and the rate of output of colors issued from finished yarn inventory. In the determinate case with processing times known (i.e., no machine breakdowns, order rejections, or other delaying influences), *Order Releasing Times* and the level of finished yarn inventory are a function of the sequence in which colors for the given *Dyehouse Orders* are processed. This functional relationship between order sequence and inventory level provides the basis for the attempt to regulate the inventory level through readily controllable means--order sequencing. Since the criterion for *best* scheduling schema is that which minimizes inventory (a factor developed and later described and referred to as the *Total Time Span* of processing), the basis for development of a representative model has been formulated.

AN OBJECTIVE CRITERION

Studies of industrial operations are usually prompted by efforts to maximize profits, minimize costs, or optimize some operational characteristic such as time, order tardiness, machine idleness, or some other factor of efficiency. This minimum or maximum criterion, then, becomes the basis of an explicit, objective function. However, in all instances, this need not be the case as Jackson (1959) states:

> *It is not "necessary"... to pick a criterion function. One can also--and...perhaps more intelligently, from a basic research point of view--seek to discover the relationships among sequencing procedures in general and consequent input-output characteristics of the system concerned.*

There is a relationship between the sequence in which orders are processed and subsequent inventory levels. This relationship is functional in that inventory levels are related to, and affected by, prior processing decisions. If an operational guideline can be identified as having a *closer* causal relationship with pertinent organizational activity, e.g., inventory levels, implementation of such a guideline could produce favorable results.

The objective criterion established to evaluate the different rules tested is a *Minimum Time Span* factor. *Time Span* is defined as the length of time between the receipt of the first yarn color and the last yarn color into storage, for any given order. This is specifically referred to as an *Order Time Span*. An aggregate, or *Total Time Span*, is defined as the summation of the individual *Order Time Spans* for all orders in a given time period.

If, for example:
$T_f(j)$ = time the first color for the jth order is received in yarn storage,
and
T_1 = time the last color for the jth order is received in yarn storage,
then,
$T_1(j) - T_f(j)$ = *Time Span* for the jth order.
Moreover, if:
$T_s(j) = T - T_f(j)$,
the *Total Time Span* may be defined as:
$TTS = \Sigma\ T_s(j)$ $\quad j = 1, 2, 3, \ldots, n.$

CONCLUSION

A comparison of the *Total Time Span* for each case enumerated indicates a *high* correlation between the *Total Time Span* for an ordered sequence and the average inventory for that same sequence. That such a relationship should occur can be defended on logical grounds. However, observation of the results summarized in Table 2 does not indicate a close relationship between the *Total Time Span* calculations and the maximum inventory levels. The correlation between the *Total Time Span* values and the average inventory levels remains to be shown.

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THE CASE OF AN INTEGRATED CARPET MANUFACTURER: A PRESENTATION OF SELECTED SIMULATION RESULTS OF DECISION RULES TESTED

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ABSTRACT

The factory selected for study is an integrated carpet manufacturer in the South. One purpose of the simulation was to observe whether a minimization of the "Total Time Span" tends to be associated with a minimization of "Average Inventory." If so, how close is this relationship? It was found that there was a close association between the "Total Time Span" and "Average Inventory" quantities. A sample of size 15 was obtained and a coefficient of correlation (r) was found to be 91.7. Such a finding gave a rather strong indication that minimizing the "Total Time Span" tends also to minimize the "Average Inventory"--an ultimate and practical objective.

INTRODUCTION

A set of decision rules was tested by simulating the effects of order processing under the guidance of each specified priority-dispatching rule. To serve as a comparative basis and to investigate the nature of the population of all *Total Time Span* values, a random sample of orders was drawn from the population of all possible order alignments. The results of each decision rule tested could be strengthened if the population from which all decision rules were tested could be identified as one of the characteristic probability distributions, such as the normal, Poisson, chi-square, t, F, or other common probability distribution. Then, it becomes possible to test each decision rule and estimate the efficiency of that specified rule (i.e., relative to the divergence of the results of that specified decision rule tested, from the average of the identified probability distribution) in effectively reducing in process inventory.

AN EXAMPLE OF A SINGLE SIMULATION RUN

Before proceeding with the evaluation of the various decision rules tested, an illustration is given of the actual input, processing, and output of order data used in the derivation of an individual *Total Time Span* factor. The illustration is of a randomly selected order sequence in which the dyehouse order numbers for the simulation model were randomly chosen prior to simulation processing. The random number generator was supplied by IBM, and was given in the manual *Random Number Generation and Testing*. The routine computes uniformly distributed random floating-point numbers between 0 and 1.0 and/or integers in the range 0 to 2.0 (Heller, 1959).

The simulation model (the coding for the simulation process model was in FORTRAN 4) processes the order data through the represented manufacturing stages of dyeing, blending, carding, spinning, twisting, and winding. For each color on each order, the simulation model is programmed to list the *time received* into yarn storage. Also, a cumulative inventory is maintained as the colors for each order are received into the finished yarn storage area.

When the last color for each order is received into finished yarn storage, the total yarn inventory (in pounds) is reduced by the total poundage of yarn for each color on that particular order. The first order that completed processing into the finished yarn storage area is Order Number 15 at time 752. Also at time 752, the total poundage in the yarn storage area is reduced by the total poundage received for Order Number 15 prior to the receipt of the last color for that order. An assumption has been made, and built into the computer model, that the last color received into yarn storage for any given order does not have to be physically placed into the storage area.

TEST OF THE SAMPLE DISTRIBUTION

In order to gain some insight into the nature of the distribution of *Total Time Span* values, a sample size of 308 observations was taken from the population of all possible order sequences. The sample size was predicated on the practical limitations imposed by the available computer time. The randomly sequenced group of *Dyehouse Orders* for each of the 308 samples was processed through the simulation model, and the resulting *Total Time Span* calculations were noted for each random sample.

The *Total Time Span* values computed for each randomly determined order sequence were determined. The average *Total Time Span* was computed to be 712.23 hours, with a standard deviation of 100.91 hours. By visual inspection, the distribution of *Total Time Span* values appeared to be equally distributed above and below the average line, with no observable trends or lengthy runs. There appeared to be a heavy clustering of plotted values around the average of 712.23 hours. The visual observation was suggestive enough to warrant testing the distribution of sample values against the expected frequency of values that would be generated if the distribution were normal.

To check whether the *Total Time Span* values generated by the 308 randomly aligned order sequences tended to distribute themselves normally around the average *Total Time Span* value of 712.23, the observed results were subjected to the test for goodness-of-fit between the hypothetical and sample distribution. The formula used for the test was the chi-square:

$$\chi^2 = \frac{\sum(O_i - e_i)}{e_i}$$

where O_i was the observed frequencies, and e_i the expected frequencies based on the normal distribution.

The specific hypothesis tested was the null hypothesis that there was no difference between the observed distribution of *Total Time Span* values and the theoretical, normal distribution. The level of significance was chosen to be five percent ($\alpha = 5\%$). The χ^2 value was l0.358. The computer program generated 308 *Total Time Span* values before terminating; therefore, the full number of observations was used for the χ^2 test. At the five percent level of significance and for 14 degrees of freedom (14 degrees of freedom derived from the number of classes, minus 3, i.e., 17-3), the acceptable range for χ^2 is: $P(23.685 < \chi^2 < \infty) = 0.05$.

Thus, for the five percent level of significance, $\chi^2 = 10.358$ is not significant. It was concluded that there was no significant difference between the two distributions tested, and therefore, the distribution of *Total Time Span* values was sufficiently approximated by the normal distribution. There is an implication that the Central Limit Theorem could be influencing the *Total Time Span* values and causing the tendency of those values observed toward normality.

EVALUATION OF THE SIMULATION RUNS

Each simulated decision rule resulted in the computation of three summary figures of interest for purposes of this study. Those figures were factors referred to as the *Total Time Span*, the *Average Inventory*, and the *Maximum Inventory*. The operational objective of the simulation runs

and the decision rule tests was to observe the *Total Time Span* values generated by each decision rule and to study various selected ways (through the use of decision rules) of reducing the *Total Time Span*. It was tentatively assumed that there was a close relationship between the *Total Time Span* and the *Average Inventory* generated by each decision rule. Subsequent results confirmed this relationship.

This study was not intended to show causal relationships between the *Total Time Span* and the *Average Inventory*. Moreover, the existing relationship could, most appropriately, be defended as one of codependency related to the influence and manner in which the individual orders were processed. Although the two measures varied together, there was no assumed cause and effect relation. For this reason, the coefficient of correlation was used to observe the linear correlation between the two variables, i.e., the *Total Time Span* and the *Average Inventory*.

The simulation results of each decision rule tested were summarized, which indicates the *Total Time Span*, the *Average Inventory*, the *Maximum Inventory*, and a probability value for each decision rule tested.

The probability calculation represents the chance of observing, from a single sample, a sample value of the *Total Time Span* as small or smaller than the *Total Time Span* value indicated for each decision rule. The computed 712.23 hours was used as an estimate of the average population *Total Time Span* value, and 100.91 hours was used as an estimate of the population standard deviation.

The *Total Time Span* values generated for each decision rule were compared against the average *Total Time Span* of 712.23, computed from the sample of 308 *Total Time Span* values. Based on the results of random sampling and on the subjection of the sample results to the chi-square test, two population parameters were estimated as follows:

Estimated average *Total Time Span* = 712.23 ($\hat{\mu}$)

Estimated standard deviation = 100.91 ($\hat{\sigma}$)

With an α risk (level of significance) set at 0.05 (five percent), the *Total Time Span* values that resulted from each decision rule simulation were tested for a significant difference. The test statistic was:

$$z = \frac{X_i - \mu}{\sigma}, \text{ i} = 1, 2, 3, \ldots, 8.$$

As an example, the *Total Time Span* computed for the First Come-First Serve rule was tested accordingly:

$$z = \frac{640.00 - 712.23}{100.91} = -0.716$$

with the probability of a sample *Total Time Span* value being less than or equal to 640.00, given that the true population *Total Time Span* value was equal to 712.23, being .2385 (from the normal curve table of areas). A *Total Time Span* value of 640 is not significant since a value this low or lower could occur 23.85 percent of the time.

For two of the decision rules tested, i.e., the lowest *Total Time Span* value resulting from the *Random Sampling of 308 Sequences* and the results of the *Heuristic Sequencing Procedure*, are significantly different--with respect to the *Total Time Span* values--from the estimated population *Total Time Span* value of 712.23 hours. The fact that these two sampling procedures (rules 3 and

8) showed better results than each of the other decision rules tested indicated that some iterative sampling scheme is better, on the average, than *rule of thumb* decision rules, e.g., the First Come-First Serve or the Broadest Machine Coverage policies. More specifically, there was a strong indication that the average inventory could be reduced by following an iterative sampling procedure for sequencing orders in batch-type systems as characterized by this study.

Between the two iterative sampling procedures, i.e., the *Random Sampling of 308 Sequences* and the *Heuristic Sequencing Procedure*, the latter decision rule performed considerably better with respect to the defined measure of effectiveness, *Total Time Span*, and with respect to the ultimate objective, i.e., reduced level of inventory. The *Total Time Span* values generated by simulation of the *Heuristic Sequencing Procedure* were determined. The smallest *Total Time Span* generated by the *Heuristic Sequencing Procedure* was 402.5 hours. This is a value that could be expected to occur by chance only 11 times out of 10,000 if the choice of an order sequence was purely random.

The *Heuristic Sequencing Procedure* was based on an algorithmic procedure that systematically rearranged the orders to be processed. The orders were processed in that specified manner and the resulting *Total Time Span* computation was retained if it was smaller than the previous *Total Time Span* computation. It is interesting to note the number of iterations required to locate the order sequence that resulted in the smallest *Total Time Span* value. Sample number 153 produced a *Total Time Span* value of 402.5 hours. The computing time required to reach this minimum value was approximately 38 minutes, with an additional 40 minutes to complete the sampling scheme.

The retention of the smaller *Total Time Span* value generated by the *Heuristic Sequencing Procedure* should and does show a general downward trend in *Total Time Span* values. Such did occur; however, further improvement, after 100 to 150 samples were taken, became very slow.

The *Total Time Span* values resulting from the heuristic simulation appear to be more closely clustered around a lower central tendency. This could be anticipated since the *Total Time Span* values resulting from 308 random samples drawn from the population of all possible *Total Time Span* values derived from independent random sampling, whereas the values plotted in the sample of *Total Time Span* values generated by 308 samples selected according to the heuristic algorithm were based on a non-random, specified, sampling procedure.

CONCLUSION

It is most advantageous in a sampling procedure to derive as much information as possible from a limited amount of experimentation. This is especially the case when using large- scale computers to trace through the great number of steps that are frequently required in simulation studies. For this reason, it would seem that considerable effort might be expended towards reducing the sample size necessary to gain a certain degree of confidence relative to observed sample results.

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SELECTED ALTERNATIVE SCHEDULING POLICIES ON IN-PROCESS INVENTORIES IN AN INTEGRATED CARPET FACTORY

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ABSTRACT

One of the primary goals of this paper is to examine the effects of selected alternative scheduling policies on in-process inventories within a processing system of a batch-type nature. The system selected for study was a totally integrated carpet manufacturer in the South with batch-type operational characteristics falling somewhere between the continuous flow and batch-type processors.

INTRODUCTION

In order to explore the problem of alternative scheduling policies on in-process inventories, it was necessary to study the processing characteristics as well as the scheduling procedures that were used by the carpet manufacturer. The process characteristics were outlined and were explicitly included as part of the computerized simulation model. The scheduling procedures were characterized by decision rules (the firm studied, however, operated under the guidance of one decision rule, First Come-First Serve). The relevant characteristics of yarn mill processing, including dyeing, carding, spinning, twisting, and winding were studied, with emphasis being placed on the development of a conceptual process model. The specific nature of certain scheduling problems was indicated, with particular reference to the effects of scheduling on levels of in-process inventory.

SIMULATION

There is a continuous search for ways and means of predicting economic behavior. Simulated experimentation provides a way to test alternative courses of action through the pre-operation of a modeled system, or subsystem. This was the procedure followed in attempting to project the results of various scheduling decision rules. There appeared to be no other way (other than simulation) to appropriately account for the many interrelationships and external complexities encountered in building a representative model of the system under study.

A quantifiable aggregate order variable, referred to as the *Total Time Span*, was defined and developed. The *Total Time Span* was selected as a measure of effectiveness for two primary reasons. First, the *Total Time Span* could be derived by summing the individual *Order Time Spans*, thus, it was directly and quantitatively related to the individual orders. Second, it was assumed, and later statistically verified, that the *Total Time Span* factor was closely associated with the average level of inventory in the finished yarn storage area. The *Total Time Span* factor, therefore, provided a link between the individual *Dyehouse Orders* to be processed and the average inventory level of finished yarn that resulted from processing the individual orders.

An additional factor contributed to and solidified the utilization of *Total Time Span* as an objective criterion--the statistical verification of the hypothesis that the population of all *Total Time Span* values was normally distributed. The experimental verification of the shape of the population distribution strengthened the degree of confidence that could be placed in the results of each decision rule tested. It was then possible to draw inferences about *how well* each decision rule performed in relation to *good* schedules, *poor* schedules, or *average* schedules, from the population of schedules.

The alternative courses of action tested were the decision rules described and/or developed. The experiment was not intended to enumerate all possible decision rules, but to test the sensitivity of selected, yet representative, rules on an expressed measure of performance. It was found, however, that certain kinds of decision rules did perform better than others. This was especially true of the decision rules that incorporated some type of iterative searching routine.

It was observed that a repeating, random procedure for sequencing orders did eventually generate order alignments that were better (relative to *Total Time Span*) than those alignments produced by the structured decision rules, that is, First Come-First Serve, Smallest Orders First, Largest Orders First, or Broadest Machine Coverage. Through repeated random sampling and evaluation of order sequences, it was possible to ascertain the probability of observing a *good* schedule sequence from a specified sample size.

The Heuristic Sequencing Procedure developed and experimentally tested showed the most promising results. The heuristic decision rule was based on an iterative sampling routine that systematically interchanged order alignments, in search of improved schedule sequences or lower *Total Time Span* values. Based on the results of the heuristic sampling procedure, several conclusions were drawn. First, the heuristic decision rule was considerably better than the other decision rules tested, relative to the expressed measure of effectiveness. Second, under the given conditions, the systematic sampling procedure, that is, the heuristic procedure rule, generated better results than the purely random sampling procedure. Third, the Heuristic Sampling Procedure located better schedule sequences at a faster rate than did the random sampling procedure. And last, the results of the Heuristic Sampling Procedure, as measured by the *Total Time Span* factor, tended towards a lower average *Total Time Span* value, with less dispersion between points, when compared with the random procedure.

The general conclusion was that in-process inventory levels were closely related to the sequence of order processing, and a heuristic routine that searches the *tree* of alternative order sequences for improved schedules (lower *Total Time Span* values) can locate order sequences that could, potentially, reduce levels of in-process inventories.

SUGGESTIONS FOR FURTHER STUDY

Several problems were confronted during the study and deserve mention. There is a need to develop reliable and expeditious means for testing the validity of complex simulation models. The empirical method of comparing simulated results, in a posterior manner (the test of time, i.e., does the model work?), is likely to be very time consuming. One approach for facilitating attempts toward model verification utilizes past data to *run* the model. This was the approach used for this study. Care should be taken to ensure that the system's parameters and/or other system's characteristics are properly represented for the two time periods: the process systems when the actual data (parts) are run, and the process systems as subsequently modeled.

The design of Heuristic Scheduling Procedures which can reduce the searching time required for locating improved schedules appears to be a fruitful area for further study. For most scheduling-sequencing type problems, there are a finite number of machines, processes, and/or orders to be scheduled, and therefore, a finite number of schedule permutations. It can be assumed that some of the schedule permutations are better than others, relative to a specified objective criterion. An

efficient scheduling heuristic would be one that could systematically and rapidly (in recognition of the high cost of computer time) search for and locate a schedule close to an optimum solution.

Developing solutions for complex scheduling problems requires some understanding of both descriptive statistics and statistical inference. The numerous facts generated in the ordinary course of daily manufacturing operations contain much potentially useful information. The field of statistics provides a means for setting statistical goals, gathering pertinent facts relative to processing times, machine speeds, and production quantities, and reducing the data into manageable and meaningful numerical representations for statistical testing. With knowledge about a system's characteristics, the scheduler can predict performance with a specified degree of confidence that his or her schedule is correct.

Because of the large number of possible alternatives that usually exist in scheduling-sequencing type problems, only a small portion, or subset, of the total number of schedules may be evaluated. In the tandem line production process, each break between operations, where orders accumulate prior to further processing, provides for a potential order rearrangement. The selection and testing of schedule policies draws heavily from sampling theory and statistical inference, both of which provide a means for partially overcoming the computational restraints imposed by large scale combinatorial problems.

CONCLUSION

A final observation relates to the use of the computer in conjunction with probability and statistics for solving simulation problems. These two important problem-solving tools provide a means for analyzing and seeking solutions to complex scheduling-sequencing problems, and it is likely that there will be a continued need for blending these two particularly important problem-solving tools into new and improved methodological procedures.

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PRODUCTION PROCESSING AND SCHEDULING IN A SELECTED CARPET TEXTILE PLANT

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ABSTRACT

The factory selected for study is an integrated carpet manufacturer that processes wool or synthetic fibers through sequential production stages of blending, carding, spinning, twisting, dyeing, setting, weaving, and finishing. These production stages are grouped into two major divisions: yarn preparation, including the first five processes of blending, carding, spinning, twisting, and dyeing; and weaving, which includes setting, weaving, and finishing.

INTRODUCTION

Since the modeled representation of the system pertains to the processing of carpets, a brief explanation of terminology and an overview of the scheduling system is necessary. In the preparation of yarn, there are two processing procedures--stock dyeing and package dyeing. The yarn processing sequence is slightly different for package dyed yarn orders than for stock dyed yarn orders. Although the finished yarn processed by either procedure is equivalent relative to physical characteristics, it is generally more economical to stock dye yarn orders (colors) which exceed one thousand pounds and package dye yarn orders which are less than one thousand pounds.

PRODUCTION PROCESS

The yarn preparation division processes colors as separate and distinct batches, with only a single assembly operation: two single yarn strands are twisted together. Within the weaving division, however, colors are assembled together and processed as orders.

Stock dyeing refers to the process of dyeing batches in a bulk or fiber form. The input, or raw material for the stock dyeing process, is undyed fiber, and the output is dyed fiber. The distinguishing characteristic of stock dyeing (in contrast to package dyeing) is that the batch is dyed before it is in a yarn form. Processing time is primarily a function of the weight of the batch to be dyed.

If the batch on an order is less than one thousand pounds, it is dyed by the package dyeing process. The input to the package dyeing process is an undyed (white) yarn, and the output is a dyed yarn of the desired color. In contrast to stock dyeing, the time required for package dyeing a batch of yarn is a variable closely related to the human factor, i.e., the individual dyer's ability to match the specified color against a *standard* for that specified color.

One other factor associated with the package dyeing process deserves mention. Under the present method of package dyeing, it is practically impossible to repeat previous results even with apparently identical conditions. If the same dyer were to load two identical package dyeing machines with undyed yarn from the same batch of raw material, measure and apply identical dyeing compounds, and mix them with water raised to the same temperatures, the results would not be the same. Because of this condition, it is difficult to predict processing times for package dye batches.

All stock dyed batches must pass through the blending process before moving in sequence to the next processing stage. Almost all stock dyed batches must be modified, to some extent, to match *standard*. Blending, or mixing the fibers, is the process by which the desired match is obtained. After the desired color has been reached, the entire stock dyed batch is blended to ensure an evenness of color throughout the batch.

Each stock dyed batch processed within the blending department is blended at least three times. Some batches are blended four or five times before the blended color matches the standard color, although this occurs for only a very small portion of the total colors (less than five percent). The time required for blending each batch is determined by the weight of the batch blended, and the processing priorities are determined on a first-come, first-serve basis.

The next sequential processing stage for stock dyed colors is the carding operation. This carding operation, however, is the first step in the processing of yarn for package dyeing (see Figure 1). The carding operation is the production stage in which the bulk fiber begins to take on the appearance of a yarn strand. The purpose of the carding operation is to *comb* the fiber and produce a *roving* material, which is a continuous strand of unspun yarn. This output (roving) is the input to the next process, spinning.

The spinning operation applies a twist to each individual strand of roving and delivers a single *end* of spun yarn. The spinning operation adds strength and cohesiveness to the yarn. Whereas the spinning operation applies twist to a single yarn strand, there is a specialized twisting operation that twists two individually spun yarns together. The purpose of the twisting operation is to increase the yarn strength.

Winding is a preparatory step that does not modify the yarn in any way but transfers the yarn from one type of yarn spool to another. If the yarn to be wound has been dyed, either through the package dyeing or stock dyeing process, the yarn is wound onto a hard paper spool for finished yarn storage. If the yarn to be wound is undyed, it is wound onto special purpose metal spools, or tubes, for package dyeing and shipped into the dyehouse. After the batch has been package dyed and the color has been approved, the batch is wound onto paper spools and shipped to the yarn storage area.

Setting is the first production process to take place after all dyed yarn for a manufacturing order has been received into the yarn storage area. The setting process *sets* the individual yarn colors onto a loom spool according to the pattern to be woven. After the completion of the setting operation, the loom spools are placed into a weaving machine (loom) and the ordered numbers of carpet rolls are woven. The finishing operation applies a rubberized, latex solution to the back of each carpet roll and ships the roll into the warehouse.

THE SCHEDULING SYSTEM

The scheduling procedures described are those utilized by the carpet plant for receiving orders and placing those orders into production. *Mill Orders* were received in triplicate by the carpet manufacturer and stamped as to the date received. The orders were then entered in numerical sequence in the *Orders Received Journal*. The journal entry contained the following information:

1. The manufacturing order number
2. The date the order was received
3. The grade name and pattern number of the carpet ordered
4. The number of rolls ordered
5. The width of the rolls ordered
6. The due date for completion of the order.

The information contained on the *Mill Order* was entered on the *Master Manufacturing Weaving Schedules*. The number of rolls of carpet on order was entered on the master schedule according to the desired delivery date, which was broken down according to workweeks. Thus, the number of rolls of carpet to be woven in any scheduled week could be obtained by totaling each week.

Mill Orders were grouped according to projected delivery dates, which were expressed as *Week Beginning*, recognizing Monday as the beginning of a week. If a particular week's scheduled workload exceeded the plant's capacity, it was necessary to smooth out the production by rescheduling orders for earlier or later delivery.

ISSUANCE OF THE *YARN REQUIREMENT FORM*

After the above preliminary steps had been taken, the requirements for yarn were calculated for each order. The requirements were listed by each color of the order on a *Yarn Requirement Form* and forwarded to the yarn storage area where all finished yarn was stored. If there was yarn of the required amount and color in storage, for any color on an order, the color and the amount available was listed on the *Yarn Requirement Form* for that order. If an inventory check indicated that certain yarn colors were available (and acceptable), the batch numbers of the yarn colors on hand were listed on the *Yarn Requirements Form*, and the poundage available was deducted from the original weight.

ISSUANCE OF THE *DYEHOUSE ORDER*

The *Dyehouse Order* was an order for the dyehouse to dye a required poundage of a given color. The source document used in preparing the *Dyehouse Order* contained the balances taken from the *Yarn Requirement* form for each color not filled from inventory. The *Dyehouse Order* listed the following information:

1. The *Dyehouse Order* number
2. The grade and pattern name
3. The repeat (number of times the grade and pattern had been ordered before)
4. The individual colors on each order
5. The yarn weight required for each color
6. The date the order was to be completed dyeing
7. The date the order was to be delivered into finished yarn storage.

The last two schedule dates on the *Dyehouse Order* were derived by working backwards from the delivery date given on the *Mill Order*. For example, when a *Mill Order* was received by the mill, it specified a date for finished carpet such as six rolls the week of January 9, 1967, and five rolls the week of January 16, 1967, for a total order of eleven rolls. To determine when the order should begin processing, it was necessary to work back through each major processing department as follows:

Departments	Dates
1. Finishing	Week of 1-9-67
2. Weaving	Weeks of 12-26-66 and 1-2-67 (2 weeks)
3. Setting	Weeks of 12-12-66 and 12-19-66 (2 weeks)
4. Yarn Mill	Week of 12-5-66
5. Dyeing	Weeks of 11-12-66, 11-19-66, and 11-26-66 (3 weeks)

An order scheduled for delivery the week of January 9, 1967 was ordered into the dyehouse no later than November 12, 1966. This nine-week processing cycle was considered to be the average processing time for an order of carpet.

ISSUANCE OF THE *YARN PROCESSING ORDER*

After a yarn color had been dyed and approved, the color was shipped to the yarn mill for further processing. A *Yarn Processing Order* accompanied the color and specified whether the color

was to be twisted with another color, twisted with itself, or both. The *Yarn Order* contained the following:

1. The *Yarn Order* number
2. The date the yarn was due into yarn storage
3. The color number
4. The pounds to be processed
5. The amount of spinning twist
6. The amount of twisting twist
7. The color the yarn was to be twisted with, if another color was to be used.

After the winding operation, which was the last step in yarn mill processing, the yarn batch was entered on a shipping journal and moved to the yarn storage area to await the next operation.

ISSUANCE OF THE *YARN AVAILABLE TO SETTING REPORT*

The number of colors that made up a pattern varied from one to 40, with an average number of colors between 12 and 15. The colors of a pattern were processed individually prior to the setting operation. All processing beyond the yarn storage area, i.e., setting, weaving, and finishing, required all colors to be available. The setting process, the first process after all colors for a pattern had been collected in yarn storage, *set* the colors into a permanent position on *loom spools*. The setting process could not begin until all colors for a pattern were available.

The *Yarn Available to Setting Report* was prepared by the Yarn Storage Department daily, listing all patterns for which the last color on order had been received. The *Yarn Available to Setting Report* gave the following:

1. The grade name and pattern number of the order available
2. The date the last color, and thus the pattern, became available
3. The *Dyehouse Order* under which the yarn was received under.

The date that the yarn became available for further processing, i.e., when all colors for a pattern were available in yarn storage, was posted to the *Master Weaving Manufacturing Schedules*. The grade name and pattern number of each pattern that began setting was posted to the *Yarn Available to Setting Report* and the *Master Weaving Manufacturing Schedules*.

The *Daily Loom Report* listed all patterns available for setting, all patterns that were setting, all patterns which had completed setting, and all patterns which were weaving. This comprehensive daily report was the principal scheduling report for the weaving division. For each roll of carpet woven, a ticket stub was sent to the scheduler for daily posting of carpets finished weaving. At the end of each week, the production scheduler would total the actual production of woven goods and list the actual figure beside the scheduled figure for each order.

CONCLUSION

The sequential production stages of blending, carding, spinning, twisting, dyeing, setting, weaving, and finishing were reviewed for a carpet manufacturer. Two major divisions, yarn preparation, and weaving were studied for a manufacturer that processes wool or synthetic fibers.

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Academy of Legal, Ethical and Regulatory Issues

SCIENCE OR PSEUDO-SCIENCE? HEDONICS IN THE COURTROOM

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ABSTRACT

Hedonics studies the valuation of the pleasures of living. Economists with this training testify in court and help lawyers bring about several large awards for lost opportunities with regard to pleasure. Hedonics puts a theoretical measuring stick to life and yields a relatively close estimation of the amount of pleasure consumers would miss if injured and the monetary value of pleasure.

INTRODUCTION

What is a human life really worth? What is life? Why is life worth living? What is dying worth? These are a few questions that philosophers and laymen alike have been asking since mankind first became civilized. And more times than not, this worth has been judged to relate more closely with monetary value than with any psychological or spiritual values.

It has been said that the value of a man is equal to his production minus his consumption, which is much like economic value, where success is equal to acquisition minus consumption (Carver, 1970). Therefore, using this formula, the net economic value of a man could be calculated. However, one would have to accept the fact that production can be direct or indirect. A farmer produces a crop, which is considered direct production. However, a teacher, lawyer, or a policeman produces in the form of indirect intangible services (Staller, 1989).

Also, on the same guidelines, as a purely mathematical assumption, a man could have or reach a negative net worth if that man consumed more than he produced. For example, with the amount of consumer credit extended in the U.S. to unqualified consumers, there are many consumers who will experience a negative net worth.

WHAT IS A MAN REALLY WORTH?

However, the value of a man is viewed differently, sometimes depending only on the person you talk to. For instance, the federal government does cost-benefit analysis on safety measures that can be installed to save lives. These measures are usually very expensive and typically save only a few additional lives. For example, the government checked and updated the safety of the ejection seats that the U.S. Air Force, uses and the imputed value of a life in those expenditures was $9,800,000 (Staller, 1989).

Another example of how monetary value is placed on life is a survey conducted by economists to find out how much extra people would pay to fly on safer airlines, or how much private citizens spend on safety items such as air bags, smoke detectors, burglar alarms, etc. Surveys have also been conducted in the labor market to find out how much extra pay it takes for a worker to perform a job with a measurable life-risk, such as coal mining or high-beam welding (Smith, 1988). These costs give an estimation of how much one person values the life of another and how much an individual values his own life.

In the judicial system, these values are used to determine the amount of monetary judgment a person will receive in personal injury and wrongful death cases. However, the emergence of another value in the *cost accounting school of life* has brought about a controversy. This involves trying to find the hedonic value of life.

WHAT IS HEDONIC VALUE?

Hedonism is the doctrine that pleasure is the principal or only intrinsic good. An intrinsic good is something worth having, choosing, achieving, desiring, experiencing, bringing into existence, or sustaining in existence, for its own sake. It is an end in itself and not to be desired or chosen simply as a means to some goal. To give hedonic value to something is to try and put a monetary value on the pleasures gained from life (Edwards, 1979).

Economists contend that valuations can be made according to hedonic and financial attributes of life (Karns, 1990). Hedonic attributes include quality of life factors such as environmental standards, quality of education, weather, and the amount of time spent pursuing vocations. Hedonic value should also be measured independently of social rank, education, wealth, gender, or family position.

For the last 20 years this theory of hedonic value has been put into application in both wrongful death and personal injury cases. Economists have been called as expert witnesses in such cases.

COURT CASES

Although it has been established that damages can be awarded for deprivation of life, Section 1983 does not cover the right of hedonic damages for a decedent's estate. However, an example of a federal court fashioning a remedy in a Section 1983 action can be found in the decision of the United States District Court for the Northern District of Illinois in Sherrod v. Berry.

The first U.S. court case to describe a damage award for the hedonic value of a decedent's life was Sherrod v. Berry (629 F. Supp. (N.D. 111, 1985)). In that case, a father brought a lawsuit against the city of Joliet, Illinois on the behalf of his deceased son.

On December 8, 1979, Ron Sherrod was driving a car when Officer Berry of the Joliet police force stopped him. The officer stopped the car because he recognized a passenger who was being sought for a theft offense that had happened earlier in the day. Once stopped, Sherrod, not knowing the reason he was being stopped, reached inside his coat pocket for his driver's license. Berry thought that Sherrod was reaching for a gun and fired at point blank range, instantly killing Sherrod.

After a jury trial, the courts ruled that the defendants were liable due to the excessive use of force. Sherrod's father received $450,000 for the loss of parental companion and the jury also awarded $850,000 for the hedonic valuation of the son's life (Williamson, 1987). The court supported the plaintiff's argument that the hedonic value of life encompasses the person's entire existence, including the moral and philosophical value that society places on life.

"In Sherrod, the district court allowed the jury to award damages for the 'hedonic value' of the decedent's life. The purpose of hedonic damages is to compensate the decedent's estate for the decedent's loss of life and loss of the pleasure of living. The Sherrod court, therefore, recognized as actual injury the loss of life and the loss of pleasure of living that a decedent sustains when a wrong doer unconstitutionally deprives the decedent of life" (Williamson, 1987).

Another case that awarded damages for the loss of the enjoyment of life when the decedent's death is instantaneous was Katseto v. Nolan. "The Katseto court recognized that Connecticut law allows a decedent's estate to recover damages for a decedent's loss of the ability to live and enjoy life's activities" (Williamson, 1987). Even though several states allow damages for the loss of life's pleasures, few have decided if a plaintiff must be aware of the loss of these pleasures to be entitled to damages.

Only one state, Connecticut, has permitted hedonic damages to be paid. Under Connecticut law, a person's estate is entitled to *just damages* along with other more common cost such as medical, hospital, and funeral expenses (Goldstein, 1988). Just damages include compensation for the destruction of a person's capacity to carry on and enjoy life's activities in a way he would have

done had he lived. The Connecticut courts have awarded in numerous cases hedonic damages under this area of just damages.

On the other hand, no other court has granted such awards. In New York, for instance, the Court of Appeals ruled that the recovery of the loss of enjoyment of life requires "some degree of cognitive awareness" (McDougald v. Garber, 538 N.Y.S. 2d 937 (New York, 1989)).

Emma McDougald suffered severe brain damage, due to the neglect of her doctors, and was left permanently comatose during the course of an operation. A suit was filed, and a jury awarded $9,650,102 in damages, including $3,500,000 for loss of enjoyment of life. The Supreme Court Appellate Division upheld the lower court's decision that the loss of enjoyment of life is distinguishable from conscious pain and suffering. However, the New York Court of Appeals reversed and remanded for a new trial on the issue of non-pecuniary damages (Recent cases, 1990). Justice Wachtler stated, "that damages for negligent injury should compensate the victim, not... punish the wrongdoer. Although non-pecuniary damages can 'neither ease the pain nor restore the victim's abilities,' they may provide a measure of solace for the condition created. When such damages are awarded to a plaintiff whose injuries have left her unaware of her loss, they can have 'no meaning or utility to the injured person,' and are simply punitive" (McDougald v. Garber, 538 N.Y.S. 2d 937 (New York, 1989)).

The concept of ordinary tort damages serves both to compensate the victim and to provide incentives for future defendants to exercise due care. The failure of the court to award loss of life's enjoyment damages in the McDougald case could provide a perverse incentive to physicians by rewarding them for a greater lapse of care. In essence, the courts have ruled that, economically, it is better to permanently disable a person, effectively depriving them the enjoyment of life. However, the Court of Appeals reversed the decision and handed down judgment that when such damages are awarded to a plaintiff whose injuries have left them unaware of any loss, the award would have no meaning or utility to the injured party and would therefore be punitive damages and could not be considered a separate award (Staller, 1989).

Although the damages for the loss of the enjoyment of life do not yet pertain to individuals permanently disabled by the wrongful acts of others, it is expanding in the area of wrongful death. In states such as Connecticut, Illinois, California, and Alaska, "Plaintiffs should now be able to include measurement of the hedonic component of life as an element in proving pecuniary damages" (Smith, 1988).

Almost all courts agree that the loss of enjoyment of life is not a separate element of damages deserving its own distinct award but is, instead, only a factor to be considered by the jury in assessing damages for conscious pain and suffering. However, with today's professional witnesses, courts will have to study what pleasure is all about and then how to measure it.

THE MEASUREMENT OF PLEASURE

To measure, by definition, is to find the extent, dimensions, capacity, etc. of something. Therefore, it is implied that anything that can be measured has a basis for being quantified. Under normal tort awards, damage awards are handed down after being measured by a few approaches.

The most common approach is the income-based approach. This method considers the value of a life to be a function of a person's lifetime earnings. Insurance companies use this approach to estimate life insurance requirements, and it has been adopted by the courts as a method of placing value on economic loss in personal injury and wrongful-death matters (Staller, 1989).

Another approach is to examine the amount people are willing to pay for safety measures and how much some people have to be paid to work in hazardous occupations. This approach has measured lives at as little as $70,000 and others at the millions of dollars. However, neither approach measures any value of pleasure.

Since hedonic damages are based on lost pleasures, how would pleasure be measured or valuated? First, pleasure would have to be defined. Pleasure is a concept that has perplexed those

who have tried to show its precise nature. The concept of pleasure belongs in the same company of such ideas as power, existence, unity, and success (Perry, 1967).

Pleasure is not sensation in any accepted sense, but pleasure is a feeling or emotion only in the broad sense in which feeling and emotion are contrasted with unfeeling cognition. Pleasure is private and subjective. No one else can feel the pleasure of another, and pleasure can be experienced without any external evidence of the fact. Also, pleasure can be achieved or experienced either from external or internal activities. That is to say that one can gain pleasure from remembering a pleasurable experience as well as experiencing the same event (Cowan, 1968).

The pleasure that the hedonists are interested in are the inner qualities of feeling. Pleasures are not objects defined by the senses in the external world. They are intangible *feelings* that cannot be communicated with great clarity (Edwards, 1979). There is little to gain from thinking of pleasure in this hedonic tone except that it shows pleasure never exists by itself and therefore one is less likely to imagine pleasure as an object of experience.

Once pleasure is discerned, one must find a way to quantify it in order to attach a value. Since pleasure is intangible, it cannot be measured in any physical way. However, suppose that pleasure can be quantified in some way. Then a basis for valuation would be established. However, life does not yield all positives. For instance, as in the valuation using the income-approach, one must consider both the amount of income and the amount of consumption. In hedonic terms, one would use pain as one would consumption (Karns, 1990). Happiness, hedonistically defined, consists of a positive surplus of pleasure over pain through an extended period of time (Karns, 1990). Therefore, one could experience pleasure but maintain a negative balance if the pain side of the equation were constantly greater. Consequently, there is no way to measure pleasure or pain. It can only be gauged from an introspective view and is never identical from day to day and from individual to individual.

CONCLUSION

Economic philosophers tend to confuse the pursuit of happiness with the pursuit of pleasure. Pleasure cannot be pursued because it is an *object of experience*. It cannot be measured; therefore, it cannot be quantified. Pleasure cannot be stored for the purpose of giving it to someone else. Pleasure, like beauty, is in the eye of the beholder.

Many people consider hedonics a pseudo-science and thus believe it should not be allowed as evidence in court. In a case of catastrophic human loss, to translate that loss into money damages precision is difficult to achieve on any level. The concept of hedonic damages and whether or not to award damages to individuals or estates of decedents is primarily a social issue. It shall be resolved according to the morals, religious beliefs, and feelings of jurors as the evidence is presented to them.

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CURRENT REALITIES OF ETHICAL ISSUES IN CORPORATE AMERICA: HOW DOES ETHICS EFFECT THE FINANCIAL ARENA

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ABSTRACT

Modern business and nineteenth century philosophy would seem, on the surface, to have very little in common. However, the increasing complexities of business, in the face of technological advances and globalization, provide a clear indication that they should be considered together as a whole. Ethics is an everyday occurrence in the corporate world as well as one's personal life. Business ethics is the same as normal ethics. In both cases, ethics is knowing what is right or wrong, and/or learning what is right or wrong in the environment in which one is involved. An ethical issue may not have a concrete answer; therefore a person's decision may depend on that person's situation. This may happen because "ethics is a broad and murky area and the workplace is full of ethical dilemmas and issues" (Orsini and McDougal, 1999). Therefore, employees feeling the pressure to perform may resort to unethical decisions in order to meet the goals that they feel are unreasonable. This can happen at any level of management (Orsini and McDougal, 1999).

The current ethical dilemmas in Corporate America have caused the subject of ethics to come to the forefront for the people in the United States as well as the world. In an attempt to reveal these ethical issues faced by CEOs, CFO's, accountants, and employees, this study have tried to determine a definition of ethics and its purpose. An overview of a few of the corporate business failures caused by unethical, as well as, illegal practices have been incorporated. This study develops an insight to the evolution of ethical practices in the workplace and differentiates between ethicality and legality.

THE CHANGING FACE OF PETS IN AMERICA - MORE THAN JUST "PROPERTY"

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ABSTRACT

This paper researches the status of animals in the legal environment, focusing on estate planning for the benefit of pets. The principal findings show that animals have become an increasingly important part of the American family yet the legal systems do not recognize their place in society. While there have been a growing number of states that are addressing the issue, the vast majority of the states have no laws or rules in place to define the relationship. Furthermore, this paper explores the relationship that select states have defined for pets.

Academy of Marketing Studies

TARGETING THE ASIAN-INDIAN AMERICAN MARKET

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ABSTRACT

Most U.S. marketers are woefully ignorant about most foreign cultures and do not understand that to be successful, it is important to build a positive relationship with ethnic niche markets. This paper discusses the market potential of the Asian-Indian American market by highlighting the demographic characteristics and the changing population density of this ethnic market.

COMPETITION AGAINST THE COLA KINGS

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ABSTRACT

Three Brooklyn entrepreneurs started Snapple with approximately $30,000 and a hunch that consumers were ready to drink something besides colas and carbonated sodas. With that small idea and an inspiration to use the jam-sweetened tea recipes brewed by the owners' Jewish grandmothers, the beverage industry had its first fruit-flavored ready-to-drink iced tea.

INTRODUCTION

In 1992 Tom Lee, a corporate buyout merchant, made "the steal of the century" and became nationally recognized after purchasing Snapple for $140 million when the company was already making $95 million a year in revenues. Within two years, Lee had built the company into a $750 million sales empire, and then quickly sold it to Quaker for $1.7 billion in 1994.

This purchase by Quaker may have seemed like a deal at the time of purchase. This may have been due in part due to the rumors that "the once high-flying Snapple was again the subject of buyout rumors, with speculation that Coca-Cola, Pepsi or Unilever (Lipton) [was] readying a $2 billion takeover" (Benezra, 1994).

The next part of the Snapple story did not go as well as the first quarter of a century for the company. After Quaker bought Snapple, it meddled with Snapple's distribution system and each of the other key success factors of the beverage industry, consisting of packaging, product innovation, and marketing. The mistakes that were made created such a disaster that Snapple was almost destroyed and Quaker had to sell the company to Triarc, salvaging only 18 percent of its initial investment. Quaker also lost more than $100 million in cash and sustained additional losses due to subsequent capital gains taxes related to the sales of Quaker's pet food and candy businesses used to help finance the acquisition of Snapple. These miscalculations added up to be one of the decade's worst acquisitions, resulting in Quaker Chairman William Smithburg losing his job (Berman, 1997).

THE TRIARC TRIUMPH

Since acquiring Snapple from The Quaker Oats Company in 1997, Triarc's main focus has been to capitalize on the possible synergies created between the newly acquired Snapple and other Triarc brands, such as RC and Mistic. It is also refocusing Snapple's highly marketable brand image while attempting to build back the once unmatched relationship between Snapple and its distributors. The distributors were comprised of a network of over 300 independent distributors who zealously developed new micro-markets the Coke and Pepsi's of the world had always ignored.

"Prior to the Quaker deal, Snapple had developed an almost cult-like following of loyal customers. Identifying a very specific, narrow market segment, the demographics of a Snapple drinker were identified as two specific and highly marketable groups. Snapple's products and image were being marketed as 'the best stuff on earth' to an increasingly health-conscious crowd while simultaneously grounding their beverages with things that were considered cool by the younger targeted demographic group. As a result, the Generation-X target group tended to become more attracted to the Snapple products. The efforts include Snapple's sponsorship of 'raves and midnight in-line-skating parties'" (Caggiano, 1997). Other attempts to present the products to the Generation-

X target group included spots on various TV shows such as *The X- Files* and *Spin City*. "It is all word of mouth. That is your brand" (Caggiano, 1997).

Triarc's attempt to return Snapple to its niche market is apparent by its website. Snapple consumers are labeled as those who: 1. Appreciate things that are different. 2. Value things that are both genuine and honest. 3. Can laugh at themselves and the world around them. 4. Are constantly on the go. 5. Are both male and female--Snapple is loved by all. 6. Are aged 16 to 44. 7. Are urban and suburban; Snapple consumers live mostly in or near a city. (The Beverage Group, 1999).

Regardless of the product, Snapple promotes its products as possessing many key features and benefits that differentiate its product from all the others. Snapple contains all natural ingredients with no preservatives added, and consists of various categories including the original Iced Teas, Juice Drinks, Diet Snapple, Snapple Farms, Snapple Refresher, and Lemonades (The Beverage Group, 1999).

The Snapple product was initially grown to make it a complete national and international brand. Future growth was expected primarily from international outposts; therefore, international strategies and scope of other Triarc products resulted in its success in distributing in 63 countries, resulting in the 20 percent growth rate of its international sales.

INTERNAL STRATEGIC SITUATION

Snapple may not be as good as claimed, but no other beverage has symbolized the beverage industry 90s style, even with its highs and lows in product distribution, innovation, packaging, marketing, and sales. What makes Snapple's success difficult to understand is that it has no mission or vision statement, even at the holding company.

Although not clearly defined by either corporate entity, Triarc and Quaker's reasoning for the acquisition of Snapple was similar in that each was looking for new distribution channels, and it is easier to buy it than to build it. A prime example was Quaker Oats' effective distribution channels for Gatorade in supermarkets. Having that ability already in place was supposed to make the distribution easier for Snapple. The problem with Quaker Oats was that it "attempted to remake Snapple in its own image. It did not work. They wanted to 'Gatorize' Snapple. It was a major problem. The supermarket-driven distribution that had worked wonders for sports drink titan Gatorade was lost on street-fighting Snapple" (Prince, 1997). Also, by Gatorade using many of Snapple's more effective distributors, it essentially cannibalized Snapple to distribute Gatorade to the remote locations that gave Snapple an early advantage.

It makes sense for large companies to want to combine their strong brands with Snapple. The synergy creates a strong advantage in many areas such as the mass marketing capability and moving like products through common distribution channels that are strong, assuming the market can absorb the additional products easily. This type of synergy can make the overall company a terrifying competitor that is sure to take market share away from Coke and Pepsi.

The competitive advantage Snapple once had is no longer sustainable in this segment of the industry, as Coke, Pepsi, and other competitors have introduced similar New Age products. The strategies of avoiding price wars, segmenting the market to avoid head-to-head competition, and keeping the number of competitors low by putting up entry barriers around the industry is now impossible.

Snapple does have a slight advantage in that through strategic maneuvering, they continually creates, erodes, destroys, and recreates products, which displays its flexibility and ability to be innovative. One example is its ever-shifting label lineup, which again exceeds 50. Triarc, Snapple, and many of their consumers feel that the equity Snapple presents to the market is its ability to retain a wide range of flavors. They also feel that the product image is more fun because there are more brands. At the corporate level, Triarc is looking at how it can continue this successful strategy in

a way that is highly efficient from a supply-chain standpoint, since mass customization brings a unique set of problems to the forefront.

STRENGTHS AND WEAKNESSES

No other New Age brand has the sales strength of Snapple. Snapple's goal has been highly profiled in the media. Its goal is to provide consumers with what they are looking for every time they enter the store. Distinctive and tasty drinks are too many for one single company to try and emulate. In this industry, one approach most definitely does not fit all. What works for one corporation with its own unique competitive position, core competencies, and capabilities may not work for another with similar product offerings and market positioning.

Distinctive competencies are not possible for more than short periods of time within this category of the industry. The reason is that Snapple's approach in providing the consumer with value added features is quickly emulated by competitors and upstarts. Snapple's products were marketed as containing ingredients that appeared to be better for you, offered change-of-pace flavor combinations, and were packaged in distinctive packages that have set the standard by which most others in the industry are now following, regardless of the product segment category. Although many attribute growth in the New Age category to the consumer's search for healthier products, there is one thing that every great brand has had in common--eye-catching, distinctive packaging that describes the product in a relatively short period of time.

"The diet business, which is but 11 percent of Snapple volume, accounts for five million cases, which would make Diet Snapple alone a leading label in the entire New Age field. Playing to strengths and potentials, low-calorie is high priority in the first part of 1997" (Prince, 1997).

Another strength possessed by Snapple is that the new juices, juice drinks, iced teas, and water combinations are perceived as healthier than most carbonated beverages.

The entire New Age segment lacks the momentum needed to overcome the regression back to the standardized products of Coke and Pepsi. Also, the thinking in the industry is that although now Snapple will have more marketing muscle behind it by being part of a major corporation, the brand may not be as fast to react to trends now that it is part of a larger firm. For some other brands, that is a competitive advantage.

Focusing momentarily on substitute products, which in this industry consist of beverages that are part of another category within the industry, juice drinks from Ocean Spray and others certainly have advantages such as limitless flavor combinations, better color hues, and no homemade competition.

The urge to consolidate is driven, in part, by consumers who are looking for specific products available in most locations. Ocean Spray's partnering with Pepsi created enormous benefits for both companies overnight; economies of scale for Pepsi's distribution network and Ocean Spray turned a 5,000 point of distribution network into a 50,000 point network overnight. Seeking such an alliance would quickly propel Snapple back to the market position it once held.

The two cola kings and their smaller competitors, such as National Beverage and Triarc Companies, have engaged in a price wars in recent years. Behind the scenes are battles for shelf space as bottlers offer incentives, referred to in the industry as slotting fees, for stores to stock brands in the best display areas.

There is a definite threat of new entrants in the New Age category due to relatively low barriers to entry. Co-packing plants are available, eliminating the need for high capital requirements. At the same time, there is the threat of industry consolidation due to the overly competitive market and the extreme power the buyer has in the market. This power translates into lower retail prices for consumers and lower margins for the manufacturers. In all beverage categories, there are a few leaders and many followers, and through consolidation, the strong are usually getting stronger. There is also a proliferation of products that are clogging distribution channels, has started to overwhelm consumers with too many choices. Although listed as a key

success factor in the industry, long-term success in this industry segment will depend on the producers' ability to create distinctiveness in each of their products as the innovations take place.

Similar to Quaker Oats, Triarc's purchase of Snapple created the potential for synergies, which is what made the Snapple deal fit for each entity. There was commonality in distribution systems since each of the top 10 RC bottlers handles Mistic, and most of them already sell Snapple. This was a major weakness for Quaker Oats in that its apparently attempted to use both of its distribution networks to get what it felt would be the best results.

Purchasing and outsourcing has become more cost effective since Triarc can take the volumes of all the brands and use that as a form of customer power, reducing the supplier power competitive force influencing Triarc's decision making process. It gives Triarc better pricing, which reduces costs on cap suppliers, label suppliers, glass suppliers, and flavor suppliers.

For sales, marketing, and administrative efficiencies, RC is off on its own with carbonated beverages domestically. Snapple and Mistic are marketed separately and distinctly which lowers the positive effects made possible by the synergies created by the acquisition. Sales forces for each are also separate in their strong East Coast markets. Sales forces are combined through much of the rest of the country. It creates a more challenging environment since there is a balancing act when considering the different brands are being managed simultaneously. "All Snapple, Mistic, and RC really have in common is they all taste great. People wonder where you're spending your time, where your loyalties are. You have to tell them it is like having three children. You love them all in different ways. The three major beverage legs of Triarc walk toward the same destination of profitability and growth, but each along a somewhat different route" (Prince, 1997).

ASSESSMENT OF THE FIRM'S OVERALL COMPETITIVE POSITION

The competitive strength assessment shows that Snapple has positioned itself well within the industry, having practiced its strategy with success compared to its direct competition within the New Age category. If Snapple were to spend additional energy on the distribution of its product, it would have a sizable advantage over all other New Age competitors. The bad news is that relative to substitute products, which consists of other beverage categories such as soft drinks or beer, its position in the industry does not look as phenomenal. In fact, it is quite poor.

Within the New Age category, Snapple dynamically changes as the market changes, presenting Snapple with a possible competitive advantage. The sustainable advantage should result from its packaging and product innovation capabilities, which are factors critical to its overall success. Snapple's distribution, a third key success factor for the industry, is weaker than it should be considering its sister companies and their distribution networks are well established. Coke, Pepsi, and the other major players in the soft drink category are at a marketing disadvantage, this being the fourth key success factor. With Coke and Pepsi's New Age offerings presented to consumers, their disadvantage is that they are accustomed to doing broad-based brand advertising, an approach that often does not work for niche products in narrow market segments such as New Age. Also, due to its recent poor performance, Snapple and Triarc's access to capital is limited more than its competitors. This creates a disadvantage when trying to produce those make-or-break innovative and industry-altering products.

The growth potential for Snapple is available again and it will be there for several more years. The biggest challenge for Snapple is to reestablish distribution, because where it gets distribution, the product is recognized and demanded. Products must reach the extended points of availability they once had.

CONCLUSION

The least likely event to occur would be for Triarc to partner with either Coke or Pepsi. This arrangement would add to the problem of industry consolidation and subsequently reduce

competition, eventually resulting in a rise in prices, possibly creating a more profitable Snapple. This arrangement would have positive effects in that it would solve very big problems in the distribution of products to hard-to-reach domestic and international areas. If Snapple and Pepsi were to partner against Coke, Snapple could give Pepsi another line of drinks in the U.S. to grab shelf space away from Coke.

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A STATISTICAL ANALYSIS OF FARM REAL ESTATE VALUE--1959-1976

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ABSTRACT

This paper discusses the cause and effect relationship between the value of farmland real estate and a number of other factors that may or may not actually be associated with the fluctuation of farm real estate value. The relationships among variables stated in this paper are merely statements concerning a number of existing possibilities. Cause and effect relationships involve an almost infinite number of variables, particularly in the present case.

INTRODUCTION

The rapid increase in the value of farmland real estate is the subject of analysis of this paper. The time span 1959-1976 has been chosen due to the availability of data as well as the rate of increase in value. Farmland includes grassland and other non-forest pasture and range, and excludes reserved forestland in parks and other special use land (Cassel, 2002). Due to the limited scope of this paper, many factors that could effect farm real estate value were not analyzed. Examples of these are the number of farm real estate transfers and other farm asset valuations, such as buildings and equipment (Cook & Derry, 2002).

The U.S. Department of Agriculture has suggested probable explanations for the surge in farmland value, such as the rising price for farm commodities, prospects for a continuing strong export demand, ready availability of funds for financing transfers, and strong demand for land for non-farm use (Anonymous, 2003). Also, a possible answer to the increase in value is investors attempting to utilize farmland investments as hedges against inflation (Long, 1987).

Statistical studies are designed to aid the researcher in discovering and formulating characteristics of a population for application on whatever problem they may have at hand. The basic concepts and techniques will be briefly described in the next section before the presentation and analysis of data.

ANALYSIS

The Statistical Package for the Social Sciences (SPSS) was utilized in this analysis. Farm real estate value's data was in the form of an index. The minimum value of farm real estate, 66, and the maximum value, 243, have a range of 177. These are the values for 1959 and 1976, respectively. This signifies that the lowest value of the data was 66 and the highest value of the data was 243. The mean is 116.6667, which is approximately the value for 1970, toward the latter part of the data. This infers that the greatest increase occurred during the mid-1970s. The coefficient of skewness indicates that the distribution is indeed skewed to the right. Farm real estate value has experienced tremendous increases in the 1959-1976 time span.

Farm real estate debt's values range from 11,091 to 50,876. Once again, these are the values for 1959 and 1976, respectively. The mean is 25,753.5, falling approximately between the values for the years 1969 and 1970, toward the latter part of the data. The distribution is positively skewed. Farm real estate debt has increased approximately 4.6 times over the 1959 level, with increases each year.

The volume of agricultural exports' data was in the form of an index. The minimum value was 68 and the maximum value was 174, again reflecting the 1959 and 1976 values, respectively.

The mean is 112.2222, closely corresponding to the years 1970-1971. The distribution is again skewed to the right. This data differs slightly in its pattern from the other data, in that exports dropped from 1967 to 1970. Also, a decline occurred from 1973-1974 and 1975. However, the index has increased about 2.5 times over the 1959 value. Contrast this with only a 1.5 times increase in agricultural imports.

The volume of agricultural imports' data was also in the form of an index. The range of data was 49, with a minimum value of 89 and a maximum value of 138. These are the values of 1960 and 1976, respectively. There were fluctuations in agricultural imports more than exports during this time span. Imports did increase, more so in the latter years. The coefficient of skewness is positive; thus, the distribution is skewed to the right. The volume of agricultural imports probably experienced less fluctuation during the 1959-1976 time span than any other index presented here, increasing about 1.5 times.

National income is stated in billions of dollars, with values ranging from 403.6001 to 1,399.3. The range of these values is 995.7. The minimum and maximum values correspond to the years 1959 and 1976, respectively. The mean is 106.111. The distribution is skewed slightly to the right. National income increased approximately 3.5 times from its 1959 value, increasing each year. This index is closely akin to disposable personal income. Disposable personal income is stated in billions of dollars. The minimum and maximum values are 336.1001 and 1185.8. These are the values for the years 1959 and 1976, respectively. The mean is 633.5667 and the distribution is skewed to the right. Disposable personal income tripled for the 1959-1976 time span, increasing each year instead of exhibiting temporary lags as experienced by other indices, such as industrial production.

Industrial production has a range of 65 with the minimum and maximum values of 64.8 and 129.8. These values correspond to 1959 and 1976, respectively. The mean is 97.67778. This distribution has a skewness coefficient of -.1949526; thus, it is slightly skewed to the left. This data is presented in the form of an index, which doubled rapidly during the time span in the latter years. However, industrial production dropped from 1974 to 1975, unlike the patterns of consumer and wholesale prices, disposable personal income, or national income. Prices received by farmers, realized gross farm income, realized net income of farm operators, total net income of farm operators, and realized net income per farm all decreased in value from 1974 to 1975.

Consumer price data are also in the form of an index. The range of 83.2 increases from the minimum value of 87.3 (1959) to the maximum value of 170.5 (1976). The coefficient of skewness is .977916. Therefore, the distribution is positively skewed to the right. In no year did consumer prices fall from the year before. The mean is 112.3278. Consumer prices almost doubled during the 1959-1976 time span. The sharpest increase occurred in the latter years.

Wholesale prices were also expressed in terms of an index. The mean is 115.0945, which relates approximately to 1971. Values ranged from 94.5 to 182.9, a range of 88.3999. Only a small degree of fluctuation occurred in the years 1959-1966. A coefficient of skewness of 1.371597 was computed indicating a strongly skewed distribution to the right. Wholesale and consumer prices appear to share a similar pattern of increases. The index doubled from 1959-76.

Total prices paid by farmers ranged from 87 to 201, representing 1959 and 1976, respectively, for a range of 114. The values are in the form of an index. The mean is 116.9444, and the coefficient of skewness is 1.225690. The distribution is strongly skewed to the right. These values increased approximately 2.3 times over the 1959 figure. The latter years experienced the sharpest increase in value.

Commodity prices paid by farmers' values are again in index form. The range is 107, increasing from 87 (1959) to 194 (1976). The mean is 115.6667. The coefficient of skewness is 1.201512, signifying the distribution is strongly skewed to the right. Commodity prices paid by farmers increased at a rate similar to that of total prices paid by farmers, although at a somewhat slower pace.

Prices received by farmers are expressed in terms of an index. The minimum value is 95 (1960) and the maximum value is 192 (1974). The range is 97. The coefficient of skewness is 1.174090, signifying that the distribution is skewed to the right. The mean is 121.1111, which is approximately 1972's value. These values doubled in the 1959-1976 time span.

Realized gross farm income is expressed in millions of dollars and has a mean of 60,176.55, which closely approximates 1971's value. The data again appears to have its greatest fluctuations in the latter years. The coefficient of skewness is .910453, signifying the distribution is skewed to the right. The minimum value for 1959 is 37,876 and for 1976, 103,643 is the maximum value, resulting in a range of 65,767. Realized gross farm income has almost tripled in the 1959 to 1976 time span. The major increases first appear in the 1971-1972 time span.

Production expenses spread from 27,177 to 81,735, for a range of 54,558. The minimum was the value for 1959 and the maximum was the value for 1976. The mean is 44,793.45, close to the 1970 value. The coefficient of skewness is .9190087, signifying the distribution is skewed to the right. Production expenses more than tripled during the 1959-1976 time span, in contrast to realized net income of farm operators doubling during the same time span.

Realized net income of farm operators is expressed in millions of dollars. The mean is 15,383.11, closely related to the 1971-1972 time span. It may be noted that the realized net income of farm operators increased very gradually (with the exception of 1966) until 1969, and in 1973 increased by about 70 percent. In contrast, realized gross farm income (including government payments) rose steadily at a much faster rate, with sharp increases exhibited in the 1972-1973 time span.

In 1959, the ratio between the two indices was about 3.5 to 1. In 1976, the ratio was approximately 5 to 1. Thus, production expenses increased at a much faster rate than income. As might be expected, the distribution is strongly skewed to the right, with a coefficient of skewness of 1.384604. The range is 19,244 with a minimum of 10,699 and a maximum of 29,943.

Total net income of farm operators has a range of 22,857 with a minimum of 10,492 (occurring in 1964) and a maximum of 33,349 (occurring in 1973). The distribution is positively skewed with a coefficient of skewness of 1.522059. The mean of the distribution is 15,862.61, which closely approximates the 1971-1972 time span. Logically, total net income of farm operators experienced a similar pattern to that of realized net income of farm operators. The increase happened slowly, with a distinct jump of the values in the 1972-1973 time span. During the 1959-1976 time span, total net income of farm operators nearly doubled, as did realized net income of farm operators.

Realized net income per farm spread from 2,611 (1959) to 10,529 (1973), for a range of 7,918. The mean is 4,964.277, and the distribution is positively skewed with a coefficient of 1.134928. A tremendous surge occurred in the 1972-1973 time span and then declined. This gradual upward swing is also affected by the fact that the number of farms has steadily dropped. The number of farms decreased from 4,104,520 in 1959 to 2,778,380 in 1976. Conversely, the average size of a farm has increased from 288 acres in 1959 to 390 acres in 1976. The total land in farms has decreased from 1,182,563,000 acres in 1959 to 1,084,046,000 in 1976.

As stated earlier, prices paid by farmers and production expenses are closely correlated to farm real estate value. Income of farms and farm operators is much less related. Gross income has somewhat followed the rate of increase of farm real estate value, but it is obvious net income has not.

Simple regression and correlation was examined with the selected variables' SPSS's output. The correlation coefficient r is the square root of the coefficient of determination r^2. The coefficient of determination r^2 is, as implied by the name, a measure of cause and effect, and as such is a most useful technique. Farm real estate value and prices received by farmers are the dependent and independent variables, respectively. The SPSS program permits a multiple r and a simple r for comparative purposes in multiple regression. The coefficient of determination r^2 is .85918, translating as 85.918 percent of the variation in farm real estate value is caused by total prices

received by farmers. However, this is a rough statement at best. Other variables enter into the variations, but this is a starting point in the analysis. Simple *r* is .92692. This is not quite as easy to translate as is the r^2. An *r* of .92692 reflects a very high degree of relationship. There appears to be a higher degree of covariance than there is a cause and effect relationship. Beta is a familiar concept--the slope of the regression line, which is .9269214. Beta signifies that when the independent variable increases by one, the dependent variable increases by the amount of beta, assuming all other things remain constant. The standard error is 20.07355, which measures the standard deviation of the dependent variable, farm real estate value, based on the independent variable, prices received by farmers.

The regression and correlation analysis of farm real estate value (dependent variable) and realized gross farm income illustrates that *r* is .95746, demonstrating a very high degree of association, higher than that of farm real estate value with total prices received by farmers. The r^2 is .91673, signifying 91.673 percent of the fluctuation in farm real estate value is attributed to realized gross farm income. The standard error is 15.43635 and beta is .9574595.

Farm real estate value (the dependent variable) and production expenses (the independent variable) exhibit extremely high coefficients. The *r* is .98469, signifying that there is almost perfect covariance between the two variables. The r^2 is .96961, signifying that 96.961 percent of the variations in farm real estate are due to the variations in production expenses. As observed earlier, production expenses have closely followed such national indices, such as national income and personal disposable income.

A distinct change may be noted in the analysis of farm real estate value and realized net income of farm operators. The *r* is .7835, much lower than the preceding variables' *r*. The r^2 is .61388, signifying that 61.388 percent of the changes in farm real estate are due to the changes in realized net income of farm operators. The standard error is 33.23992, much larger than in the other analyses thus far, signifying that the estimate based on this data is less reliable.

A similar trend is evident with farm real estate value (dependent variable) and total net income of farm operators (independent variable). The *r* is .73828 and the r^2 is .54506, revealing a very low association between the two variables. The coefficient of non-determination is .45594, signifying that 45.594 percent of the variation in farm real estate is not due to the variation in total net income of farm operators.

Logically, if net income is down, expenses must be up (relatively speaking), since gross farm income has risen. If the total price paid by farmers is the independent variable, then the r^2 is .98147, meaning that 98.147 percent of the variation in farm real estate is caused by total prices paid by farmers. The *r* is .99069, which signifies that almost perfect correlation appears to exist between the two variables. The standard error is low at 7.28083. If commodity prices paid by farmers is the independent variable, then the relationship is greater than that of total prices paid by farmers to farm real estate value. The standard error is also less, 6.16685 as compared to 7.28083. The *r* is .99333, and the r^2 .98671.

CONCLUSION

In general, farm real estate value fluctuations do not appear to be related to the net income of farms. Although production expenses increased at a rapid pace, farm income increased slowly. Agricultural imports do not appear to be strongly related. Changes in farm real estate may be due to more intangible and immeasurable variables, such as consumers' attitudes and expectations, upon which it would be difficult to make a prediction. For the time span studied, it appears that farm value kept pace with national income and disposable personal income, and as such may very well be used by investors as a hedge against inflation. It is obvious that many more variables should be introduced to make a fair analysis of the situation.

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CUSTOMER SATISFACTION ASSESSMENTS FOR COMPANY AND CUSTOMER GOALS

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ABSTRACT

Customers in the hospitality arena depicted in this paper are multi-dimensional. The customer satisfaction variable can make or break any organization. In this paper, modern management theories regarding customer satisfaction will be discussed. The logic of attaining superior customer satisfaction is generic across many industries and will be explored. This paper will also present best practices for certain industries as guidance for companies wishing to improve marketing positioning.

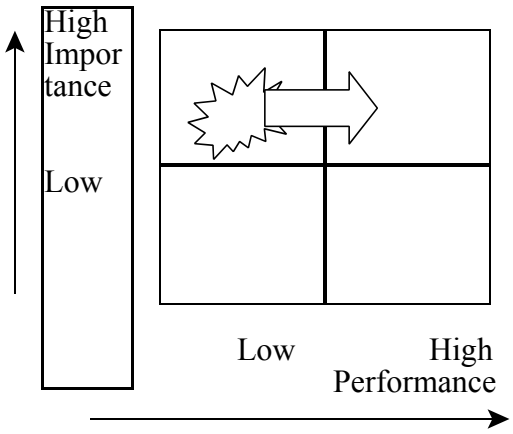
INTRODUCTION

The basis for all modern marketing includes incorporation of the four "P's": *Product*, *Price*, *Place* (Distribution), and *Promotion*. The definition of marketing, as coined by the American Marketing Association, is: "Marketing is the process of planning and executing the conception, pricing, promotion, and distribution of ideas, goods and services to create exchanges that satisfy individual and organizational goals" (Bennett, 1995). This maxim supplies all of the components of previous definitions of marketing, yet expands on the idea of satisfaction of individual and organizational goals. Ways and means to achieve these satisfaction goals can vary industry-to-industry, customer-to-customer. These elements of marketing are further refined in relation to a recent definition of marketing as the "total system of business activities designed to plan, promote, and distribute want satisfying products to target markets in order to achieve organizational objectives" (Etzel, Walker & Stanton, 2001, p. 2). Marketing as viewed in this perspective is directed toward the *want satisfaction* of target markets. Is this a new finding about the marketing concept?

DEVELOPMENT OF THE CUSTOMER SATISFACTION MODEL

The interpretation of quantitative studies can certainly play out what the organization views as customer satisfaction, but unless a company has an intimate understanding of the customer, that customer may be lost to the competition. The competition's product and perceived value may align better with the needs (wants) and expectations of the customer. Therefore, it is important that organizations drive initiatives toward marketing orientation, which ultimately is customer orientation.

EXHIBIT 1
CUSTOMER SATISFACTION--ATTRIBUTE



In Exhibit 1, Gordon's (2003) diagram shows a method that may not pay sufficient attention to dimensions of importance other than customer profitability and strategic value. According to Gordon (2003), companies should measure the right things and measure them correctly. This method does not oppose the idea that all customers are important. However, the positioning of the modern organization does require that improvement in the attitudes of the most profitable customers is of great importance. Also worthy of further development is the marketing to potentially profitable customers where the organization enjoys a positive relationship.

CUSTOMER SATISFACTION MODEL AS DEVELOPED FROM A MEETING CENTER PERSPECTIVE

Customers participating or enjoying the services of hospitality facilities range from:

- Decision-Makers--those responsible for the selection of sites to convene a group which could range from trade shows, fundraisers, company recognition events, and community-wide informational activities.
- Exhibitors--those paying a fee to participate in certain events with different expectations from those making decisions.
- Attendees--those who participate in events being sponsored by various organizations and who pay gate admissions or are admitted free because of an affiliation with a particular organization. These attendees have various reasons for being involved in the event held. Attendees have other needs that surface as management strives to provide for customer satisfaction.

Interviews with the Decision-Makers regarding the selection of the event site yielded the following data.

TABLE 1
Decision Makers' Positioning Variables

	N	Mean	Std. Error Mean	Description
PUB_SP	23	3.26	.129	Public Space
MEET_RM	20	3.35	.131	Meeting Rooms
EXH_HALL	20	3.35	.150	Exhibit Hall
ACCURACY	23	3.30	.159	Accuracy of details
TIMELNS	23	3.13	.192	Timeliness of response
RESPON	23	3.39	.163	Responsiveness of staff
APPEARAN	23	3.48	.106	Appearance of Staff
PER_RESP	21	3.43	.130	Attention from Staff person
PRESENTA	21	3.48	.148	Presentation of Food
SELECTN	21	3.29	.140	Food Selection
VALUE	21	3.14	.143	Food Value
KNOWLEDG	23	3.48	.124	Knowledge of Staff
RESPONSI	23	3.43	.138	Responsive of Management
ATTITUDE	23	3.43	.123	Attitude of Staff
FOOD_QUA	21	3.38	.146	Food Quality
EV_MG_AT	23	3.52	.139	Event Management
SEC_ATTI	20	3.20	.138	Security Attitude
SEC_RESP	19	3.26	.150	Security Response
SEC_APPE	19	3.21	.181	Security Appearance

Overall mean for the Decision-Makers: 3.34

TABLE 2
Decision Makers' upper and lower value for selected variables (Test Value = 0)

			95% Confidence Interval of the Difference	
	Df	Mean Difference	Lower	Upper
PUB_SP	22	3.26	2.99	3.53
MEET_RM	19	3.35	3.08	3.62
EXH_HALL	19	3.35	3.04	3.66
ACCURACY	22	3.30	2.97	3.64
TIMELNS	22	3.13	2.73	3.53
RESPON	22	3.39	3.05	3.73
APPEARAN	22	3.48	3.26	3.70
PER_RESP	20	3.43	3.16	3.70
PRESENTA	20	3.48	3.17	3.79
SELECTN	20	3.29	2.99	3.58
VALUE	20	3.14	2.84	3.44
KNOWLEDG	22	3.48	3.22	3.73
RESPONSI	22	3.43	3.15	3.72
ATTITUDE	22	3.43	3.18	3.69
FOOD_QUA	20	3.38	3.08	3.69
EV_MG_AT	22	3.52	3.23	3.81
SEC_ATTI	19	3.20	2.91	3.49
SEC_RESP	18	3.26	2.95	3.58
SEC_APPE	18	3.21	2.83	3.59

Table 2's values attest to the level of customer satisfaction based on the various attributes that management believes are the most important to those that make decisions regarding the use of the facility. This method has brought repeat users to the facility and has led to a referral business that is needed in this industry in order to expand the customer base.

The customer satisfaction questionnaire utilized by this organization revealed that the needs and wants of this group and the intimacy needed to completely satisfy those needs and wants drive the efforts of management.

Food, security, and comfort levels are the most important factors influencing the ranking of the facility in its effort to provide the highest level of customer satisfaction. Table 3 shows the Exhibitors' Satisfaction Results.

TABLE 3
EXHIBITORS' POSITIONING FACTORS FOR 2001-2002

	Mean	Std. Deviation	Std. Error Mean
Enjoyed Experience	3.20	.427	.027
Cleanliness of Building	3.13	.582	.037
Staff Friendly	3.38	.503	.032
Concession Food Price	2.72	.715	.059
Cleanliness of Bathrooms	3.03	.688	.045
Staff Helpful	3.34	.509	.033
Parking Facilities	2.92	.760	.052
Food Service	3.03	.613	.046
Construction Impact	2.97	.729	.046
The Security at MCCC	3.19	.471	.031
Loading Logistics	3.09	.703	.048
Security for Show	3.21	.476	.031
Future Exhibiting	3.24	.522	.033
Adequate Public Phones	3.06	.580	.041
Recommended to Friends	3.18	.509	.033
Enjoyed Using Facilities	3.18	.482	.031
Electrical Support	3.04	.669	.047
Move-in Handled Properly	3.16	.582	.039
Temperature in Space	2.92	.773	.048
Lighting in Space	3.23	.490	.031
Sound in Space	3.12	.539	.037
Overall Expectations Met	3.17	.492	.031
Quality of Food	3.05	.542	.041

Mean average for this group: 3.11

Table 4 data refers only to the level of enjoyment of exhibitors for certain days.

TABLE 4
DATES--LEVEL OF ENJOYMENT

DATE	Disagree	Agree	Strongly Agree	Total
09-13		6		6
09-19		11	3	14
09-21		11	2	13
10-04		3	3	6
10-10	1	26	8	35
04-14			1	1
10-05		2		2
11-16		13	1	14
11-08		4	2	6
02-18		7	1	8
02-21		14	8	22
02-09		6	1	7
03-14		13	2	15
03-02		18	4	22
03-22		6		6
03-08		19	3	22
04-07		3	3	6
06-20		5	2	7
06-09		8	6	14
Total	3	195	52	250

CONCLUSION

The results in this survey show the means of the four variables. Responses were tabulated according to ranking: 1) Strongly Disagree, 2) Disagree, 3) Agree, and 4) Strongly Agree.

These results show that the questions directly associated with the subliminal issue of customer satisfaction and expectations met include questions involving recommendations to friends, overall expectations, plans to exhibit in the future, and the enjoyment of the facility. "Disagree" and "Strongly Disagree" responses in these areas would most likely prod the management of the facility to develop a plan to avert any defections of the exhibitor groups. More attention should be paid to the negative comments on the dates as shown in Table 4. The goal of management in the context of the perceptions of customer satisfaction/dissatisfaction from the users of the facility centers on the areas identified in the lower quadrants. These more negative responses, though not prevalent, should be addressed in order that a more positive response may be elicited from those customers that already scored the facility in the "Agree" and "Strongly Agree" categories. If management notes the date of events and can appreciate the financial impact of the bottom line results, then the customer-focused approach could be implemented. Depending on the groups' effect on the bottom line, management can address the issues perceived as lessening customer satisfaction. Food prices and quality were the least satisfying items for the exhibitors. In today's competitive environment, by using the anticipative mindset of satisfying customers' wants, new directives could be driven.

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AN ABBREVIATED SUMMARY OF AN EMPIRICAL STUDY OF THE INDICATORS OF THE NEED FOR POWER, ACHIEVEMENT AND AFFILIATION: AND THE ETHICAL, MACHIAVELLIAN AND POLITICAL ORIENTATION OF MARKETING MAJORS

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ABSTRACT

This research studies personal and behavioral indicators of the need for power, achievement, and affiliation, and the ethical, Machivallian and political orientation of 178 marketing majors. The statistics indicate that for all respondents in the study, those with a high level of academic achievement had a lower need for affiliation, were less politically oriented, but were more ethically oriented and that females are more ethically oriented than males. Surprisingly, there was no statistical difference in the median score for the need for achievement and the need for power between males and females; however, males had a statistically higher level of need for affiliation. Those respondents that had a high need for affiliation had a lower level of academic achievement and Machiavellian orientation but were more politically oriented. Those respondents that had a high need for power were more politically oriented but less ethically oriented. Those respondents that had a high level of Machiavellianism had a lower need for power, and those respondents that were more ethically oriented had a lower need for power and affiliation were less politically oriented but had a higher level of Machivalliasm. Politically-oriented respondents have a higher need for affiliation, a higher need for power, a lower degree of Machiavellianism, and a lower degree of ethical orientation than respondents who are not politically-oriented.

INTRODUCTION

The need for power, achievement, and affiliation is central to the study of organizational ethics, politics, and Machiavellian tendencies. The need for achievement is the employees' desire to perform to high standards and to excel in their job. Employees who have a high need for power use that power as manipulative for personal gains or as a means to help others in the organization to achieve their goals. However, individuals who have a high need for affiliation enjoy associating with other employees in the organization and are concerned about their happiness. These individuals like to work for organizations that are employee centered.

Employees having a high Machiavellian orientation have the potential for disrupting an entire organization. These individuals see what they can get away with, but not to the point of becoming obvious to others that are in a position to retaliate. The Machiavellian personality has no loyalty to the organization and mainly approaches all situations from a self-interest perspective. Therefore, an individual with a Machiavellian orientation represents a significant personality variable which directly affects other employees and also the organization.

HYPOTHESES AND METHODOLOGY

The data was obtained from 178 undergraduate marketing majors at two medium-size universities located in the mid-west and mid-south during. Completing the questionnaire was voluntary and anonymous. It took students approximately twenty-five minutes to complete.

The survey instrument included 82 questions or statements. The section of the survey which assessed the student's need for achievement, affiliation, and power used the 15-item motivational needs survey developed by Steers and Braunstein (1976) and Steers (1977). The student's political orientation was measured using the 20-item survey developed by DuBrin (1978). The section of the survey which assessed the student's need for achievement, affiliation, and power used the 15-item motivational needs survey developed by Steers and Braunstein (1976) and Steers (1977). The student's political orientation was measured using the 20-item survey developed by DuBrin (1978). The degree of Machiavellianism was measured using the MACH IV scale developed by Christie and Geis and included 20 questions (Hunt & Chonko 1984). The 27-item ethical scenarios section of the questionnaire was adopted and expanded from the 1991 Whipple and Wolf study. For the MACH IV survey, the motivation needs survey, the ethical orientation survey, the respondents were asked to answer in a Likert type format. For the political orientation survey the respondents were asked to answer each question with "mostly agree" or "mostly disagree".

Ho1: There is no difference between male and female students as to their academic achievement, motivational needs, political orientation, Machiavellianism, or ethical orientation.

Ho2: There is no difference between students who have a high level of academic achievement and students who have a low level of academic achievement as to their motivational needs, political orientation, Machiavellianism, or ethical orientation.

Ho3: There is no difference between students who have a high level of motivational needs (power, achievement, and affiliation)and students who have a low level of motivational needs as to their academic achievement, political orientation, Machiavellianism, or ethical orientation.

Ho4: There is no difference between students who are politically-oriented and students who are not politically-oriented as to their academic achievement, motivational needs, Machiavellianism, or ethical orientation.

Ho5: There is no difference between students who have a high level of Machiavellianism and students who have a low level of Machiavellianism as to their academic achievement, motivational needs, political orientation, or ethical orientation.

Ho6: There is no difference between students who are highly ethical and students who are not highly ethical as to their academic achievement, motivational needs, political orientation, or Machiavellianism.

RESULTS

There were 100 female students and 78 male students who completed the survey. The results for the test of hypothesis 1 are shown in table 1. As expected, females had a higher level of academic achievement, as proxied by GPA, than males ($Z = -3.69$, two-tailed $p < 0.01$). There was mixed evidence as to differences in males' and females' level of motivational needs. Surprisingly, there was no statistical difference in the median score for the need for achievement and the need for power between males and females; however, males had a statistically higher level of need for affiliation (4.60 vs. 4.40; $Z = 2.19$, two-tailed $p < 0.03$). It was expected that females would have a higher need for affiliation. Although the Z statistic indicated a statistical difference in males' and females' political orientation, the median values indicated that the difference between males' and females' political orientation was not significant. Another surprising finding was that there is no difference in the degree of Machiavellianism between males and females ($Z = -0.17$, two-tailed $p > 0.10$). However, females were more ethically-oriented than males (123.50 vs. 111.06; $Z = -4.74$,

two-tailed $p < 0.01$). This finding was supported by previous research studies (Akaah, 1989; Chonko & Hunt, 1985; Tsalikis & Ortiz-Buoafina, 1990).

Table 1
Test for Differences in Academic Achievement, Motivational Needs, Political Orientation, Machiavellianism, and Ethical Orientation Between Males and Females

Column 1	Column 2	Column 3	Column 4	Column 5
Variable	Males	Females Z	Score	P-Value
Academic Achievement(GPA)	2.94	3.25	-3.69	0.01
Motivational Needs:				
Need for Achievement	5.00	5.20	-0.80	0.42
Need for Affiliation	4.60	4.40	2.19	0.03
Need for Power	4.75	4.55	1.00	0.32
Political Orientation	7.00	7.00	1.80	0.70
Machiavellianism	77.50	77.00	-0.17	0.86
Ethical Orientation	111.06	123.50	-4.74	0.01

The results for the test of hypothesis 2 are provided in Table 2. The findings indicate that respondents with a high level of academic achievement (GPA = 3.00) have a lower need for affiliation ($Z = 2.96$, two-tailed $p < 0.01$), are less politically-oriented ($Z = 2.03$, two-tailed $p < 0.04$), and are more ethically-oriented ($Z = -2.72$, two-tailed $p < 0.01$). There is no statistical difference in the need for achievement, the need for power, or the degree of Machiavellianism between respondents with a high and low level of academic achievement. Previous studies by Touhey (1973) have found that intelligence does aid the deployment and concealment of Machiavellian tactics. However, Calhoon (1969) found that there is no difference in IQ between high and low Machiavellian individuals.

Table 2
Test for Differences in Motivational Needs, Political Orientation, Machiavellianism, and Ethical Orientation Between Respondents with a Low Level of Academic Achievement and Respondents with a High Level of Academic Achievement

Column 1	Column 2	Column 3	Column 4	Column 5
Variable	Males	Females	Z Score	P-Value
Motivational Needs:				
Need for Achievement	5.00	5.10	-0.76	0.44
Need for Affiliation	4.60	4.40	2.96	0.01
Need for Power	4.60	4.60	-0.24	0.80
Political Orientation	8.00	7.00	2.03	0.40
Machiavellianism	77.50	77.00	0.10	0.92
Ethical Orientation	116.15	121.00	-2.72	0.10

Table 3 presents the results for the test of hypothesis 3. When respondents are classified by their need for achievement, there is no statistically significant difference in academic achievement, political orientation, Machiavellianism, and ethical orientation between respondents with a low level of motivational needs and a high level of motivational needs (panel a). In contrast, respondents with a high need for affiliation (panel b) have a lower level of academic achievement ($Z = 2.26$, two-tailed $p < 0.02$), are more politically-oriented ($Z = -3.35$, two-tailed $p < 0.01$), and have a lower level of Machiavellianism ($Z = 1.76$, two-tailed $p < 0.08$). There is no difference in ethical orientation between respondents with a high and low need for affiliation (121.00 vs. 117.00; $Z = 1.48$, two-tailed $p > 0.10$; panel b). Respondents who have a high need for power (panel c) are more

politically-oriented ($Z = -3.08$, two-tailed $p < 0.01$) and are less ethically-oriented ($Z = 2.20$, two-tailed $p < 0.03$) than respondents with a low need for power. The median values for academic achievement and Machiavellianism are not statistically different between respondents with a low and high need for power. The finding that Machiavellianism is not statistically different from respondents with a low and high need for power is not surprising because power need is not a major characteristic of high Machiavellian individuals (Christie & Geis, 1970).

Table 3
Test for Differences in Academic Achievement, Political Orientation, Machiavellianism, and Ethical Orientation Between Respondents with a Low Level of Motivational Needs and Respondents with a High Level of Motivational Needs

Column 1	Column 2	Column 3	Column 4	Column 5
	Median Values			
Variable	Low	High	Z Score	P-Value
A. Need for Achievement				
Academic Achievement	3.00	3.10	-0.79	0.43
Political Orientation	6.00	7.00	-0.48	0.63
Machiavellianism	77.50	76.50	1.41	0.16
Ethical Orientation	117.00	120.00	-1.01	0.31
B. Need for Affiliation				
Academic Achievement	3.25	3.00	2.26	0.02
Political Orientation	6.00	8.00	-3.35	0.10
Machiavellianism	78.00	76.00	1.76	0.80
Ethical Orientation	121.00	117.00	1.48	0.14

The results for the test of hypothesis 4 are provided in Table 4. Politically-oriented respondents have a higher need for affiliation (4.70 vs. 4.20; $Z = -4.41$, two-tailed $p < 0.01$), a higher need for power (4.80 vs. 4.40; $Z = -2.43$, two-tailed $p < 0.02$), a lower degree of Machiavellianism (75.00 vs. 80.00; $Z = 3.30$, two-tailed $p < 0.01$), and a lower degree of ethical orientation (116.00 vs. 125.00; $Z = 3.92$, two-tailed $p < 0.01$) than respondents who are not politically-oriented. There is no statistical difference in the level of academic achievement and the need for achievement across these two subsamples. The finding that politically-oriented respondents have a low degree of Machiavellism is not surprising because organizational politics appears to be a more diffused process. (Christie & Geis, 1970).

Table 4
Test for Differences in Academic Achievement, Motivational Needs, Machiavellianism, and Ethical Orientation Between Respondents Who Are Not Politically-Oriented and Respondents Who Are Politically-Oriented

Column 1	Column 2	Column 3	Column 4	Column 5
	Median Values			
Variable	Low	High	Z Score	P-Value
Academic Achievement	3.20	3.00	0.98	0.33
Motivational Needs:				
Need for Achievement	5.00	5.20	-1.13	0.26
Need for Affiliation	4.20	4.70	-4.41	0.01
Need for Power	4.40	4.80	-2.43	0.02
Machiavellianism	80.00	75.00	3.30	0.01
Ethical Orientation	125.00	116.00	3.92	0.01

Table 5 presents the results for the test of hypothesis 5. The median values for academic achievement, the need for achievement, and the need for power are not statistically different between respondents with a high level of Machiavellianism and respondents with a low level of Machiavellianism. Respondents with a high level of Machiavellianism, however, have a lower need for affiliation ($Z = 3.21$, two-tailed $p < 0.01$), are less politically-oriented ($Z = 4.20$, two-tailed $p < 0.01$), and are more ethically-oriented ($Z = -2.44$, two-tailed $p < 0.01$). The finding that individuals that have a high level of Machiavellian have a lower need for affiliation is expected because the characteristics of an affiliation need is a concern for other employees' happiness and satisfaction (McClelland & Burnham, 1976). The characteristics of a high Machiavellian individual are that the needs, feelings, and rights of others in the organization are secondary. (Machiavelli, 1961).

Table 5
Test for Differences in Academic Achievement, Motivational Needs, Political Orientation, and Ethical Orientation Between Respondents with a Low Level of Machiavellianism and Respondents with a High Level of Machiavellianism

Column 1	Column 2	Column 3	Column 4	Column 5
	Median Values			
Variable	Low	High	Z Score	P-Value
Academic Achievement	3.30	3.23	-1.06	0.29
Motivational Needs:				
Need for Achievement	5.20	5.00	0.71	0.48
Need for Affiliation	4.60	4.40	3.21	0.01
Need for Power	4.78	4.60	0.17	0.86
Political Orientation	8.00	6.00	4.20	0.01
Ethical Orientation	116.15	121.00	-2.44	0.01

The test for the final hypothesis, hypothesis 6, are provided in Table 6. Highly-ethical respondents have a higher level of academic achievement (3.24 vs. 3.00; $Z = -2.85$, two-tailed $p < 0.01$), a lower need for affiliation (4.40 vs. 4.60; $Z = 2.59$, two-tailed $p < 0.01$), a lower need for power (4.40 vs. 4.80; $Z = 1.69$, two-tailed $p < 0.09$), are less politically-oriented (6.00 vs. 8.00; $Z = 5.31$, two-tailed $p < 0.01$), and have a higher level of Machiavellianism (78.00 vs. 76.00; $Z = -2.06$, two-tailed $p < 0.04$) than respondents who are not highly ethical. There is no statistical difference in the median value for the need for achievement between highly-ethical and non highly-ethical respondents ($Z = -0.74$, two-tailed $p > 0.10$).

Table 6
Test for Differences in Academic Achievement, Motivational Needs, Political Orientation, and Ethical Orientation Between Respondents Who Are Not Highly Ethical and Respondents Who Are Highly Ethical

Column 1	Column 2	Column 3	Column 4	Column 5
	Median Values			
Variable	Not Highly	Highly	Z Score	P-Value
Academic Achievement	3.00	3.24	-2.85	0.01
Motivational Needs:				
Need for Achievement	5.00	5.00	-0.74	0.46
Need for Affiliation	4.50	4.40	2.59	0.01
Need for Power	4.80	4.40	1.69	0.09
Political Orientation	8.00	78.00	-2.06	0.04
Machiavellianism	76.00	78.00	-2.06	0.04

CONCLUSION

A pervasive but very significant reason for studying Machiavellianism, ethical orientation, and organizational politics in today's organizations centers around the issue of loyalty. Loyalty refers to the dedication or commitment to a person, a task, or the organization where the loyalty to one factor results in being at odds with the others. Self interest is the most powerful force affecting loyalty and influences both those who employ political and Machiavellian tactics and also the recipients. Since Machiavellian, ethical, and political orientation exist in individuals in differing degrees, professors need to know more about the students' orientation and ethical attitudes. By understanding an individual's Machiavellian, ethical, and political orientation and motivation characteristics, employees can make counteractions to prevent damage to themselves or the organization. This information could help the socialization process of new employees in the workplace, in structuring university ethic's courses, and in understanding Machiavellianism and organizational politics in the workplace.

THE IMPACT OF SALESPEOPLE'S WORK SCHEDULE AND TRAVEL REQUIREMENTS ON WORK-FAMILY CONFLICT & TECHNOLOGY ISSUES

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ABSTRACT

The two-fold purpose of this exploratory study was to assess, in part, the impact of salespeople's work schedules and travel requirements on work-family conflict (WFC) and information technology issues. The authors designed and distributed a survey on work-family conflict and technology issues to 35 salespeople they knew. WFC scale items were borrowed from two sources, and new items and questions were created to measure technology issues. Significant differences related to work schedule and travel requirements were found with regard to length of employment, amount of time spent on selling tasks, and tension over how much time is spent on travel. Limitations of the study are then addressed, followed by implications for future research.

LITERATURE REVIEW

The psychology, organizational behavior, human resource management, and family sciences literature is full of studies on the impact of work and family conflict on employee productivity, job satisfaction, job loyalty, marital happiness, and physical and mental health, among other attitudinal, physiological, and behavioral consequences. Work-family conflict has been established by prior research to be bi-directional; i.e., it involves two types of conflict, work obligations interfering with family life (work-family conflict, WFC) and family life interfering with work duties (family-work conflict, FWC)(Marchese, Bassham and Ryan 2002, pp. 145, 146). Greenhaus and Beutell (1985) identified three key types of WFC: time-based conflict (e.g., hours worked per week, schedule flexibility, child care demands); strain-based conflict (e.g., tension, depression, irritability, family roles expectations); and behavior-based conflict (role expectations). Boyar, et al. (2003) found through structural equation modeling that work-role conflict and work-role overload were positively related to WFC and thus affected turnover intentions. However, family responsibility was not related to FWC. Namasivayam and Mount (2004) found an unexpected linkage of FWC issues with higher, not lower, job satisfaction. They cautioned that the result may be due to the overwhelmingly Hispanic workforce that participated in the hotel chain study. Research on WFC has also been done on the salesforce, involving topics such as satisfaction (Boles, Wood and Johnson 2003), coping strategies (Nonis and Sager 2003) and turnover intentions (Netemeyer, Brashear-Alejandro and Boles 2004).

One area that has received more attention lately is that of the impact of caregiver arrangements and related issues on employees' attitudes and behavior. Jansen et al. (2003) found that having to care for a chronically sick child or other family member at home was a significant risk factor for WFC for men but not for women. Kossek, Colquitt and Noe (2001) found that "managing elder care interacts with variables to influence employee outcomes more negatively than does

managing child care, especially when caregiving is at home or by a family member" (p. 40). Personal resources, health and age are postulated to affect how much influence aging parents have on family decision making (Watson, Srisupandit & Tung, 2002).

Little research was found in terms of the influence of technology on salespeople's careers and role conflict (e.g. see Boles & Sunoo, 1998; Prewitt, 1998). Salesperson technophobia was found to be related to age and education level of salespeople and was a contributing factor to increased role stress (Rich, 2000). Since the terrorism attacks on September 11, 2001, and given the subsequent passage of the Patriot Act, the authors decided to investigate attitudes toward computer security issues both at home and in the sales office. In order to better cope with family versus work issues, more and more employees are working from home; thus technology issues may now become a part of family/work issues.

METHODOLOGY

A questionnaire was originally designed in November 2003, pretested on marketing students, and minor wording revisions made. The final version of the questionnaire contained 28 numbered questions, with three of the numbered questions containing a total of 33 Likert-type statements about work, family-related issues, and technology usage borrowed from scales or created just for this study. Four items from Chonko and Burnett's (1983) scale were used; these addressed time spent working, socializing (with customers and other salespeople), and traveling. Good, Page and Young's (1996) 13-item WFC scale was also used. Four questions were added to their WFC scale to measure the impact of family members' health on careers. No up-to-date measures of current technology issues (security, training, viruses, and computer usage) were found so the authors developed 12 questions. The final questions dealt with demographics, including gender, age, marital status, number of children, state of residence, and education, computer usage (number at home, Internet access), and family information (parents living, distance from parents, distance from children, and primary caregiver).

A convenience sample was used in this exploratory study. Surveys were distributed by hand and through e-mail to 35 salespeople known by the researchers. The salespeople were employed by business-to-consumer companies. All 35 surveys were completed during December 2003 and used in this exploratory study.

OVERVIEW OF FREQUENCIES

Twenty (57%) of the 35 survey participants were women. Twelve (34%) of the respondents were between the ages of 35 and 44 and ten (29%) were between the ages of 45 and 54. Twenty-five salespeople (74%) were married. Thirty-three participants reported having one computer at home. All but one person had Internet access from home. Of those 34 with Internet access at home, 16 (47%) used a dial-up modem while 17 (50%) had broadband access to the Internet. Thirteen (37%) of the 35 respondents have earned an undergraduate degree. Just over half (51%) indicated that both parents were still living. Nineteen (70%) out of 27 who answered the question reported that they lived less than 20 miles from their parents. Ten (42%) out of 24 who responded to the question reported that they lived less than 20 miles from their spouse's parents. Thirty participants (86%) said they have children; of these, 43% have two children and 30% have one child. Twenty-two of the thirty parents (73%) indicated that they lived less than 20 miles from their children. With regard to being the primary caregiver for parents, only one out of the 35 participants reported that they had that responsibility. All of the respondents lived in one southern state.

The respondents have been with their present employers an average of 65.26 months (or almost five and a half years). Over three-fourths of the salespeople (77%) are required to travel as part of their jobs. Twelve people (44%) indicated that they had to travel two to three times a week, while another eight people (30%) had to travel on a weekly basis. Of the 27 who indicated that they

had to travel, 15 (56%) said that their travel did not require an overnight stay. Respondents averaged 52.57 hours of work per week. Eighteen salespeople (51%) indicated that they had a flexible work schedule. Most (97%) reported daily usage of any kind of technology (computers, registers, etc.) at work. Nine people (26%) reported using technology at home for work monthly, while 12 (34%) rarely or never used technology at home for work purposes. Most of the salespeople (91%) indicated that their use of the Internet for work is more than it was a year ago. Respondents were then asked to allocate 100% of their time in a typical week among seven sales-related tasks. Over half the time was allocated on two tasks: selling (planning, calling, prospecting, presentations) and sales follow-up (customer service, training).

The first set of scale questions dealt with time spent working, socializing with customers, socializing with other salespeople, and traveling. A five-point rating scale was used to measure agreement with the four statements, with 1 reflecting "complete agreement" with the statement. Respondents felt there was very much agreement between them and family members on how they spent their time in these four areas (means between 1.80 and 1.91).

The next set of scale questions dealt with WFC issues, including new items on family members' health. For purposes of analysis, any "5" score was dropped since it represented "not applicable," leaving a four-point scale. Respondents tended to agree with positive self-related statements (e.g., able to do things) and spousal career statements (e.g., spouse content with his/her job). Salespeople tended to disagree with negative self-related statements (e.g., feel useless), conflict statements (e.g., spouse's career conflicts with mine), and all four health-related career-impact statements.

The last set of scale questions focused on technology issues; respondents tended to agree with most of the statements. Participants tended to disagree with only two statements: my spouse uses the home computer for work and time spent on computer takes away from family time.

DISCUSSION OF KRUSKAL-WALLIS TEST RESULTS

Salespeople who were required to travel averaged a longer period of employment with their current employers (about two years), worked almost 15 more hours per week, and were less satisfied with the city in which they lived, than did those who were not required to travel. Traveling salespeople spent more time selling, traveling, and entertaining, and less time in meetings, and doing sales follow-up and paperwork than did their nontraveling counterparts.

Of the twenty-seven salespeople who do travel as part of their job, several significant differences were found regarding whether they had to stay overnight or not. Those who had to stay overnight tended to spend more time on selling, travel, and entertaining, and less time doing sales follow-up, paperwork, and professional development than did those who did not have to stay overnight during their travels. Those salespeople staying overnight also reported some tension between their family and themselves over how much time they spent socializing with customers and on traveling itself. On the other hand, they reported less frustration when they get home from work and a more positive attitude with themselves than did salespeople who did not have to stay overnight.

With regard to having a fixed or flexible work schedule, salespeople with fixed schedules (e.g., 9:00 a.m. to 5:00 p.m.) reported working about 11 less hours per week than did their counterparts who had flexible schedules. Those with fixed schedules tended to spend less time selling, traveling, and entertaining, and more time in meetings and on sales follow-up, professional development and paperwork tasks than did those with flexible schedules. However, they reported less self-assurance and more frustration when coming home than did those salespeople with flexible schedules.

LIMITATIONS OF THE STUDY

There are several limitations that need to be addressed first. The analyses were limited by the small sample size of 35 (or fewer, depending on variable and analytical method). The sample is not a representative sample, since it was a convenience sample and also drawn from a small region of the United States. The study also is affected by the use of borrowed scales and the appropriateness of added items (see Engelland, Alford and Taylor 2001 for cautions in such use). Scale reduction was attempted through the use of common factor analysis. Given the sample size of 35, the common factor analysis (CFA) could not be accomplished. We acknowledge that the inability to conduct CFA on the scale items, especially the new items, is a major weakness of this paper.

IMPLICATIONS FOR FUTURE RESEARCH

Given the exploratory nature of this study and the small sample size, any implications to be drawn are speculative at best. Salespeople who travel will typically spend more time on travel-related tasks and are likely to encounter some tension at home over the amount of time they spend on the road. A larger sample size is needed to test whether or not these generally significant differences between salespeople who travel and those who don't, can be generalized to a larger population. A wider geographic range of participants is also warranted. The scales need to be assessed by CFA with a larger sample size.

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Academy of Organizational Culture, Communications & Conflict

UPWARD INFLUENCE TACTICS AND MANAGERS' PAY ALLOCATION DECISIONS: A DEPENDENCY PERSPECTIVE

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ABSTRACT

In many different contexts within organizations today, attempts are made by direct reports to influence the decisions of their managers. In no context does the resulting decision hit closer to home for a direct report than those related to the allocation of pay raises. It appears that attempts by direct reports to influence their managers' pay allocation decisions are effective only under certain circumstances: when the manager is dependent on the direct report and when the direct report threatens the dependence relationship. Does the severity of the threat used matter? Is there a point at which the threat becomes too severe and the manager reacts negatively?

In an attempt to answer these questions, a study was conducted of managers' pay allocation decisions under the conditions of varying levels of dependence and varying levels of severity of threat used by a focal direct report. Results indicated support for the interactive effects between dependence and dependency threats on managers' pay allocation decisions (i.e., managers allocated significantly higher increases to those direct reports upon whom they were highly dependent only when the direct report threatened the dependence relationship). Partial support was found for the effects of threat severity. The results allow a more complete understanding of managerial pay allocation decisions and provide the groundwork for additional research.

BLOC VOTING IN AMERICAN ELECTIONS

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ABSTRACT

There are four groups who exercise the power of bloc voting in local and national elections: women, minorities, labor unions and the elderly. This paper will define and discuss each of the four groups that have made significant impacts throughout elections in America as well as suggest future trends in political party affiliations. This research is important to analyze so that predictions may be made for the upcoming elections and political trends.

Academy for Studies in International Business

TARIFFS IN GLOBAL BUSINESS: CONCEPT, PROCESSES, AND CASE EXAMPLES

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ABSTRACT

The manuscript, "Tariffs in Global Business: Concept, Processes, and Case Examples," examines the concept and processes of tariffs in global business. The manuscript contains a comprehensive review of the market-entry literature, an examination of purposes and types of tariffs, a critical analysis of four case examples of tariffs in global business involving the steel, lumber, automobile, and textile industries, and a discussion of the use of foreign trade zones in managing a firm's tariff exposure.

An opening vignette begins the manuscript as follows. After a month at sea in a container aboard a cargo ship, a product lands at a port in a host country. Then begins the process of moving the product through the various host-country governmental offices related to country entry and customs. Priced conservatively on export from its home country, the product must be competitive in the host-country market. A recent market research study indicates that the host-country promises to be a profitable market for the exporting firm, but it is a price-sensitive market and the product's price, therefore, must be competitive with local products.

The market-entry process moves smoothly at the port until the host-country government levies a tariff of 60% on the specific product type and country-of-origin locale of the product imported to the host country. At the imposition of the tariff, the landed cost of the product increases from (X) in host-country currency to [(X) + 0.60(X)]. At a tariff-imputed landed cost of [(X) + 0.60(X)], the product likely will not be competitive, particularly in the host country's price-sensitive market.

The opening vignette typifies an unfortunate experience of some managers in international market-entry transactions. A foreign market is selected, a product is shipped, and upon arrival a higher than anticipated tariff is levied. While it is possible to request "advanced tariff classification" from a country to which a product is being exported to know the likely amount of tariff beforehand, tariff schedules in a host country sometimes will change without prior notification

The product is at the port, but with a cost basis of 60% more than anticipated. Among options for management's consideration examined in the manuscript are either withdraw the product back to its home country, ship the product to another country having no or lower tariffs, or stick it out in the initial host country by increasing marketing expenditures to support the product at its higher price. Likely, as discussed in the manuscript, the product will remain in the initial host country, particularly if the product enters a Foreign Trade Zone area at the port of entry.

Using a Foreign Trade Zone provides financial and operating benefits for a firm, especially, as explained in the manuscript, improved cash flow. Only, when the product exits the FTZ is a tariff paid. The cash flow savings enable a firm to use the monies for marketing the product to enhance a firm's chances of successfully consummating the exchange process.

THE IMPACT OF HISPANIC IMMIGRATION ON THE ECONOMY IN MEMPHIS, TENNESSEE

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ABSTRACT

This paper discusses the social, legal, demographic, and economic aspects of immigrant Hispanic influence on Memphis, Tennessee's economy. The history of immigration is briefly presented in order to show the complexities of current immigration issues. Current demographics influencing the U.S. economy and new laws implemented in order to help the Hispanic population and benefit the community in general are also discussed.

INTRODUCTION

Memphis, Tennessee is paying increased attention to the Hispanic community. Many businesses now translate advertisements into Spanish, which was virtually unheard of 10 years ago. Latino workers in the Memphis area have a total economic impact of over one billion dollars and about 36,000 jobs (Mendoza, Ciscel & Smith, 2001). These numbers have captured the attention of businesses in Memphis and can summon many others to concentrate efforts and develop their market. Louderback (2002) reports: "The profit potential in the Latino market is too lucrative to resist."

ECONOMIC IMPACT OF HISPANICS ON THE MEMPHIS MARKET

In the last 12 years, the Latino population has more than doubled in four Southern states: Georgia, North Carolina, Tennessee, and Arkansas (Mendoza, Ciscel & Smith, 2001). In 1990, the majority of Latinos in Tennessee were concentrated in the Nashville-Davidson County metropolitan area. Since 1990, the Memphis metropolitan area, Clarksville, and Chattanooga have experienced significant Latino immigration. The 2000 U.S. Census reported that Davidson County had 26,091 Hispanics, followed by Shelby County with 23,364 Hispanics, representing the largest minority after African-Americans.

It is a common belief that Hispanics concentrate in Florida, California, and Texas since California and Texas were once part of Mexico and many Mexicans remained in the territory. Florida is in fact the state of choice for many South American refugees. Nevertheless, Hispanics experience competition in those states and seek new employment opportunities in other states, including Tennessee. Johnson, Johnson-Webb, and Farrell (1999) state that the characteristics of new Latino immigrants are very different from Latino immigrants from previous years (1999).

Mendoza, Ciscel and Smith (2001) describe two new groups of Latino immigrants. The first is younger, more skilled, and highly educated. Some Latinos arrive in metropolitan areas with legal status (e.g., student, working, or research visas). This group of educated Hispanics travels to the U.S. mainly from Venezuela, Argentina, Mexico, and Colombia. Immigrants in the second group are also young and hard working, but have less education. Most of these immigrants are originally from countries such as El Salvador, Guatemala, and Mexico. The second group is made up of illegal aliens attempting to remain invisible in the U.S.

Hispanic immigrants, such as Cubans and Nicaraguans, acquired permanent status as a result of amnesty provisions of the Immigration Reform and Control Act of 1986, but many Hispanics remain undocumented (Chavez, 1993). Johnson, Johnson-Webb and Farrell (1999) state that more women and children are joining the immigration flow each year, suggesting that these Latino families might become permanent settlers.

Mendoza, Ciscel and Smith (2001) state that the most common reason why Latinos come to the U.S. is for employment. The settlement of Latino immigrants is an important factor for the economy of any city.

Because of the fear of deportation, many Hispanics do not report the total number of people living in their homes, thus understating the census. Several researchers mentioned the term *invisibility* to describe this effect of Latinos wanting to remain unnoticed. This invisibility status hinders many businesses in fully understanding the emerging Latino population and, consequently, businesses cannot plan accurately for the future.

The 1990 Census counted 8,116 Hispanics, most of whom were from Cuba, Puerto Rico, and Mexico, in the Memphis Metropolitan Statistical Area (MMSA). Many immigrants of Mexican descent who settled in Memphis prior to 1990 arrived from the U.S. Southwest. Burrell, Redding, Lawrence and Sunkara (1997) state that in 2000, the local Latino population experienced a significant increase in size.

Latinos in Memphis concentrate in the following areas: the Jackson Avenue corridor, Hickory Hill, Parkway Village, Fox Meadows, and Southeast Memphis. In 2000, the Center for Research on Women (CROW) reported 26 businesses catering to Latino immigrants. These include restaurants, bars, supermarkets, video-rental stores, churches, a bakery, a disco, a radio station, and a short-lived movie theater with Spanish subtitles. About 100 establishments service the Hispanic market in the MMSA.

Many businesses and service agencies have expanded their workforce by hiring Spanish-speaking or bilingual workers to serve the Hispanic community more effectively. Many banks, supermarkets, and stores train their employees to serve the growing immigrant clientele. Most convenient stores have money services and wire transfers in Spanish since many Hispanic customers send money back to their countries.

The Selig Center for Economic Growth (2002) rated Tennessee as one of the top 10 states for growth in Hispanic buying power during 1990-2002. Projections revealed that Hispanics controlled about $580 billion in spending power in 2002 (The Selig Center for Economic Growth).

Some Americans believe that Hispanics are taking jobs away. However, it appears that Latinos did not displace local workers. From 1995 to 1999, the number of jobs in the Memphis economy grew from 531,600 to 586,300. While the number of jobs grew by 54,700, the number of workers in the labor force grew by only 35,100, and so there were jobs available for new workers (Burrell, Redding & Schenk 2000; Mendoza, Ciscel & Smith, 2001).

The multiplier effect is reflected when a new Latino worker accepts a job in Memphis. He or she helps the regional economy grow by earning an income and by spending a portion of that income on housing, food, and other locally purchased goods and services. These expenditures help create even more jobs. In 2000, Latinos generated about $12.3 million in local and state sales taxes. Latinos spent $359.6 million in the local economy (Burrell, Redding & Schenk, 2000; Cantu, 1999; Fordham, 2000; Martin, 2000; Mendoza, Ciscel & Smith, 2001; Williams, 2000).

The multiplier impact of these expenditures by Latino workers is impressive. These expenditures resulted in another $664 million spent locally by workers and businesses that benefit from Latino workers in the Memphis economy. Consumer expenditures by the Latino community resulted in the creation of 8,544 additional jobs in Memphis. These local expenditures and additional workers increased the regional payroll by $570.8 million for Latino workers and $176.5 million for workers in the other 8,544 new jobs (Mendoza, Ciscel & Smith, 2001).

IMMIGRATION ISSUES AND COMMUNITY CONCERNS

The Tennessee Immigrant Coalition urged passage of the Dream Act (S-1291) and the Student Adjustment Act (HR 1918) in 2002. The Senate Judiciary Committee passed in 2002 the bipartisan Senate Bill 1291 introduced by Senator Hatch (R-UT), which repealed the provisions of the current federal law that discourages states from providing in-state tuition to undocumented student immigrants. The bill would also permit long-time resident immigrants, young people with "good moral character," to obtain legal permanent resident status once they graduate from high school in the U.S. The bill is titled the Development, Relief, and Education Relief for Alien Minors Act [Dream Act] (Tennessee Immigrant Coalition, 2001).

The House leadership has strongly indicated a need for direction from the President concerning how to proceed with the Dream Act. The White House has indicated that the issue is pending. However, many leaders in Tennessee support the Dream Act for the following reasons. First, it will improve educational opportunities for Hispanic-Americans by enabling students to achieve their "dream" of pursuing higher education. Second, it will raise the educational achievement of Hispanic students, which is critical for the U.S. economy. Income is directly proportional to educational attainment. By passing this law, these exemplary students would help to double the rate of Hispanic college and/or university graduates by the year 2010, which would produce additional tax revenue of $13 billion. Finally, it will extend dignity and justice to children who are committed to making a difference in their lives and the well being of their families (Tennessee Immigrant Coalition, 2002).

A variety of federal and state court decisions have also mandated unemployment compensation and disability benefits for illegal aliens, even though it is illegal for an employer to hire them. For immigrants, rights are plentiful, they pay taxes at their jobs, they contribute to the economy, but still it is a crime for immigrants to work and they can be imprisoned (Chavez, 1993).

Most Latinos came to the Memphis area in the mid-1990s searching for jobs in the growing industries of trade, distribution, and construction. In general, these immigrants have found their job expectations fulfilled. Low unemployment rates in the region made it relatively easy to find employment even if workers did not speak English (Burrell, Redding & Schenk, 2000).

Tennessee is changing some laws in order to enhance public safety. Specifically, the state no longer requires a social security number in order to obtain a driver's license. The reasons for this policy change are varied. Unlicensed drivers endanger everyone. Receiving a Tennessee driver's license ensures that all drivers learn proper driving techniques. Without adequate testing, a driver may never learn the rules of the road. Unlicensed drivers are far more likely to flee the scene of an accident or to flee when pulled over by a police officer. Nationally, uninsured motorists cause a large percentage of all accidents and several billion dollars in insurance losses per year. Drivers who cannot lawfully obtain a driver's license cannot obtain auto insurance, increasing the number of uninsured drivers and insurance premiums for everyone. Since Tennessee has not adopted a "no-fault" system of auto insurance, if an uninsured driver injures another person, the injured person would have no recourse to recover from the pain and suffering associated with their injuries unless they carried their own uninsured motorist coverage. Without the policy change, Tennessee would be placing an unfounded federal mandate on itself. It is expensive for the Tennessee Department of Safety to enforce federal immigration laws. The responsibility for borders and immigration constitutionally belongs to the federal government, not with the state. If the federal government fails to adequately fund the INS enforcement division to root out illegal immigration, then why should the state government pick up the responsibility at great expense to the state's taxpayers? Finally, previous licensing requirements created a crisis for families and businesses. Without legal access to driver's licenses, immigrant workers were impeded from getting to their jobs, undermining the stability of the state economy. Many Tennessee businesses depend on immigrant workers, such as the food service industry, tobacco farmers, and the construction industry.

CONCLUSION

Laws such as affirmative action protect minorities in business. Civil rights protect every citizen living in the U.S. Chavez (1993) states: "Legal or illegal, immigrants should make their way by the age-old methods of immigrants, self-help, self-education, and eventual assimilation. If the illegal immigrants broke the law to arrive here, they cannot expect the law immediately to privilege them over actual citizens of whatever race."

Minorities must appreciate that affirmative action is a remedy for the discrimination experienced in previous years. People still suffer hidden discrimination, but also many more take advantage of it. Affirmative action makes up for the head start that others have otherwise had.

All remedies have an end. Minorities, including immigrants, need to move on and continue working hard in order to obtain the American dream. Although many costs are involved in providing Hispanics immigrants access to basic services, the investment, if done properly, can pay high returns to the economy at large.

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Academy of Strategic Management

THE EARLY YEARS OF THE CABLE TELEVISION INDUSTRY: 1990s

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ABSTRACT

The cable television industry operated as an unregulated monopoly in the early 1990s. The industry was described as a natural monopoly and displayed the characteristics of this market structure. However, this paper illustrates this was due, at least in part, to the actions of local government officials when granting a franchise to operate.

INTRODUCTION

In the late 1940s, the cable television industry originated as a way to provide better reception of broadcast television to rural areas. By 1955, 400 cable systems existed, with a subscriber base of 150,000. By the mid-1970s, cable systems still served only approximately 15 percent of homes in the U.S. (Evolution of the cable industry, 1991). However, in 1975, the cable industry was revolutionized by the development of the first satellite delivery system. Via satellite, it became economically feasible to deliver specialized programming to audiences, leading to a period of expansion of cable into larger cities.

By 1989, total revenues for the cable television industry had grown to $17.5 billion, with advertising revenue of $2.5 billion (Profiteers of diversity, 1990). In the early 1990s, the number of cable operating firms was approximately 9,600; however, only about 45 operated in a competitive environment. The General Accounting Office (GAO) reported an increase, between 1986 and 1988, of 29 percent for the cost of basic cable, while inflation was below eight percent for this same period (Merline, Davidson & Pierre, 1990). Using data that dates to 1984 (the date the Cable Communications Policy was enacted by Congress), basic cable rates increased 66.5 percent (Gershon, 1992).

Today, many subscribers to cable television are dissatisfied with not only the cost, but also the service provided by the industry. However, consumers continue to subscribe. To understand this willingness to pay for a good that is overpriced and often of poor quality, it must be remembered that in rural and densely populated urban areas, where the only clear signals come from cable wires, this product is not viewed as a luxury. Another factor is the increasing use of electronic systems to dispense information.

IS CABLE A NATURAL MONOPOLY?

A monopoly is a market structure characterized by one firm with many buyers. Competition is inhibited as there are no close substitutes and the barriers to entry make it virtually impossible for new firms to enter the market. These barriers to entry can include cost advantages due to economies of scale and control of market outlets by established firms through the use of franchises and exclusive dealing contracts. At the equilibrium price, the monopolist is able to earn an above-normal profit.

A natural monopoly exists when economies of scale are so great that costs can only be minimized when one producer supplies the entire output of an industry. The cable industry has long been described as a natural monopoly. As expansion of the industry moved into urban areas, wiring methods changed to more expensive hard wiring, underground systems that require city streets to

be dug up. It is the prohibitive cost of wiring that leads many to describe cable as a natural monopoly.

Cable operators are also able to dominate the market because alternative methods of delivering service, such as broadcast, direct-broadcast satellite, and microwave, could not as of the early 1990s offer what cable does. In 1991, of the 54 million American households that subscribed to cable, more than 99 percent had no comparable alternative (Aufderheide, 1991).

The cable industry exhibits the classic characteristics of a monopoly: above-normal profits, no close substitutes, and economies of scale. However, many economists agree that municipal regulation is the cause for market inefficiencies in the cable industry. Local governments have blocked the entry of potential competitors, creating serious inefficiencies (Gershon, 1991).

The power of local government in this industry stems from the 1984 Cable Act. The Cable Act required rates for basic cable service to be deregulated where there was effective cable competition. As defined by the Federal Communications Commission (FCC), effective competition exists if subscribers can receive six over-the-air broadcast signals. This liberal definition of competition has caused virtually all subscribers to be dependent upon cable operators who, in theory only, operate in a competitive environment. In these competitive areas, state and local governments are prohibited from regulating rates charged by cable operators.

The Cable Act also required potential cable operators to obtain a valid franchise from local authorities. Local governments and politicians have abused the Cable Act in this area, specifically manipulating franchise agreements to their advantage. While the Cable Act required any cable operator to obtain a franchise from the city, it did not prohibit franchises from being granted to more than one company. However, in most cases, cities required such numerous commitments by the cable company before granting the required franchise that competition was barred due to the extreme costs and time required. Included most often in these commitments were elaborate plants and facilities, access facilities and funding, free telecommunications services for local government, and most importantly, the franchise fee (Merline, Davidson & Pierre, 1990). The fee ranged from three to five percent of the cable company's gross revenues, and local politicians used these funds to underwrite the cost of city government. At a time when city budgets were stretched, this fee was a significant source of revenue. Rather than a natural monopoly, the cable industry is a monopoly due to the actions of local politicians. The enormous costs and time required to win a franchise were the primary reasons competition was lacking in the industry. The decision to award a cable franchise reflected political and economic considerations rather than the best interests of the consumer (Gershon, 1992). The franchising system not only fails to regulate a monopoly, it creates one. The system can be manipulated to keep competition out of an area in exchange for the cable operator's catering to local politicians (Merline, Davidson & Pierre, 1990).

Not only did the franchise system fail to regulate a monopoly, it added to the cost of the service. Researchers estimated that city-imposed franchise costs added $5.60 per month to each subscriber's bill, while also stating that these costs ranged from 20-30 percent of the average consumer's monthly bill (Merline, Davidson & Pierre, 1990).

While the franchise system appears to be flawed, city officials argued that without it and the guaranteed profits of a monopoly, no company would provide wiring to the poorer sections of a city. This theory is flawed, however, as companies would find it cheaper to wire in neighborhoods where the homes are generally closer together than in the more affluent areas.

Another area of concern was the industry's movement toward monopsony through the control of programming. In the early 1990s, five corporations controlled half of the cable subscribers in the U.S. What caused this statistic to be even more significant was the fact that these same companies also owned, wholly or in part, seven of the 10 largest basic cable television channels (Aufderheide, 1991). Cable companies increasingly insisted on owning a part of any programming shown on their systems. Ownership allowed the companies to keep rival programmers off of their system, and operators could refuse to sell their programming to competitors and alternative delivery systems (Aufderheide, 1991). Virtually all major programmers, whether

because of operator ownership of the programming or undue pressure by franchised operators, denied access to others (Merline, Davidson & Pierre, 1990). When a cable operator was able to control access to programming, another barrier to entry was then created.

In theory, cable companies with more than 36 channels must keep between 10 and 15 percent of the channels open for leased access (channels available to any programmer). However, cable companies did not have to bill subscribers for this programming, leaving it to the purchaser of the channel to collect from any viewers. Cable companies could also set both the price and the terms of the leased access. Due to these underlying difficulties, potential programmers often opted to deal with the cable companies.

The problem also extended to alternatives to cable because many networks sold only to franchised operators, automatically excluding wireless and private cable operators who did not require a franchise in order to operate (Merline, Davidson & Pierre, 1990). Without programming, no competition could exist in the industry.

PRICING IN THE CABLE INDUSTRY

The rates for cable service have increased dramatically since the enactment of the 1984 Cable Act. The Cable Act was passed at a time when deregulation was seen as a means of returning many industries, such as the airlines, banking, and cable television, to a competitive marketplace. Smith's invisible hand would ensure consumers lower prices and better service. What has occurred in many industries, however, is a deterioration of service and discriminatory pricing practices.

The Cable Act, in effect, allowed cities to create monopolies, yet it prohibited municipalities from the regulating of these monopolies. Cable television, as it exists today, operates in an environment that allows it to take advantage of its subscribers' dependence upon the service by increasing profits at the expense of these same subscribers.

Between 1986-1988, cable rates increased at three times the rate of inflation. The cable industry stated that the reason for this tremendous increase was that, prior to deregulation, rates were kept artificially low. Another reason given by industry officials was the increased cost for programming. Research, however, found this statement to be inaccurate. The cost for programming actually declined from 25 cents per subscriber dollar in 1984 to only 21 cents in 1990 (Merline, Davidson & Pierre, 1990). The virtual price gouging by the industry can instead be attributed to the lack of competition and costly acquisitions and mergers.

While cable operates in most areas under the auspices of a natural monopoly, in the few areas where competition flourishes, the consumer has benefited. A survey by *Consumers Research* found rates in the non-competitive markets, which dominate this industry, to be 18 percent higher than in comparably sized competitive markets. This translated in 1990 to an average monthly rate for basic cable of $17.31 in monopoly markets versus $14.13 in competitive areas. This survey also found that price is not the only significant difference. Monopoly markets generally have fewer channels with a higher cost per channel (Merline, Davidson & Pierre, 1990). Other researchers found similar differences between monopoly and competitive areas (The new world of television, 1991).

Subscribers to cable companies that have been bought and sold in recent years also have higher rates, generally paying 20 percent more than others. This increased rate can be attributed to the substantial debt incurred during such mergers and acquisitions. Cable systems sell at three to four times the cost to rebuild the system from startup. Benoit (1991) estimated that cable companies sold for $2,500 per subscriber during the height of the expansion in the 1980s, and that systems commanded as much as $2,000 per subscriber in 1991, far in excess of other researchers' estimates of $750 per subscriber to recreate a system.

WHAT IS THE FUTURE FOR CABLE?

In the early 1990s, Congress debated whether or not to re-regulate the cable industry. Before reversing itself and imposing too much regulation, Congress noted that the industry's inability to compete was primarily the result of artificial restraints on competition, not the inherently monopolistic nature of the industry itself. Any re-regulation should be moderate in nature, and it certainly should not include price setting tactics that would further distort the market. Many economists maintain that regulation should be designed for a particular problem, and that neither more nor less of the problem should be treated than is required in a given circumstance (Leland & Reed, 1992).

An alternative to regulation of cable rates would be the elimination of franchising. With its prohibitive cost and time commitments, many prospective competitors are automatically eliminated. If Congress banned franchising, the ties between local politicians and cable operators would be eliminated, opening the door for greater competition. While cable operates as a monopoly, this is not so much a reflection of a natural monopoly as it is the reflection of the need for market entrants to obtain municipal franchises, which officials are reluctant to grant (Gershon, 1992). Instead of a franchise, cable operators could be treated as other developers, which entails making application for a right of way to use the necessary public property and posting a bond to cover any damages (Barnes, 1989).

The approximately 50 areas that operated on a competitive basis in the early 1990s tended to reinforce the position that what was needed was more competition, not re-regulation. As the industry's power was concentrated into five major multiple system operators, it was the telephone companies that presented the biggest competitive threat to the industry.

Independent telephone companies were allowed into the U.S.'s cable market on October 7, 1991; however, they could not transmit original programming. Regional phone companies were eager to enter the cable television business as it offered an opportunity to expand their competitive position beyond telephone service. Advances in fiber-optic technology made entry by phone companies possible, but the cost to replace existing copper telephone wires with fiber-optic cable was estimated at $200 billion or more. Unlike cable companies, telephone companies are designated as common carriers and thus are required to transmit any program for a standard fee. As phone companies anticipated profits from the transmission of original programming, they were unwilling to convert to expensive fiber-optic technology if they could only transmit programs that they did not own.

As the technology for cable television and telephone companies are converging, a realistic approach would be to allow telephone companies to compete with the cable television operators. To effectively limit the power of the telephone companies, which also operate as a monopoly, restrictions will be needed. Telephone companies should be restricted from using revenues from telephone service to subsidize any cable operations. This can be assured if they are required to establish a subsidiary to oversee the cable business. The phone company's entry into the original programming market could also be monitored by the subsidiary. As the purpose of allowing telephone companies to enter the cable market is to ensure competition, Congress should also prohibit them from simply purchasing an existing cable facility. Finally, to be certain that the telephone companies and cable television operate from the same basis, if franchising is not abolished, both monopolies should be subject to franchise agreements.

CONCLUSION

As discussed in the paper, the price for cable television service increased dramatically since deregulation of the industry in 1984, while the quality of both the product and the service deteriorated. To rectify these problems, the industry took corrective action, but it cannot arbitrarily be assumed that the answer is re-regulation. When competition is allowed, prices are lowered and

quality improves. Given the advances in technology, competition may be the answer to the problems in the industry. If competition comes from the entrance of more telephone companies into the industry, care must be taken that one monopoly is not simply replaced by another.

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A REVIEW OF THE ADVANTAGES AND DISADVANTAGES OF VERTICAL INTEGRATION FROM A STRATEGIC MANAGEMENT AND FINANCE PERSPECTIVE

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ABSTRACT

The purpose of this paper is to provide a summary of past research conducted on the topic of vertical integration in both the strategic management and finance disciplines, providing a theoretical foundation for further study. Second, and more important, this paper is designed to illustrate the incomplete research on vertical integration.

INTRODUCTION

As with every strategy a firm may choose to follow, vertical integration has both advantages and disadvantages associated with it. In the following paragraphs, three advantages of vertical integration will be discussed, followed by a summary of three disadvantages.

TECHNOLOGICAL INSEPARABILITY

Bain (1968) pointed out that the technological process in the value-added chain might necessitate vertical integration. For example, in the production of rolled steel, if all steps of the process, from the making of pig iron to the rolling of flats and bars, are performed under the same roof, neither the pig iron nor the steel ingots would need to be cooled and then reheated. Using such an example, Bain illustrates how technological inseparabilities may make vertical integration logistically efficient. This can also be viewed as an example of how two consecutive stages in the vertical integration can be related enough procedurally as to be performed under the same roof.

TECHNICAL ECONOMIES

Vertical mergers may produce technical economies through several sources. First, cost reductions may arise through more efficient utilization of managerial skill (Levitt, 1975). Secondly, shipping costs may certainly be reduced because the inputs of one stage are the outputs of another process located under the same roof. Finally, it has been argued by several researchers (Buzzell, 1983; Mansfield & Wagner, 1975) that firms which integrate backwards innovate better than other firms, perhaps due to possible similarities or relatedness between steps in the vertical chain.

BARRIERS TO ENTRY

If a firm must be vertically integrated to compete successfully in an industry, established companies may combine operations as a means of discouraging potential entrants (Buzzell, 1983).

Because the vertically integrated firm will have invested many resources (both financial and managerial) to its business structure, it becomes harder for new entrants to compete (Balakrishnan & Wernerfelt, 1986; Buzzell, 1983). This precludes many competitors from replicating any product differentiation advantages the firm holds (Caves & Porter, 1977; Comanor, 1967) creating an entry barrier and an advantage to the established firm.

DISADVANTAGES OF VERTICAL INTEGRATION

The preceding discussion illustrates how vertical integration can provide many benefits to the firm. The advantages must be weighed against any disadvantages discussed in the following paragraphs.

CAPITAL REQUIREMENTS

The process of integrating either through internal growth or acquisition often requires heavy investment (Buzzell, 1983). Because of the negative association researchers have found between investment intensity and profitability (Gale, 1980), vertical integration requiring massive capital investment may be an unprofitable strategic move for firms.

UNBALANCED THROUGHPUT

Unless economies of scale are established at equal levels of production in every stage in the production process, a firm may find itself having to operate at inefficient levels of production (Buzzell, 1983). In order to maximize economies of scale at one stage, for example, the firm may have storage costs at another.

REDUCED FLEXIBILITY

Although vertical integration can create barriers to entry as mentioned above, massive capital requirements can also reduce a firm's flexibility. For example, if one stage of the production process becomes obsolete, a company may be committed to continue in that stage because of its alignment with other stages of production (Buzzell, 1983). Furthermore, when a firm chooses to transfer in-house, it loses its exposure to outside innovations occurring in the supplier's industry. Balakrishnan and Wernerfelt (1986) empirically showed how integration can be negatively affected by the frequency of technological change, especially if competition is high.

CONTINGENCY THEORY

Probably the most work dealing with vertical integration can be attributed to Harrigan (1980, 1983a, 1983b, 1985a, 1985b, 1985c, 1985d, 1986). Harrigan's studies concluded that vertical integration differs not only among industries but within them as well. Her work provided substantial evidence that vertical integration should be viewed from a contingency viewpoint. In other words, vertical integration is a more viable option in some situations than in others.

Drawing on this extensive background of information, in 1986 Harrigan again extended the literature on vertical integration by comparing *successful* and *unsuccessful* firms in terms of their vertical integration decisions. Unsuccessful firms were defined as organizations "identified by a consensus of managers as firms suffering *significant* losses in the target industries. (Significant losses were those exceeding 5 percent ROS (Return on Sales) over 5-year averages.)" (p. 543). She came to the following conclusions outlined in the next two section.

CHARACTERISTICS OF SUCCESSFUL FIRMS

- Successful firms that were involved in selling high quality or complex products employed higher degrees of backward integration.
- Within volatile industries, successful firms were vertically integrated to a lesser degree.
- Successful firms sold highly proprietary outputs in-house, gaining benefits of market strength and unique brand image.
- Successful firms had higher breadth of activities during periods of relatively high bargaining power for suppliers or customers.
- Successful firms did increase the number of stages of vertical integration when the industry was young.
- Successful firms would often use less than full ownership forms of vertical integration when value addition was low. As the integrated activities became more profitable, successful firms used more quasi-ownership forms.
- Successful firms were involved in more stages of vertical integration during early phases of industry development.
- Successful firms were more integrated with greater breadth of activities within stable industry settings.
- Successful firms were only vertically integrated in cases where they had low bargaining power.
- Successful firms which had goals of high product quality and product leadership protected knowledge through vertical integration when adjacent industries could contribute "substantial value to their products" (Harrigan, 1986, p. 552).

CHARACTERISTICS OF UNSUCCESSFUL FIRMS

1. Unsuccessful firms used lower degrees of vertical integration when their products were commodity-like.
2. During the birth stage of the life cycle when brand images are first being established, unsuccessful firms used outsiders to market their product.
3. During periods of high demand uncertainty, unsuccessful firms vertically integrated to a greater degree.
4. Within a concentrated industry, unsuccessful firms were engaged in more breadth of activities.
5. Unsuccessful firms engaged in few stages of vertical integration when their industry was young, missing opportunities to enter new, profitable markets.
6. Unsuccessful firms showed no significant pattern of ownership forms.
7. Unsuccessful firms transferred more outputs in-house during periods of high uncertainty.
8. Unsuccessful firms did not use vertical integration in stable industries and overexposed themselves in volatile industry settings.
9. Even when customers with low bargaining power existed, unsuccessful firms were highly integrated downstream.
10. Unsuccessful firms did not vertically integrate in situations where high value-added margins could be captured.

Others as well have suggested that the success of vertical integration is contingent upon other factors. Stigler (1951) suggested a life cycle theory of vertical integration, where vertical integration is important during the youth and decline stages in an industry's or firm's life cycle. Nonintegration, on the other hand, is characteristic of the maturity stage of the life cycle.

CONCLUSION

Researchers in strategic management studying the relationship between related versus unrelated horizontal diversification and firm performance have found conflicting results. Although many researchers have supported Rumelt's (1974) finding that related diversified firms perform better than unrelated firms (Bettis, 1983; Lubatkin & Rogers, 1989), others have come to the opposite conclusion (Chatterjee, 1986; Elgers & Clark, 1980). Despite these equivocal results, there remains "the dominant theory... that firms acquire other firms with some form of relatedness, thereby creating efficiency through synergy" (Harrison, Hitt, Hoskisson & Ireland, 1991, p. 174). By taking advantage of these synergies firms can realize gains through economies of scale or scope, management expertise transferred to a related process, and skill transfer.

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International Academy for Case Studies

FELLOWSHIP MISSIONARY BAPTIST CHURCH: FINANCING THE VISION

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CASE DESCRIPTION

The challenge facing a church seeking to acquire capital on favorable terms to finance a major construction project is the primary subject matter of this case. Students are asked to evaluate the major terms of the deal structure. A quantitative and qualitative assessment is required. Students will see a practical application of short and long-term financing decisions. The case is appropriate for the first or second undergraduate course in financial management and the undergraduate money and banking and financial institutions courses. It can also be used in a graduate survey course in finance. The case is designed to be covered in one 50-minute class period and will likely require 2-3 hours of outside student preparation.

CASE SYNOPSIS

In 1996 Fellowship Missionary Baptist Church (Fellowship) acquired 104 acres of land across the street from its current location. During the ensuing years, various committees and a noted architectural firm developed a detailed master plan. The mater plan was approved by the Church congregation and requisite officials of the City of Charlotte. Now it's time to make the vision a reality. The price tag for the first phase of the project is $25 million. Fellowship must secure financing on favorable terms in order for this monumental project to move forward.

INTRODUCTION

Fellowship Missionary Baptist Church, founded in 1891, is one of the oldest and largest churches in Charlotte, North Carolina. Over the years, Fellowship has attracted a membership that includes a "who's who" of the African American business and political community.

Initially, the church was located in uptown Charlotte. It relocated to a site on the westside in 1961 when urban renewal occurred. The purchase of land and construction of a new facility required a great "leap of faith" by members of the congregation. Bonds were sold to finance this project. They were later successfully redeemed.

Fellowship experienced constant growth over the years. The Church acquired a closed postal facility adjacent to its sanctuary. This facility was converted to an Enrichment Center at which health and wellness programs are offered to members of the church and residents of surrounding communities.

In order to accommodate its growing membership, a Saturday night service was added. Three services are conducted on Sunday morning. Nonetheless, Fellowship does not have the number of seats or parking spaces required. If only Fellowship could acquire the large parcel of vacant land located across the street from its current sanctuary!

THE ACQUISITON

The leadership and members of Fellowship have desired to acquire the land for years. There had been periodic attempts made to purchase the land, but the Church was never successful in enticing the owners to sell. In 1996, Fellowship learned that the land was now owned by a trust administered by NationsBank (now Bank of America). Further, a decision had been made to sell

the land via a blind auction. Each prospective bidder was requested to submit its best offer in a sealed bid.

The congregation of Fellowship was determined to acquire the land. A decision was made to make an aggressive bid for the land which was thought to total 101 acres. It was later determined to be 104 acres. A bid of $19 million was made. The congregation was ecstatic to learn that Fellowship was the successful bidder. Bank financing was arranged and the transaction closed.

THE VISION

The Pastor appointed a committee, Vision 101, to identify potential ministries and programs to be conducted at the new site. The goal was to develop a list of appropriate ministries and programs in order to establish what specific facilities would be required to house those activities.

The Committee surveyed the congregation and interviewed Fellowship leaders. Focus groups were conducted with neighborhood leaders to obtain their input regarding programming. The Committee also completed several brainstorming exercises to identify appropriate uses of the newly acquired land.

It was understood that a new sanctuary would be built, but there was a tremendous opportunity to do so much more. Several new initiatives placed high on the priority list. These included building:

- A certified Child Development Center that will accommodate 200 or more children
- An Alzheimer's Center
- Multi-level housing for seniors
- A hospice facility
- Indoor and outdoor recreational facilities
- An educational complex for grades K-12
- A facility to assist those with HIV and AIDS

A preliminary master plan was developed by the Vision 101 Committee that illustrated the roads and location of buildings to support planned ministries and programs. This plan was presented to the Church leadership and was ultimately adopted by the congregation.

Fellowship has always relied on tithes and offerings to raise funds. The Church does not hold fundraisers and has not conducted a capital campaign. Special appeals are made from time to time to meet special needs. After steadily reducing the debt acquired to finance the purchase of the land, the congregation adopted the goal of retiring the debt. This was accomplished in 2001. The congregation responded diligently to the call to increase tithes and offerings in order to pay off the debt.

In subsequent years, a portion of excess cash flow was directed to a Future Development Fund. The purpose of this fund was to accumulate monies to be used to finance the early stages of the construction project. Gantt, Huberman and Associates was engaged to prepare detailed architectural plans and to manage the construction project. This firm is noted for its work with non-profit organizations and has designed numerous public facilities.

Gantt, Huberman and Associates refined the preliminary master plan developed by the Vision 101 Committee. This plan was adopted by the congregation and approved by the City. The estimated price tag is $25 million for the first phase.

The project began in 2002 with leveling and grading the land. Drainage systems were installed and a parking lot directly across the street from the existing sanctuary was completed. All of this work was paid from Fellowship's monthly cash flow. Church administrators determined that the first $5 million of the project could be funded with cash flow and the monies accumulated in the Future Development Fund. The obvious questions was, “Where would the remaining $20 million come from?”

THE SEARCH FOR FUNDING

Approximately six banks were contacted regarding providing the required financing. While several banks expressed interest, only two banks had the capacity to structure an arrangement to provide $20 million. It should be noted that another large church in Charlotte had completed a major capital project several years ago. In subsequent years, this church was not able to meet its debt obligations because expected growth in membership did not occur. The loan was restructured and the lender incurred a significant loss. Accordingly, banks are somewhat reluctant to lend large sums to churches.

The prospective lenders required Fellowship to submit its financial statements and other supplementary information. After a detailed review of the Church's finances, Bank of America and Wachovia agreed to make the loan. Loan terms differed between the two financial institutions. Fellowship's administrators elected to accept the terms offered by Wachovia and a loan commitment letter was executed in May 2004.

LOAN TERMS

Wachovia agreed to provide up to $10 million (or 50% of total financing, whichever is less) in financing provided that an additional $10 million could be secured from participating lenders. Fellowship took a proactive role in identifying banks, credit unions and other financial institutions that might participate. The $10 million was readily secured. Further, Fellowship is incented to raise $5 million in a capital campaign over the next three years. If Fellowship is successful, bank financing will total $15 million and will carry a lower interest rate. The leadership of Fellowship is confident that $5 million will be raised in a capital campaign.

The loan is expected to close the 2nd week of June 2004. Draw downs during the 2 year construction period will be charged the monthly LIBOR rate plus 300 basis points. Interest only payments will also be made the following year (i.e. year 3 of the project).

The construction loan will convert to a $15 million term loan three years from loan closing. This assumes that Fellowship is successful in raising $5 million in its capital campaign. The interest rate is also dependent on a successful capital campaign. The rate will be the one month LIBOR rate + 200 basis points if the $5 million is raised. If not, the rate will be the one month LIBOR rate + 300 basis points.

At the time of the Loan Commitment Letter, the 1 month LIBOR rate was 1.1%. Accordingly, the current effective rate would be 3.1% assuming the lower credit spread (i.e. 200 basis points) based on a successful capital campaign.

The term loan has a 19-year amortization period. However, the term loan balloons in seven years. The note may be prepaid in whole or in part at any time.

INTEREST RATE HEDGE

Fellowship is required to hedge the loan's floating interest expense by entering into an interest rate swap on 50% of the loan commitment at time of closing (i.e. $7.5 million). Accordingly, Fellowship will pay a floating rate on one-half the debt and pay a fixed rate on the other half. The fixed rate will be 6.15% plus the credit spread of 200 basis points (i.e. 8.15%). 8.15% also represents the highest rate Wachovia can assess on the floating rate side over the life of the loan. Bank of America included a similar interest rate hedge in its proposal.

PREPAYMENT

The loan can be prepaid at any time. No penalty will be incurred for prepaying the balance on the $7.5 million floating rate side. However, a penalty will be incurred for prepaying the $7.5

million "hedge" side if the monthly LIBOR rate is less than the locked-in fixed rate (6.15%) at the time of prepayment. Fellowship will receive a "refund" if the locked-in rate is less than the floating rate at the time of prepayment. The penalty or refund amount is computed by multiplying the rate differential times the average loan balance over the remainder of the term loan times the number of years remaining on the term loan.

OTHER TERMS

Wachovia requires Fellowship to maintain its operating account at Wachovia. Further, Fellowship is required to maintain a $1 million reserve at Wachovia and to maintain a debt service coverage ratio of at least 1.1 to 1 tested annually. Debt service coverage is defined as Net Income plus Depreciation Expense plus Interest Expense divided by Annual Principal and Interest Payments. Fellowship will satisfy the reserve requirement by transferring $1 million from a brokerage account established to endow mission projects.

Fellowship was also required to pay an upfront loan commitment fee and to pledge all of its real property as collateral.

VISION TO REALITY

With financing secured, Fellowship is moving forward to transform the vision to reality. Construction activity is proceeding at a rapid pace. Members of the congregation are excited because they can see dirt moving. Committees have been formed to plan and operate the many new ministries that will be established. A Certified Development Corporation has been formed. One hurdle remains, however. Fellowship must secure $5 million in pledges within the next three years from a capital campaign to be conducted. Given the Church's history and "can do" spirit, it's expected that a successful capital campaign will be completed. In doing so, Fellowship will be better positioned to make substantive contributions to improve the lives of the many people it reaches.

A LOOK AT WEBTRUST AND OTHER WEB ASSURANCE SEALS

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CASE DESCRIPTION

The primary subject matter of this case concerns the CPA's requirements and responsibilities for performing a WebTrust attestation service engagement. Additionally, this case provides a framework for discussion on the control issues with information systems. This case has a difficulty level of three, appropriate for junior-level courses. This case is designed to be taught in one class hour and is expected to require ten hours of outside preparation by students.

CASE SYNOPSIS

Patricia Greene, CPA is approached by Bill Miller, president of E-commerce.com, who is inquiring about web assurance seals. Mr. Miller wants to know what web seal programs are available and what requirements does his company have to meet to display a seal on its website. Ms. Greene, CPA has the task of identifying and comparing the various web seal programs. Additionally, she needs to investigate the requirements and responsibilities for performing a WebTrust engagement. Finally, she needs to communicate her findings to Mr. Miller.

INTRODUCTION

Bill Miller, president of E-commerce.com is concerned about his revenue stream. E-commerce.com's revenues are below what had been forecasted. Mr. Miller conducts business that can be categorized as both retail business-to-business (B2B) and retail business-to-consumers (B2C). Therefore, Mr. Miller decides to meet with Patricia Greene, CPA to obtain advice on ways to improve his revenues. Ms. Greene has not had previous business dealings with Mr. Miller or his company, E-commerce.com. Ms. Greene is aware of WebTrust, but does not know what the specific responsibilities and requirements are of this type of engagement. She informs Mr. Miller that e-commerce-based businesses have begun to display web assurance seals on their websites. The web seal programs are supposedly oriented to give e-commerce consumers a sense of confidence that when they deal with Internet merchants that the consumer's personal data will be handled in a secure and confidential manner. She tells him about the WebTrust seal offered by the AICPA. Mr. Miller asks Ms. Greene to provide him with information on alternative web assurance seals. Specifically, he wants to know what web assurance seals are available and what requirements does his company, E-commerce.com, have to meet to be able to display a seal on its website. Additionally, he wants to know if web seal programs are all alike. Ms. Greene tells Mr. Miller that she will provide this information to him.

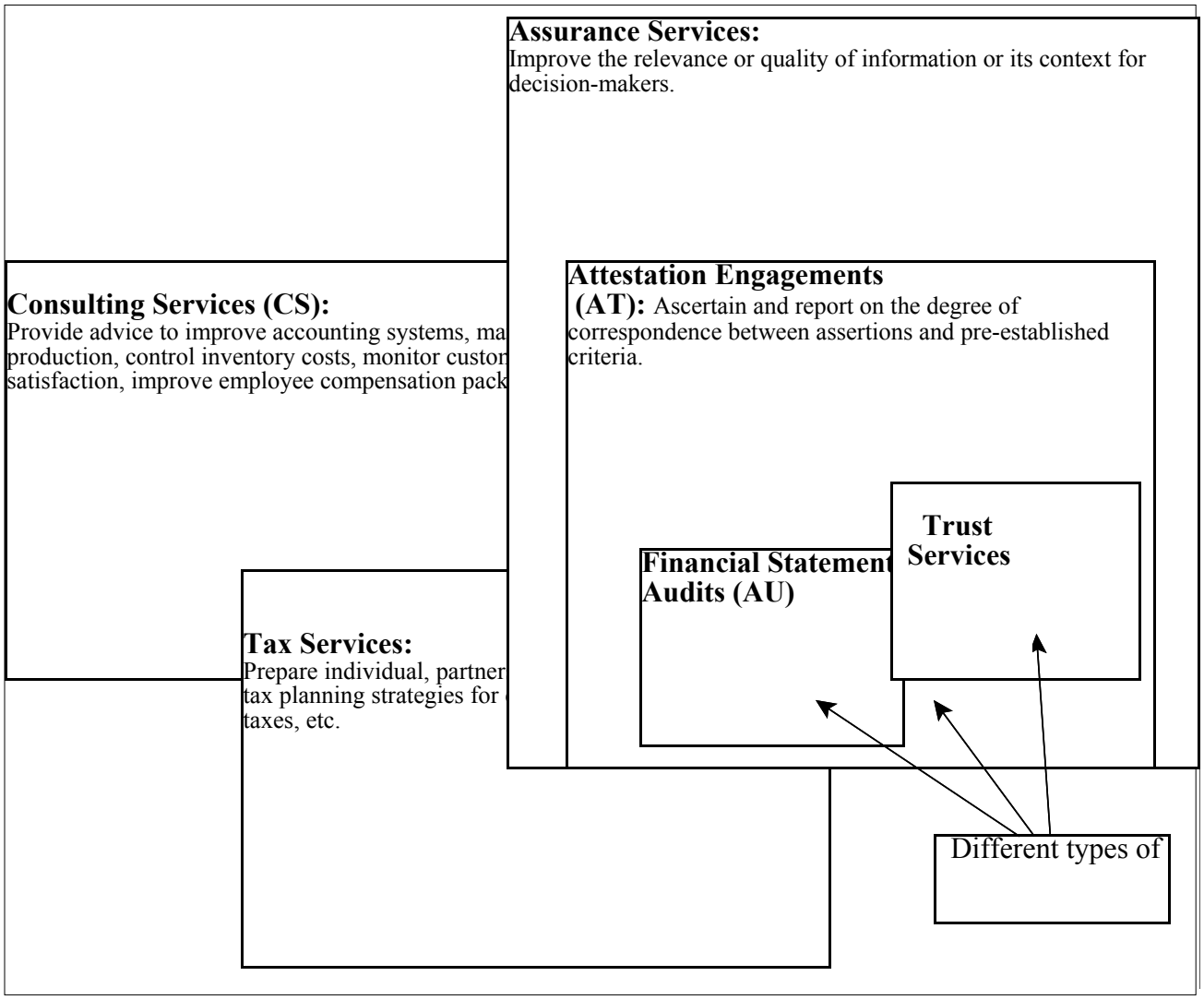
Between her own background and the technical support available through the staff in her office, Ms. Greene knows that she has the technical competence to evaluate the internal controls over financial reporting. However, she has never personally performed an engagement on web seal programs and needs to know the technical skills required for such an engagement. To undertake this task, Ms. Greene designed a four step process:

- **Step 1:** In the first step, she does some background research and investigates what types of assurances merchants should be giving to e-commerce consumers. She builds a short questionnaire that she will use to evaluate the different merchants she intends to review. She goes to the websites of many merchants and analyzes the customer security and privacy statements posted on the commercial websites. She also observes what type(s) of web assurance seals were found on those web sites. Her purpose is to see how comprehensive the stated customer policies are for many merchants and whether better policies are associated with specific web seal programs.

- **Step 2:** In the second step, using the background she had already developed on the types of assurances merchants should be giving to consumers, Ms. Greene builds another questionnaire aimed at investigating the different web seal programs themselves. Ms. Greene selects a few of the most commonly found web seals and goes to their websites. Her purpose is twofold: (1) to find out how comprehensive the web seal program is at providing a full set of consumer assurances; and (2) to find out how difficult it is for a merchant to obtain, display, and renew the web seal. She is also interested in knowing whether her services as a CPA would be required for a merchant, such as Mr. Miller, to obtain each web seal. From her findings she will be able to select those web seal programs that seem more comprehensive and appropriate for Mr. Miller's business, and for her services as a CPA.

- **Step 3:** In the third step, Ms. Greene investigates the American Institute of Certified Public Accountants (AICPA) Professional Standards for guidance relative to performing an engagement for Mr. Miller designed to qualify his business (E-commerce.com) for an appropriate web seal program. ***She knows that she would be conducting a study of the client's website, using written website performance standards (criteria) developed by a web seal program. She would then report her findings to the client and the web seal program, wherein she would have to state her opinion about how well the client met the web seal program's demands. The representative for the web seal program would then make a judgment about awarding the seal.*** On a notepad, Ms. Greene sketches out a diagram of the different services a CPA practitioner could provide to clients. Overlap sometimes occurs between the different types of services when aspects of each service exist in an engagement. Figure 1 shows what she has sketched. This is obviously ***not*** a tax engagement. She knows that this will ***not*** be an audit engagement, because it does not relate to an audit of financial statements. That leaves only the possibility that the engagement would be either a consulting services or attestation engagement. However, she is unsure which type of engagement would be appropriate. If it is an attestation engagement, she is unsure which of the specific attestation standards will govern her activities while performing the engagement for Mr. Miller. She is particularly interested in knowing (1) what type of report can be issued, (2) whether there are restrictions on report distribution, (3) if the appropriate standard indicates that special training or certification is needed for her to properly conduct such an engagement, and (4) what the standards state about the issue of her independence from the client in order to perform the engagement. Ms. Greene builds a questionnaire she will use to summarize the guidance from the different professional standards she will review.

Figure 1. Different CPA Practitioner Services



- **Step 4:** In the fourth step, Ms. Greene will communicate her findings to Mr. Miller of E-commerce.com. She will compare and contrast the differences between a WebTrust assurance seal and the other web seal programs that are available for e-commerce businesses to display.

Having designed the process and developed the questionnaires to guide someone through the process, Ms. Greene then turned-over the task to a junior level CPA in her firm and gave the following instructions to the accountant. ***You*** are that junior level CPA.

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