AN INFORMATION PROCESSING ANALYSIS

OF BUDGET VARIANCE INFORMATION

by

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ABSTRACT

This paper summarizes a behavioral experiment designed to explore human information processing and its relationship to key budgeting issues in three areas: organizational, informational, and behavioral. A model composed of Mock's (1971) information economics and Brunswick's (1955) "lens" approaches is used as a framework for integrating key issues in budgeting research. A number of hypotheses are derived from the framework which involve: 1) budgetary slack and learning, 2) the modeling of decisions and judgments in terms of feedback cues, and 3) the effect of explicit budget variance information on objectives, performance, decision time and budget accuracy.

An experimental setting is described and the results of an experiment involving 126 MBA students are analyzed. The results for decision makers supplied with explicit variance information show significant improvements in budget performance and accuracy without the expense of significant increases in decision time. The results also suggest learning patterns throughout the experiment but fail to indicate any slack behavior by the decision makers. These findings corroborate the desirability of additional budget studies with a human information processing orientation.

Budgeting is an integral part of modern management technology. Understandably, a considerable portion of the management, as well as the accounting, literature has concentrated on the budgeting process. Hofstedt (1975) in a survey of behavioral accounting research classified studies into five main categories, including one of budgeting and leadership. This paper modifies his classification by subdividing accounting budgeting research (ABR) into three areas: 1) organizational, 2) behavioral, and 3) informational. A common link for the experimental analysis of these three areas is the human information processing approach.

Budgeting is an area in need of experimental analysis and an integrating framework that would bring a common context to many parallel research efforts. Evidence of this need is the constant importation of theories from other sciences in an attempt to synthesize diverse budget related findings. For instance, Cherrington and Cherrington (1973) borrowed the concept of reinforcement contingencies from psychology and experimentally examined supervisor-supervisee relations vis-a-vis performance and reinforcement. Also, Ronen and Livingstone (1975, p. 671) made use of psychological expectancy theory to ". . . integrate and accommodate the fragmented research findings on budget and behavior in the accounting literature." The research described here endeavors to further this integration process by focusing on human information processing research in accounting. The human information processing model is a combination of two information theoretic approaches (information economics and information processing). This model is utilized as the integrating framework for analyzing the three areas of accounting budgeting research in relation to specific hypotheses. These hypotheses are tested in an experimental setting and results are analyzed in relation to the proposed model. Finally, the paper presents a critical analysis of this research, integrates the findings into the literature, and proposes paths for further research. The following section introduces the key features of the behavioral model on which the experiment is based and in relation to which the findings are analyzed.

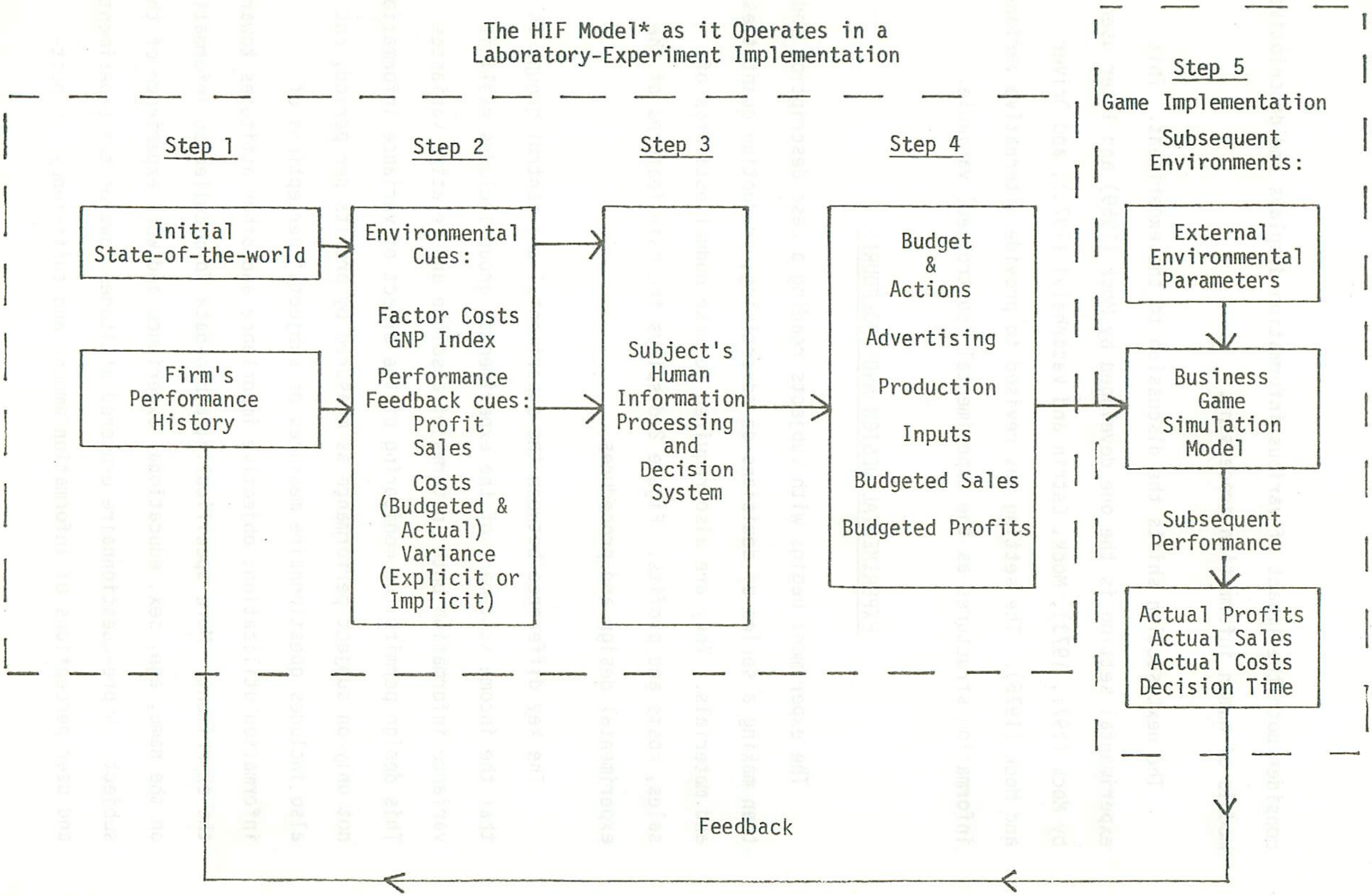
A HUMAN INFORMATION FEEDBACK MODEL

Mock and Vasarhelyi (1977) combined the information economics and lens models, and added a feedback dimension, to create what may be called a "Human Information Feedback" (HIF) model. That model describes a four-step process which includes 1) environment (states-of-the-world), 2) information (environmental cues), 3) information processing (judgments, predictions, decision models, etc.), and 4) action. The four steps lead to a "fifth step," the incorporation of past actions by the environment, which then initiates another four-step process for the next period. Thus, feedback information becomes a part of the environmental cues which lead to judgment and to action.

Figure 1 introduces the HIF model as it was actually implemented in the laboratory experiment. The dotted rectangle to the left represents the basic four steps while the rectangle on the right encompasses the implementation of the experiment. In the experiment, individual subjects made decisions based on their personal decision models, on available environmental information and on their perception of the results of previous decisions. The empirical results reported

FIGURE 1

The HIF Model* as it Operates in a Laboratory-Experiment Implementation



*Adapted from Mock and Vasarhelyi (1977) consider both the impact of various information displays and descriptive models of human information processing.

The next section shifts the discussion to the experiment. This experimental setting is the one developed by Mock (1969) and later used by Mock (1971, 1973), Mock, Estrin and Vasarhelyi (1972), and Driver and Mock (1975). The setting was revised to provide alternative variance information structures as the experimental (controlled) variable.

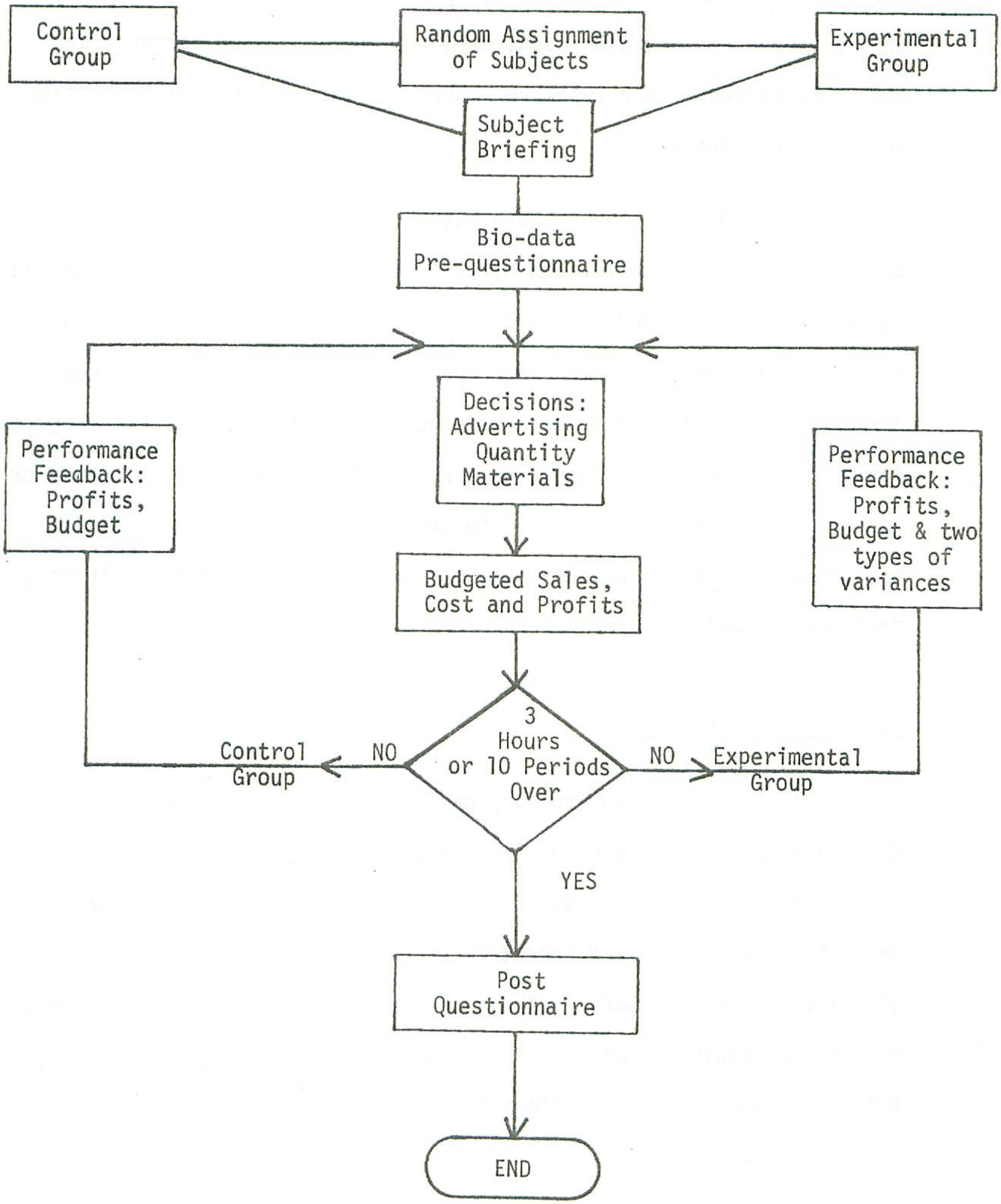
EXPERIMENTAL DESIGN AND PROCEDURES

The experiment begins with subjects reading a case description and then making a series of decisions on advertising, production quantities, and materials. They are also required to make budget estimates of sales, costs and profits. Figure 2 displays the main features of the experimental design and procedures.

The key difference between the experimental and control groups is that the income statement of the experimental group includes explicit variance information both in terms of absolute and relative variances. This design permits the monitoring of the effect of variance information not only on subject performance as measured by profits per period, but also includes questionnaire measures of subjects' perceptions of information utilization, objective importance and other attitudes toward the experiment. More specifically, a bio-data form collected information on the name, age, sex, educational experience and work experience of the subject. A pre-questionnaire explored attitudes towards the experiment and user perceptions of information amount and sufficiency. A post-

FIGURE 2

Experimental Design and Procedures



questionnaire explored the same questions, and in addition, perceptions on the type of information used, effort-time allocation factors, and user perceptions of the relative importance of experimental objectives and decision approaches.

Figure 3 displays a standard output that was given to the subjects as a response to each of their decisions. The output received by the subject included a record of his decisions, the decision year, and the income statement for that specified period. The environmental parameters for that period were printed as a footnote. Control subjects could compare their budgeted figure with actual results and manually or mentally obtain the variances. The column of variances was supplied only to experimental subjects, who could read these variances directly from the accounting reports.

Subject Characteristics

Subjects were drawn from a population of both full and part time MBA students. There were 105 male and 16 female subjects, with an average age of 25.2 years and 5 years of working experience. The experiment was a required ungraded assignment for an introductory graduate accounting course. The instructions indicated that subject's performance would be measured in terms of profits, budgetary accuracy, timeliness and quality of information processing.

FIGURE 3

Sample of Subject Performance Report

ID Number: 123

Decisions for year 1973 are:

A	Q	M
39.8	145.75	.274

Budgeted:

Sales	Costs	Profits
500,000	400,000	100,000

Variance Information (Experimental Factor)

Income statement for the year 1973

	Actual (X)	Budgeted (Y)	Variance (X-Y)	Percent Variance [(X-Y)/Y]
Sales	498,550.63	500,000.00	-1,449.37	-.003
Less Operating Cost				
Production	153,344.96			
Fixed	71,600.00			
Advertising	199,000.00			
Total Cost	425,944.96	400,000.00	25,944.96	.065
Net Profit (Loss)	72,605.67	100,000.00	-27,394.34	-27.39

STD Cost of Unit 965.38

The Environment Factors for the Year 1973 were:

Unit Cost of Material	Unit Cost of Labor	Fixed Cost	Demand Index
1170	796	71600	1228

From this total of 126 subjects, six were eliminated prior to the analysis due to experimental problems such as data input errors, lack of seriousness on the part of subjects or other factors. The remaining 120 subjects made 817 decisions of which 3 were eliminated as extreme points. Furthermore, a few students did not complete parts of the experiment and these specific data were treated as missing values during some of the statistical computations.

The number of decisions reached by each subject was dependent on his decision speed, although the experiment was designed so that each subject would complete at least five decisions. After three hours or ten decisions (whichever came first), subjects were instructed to stop making decisions and to complete the post-questionnaire. No warning was given as to experimental duration in order to avoid end-of-the-experiment effects. This time limitation feature resulted in decreasing sample sizes mainly in periods 6 through 10.

Figure 1 has displayed the configuration of this experimental setting within the HIF model which shows the manner in which the parameters of the game are applied. Subjects at period 0 receive the case history of the firm, data on past environmental parameters and a description of the game's underlying structure. Every period adds information and performance variances to this historical data base, which becomes the information cues which in turn serve as the basis for subjects' decisions. Decisions are then entered into the game formulae which lead to sales, profit and cost performances.

The next section will introduce key budget issues within the three areas of budget research, formulate these issues in the form of hypotheses, summarize tests of these hypotheses, and interpret the results within the HIF framework.

HYPOTHESES, RELATED RESEARCH AND DATA ANALYSIS

Ronen and Livingstone (1975) utilized expectancy theory to integrate a body of fragmented budget research. As already noted, the present study furthers this type of integration effort by focusing on the human information processing and feedback elements displayed in Figure 1. Variance information is included in Figure 1 as an input to the subject, while the utilization of variance data in the budget process is conceived of as a feedback cue utilization function. The value of this function, as pointed out in the Cherrington & Cherrington study (1973), will be related to factors such as the mode of reinforcement contingency and the level of budgetary control as perceived by the individuals affected by the budget. Hypotheses related to the three ABR areas will be considered in relation to human information processing with emphasis on variance information and the consequent feedback utilization function.

Organizational Budget Issues

Budget slack, tightness and adaptiveness are important organizational issues. The existence of slack in a budgetary context will allow the decision maker to make adjustments to prior budgets and still meet the target. Variance information will reveal discrepancies between budget and performance, but will not be fully reflected in the manager's decisions because slack will have a filtering and/or smoothing effect on the manager's reaction and feedback cue utilization. These kinds of considerations lead to the following hypotheses:

> H1: Budgetary variance for profits is expected to be significantly greater than zero.

> H2: There will be increasing budget accuracy.

The first hypothesis reflects the assumption that managers will budget conservatively in order to meet their budgets. This implies a potential understatement of the expected revenues and overstatement of expenses necessary to generate these revenues. This will lead to an understatement of profits.

Both Onsi's (1973) and Cyert and March's (1963) definitions of slack contrast budgeted costs with "minimum necessary costs." These concepts are conceptually valid but difficult to measure. Thus the present research uses an operationalization of the slack concept. Onsi (1973, p. 538) states that:

> Budgetary deviations between actual and standards, then, are due to different sources: intentional slack build-up in the standards, unintentional estimation errors, and changes in the level of efficiency from that planned.

Thus, slack may be considered to be one of the three components of budget variance:

Variance = f(slack, forecast error, implementation error).

Within the present context, an experimental setting, the implementation error is zero and the forecast error may be assumed to be a random variable with zero mean. These observations lead to the following operational definition:

budget variance = f(slack, 0, 0) = f(slack)

However, the assumption of zero forecast error is not supported elsewhere in the literature. Therefore, this paper stops short of using the terms slack and variance interchangeably as budgetary variance may also include some element of forecasting error.

While the first hypothesis deals with the magnitude, the second deals with change in the magnitude of the budgetary variance. It is the reflection of two related factors: (1) managers may "learn" about the budget process, and (2) managers may utilize part of their slack to absorb prior inaccuracies. These are a consequence of the increased knowledge of the decision makers about the environment and decision setting, which may lead to a relative decrease in their perceived need for slack. As the decision makers' subjective estimates of the variance and magnitude of the forecast error decreases, so will their perceived need for slack.

Budgetary variance may be measured as the difference between actual and budgeted values. For profits, if this difference is negative, then subjects were either unable to compensate enough (in terms of slack) for the forecasting error or they made poor decisions and forecasts.

Measurement of Profit Variance

The measurement of profit variance is a particularly complex issue. For most analyses, it is desirable to remove the random environmental effects in order to reduce error variance. Actual profit variance can be calculated as:

$$v_t = p_t - \hat{p}_t \qquad (1)$$

where: v_t profit variance in period t

p_t profit obtained in period t

$\hat{p}_t$ budgeted profit for period t

In order to remove magnitude effect, a normalized variance figure could be calculated as:

$$V_t = \frac{p_t - \hat{p}_t}{\hat{p}_t} \qquad (2)$$

where: V_t is the normalized variance for period t.

Unfortunately, this measurement does not eliminate the random environmental effects. This can be accomplished by using an optimal profit figure as follows:

$$V_t^* = \frac{p_t - \hat{p}_t}{p_t^*} \qquad (3)$$

where: V_t^* is the optimum normalized profit variance

p_t^* is the optimal profit achievable in period t

The derivation of each specific period optimal can be found in

Fellingham, Mock and Vasarhelyi (1976). Another measurement that could be used to evaluate decision improvement is the absolute value of the variance which recognizes the magnitude of the variances regardless of their sign.

$$v_t' = |p_t - \hat{p}_t| \quad (4)$$

where: v_t' is the absolute value of profit variance

The absolute value of the profit variance may also be normalized by the budgeted or optimal values for each period.

$$V_t' = \frac{|p_t - \hat{p}_t|}{\hat{p}_t} \quad (5)$$

$$V_t'^{*} = \frac{|p_t - \hat{p}_t|}{p_t^*} \quad (6)$$

where: V_t' normalized absolute value profit variance

$V_t'^{*}$ optimum normalized absolute value profit variance

Other normalization procedures could also have been used, such as the assumption of a linear information integration model in which actual profit would be normalized with the period's optimal profit value and the budget value normalized with the mean (or any other decision function) for the past periods in which information was provided or decisions were made.

<u>Analysis of Results</u>

The first hypothesis implies that both the normalized and actual profit variances will be significantly greater than zero. This hypothesis also implies that during step 3 of Figure 1, subjects "pad" their profit budgets. Means for profit variance, normalized profit variance and optimum normalized profit variance are displayed in Table 1. In testing hypothesis 1, the most reasonable variance measure to use is the optimum normalized profit variance as the stated hypothesis is directional in nature. A cursory examination of the data leads to the immediate rejection of the stated hypothesis due to the widespread presence of negative variances. In a test of means, the overall mean is -18.2% with a standard deviation of 22.15%. If the hypothesis had been stated in the opposite direction, it would have been supported as being significantly less than zero at a significance of 1%. This leads to the conclusion that decision makers were optimistic in their profit estimation and to a rejection of the stated hypothesis.

Operationally, hypothesis 2 implies that there will be a significant negative slope on the curve of optimum normalized absolute value profit variance. Recall that this measure allows for the elimination of environmental variations. At the same time, it incorporates a learning measure in that the absolute value concept considers how close the decision maker was to the budget. Figure 4 displays the data on the optimum normalized absolute value profit variance plotted against time and its regression line fit. Visual inspection shows the improvement in budget accuracy over time with a significant linear fit. The estimated equation for the optimum normalized absolute value profit variance was:

$$V_t'^* = 53.93 - 3.73t$$

TABLE 1

Means for Profit Variance

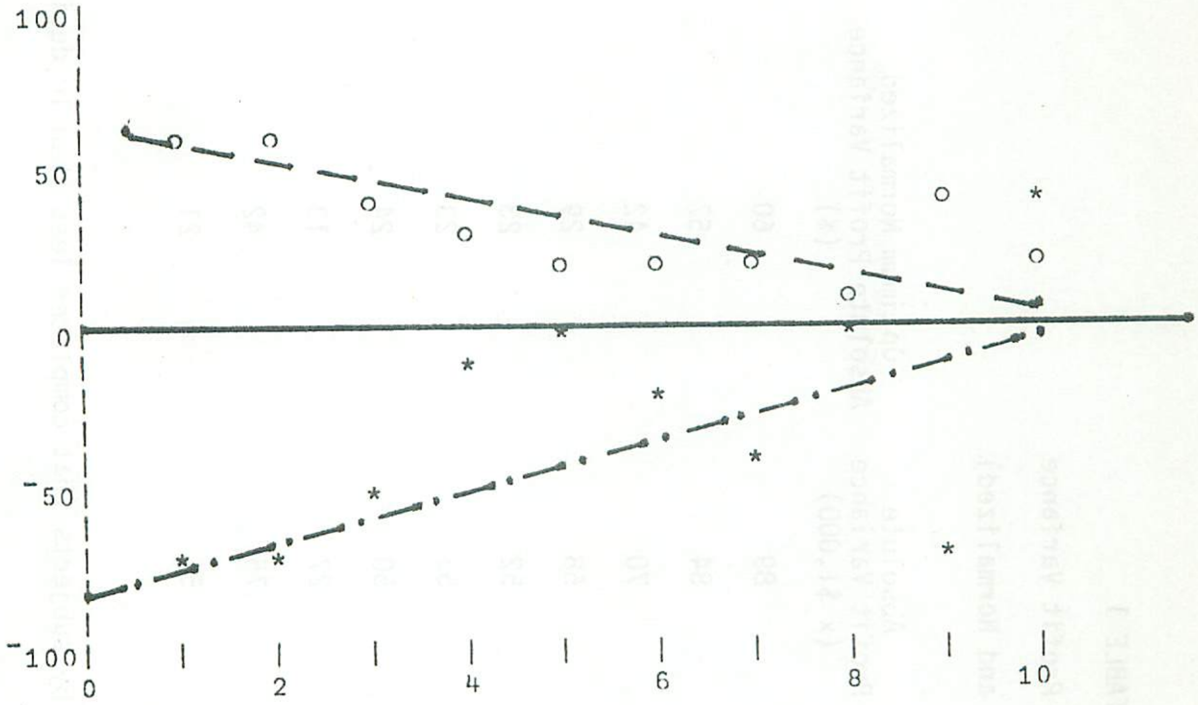
(Actual and Normalized)

	Profit Variance (x $1,000)	Normalized Profit Variance (%)	Absolute Profit Variance (x $1,000)	Optimum Normalized Absolute Profit Variance (%)	Optimum Normalized Profit Variance (%)
1	-71	-18	89	60	-48
2	-71	-30	84	57	-48
3	-50	-10	70	42	-30
4	-10	83	58	29	- 5
5	- 2	84	52	23	- 1
6	-24	33	53	23	-10
7	-38	-14	50	24	-18
8	- 5	2	27	13	- 2
9	-69	-31	75	42	-38
10	44	40	51	21	18

Decreasing sample size is mainly caused by subjects that completed less than 10 decisions due to the 3 hour time limit.

FIGURE 4

Profit Variances and their Linear Fit



o Actual Values, Optimum Normalized Absolute Value Profit Variance (%)

* Actual Values, Profit Variances (x $1,000)

_._ Regression lines

The R^2 was .498 with a t value of 2.82 which is significant at the 0.01 level. This supports the stated hypothesis. The same tests applied to the other measures of profit variance (i.e., see Figure 4) lead to similar results with a lesser degree of statistical significance. In real life situations, where implementation error compounds the uncertainties faced by the manager, this effect may be expected to be weaker. The learning effect denoted by this hypothesis is a reflection of the feedback loop postulated in Figure 1 where actual outcomes are incorporated into the firm's history and the decision processes affecting subsequent actions.

The results of the analysis of hypotheses 1 and 2 suggest that managers do not insert slack in their budget estimation and that experience and learning will lead to smaller profit variances.

Behavioral Budgeting Issues

While organizational issues are defined to include slack behavior and learning among managers, behavioral factors encompass those variables which effect the mode and manner of cue processing. Two hypotheses deal directly with the process of budget setting decision making.

H3: There will be a significant relationship between feedback information and decision maker reaction.

H4: A linear function will provide significant statistical explanation of the budget setting process.

The third hypothesis deals with the reaction of the decision maker to feedback cues from his previous decisions. The decision maker reaction relates the following elements: a management decision, an actual outcome, a measurement of this outcome (feedback response), a utilization of this message (feedback cue utilization), and the composite reaction of the decision maker which incorporates his adaptiveness, environmental cue utilization and learning.

Operationally, reaction will be measured as the difference between the decision maker's current decision and his previous one while "feedback cues" will be the comparison between two previous decisions and their consequent differences in outcomes.

The third hypothesis also reflects Holstrum's (1971) adaptiveness and tightness concepts. Managers are expected to utilize their budgetary slack to absorb environmental fluctuations and to "react and adapt" in their subsequent budget decisions. The direction and value of variance information is expected to result in a significant relationship with decision change (reaction) while slack would have a smoothing effect on the experienced variance. The key questions related to H4 are the budget setter's and budgetee's mental processes and the key variables used for the budget setting procedures. This study endeavors to explain the budget figures by a combination of traditional decision cues (past profits, past sales) and the reaction functions of the decision maker. An approach similar to this was used by Hughes and

Downs (1976) while trying to explain stock purchase decisions through a series of behavioral attributes using regression. In spite of its formulation in terms of H4, this analysis should be considered basically of exploratory nature. The main objective of H4 is to explore the possibility of modeling the decision process and provide some direction for future research.

A decision maker will react based on his perception of the environment and as a reaction to the feedback information derived from his previous performance. The experimental setting provides the decision maker with trends of historical parameters, as well as cues on prior periods' performance. Mock (1969, p. 54) proposes a reaction function to explain one of the decisions (materials input) in terms of changes (first differences) in previous materials decision and previous total cost results:

$$m_t - m_{t-1} = f[(m_{t-1} - m_{t-2}), (c_{t-1}, c_{t-2})]$$

or

$$\Delta m_t = f\,(\Delta m_{t-1}, \Delta c_{t-1})$$

Here m_t is the materials decision for period t while c_t is the unit cost incurred in that period. A more complete model would add the ratio of unit price of labor ($P_{l,\,t-1}$) and materials ($P_{m,\,t-1}$) as another independent variable such that

$$\Delta m_t = f\left(\Delta m_{t-1}, \Delta c_{t-1}, \frac{\Delta P_{m,\,t-1}}{\Delta P_{l,\,t-1}}\right)$$

where $P_{m,\,t-1}$ and $P_{l,\,t-1}$ are the cost factors affecting direct unit costs.

As a first approximation, consider the relationships between Δm_t and Δm_{t-1}. This initial analysis will serve for hypothesis testing purposes. Table 2 contains the correlations of the changes in the materials decision and the changes in the materials decision in prior periods. Large negative correlations are found between the materials decision and the materials reaction, supporting the stated hypothesis. The negative sign of the correlations indicates a strong trial-and-error effect in the decision process as the decision maker evidently attempts to compensate for former decisions.

TABLE 2

Pearson Product-Moment-Correlations of Material Decisions with 1 Period Lagged Decisions

Period	Δm_t vs. Δm_{t-1} Correlation	Significance	Sample Size
3	-.52	.001	118
4	-.37	.001	114
5	-.15	.062	111
6	-.62	.001	95
7	-.32	.005	63
8	-.59	.001	29
9	-.08	.372*	20
10	-.81	.001	14

*not significant

Table 3 further examines the reaction relationships by relating the materials reaction to the prior period's materials and cost reaction functions. The results further support H3 with 3 out of the 4 regressions significant at the 5% level. However, none of the cost reactions contributes substantially for variance explanation.

Based on the HIF model presented in Figure 1, H4 postulates a feedback effect of delayed information. Four types of cues are received: variance information, past decisions, the general environmental parameters and other past information. The above mentioned effects could be expressed by the following formulae:

$$\hat{P}_t = f(K_{t-1}, r(K_t), K_{t-2}, r(K_{t-2}), \ldots)$$

where: $r(K)$ reaction function for decision type K

K a (advertising), m(materials) or q (quantity produced)

and the general reaction function

$$r(K_t) = K_t - K_{t-1}$$

which leads to the reaction function for the materials decision

$$r(m_t) = \Delta m_t = m_t - m_{t-1}$$

Table 4 displays the results of multiple regressions which regress $\hat{p}_t$ and $\hat{s}_t$ against independent explanatory variables. Regression analysis has been extensively used in the construction of lens based explanatory models (e.g., Libby, 1975).

TABLE 3

Stepwise Regressions

Materials Reaction as a Function of Prior Period's Materials and Cost Reaction

Independent Variables	Δm_7			Δm_6			Δm_5			Δm_4		
	Indep. Vars.	Beta	Var.'s F	Indep. Vars.	Beta	Var.'s F	Indep. Vars.	Beta	Var.'s F	Indep. Vars.	Beta	Var.'s F
Dependent Variables	Δm_6	-.352	8.24*	Δm_5	-.650	61.81*	Δm_4	-.153	2.61'	Δm_3	-.366	17.31*
	Δc_6	.174	2.02	Δc_5	-.149	3.25	Δc_4	.092	.95	Δc_3	-.050	0.321
Adjusted R^2	.117			.395			.021			.129		
Overall F	4.55*			30.90*			1.67			8.80*		
Durbin-Watson	2.05			2.06			1.98			2.45		

*Significant at the .05 level

TABLE 4

Budget Setting Regression Results

Dependent Variable: $\hat{p}_7$

Independent Variables	Beta **	Variables F***
p_6	1.79	211.61
s_5	5.45	93.42
Δa_7	.59	95.85
Δa_6	.85	124.14
Δm_6	- .15	8.62
s_6	-5.99	85.75
Δq_6	2.86	81.92
p_5	- .91	70.45
Adj. R^2 = .868	F = 50.69*	DW = 2.25****

Dependent Variable: $\hat{p}_6$

Independent Variables	Beta	Variables F
p_5	.40	18.37
Δq_5	.29	9.55
Δm_5	.32	7.53
s_4	.14	2.15
Δm_6	.15	1.81
Adj. R^2 = .260	F = 7.33*	DW = 1.91

Dependent Variable: $\hat{p}_5$

Independent Variables	Beta	Variables F
$\hat{p}_4$	.58	41.26
Δa_4	.24	6.72
p_4	.07	0.42
Δa_5	.16	3.78
$\hat{s}_4$	- .50	5.43
c_3	1.14	4.30
p_3	.29	4.48
Δq_5	.13	2.20
Δq_4	.55	2.36
c_4	- .56	1.23
Adj. R^2 = .363	F = 7.03*	DW = 1.91

TABLE 4 (concluded)

Budget Setting Regression Results

Independent Variables	Beta	Variables F	Independent Variables	Beta	Variables F	Independent Variables	Beta	Variables F
s_5	-1.12	979.61	s_5	2.23	140.32	s_4	1.47	63.67
p_6	.09	203.55	Δq_6	.34	219.36	Δq_5	.39	175.36
s_6	2.31	3124.68	Δa_6	.14	35.39	Δm_5	.11	15.95
Δq_6	- .99	2252.17	Δq_5	- .72	60.67	Δa_4	- .03	0.37
Δa_7	.18	790.36	s_4	-1.35	49.51	Δa_5	.07	5.99
			Δa_5	- .15	26.47	p_3	.13	13.07
			p_5	- .10	16.48	Δq_4	- .37	10.97
			Δm_5	- .05	5.19	s_3	- .45	6.36
						p_4	- .04	1.44
Adj. R^2 = .998	F = 5640.08*	DW = 1.82	Adj. R^2 = .957	F = 260.80*	DW = 1.96	Adj. R^2 = .926	F = 151.41*	DW = 1.86

* Significant at the 5% level.

** Betas are the standardized regression coefficients also referred to as Beta weights.

*** The overall F measures the significance of the regression coefficient while the variable's Fs test for the incremental inclusion of the specific variable in the regression equation.

**** Durbin-Watson test for multicolinearity

The results show a significant linear relationship between budgeted sales and profit and previous cue variables. Considering that the significant cue variables include both environmental and feedback cues this may be viewed as indirect evidence that a joint effect exists between cue and feedback cue utilization. It seems quite clear from the results that sale estimates are much easier to predict, as profits are a considerably more sensitive measure than either sales or costs. The results also show a remarkable consistency in terms of inter-period comparisons as budget estimates for periods 7, 6 and 5 are predictable at similar levels and include approximately the same variables. It is also noteworthy that the previous period's performance cue is most generally the strongest determinant of the estimate being analyzed.

Again it should be pointed out that this analysis is exploratory in nature. It can be interpreted at most as an indication that recent decisions and budget variances might be significant determinants of current and future decisions. Hypothesis 3 points out that decision makers may tend to act in a trial-and-error type approach alternating increments and decrements to decisions on the basic variables. Meanwhile, H4 points toward the ability to have significant success in predicting human budget estimates.

<u>Information Issues</u>

Variance information is the major information issue considered. Accounting is a process of data collection, processing, storage and presentation of information, and information presentation raises two key questions. What information should be presented and in what format should it be presented?

Laboratory studies have been conducted which present alternative information structures to different groups of decision makers and examine the outcomes related to these experimental factors. Mock (1973) examined two information structures, one using, one not using, budget information. Results indicated improved performance with explicit budget information, but this was at the expense of increased decision time.

In terms of the Figure 1 model, Mock's (1973) results imply that explicit variance information will lead to higher feedback cue utilization by the simplification of the feedback cue utilization task and an attention direction effect. This might lead to improved task performance and decision making accuracy. As the focus of this study is on variance information, the effect of variance cues on subjects' budget objectives is also important. Although behavior, too, should be affected by budgets, explicit (as opposed to implicit) variance information should have little, if any, effect on decision maker internalization of particular organizational objectives.

> H5: There will be no significant effect of variance information on the internalized objectives of the decision makers.

Stedry and Kay (1966) indicate that the budget often becomes an objective in itself, and this may lead to dysfunctional budget processes.

Ridgeway (1956) discussed the dysfunctional features of performance measures by demonstrating that most performance measures will tend to effect (and perhaps bias) the task being performed. The HIF model indicates a joint effect of environmental and feedback cue utilization. The "magnitude" of the cue utilization will indicate the strength of the "budget feedback" effect. This can be interpreted as the effect of the corrective measures taken and filtered through the subject's perception of budget importance. Difficulties in the separate measurement of the effects of these two types of cues leads to the need for external measurement of objective emphasis by decision makers. If differences in objective perception are found, they would tend to indicate strong feedback cue effects to the point of influencing subjects' objective functions. To examine this, question 8 of the post-questionnaire asked subjects to distribute 100 points among the four stated objectives: 1) profit maximization, 2) budget accuracy, 3) decision speed, and 4) quality of information processing.

Hypothesis testing entails a t-test for significance in the difference of the mean points assigned to each objective. The results displayed in Table 5 do not denote any significant change in objectives based on variance information, thus supporting the stated hypothesis.

If Hypothesis 5 had been rejected, the results would imply a change in the objectives involved in the human decision model depicted in step 3 of Figure 1. Such an effect is expected only when major feedback factors are found which significantly change the subjects' view-of-the-world.

TABLE 5

Average Points Assigned to Objective Importance in Relation to Variance Information

Objective	Information Structure		Significance	Sample
	No Variance	Variance		
Profit Maximization	47.68	47.34	N.S.*	118
Budget Accuracy	22.74	22.72	N.S.	118
Decision Speed	13.77	15.75	N.S.	118
Quality of Information	15.81	14.18	N.S.	118

*N.S. t-test not significant at the 10% level.

H6: Explicit variance information will provide improved decision maker profit performance.

H7: Explicit variance information will increase decision maker decision time.

H8: Explicit variance information will improve decision maker budget accuracy.

Hypotheses 6 to 8, deal with the effect of explicit versus implicit variance information. Explicit variance information provides additional feedback cues to the decision maker and therefore there is potential for increased feedback cue utilization. These effects are dependent on the decision maker's perception of the importance of budgeting in his decision process. If he perceives the budget to be unimportant, the effects on budgets of any variance information may be expected to be negligible.

In order to evaluate hypothesis 6, decision maker performance is measured in terms of optimum normalized profits. Table 6 displays the means used in the hypothesis testing. The result of a paired t-test (t = 1.64) supports the stated hypothesis at the 10% level.

Hypothesis 7 examines another effect expected through the interpretation of Figure 1 in that subjects who receive variance information will take more time to make decisions than subjects without explicit variance information. Table 6 displays average decision time per subject for each variance information structure. The results are not significantly different on either a period-by-period basis or for the overall paired t-test (t = .41). The results do not support the stated hypothesis although their difference is consistent with previous findings (Mock, 1973) where the combined effect of required budgets and additional budget feedback resulted in significantly greater decision time. These results might be interpreted as suggesting that subjects have compensated for the lack of variance information by spending additional time analyzing their results before the following decision, maybe even mentally doing the variance calculation.

Hypothesis 8 states that variance information has a focusing effect on perception leading to enhanced awareness of estimated versus actual differences by the decision maker. Budget accuracy is best measured by the optimum normalized absolute value profit variance. Paired t-tests for the means of all 10 periods were performed comparing the experimental and control groups. Both the optimum normalized absolute value profit

TABLE 6

Variance x No-Variance

Information Breakdowns

Hypothesis Number	H6		H7		H8		H8		
Variable / Period	Optimum Normalized Profit (%)		Average Decision Time (Minutes)		Optimum Normalized Absolute Value Profit Variance (%)		Optimum Normalized Profit Variance (%)		Sample Size
	N.V.*	V.*	N.V.*	V.*	N.V.*	V.*	N.V.*	V.*	
1	45	59	53.2	48.6	58	64	-47.4%	-49.1%	120
2	42	54	27.8	28.1	45	72	-37.4	-60.6	120
3	62	60	17.0	21.0	42	42	-28.3	-31.3	118
4	64	68	14.7	15.9	27	32	5.0	-17.5	114
5	66	70	12.8	13.2	20	27	2.7	-05.3	111
6	68	68	11.6	11.5	18	29	- 4.1	-17.8	95
7	71	65	12.2	12.7	19	29	-13.2	-22.6	63
8	77	73	11.3	11.0	10	17	- 5.3	00.9	29
9	62	66	10.2	10.1	36	47	-35.7	-40.6	20
10	74	83	7.6	9.1	15	24	15.2	20.3	14
Overall Mean	62.9	66.5	17.8	18.1	29	38	-14.8	-22.4	
Paired t-test	1.64***		.41		4.29**		2.5**		

N.V.* No explicit variance information supplied

V.* Variance information supplied

** Significant at the .01 level

*** Significant at the .1 level

variance and the optimum normalized profit variance are displayed in Table 6. Both paired t-tests for period means were found to be significant at the .01 level, supporting the stated hypothesis.

Examining the results of hypotheses 6 to 8 which deal with the value of variance information, a positive effect can be observed in terms of performance improvement and budget accuracy while no significant decision time effects were observed. These results would tend to indicate that if the expected performance benefits result in larger monetary values than the costs incurred in preparing variance information, this information should be supplied.

Table 7 presents a summary of all preceding analyses. The final section discusses the overall results, presents conclusions and proposes paths for future research.

SUMMARY AND CONCLUSIONS

This paper has introduced a taxonomy that classifies accounting budget studies into three areas and examined hypotheses within each of these areas through a common focus: a human information processing model. This focus was provided by a human information feedback model introduced elsewhere in the literature.

A laboratory setting was utilized to perform an experiment with 126 subjects. Eight hypotheses were formulated of which six were supported and two rejected.

TABLE 7

Hypothesis Testing Summary

Hypothesis Number	Stated Hypothesis Summary	Test Used	Result	Null Hypothesis	Stated Hypothesis
1	Budgetary profit variance is positive	one tailed t-test	t = -2.59 (opposite effect)	Rejected	Rejected
2	Increasing accuracy in budgetary process	Regression equation, slope significance of the linear fit	$R^2 = .498$ $\beta = -3.73$ $\alpha = 53.93$ $t = 2.82$ $\alpha < .01$	Rejected	Accepted
3	Significant relationship between feedback information and decision maker reaction	Pearson Correlation	Most correlations significant at $\alpha < .01$ (except period 9)	Rejected	Accepted*
4	Linear function significantly explains budget decision	Stepwise Regression	Significant for $\hat{p}_t$ and $\hat{s}_t$	Rejected	Accepted*
5	Variance information will not change decision maker objective perception	t-test	$t_1 = .30$ (profit) $t_2 = .44$ (accuracy) $t_3 = 1.14$ (speed) $t_4 = .90$ (quality)	Supported	Accepted
6	Variance information will improve decision maker performance	Paired t-test	$t = 1.64$ $\alpha < .1$	Rejected	Accepted
7	Variance information increases decision time	Paired t-test	$t = .41$ α**	Accepted	Rejected
8	Variance information improves decision accuracy	Paired t-test	$t = 4.29$ or $t = 2.35$ $\alpha < .01$	Rejected	Accepted

* Exploratory conclusions

** Not significant at a .1 level

Hypotheses 1 and 2 discuss slack and learning by managers. While strong evidence of learning was found in subject performance, no slack was found to be introduced into profit estimates. A number of reasons may have led to this "optimistic" behavior by the subjects including lack of experimental realism, lack of slack behavior, unusual optimism or the fact that the reward structure was perceived by the subjects to be "output only" in Cherrington and Cherrington's (1973) terms.

A related hypothesis considered whether a combined effect of learning and decreased perceived need for (expected) budgetary slack would result in increased budgetary accuracy. This effect (at least learning) was observed for budget variances measured both in terms of absolute values of and actual profit variances.

Hypotheses 3 and 4 were designed mainly to consider the methodological potential of HIP research to construct and test models of cue utilization and decision making. The hypotheses may be interpreted under a HIP-feedback framework which is intended to provide an integrating framework for organizational, behavioral and informational issues.

Based upon a hypothesized relationship between feedback cues and subsequent decisions, correlation and regression analyses were conducted in an exploratory fashion. For both material input decisions and a set of budget judgments, significant relations between feedback cues and decisions were observed. The results indicate the desirability of proceeding with the utilization of feedback models for the explanation of budget phenomena.

Hypotheses 5 to 8 discussed informational issues. Tests of hypotheses 5 and 7 did not result in significant effects of explicit variance information on subjects' objectives or decision time. On the other hand, hypotheses 6 and 8 support the impact of explicit variance information on improved budget performance and budget accuracy. Taken in the aggregate, these results seem to point, in terms of cost-benefit analysis, towards the usefulness of explicit variance information. Such information does not cost much either in data preparation or in a manager's decision time while it does lead to improved decisions.

The final area for discussion concerns paths for future research. Experimental results indicate that some link between budget and performance (i.e., rewards for high profits and budget accuracy) should be established in the experiment which, if perceived by the subject, might make the budgeting process more meaningful. This would lead to a budget-output reinforcement situation and require new experimental testing of the value of variance information. Hypotheses 1 and 2 provided insights into the budget-slack phenomenon. Although the assumptions concerning forecasting error are quite limiting, extensions of this work could develop methodologies to separate and study this effect. Another area of research potential is the separation of the revenue and cost slack effects and their interrelationships. The next step in this research effort will concentrate on exploring the variates and constructs of the cognitive budget setting process as initially attempted here. Hypothese 3 and 4 were a first effort toward formal modeling of the budget decision and cue utilization process. These efforts, when extended, might provide important insights into the organizational budgeting process.

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