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ESTIMATING ACTIVITY COSTS: THE EFFECTS OF PRIOR COST INFORMATION AND TYPE OF COST ACCOUNTING SYSTEM

By

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ABSTRACT

ESTIMATING ACTIVITY COSTS: THE EFFECTS OF PRIOR COST INFORMATION AND TYPE OF COST ACCOUNTING SYSTEM

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A component of effective cost control is decision makers' ability to estimate accurately the relationships between activities and overhead costs (i.e., activity costs) [Bruns and McKinnon 1993; Cooper et al. 1992]. This research examines whether being provided with previously encountered activity data by a multiple cost pool system that generates biased cost rates is associated with improved decision maker cost estimation accuracy. Of particular interest is whether this provision is associated with increased accuracy for decision makers who possess incorrect prior information about the activity costs in their environment. Despite generating biased cost rates, many multiple cost pool systems are still capable of accurately providing decision makers with previous periods' actual activity data. Decision makers usually consider previously encountered activity and cost data when estimating activity costs. Consideration of these data often is based on decision makers' memory. Decision makers are predicted to exhibit a prior cost information-confirming bias when considering previously encountered activity and cost data. The prior cost information-confirming bias is predicted to be associated negatively with activity cost estimation accuracy for decision makers with incorrect prior cost information. Providing previously encountered activity data is predicted to be associated

negatively with the confirmation bias, and therefore, associated positively with activity cost estimation accuracy.

Experimental results indicate that decision makers with incorrect prior cost information exhibited a prior cost information-confirming bias when estimating from memory previously encountered activity and cost data. This bias is negatively associated with activity cost estimation accuracy. Finally, results indicate that providing previously encountered activity data from a multiple cost pool system that generates inaccurate cost rates is positively associated with activity cost estimation accuracy for decision makers with incorrect prior cost information. Cost system research implies that multiple cost pool systems must generate accurate cost rates to improve decision makers' cost estimation accuracy. The finding regarding the provision of previously encountered activity data has implications for how cost systems might be designed to help decision makers with incorrect prior cost information improve their cost estimation accuracy.

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INTRODUCTION

1.1 Motivation and Research Questions

A component of effective cost control is a decision maker's ability to estimate accurately the relationships between activities and overhead costs (i.e., activity costs) [Bruns and McKinnon 1993; Cooper et al. 1992][1]. Activity cost is defined in this paper as the amount by which total overhead costs increase for a one-unit increase in the respective activity. Decision makers frequently focus only on a few activities to manage and control costs. Taking actions based on information from only a limited number of activities is a manageable task for nonfinancial decision makers (Merchant and Shields 1993; Landry, Wood, and Linquis 1997; Nanni, Dixon, and Vollmann 1992).

Decision makers observe activity data on a frequent (e.g., daily or weekly) basis often from informal, nonaccounting system sources (Bruns and McKinnon 1993; Simon et al. 1954). Decision makers attempt to control overhead costs by controlling or managing the levels of these activities (Bruns and McKinnon 1993; Kaplan and Cooper 1998). Activity data receive frequent attention from decision makers because activity data are available on a more timely basis than financial data. Also, decision makers typically possess a belief or prior information about how changes in the levels of activity data translate into cost changes (Bruns and McKinnon 1993). Then, periodic (e.g.,

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[1] Overhead costs represent a large percentage (30%) of total product costs (Krumwiede 1998).

monthly) cost reports then are used by decision makers to confirm and compare their activity cost beliefs with periodic actual costs (Bruns and McKinnon 1993). Chapter Two contains theoretical arguments based on a review of relevant cost accounting and psychology literature to form a conceptual diagram of the activity cost estimation process.

Activity costs might be estimated for several reasons, such as for assessing old or evaluating new projects, products, or services that require different levels of activities. Activity costs also are estimated by decision makers attempting to improve efficiency or re-engineer operating processes (Cooper et al. 1992). Activity cost estimation is crucial in implementing strategic activity-based management. Strategic activity-based management involves "shifting the mix of demand for activities away from unprofitable applications by reducing the cost driver quantities demanded by unprofitable activities" (Kaplan and Cooper 1998, p. 138).

As part of the activity management process, decision makers estimate activity costs at various point(s) during the year. For example, activity costs often are estimated quarterly or at year-end for budgetary purposes. An increasingly feasible tool used by decision makers to plan for and control costs is activity-based budgeting (Cooper and Kaplan 1998). Cooper and Kaplan (1998) explain that activity-based budgeting, which usually is performed at year-end, is an attempt to budget resource and activity requirements more accurately for the following year. Activity-based budgeting requires that decision makers estimate the costs of activities after they have analyzed how many and what types of resources are needed for each activity (Cooper and Kaplan 1998).

The current study focuses on estimating the costs that vary with activity levels. Estimating these variable costs is required for both short- and long-term cost management. Cooper and Kaplan (1998) focus on determining full cost (the sum of fixed costs and costs that vary with activity levels) for longer-term planning. When managing costs in the short-term, however, the costs that vary with activity levels are the costs that are controllable by decision makers' actions and thus are the important costs to estimate accurately. For example, when excess capacity exists toward year-end, decisions regarding acceptance and pricing of special orders require estimation of the costs that vary with the level of the relevant activities (Atkinson, Banker, Kaplan, and Young 1997; Horngren, Foster, and Datar 1999). Long-term cost management also requires consideration of costs that are fixed, or committed, in the short-term but can vary in the long-term. Some fixed costs are traceable to a particular activity and thus are easily manageable in the long-term by selecting a particular activity level range for the subsequent year.

In estimating activity costs decision makers usually consider previously encountered periodic activity and cost data. Specifically, previous periods' data is considered to determine how costs have changed from period to period in response to changes in the levels of the activities for those periods. Consideration of such previous periods' data is important especially for decision makers who possess incorrect prior cost information, because these decision makers must adjust from their prior cost information to estimate activity costs accurately. As discussed below, when operating under a single cost pool system, decision makers' consideration of previously encountered activity and cost data often is based on memory. Therefore, the following research question is examined: (1) At the time activity costs are estimated, do decision makers provided with incorrect prior cost information exhibit a bias when considering from memory previously encountered periodic activity and cost data? Chapter Two develops a conceptual diagram of the cost estimation process, which includes the importance of decision makers' consideration of previous periods' data in estimating activity costs. As discussed in Chapter Two, a bias in considering previous periods' data might be deleterious to decision makers' activity cost estimation accuracy when their prior cost information is incorrect.

Informal conversations, such as telephone or face-to-face communications, often are the primary channel for disseminating activity information to decision makers (Bruns and McKinnon 1993). As a result, previously encountered periodic activity data often are unavailable from these channels when decision makers are creating their activity cost estimates. The cost system literature implies that multiple cost pool systems (e.g., activity based costing) that generate inaccurate cost rates do not improve decision makers' cost estimation accuracy. An important distinction between single and multiple cost pool systems receiving little attention in the literature is the difference in the activity data provided by the two systems, even when such systems generate inaccurate cost rates. Single cost pool systems provide activity data only for a single activity, whereas multiple cost pool systems provide activity data for multiple activities. Thus, at the time decision makers estimate the activity cost for multiple activities, multiple cost pool systems provide previous period data for these additional activities. The provision of previous period data for these additional activities represents the incremental information content of multiple cost pool systems over single cost pool systems examined in this paper.

Providing these incremental activity data when activity costs are estimated means that decision makers' consideration of such data does not depend on memory.

The purpose of this research is to investigate whether the provision of incremental activity data from an inaccurate multiple cost pool system, over and above that provided by an inaccurate single cost pool system, is associated with increased cost estimation accuracy. Therefore, the following research question also is examined: (2) Can the incremental activity data provided by an inaccurate multiple cost pool system improve decision makers' cost estimation accuracy over the activity data from an inaccurate single cost pool system? As discussed in Chapter Two, the multiple cost pool system's provision of incremental activity data might serve as a partial solution to the memory-based bias examined in the first research question, thereby improving activity cost estimation accuracy.

The type of data provided to decision makers and data availability for decision makers are important issues to designers of cost information systems and particularly for system integration (Kaplan and Cooper 1998). For example, designing cost reports that are effective for decision makers' production and planning decisions requires the designer to make important choices concerning the number of periods covered by the report and the format of the report (Libby 1981). A strong link exists between understanding how decision makers make decisions (e.g., estimate activity costs) and choices regarding effective cost system design and what information cost reports provide to decision makers (Libby 1981).

Studying the above two research questions provides an understanding of how decision makers estimate activity costs. This understanding is beneficial for choices regarding cost system design, refinement, and integration. For instance, this research should have implications for choices concerning the availability and timing of previous periods' activity data to decision makers. Of particular interest is whether providing previous periods' activity data is associated with cost estimation accuracy for decision makers with incorrect prior cost information. Providing decision makers with previous periods' activity data is expected to help improve their understanding of how activities impact overhead costs. Such an understanding is important in enabling decision makers to form a causal model of how activity level changes translate into cost changes within their environment.

1.2 Overview of the Hypotheses

In estimating activity costs decision makers usually consider previously encountered periodic activity and cost data. Decision makers are expected to exhibit a prior information-confirmation bias when considering from memory previous periods' activity and cost data. Specifically, decision makers are predicted to perceive that their prior information's periodic predicted costs are more consistent with (or more similar to) periodic actual costs than they were in reality. Also, decision makers are predicted to be unable to recall the activity data for those previous periods in which predicted costs were inconsistent with actual costs, meaning that such activity data are unavailable to decision makers when they estimate activity costs. The expected result of the confirmation bias is that decision makers' adjustments from their prior cost information are reduced. Reduced adjustments from prior cost information translates into reduced cost estimation accuracy when prior cost information is incorrect. Thus, the extent of the confirmation bias is predicted to be negatively associated with cost estimation accuracy for decision makers with incorrect prior cost information.

Of particular importance is the ability of decision makers with incorrect prior cost information to recognize that adjustments should be made from their incorrect information if activity costs are to be estimated accurately. Multiple cost pool systems. even many that suffer from various design problems, provide decision makers with previous periods' data for multiple activities, rather than only a single activity as provided by single cost pool systems. The multiple cost pool system's provision of these incremental activity data is expected to mitigate the extent of the prior information-confirming bias, thereby increasing cost estimation accuracy for decision makers with incorrect prior cost information. Thus, relative to the single cost pool system, the multiple cost pool system is predicted to be associated with increased cost estimation accuracy when decision makers' prior cost information is incorrect.

Most cost system research implies that multiple cost pool systems must generate accurate activity cost rates to be of use to decision makers. The effect of providing previous periods' activity data on cost estimation accuracy has received little, if any, research attention. This paper posits that multiple cost pool systems' provision of previous periods' activity data serves as a partial solution to the confirmation bias' deleterious effects on cost estimation accuracy for decision makers with incorrect prior cost information. Evidence supporting this prediction has potential implications for cost system design. For example, firms might place more emphasis on providing decision makers with previous periods' activity data at the time activity costs are estimated. Also, such evidence suggests that multiple cost pool systems that fail to generate accurate cost rates still might benefit decision makers' cost estimation accuracy by providing previous periods' activity data.

1.3 Overview of the Research Design

A laboratory experiment is used to test the hypotheses. A total of 107 MBA and undergraduate accounting students participate in the experiment. The prior activity cost information is manipulated - correct or incorrect – and provided to decision makers. The cost system type is also manipulated - single cost pool, multiple rates with single year-end activity, or multiple cost pool. Cost system type determines whether decision makers are provided with a cost rate for a single or multiple activities and whether decision makers are provided with previous periods' data for a single or multiple activities when they estimate activity costs. Thus, prior cost information and cost system type serve as the two independent variables in the 2 x 3 between-subjects design.

The experiment contains three tasks – a cost differences estimation task, an activity data recall task, and an activity cost estimation task. The first two tasks examine decision makers' ability to estimate from memory previously encountered periodic activity and cost data. Thus, the first two tasks test whether decision makers exhibit a prior cost information-confirmation bias when estimating from memory previous periods' activity and cost data. The third task examines decision makers' ability to estimate the activity cost for each of the three activities contained in the previously encountered data set. The third task tests whether cost system type is associated with decision makers' activity cost estimation accuracy.

1.4 Organization of this Dissertation

The remainder of this dissertation is organized as follows. Chapter Two develops theoretical arguments based on a review of relevant cost accounting and psychology literature to form a conceptual diagram of the activity cost estimation process. The theoretical arguments also serve as the basis for deriving the hypotheses. Chapter Three describes the research design including the decision makers who participated in the experiment, independent variables, dependent variables, experimental tasks, and the procedures followed in administering the experiment. Chapter Four explains the statistical tests employed in testing the hypotheses and analysis of the results. Chapter Five concludes the dissertation with a summary of the study, including contributions, limitations, and future research directions.

Chapter Two

THEORY AND HYPOTHESIS DEVELOPMENT

Section 1.1 reviewed the cost accounting literature relevant to decision maker estimates of activity costs (Kaplan and Cooper 1998; Cooper and Kaplan 1998; Gonsalves and Eiler 1996; Merchant and Shields 1993; Cooper et al. 1992). It also included a brief discussion of key characteristics of a typical activity cost estimation setting. Chapter Two develops theoretical arguments based on a review of additional relevant cost accounting and psychology literature that support a conceptual diagram of the cost estimation process. The conceptual diagram provides the structure for the literature review and resulting hypothesis development. In addition to providing structure for the paper, the conceptual diagram helps conceptualize the cognitive mechanism (i.e., memory) underlying the activity cost estimation process. Such an understanding is crucial to moving towards a theory of how people learn the relationships among data (Klayman 1988), such as between activities and overhead costs.

2.1 The Existence of Prior Activity Cost Information

Prior to estimating activity costs decision makers often possess information concerning how key activities impact overhead costs (see Figure 1, Step A). Prior activity cost information arises from various sources, such as outside consultants, internal colleagues at other plants with relevant expertise, or the decision maker's previous

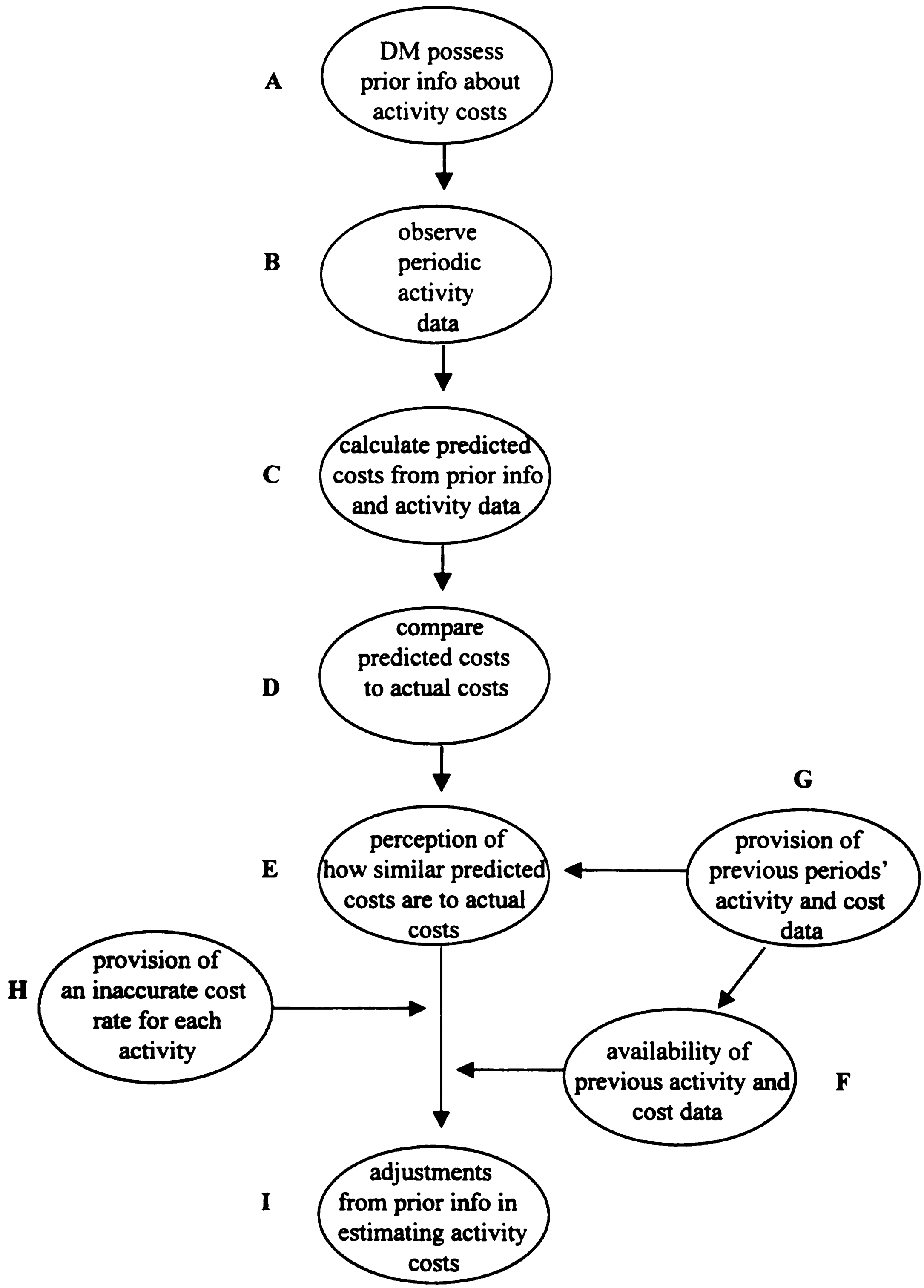

Figure 1
Conceptual Diagram of the Activity Cost Estimation Process

experiences (Bruns and McKinnon 1993). The accuracy of prior cost information varies and can be independent of the accuracy of the cost system's activity cost rate(s)[2]. For example, prior cost information can come from a consulting firm hired to analyze the activity costs of particular activities. Correct prior cost information can be produced by the consultants if they possess expertise in multiple cost pool (e.g., ABC) systems and employ the resources necessary for doing a better job of determining activity costs than the firm's cost system. Creating new cost systems or altering existing cost systems requires the firm to incur significant time, effort, and monetary expenses and sometimes is met with resistance from management or employees. Therefore, a firm does not necessarily alter its existing cost system, and in turn the generated activity cost rates, in response to the activity cost information provided by consultants. Thus, the result with respect to the particular activities considered for the consultant's project can be that the decision maker possesses correct prior cost information while their multiple cost pool system continues to generate inaccurate cost rates.

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[2] The following four boldfaced terms are used to relate to the experiment's three activity costs. (1) **Actual activity cost** refers to the actual overhead cost per unit of activity for each of the three activities employed in the experiment's data set. (2) **Cost estimate** refers to decision makers' estimate of the actual activity cost for each activity. (3) The **prior cost information**, either correct or incorrect, about each activity cost is provided to decision makers prior to observing the experiment's data set. (4) **Cost rate** refers to the cost system's approximation of the actual activity cost for one or all three activities, depending upon the type of cost system.

Alternatively, some decision makers possess imperfect causal knowledge of how activities translate into costs within their plant or environment. A decision maker might know how physical inputs relate to physical outputs, such as producing 100 units of product A requires 1,000 parts and 200 production runs. But the decision maker might not know how an additional unit of each of these activities impacts overhead costs.

Decision makers have reported that well designed and newly implemented ABC systems have provided "surprising" cost rate results, informing them of activities that were more or less costly than they had formerly believed (Pemberton et al. 1996; Cooper et al. 1992). For example, one firm reported that their prior information concerning machine maintenance costs has been much too small, because the majority of maintenance and repair resource expenditures are unscheduled. Employees realized that machine maintenance was an important activity, but before a careful ABC analysis was performed they underestimated the number and amount of the costs associated with the machine maintenance activity (Cooper et al. 1992). Other firms also have reported that a well designed ABC system indicated that security costs at their particular site were significantly different from a comparable site and, therefore, much different from what they had incorrectly believed (Krumwiede 1998). It seems clear that decision makers can possess incorrect prior cost information.

In summary, decision makers often possess prior cost information regarding their production process. Also, the accuracy of decision makers' prior activity cost information can be independent of the accuracy of their cost system's reported activity cost rate(s) because prior cost information and activity cost rates are generated by different sources. If prior cost information is incorrect, then the activity costs depicted in the actual activity and cost data are different from those anticipated by the decision maker. In order to estimate activity costs accurately decision makers must perceive the extent to which their prior cost information is incorrect and adjust from such information.

2.1.1 Prior Information and Estimation Accuracy

An individual's ability to perform the general type of parameter estimation task required in this dissertation's cost estimation task has been discussed in the psychology research literature[3]. Referred to as multiple cue probability learning (MCPL), these studies report about individuals who were provided with data on one or more independent variables and one dependent variable and asked to estimate either the regression parameter for each independent variable and/or the value of the dependent variable given

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[3] A key difference between existing studies and this dissertation's experiment is that the latter tests the effect of providing decision makers with all previous periods' activity and cost data on their cost estimation accuracy. The typical parameter estimation study provides individuals with a sequence of periodic (e.g., monthly) data involving independent (e.g., activity) and dependent (e.g., total costs) variable values, but does not provide individuals with past periods' data (Kattan, Adams, and Parks 1993). Such designs do not capture which previous activity data decision makers are able to recall for consideration when estimating activity costs. Also, such designs do not examine whether the provision of all previous periods' data at the time of cost estimation affects cost estimation accuracy.

the values of the independent variables (Klayman 1988)[4]. The general finding from these studies is that estimates are fairly accurate when task predictability is high [as measured by R^2 (Adelman 1981)] and each independent variable has a positive linear relationship with the dependent variable (Klayman 1988; Sniezek 1986; Brehmer 1979a; Muchinsky and Dudycha 1975; Brehmer 1974).

The majority of studies employ an abstract setting in which no prior information is provided to decision makers concerning the relationships to expect between the dependent and independent variables (Sniezek 1986; Klayman 1988). However, several studies have examined whether decision makers' prior information about the relationship(s) between the independent variable(s) (e.g., activities) and the dependent variable (e.g., total cost) affects their ability to estimate the actual relationship(s) from a set of subsequently observed data. These studies attempt to manipulate decision makers' expectations about variables' relationships by providing them with a label or name for the dependent and independent variables prior to the decision makers observing the data set (Sniezek 1986).

The label either is consistent or inconsistent with the actual relationship depicted in the data set. Thus, the information in the variable labels is assumed to create prior expectations for the decision maker concerning the relationships they are to estimate from the subsequently observed data set. For example, the label on the dependent variable might be "college G.P.A" while the labels on the two independent variables are "SAT

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[4] The accounting term "activity cost estimation" is used here rather than "parameter estimation", although both terms refer to the same general type of estimation task.

score" and "sociability". The prior expectation likely possessed by the decision maker before observing the data set is that the SAT independent variable has a large impact on college G.P.A, while the sociability independent variable has a small impact on college G.P.A. The prior expectations are considered to be consistent (inconsistent) when the actual relationships depicted in the data set are such that the SAT variable has a large (small) impact on college G.P.A. and sociability has a small (large) impact on college G.P.A.

The results of studies employing variable labels are mixed. Several studies find more accurate estimation performance when individuals' expectations are consistent, rather than inconsistent, with the actual values represented in the data set (Adelman 1981; Sniezek 1986; Broniarczyk and Alba 1994). In contrast, Muchinsky and Dudycha (1975) find rather accurate performance in both consistent and inconsistent settings. Adelman (1981) suggests that this discrepancy might be explained by Muchinsky and Dudycha's (1975) use of a relatively simple task. Muchinsky and Dudycha's (1975) task involved only two independent variables each with a positive linear relationship with the dependent variable. Adelman's (1981) task employed four independent variables with varying functional forms.

The experiment reported on here employs three independent variables (or activities) each with a positive linear functional form. The complexity of the present cost estimation task lies between that of Muchinsky and Dudycha (1975) and Adelman (1981). Due to the current experiment's high task predictability ($R^2 = .989$) and positive linear functional form for each activity-total cost relationship, correct prior cost information is predicted to be associated with greater cost estimation accuracy than is incorrect prior cost information.

Label-induced expectations are not exactly consistent with the need to learn the actual parameters or activity costs from the data set. Instead, expectations are speculated to guide individuals' processing of subsequently presented data in determining the correctness of their expectations and in learning the actual relations between the dependent and independent variables (Broniarczyk and Alba 1994; Sniezek 1986). Other than this general speculation, however, the process by which prior information affects decision makers' parameter estimation accuracy has received little attention. A conceptual diagram of the activity cost estimation process is developed in this paper. The diagram contains several factors that might help explain how prior information affects decision makers' cost estimation accuracy. Such factors include decision makers' perception of how closely their prior cost information predicts actual costs and the availability of previously encountered activity and cost data when decision makers estimate activity costs. A better understanding of how prior cost information affects cost estimation accuracy leads to a potential way to improve cost estimation accuracy for decision makers with incorrect prior cost information.

2.2 Using Prior Cost Information and Activity Data to Predict Periodic Costs

Decision makers attempt to control overhead costs by controlling or managing the levels of activities observed on a frequent basis often from informal, nonaccounting system sources (see Figure 1, step B). Activity data receive frequent attention from decision makers because activity data are available on a more timely basis than financial data (Bruns and McKinnon 1993). Also, as discussed in Section 2.1, decision makers possess a belief or prior information about how changes in the levels of activity data translate into cost changes (Bruns and McKinnon 1993). Decision makers perform this translation by combining their prior cost information with observed activity data to arrive at predicted costs for the period (see Figure 1, step C). Decision makers then refer to periodic (e.g., monthly) cost reports to compare predicted and actual costs as a way to check the accuracy of their prior cost information (Bruns and McKinnon 1993; see Figure 1, step D).

2.3 Perception of How Similar Predicted Costs are to Actual Costs and Availability of Previous Periods' Activity and Cost Data

Decision makers might proceed through steps B through D for only a few periods or for many periods before estimating activity costs for some specific purpose, such as year-end budgeting or projecting the profit of an existing or proposed new project. In either case, the accuracy of activity cost estimates depends on the decision maker's adjustments from prior cost information. To adjust accurately from prior cost information decision makers need to consider previously encountered periodic activity and cost data. Two aspects of considering previous activity and cost data are included in the diagram: (1) decision makers' perception of how similar predicted costs have been to actual costs (see Figure 1, step E), and (2) the availability of previous periods' activity and cost data (see Figure 1, step F). Thus, adjustments from prior cost information are expected to depend on decision makers' perception of how closely their prior cost information predicts actual costs and on whether previous periods' activity and cost data are available to decision makers when activity costs are estimated.

Actual costs sometimes possess a random element, which cause them to differ somewhat from predicted costs even when prior cost information is correct. Nevertheless, as long as the degree of randomness is not extremely large, predicted costs are expected to be consistent with actual costs when decision makers possess correct prior cost information. However, when decision makers possess incorrect prior cost information, predicted costs are expected to be inconsistent with actual costs in some periods and consistent with actual costs in other periods. Thus, actual costs might be consistent or inconsistent with predicted costs when prior cost information is incorrect.

Consideration of inconsistent data is crucial for accurately adjusting from incorrect prior cost information. The greater the difference between actual and predicted costs, the more inconsistent actual costs are to predicted costs. The periods in which decision makers' predicted costs have large inconsistencies with actual costs are the periods in particular that are expected to indicate to the decision maker that adjustments from their incorrect prior cost information are required to estimate costs more accurately. Previously encountered periodic activity data often are not provided to decision makers when they estimate activity costs. As a result, decision makers' perception of how similar predicted costs are to actual costs and the availability of previously encountered periodic activity data often are dependent on their memory of such previously encountered activity data. Therefore, a decision maker's ability to remember inconsistent data, especially the extent to which such data are inconsistent or dissimilar to their prior cost information, is expected to play an important part in the activity cost estimation process.

2.3.1 A Prior Information-Confirming Bias

A large body of research exists that examines individuals' recall of behavioral qualitative evidence that either is consistent or inconsistent with individuals' social expectations (Stangor and McMillan 1992; Rojahn and Pettigrew 1990). Such studies typically provide individuals with prior information about a person followed by a list of sentences about that person. The list is removed and individuals then are asked to recall as many sentences as possible. For instance, the sentence "the person pulled off the highway to assist a driver whose car had stalled" is an example of evidence that is consistent with the prior information that the person is very friendly. The sentence "the person publicly criticized his wife at a party" is an example of evidence that is inconsistent with the prior information that the person is very friendly (Srull et al. 1985, p. 322). The number of consistent and inconsistent evidence sentences recalled is then examined.

The type of evidence recalled by decision makers estimating activity costs is different from the type of evidence employed in the typical recall study. Most evidence recall studies utilize qualitative sentences about a person's behavior rather than quantitative numerical data. For example, studies involving personality assessments and audit going-concern judgments use qualitative sentences as the evidence to be recalled (e.g., Stangor and Duan 1991; Srull et al. 1985; Libby and Trotman 1993; Choo and Trotman 1991). This study uses numerical data in the form of activity and cost data as the evidence to be recalled and estimated from memory. Unlike qualitative evidence sentences, the degree of inconsistency for numerical evidence is objectively quantifiable. The important issue in a cost estimation setting is how well decision makers estimate the extent or degree of inconsistency between actual and predicted costs, rather than the number of times actual costs were inconsistent with predicted costs. Decision makers' estimate of the difference between predicted and actual periodic costs represents the extent to which they perceive actual costs as being consistent (i.e., similar) with predicted costs.

Adjustments from incorrect prior cost information must be made if activity costs are to be estimated accurately. Consideration of inconsistent data is crucial for accurate adjustment. The extent to which decision makers perceive predicted costs to be inconsistent with actual costs is expected to affect the extent to which they adjust their prior cost information. For example, a smaller perceived difference between predicted and actual costs would suggest to decision makers that less adjustment from prior cost information is needed than would a larger perceived difference. If decision makers perceive predicted costs as more consistent with actual costs than they are in reality (i.e., a smaller difference between the two), then decision makers with incorrect prior information are likely to adjust from their information to a lesser extent than they should when estimating costs. Less accurate adjustment from incorrect prior cost information equals less accurate cost estimation. Therefore, it is important to examine whether decision makers are biased in perceiving their prior information-based predicted costs as being more consistent (i.e., confirmation bias) or more inconsistent (i.e., disconfirmation bias) with actual costs than they are in reality.

The majority of recall studies show that recall is biased in favor of inconsistent evidence (Stangor and McMillan 1992; Hastie and Kumar 1979; Srull et al. 1985; Srull 1981; Woll and Graesser 1982; Graesser and Nakamura 1982; Garcia-Marques and

Hamilton 1996). For instance, Purohit (1989) finds that inconsistent evidence is favored in recall over consistent evidence, especially when there are more consistent evidence items than inconsistent evidence items. Although not examined, some researchers have debated the possibility that decision makers might exhibit a prior information-disconfirmation bias when performing the type of cost estimation task examined in this study. Specifically, decision makers might pursue a strategy where prior information is completely abandoned in favor of a new hypothesis when the current or previous two periods of actual data (e.g., actual costs) better "fit" the new hypothesis (Klayman 1988).

Contributing to a potential disconfirmation bias is that decision makers might have a hard time accurately determining the extent of random error. Trouble might follow in determining random error's effect on the dependent variable (actual costs) when incorporating data about independent (activity) and dependent (cost) variables into parameter estimates (activity costs) (Klayman 1988). A disconfirmation bias "may be compounded if learners use an inappropriate standard for 'sufficiently close'" for the differences between predicted and actual values (costs) (Klayman 1988, p. 129). Klayman (1988) notes that some research (i.e., Brehmer 1980) suggests that in making estimates decision makers "may use too strict a standard - even to the point of expecting a deterministic rule, despite instructions to the contrary" (p. 129).

If decision makers exhibit a prior information-disconfirmation bias, then they would perceive that predicted costs were more inconsistent with actual costs than they were in reality. Also, a disconfirmation bias would suggest that decision makers are able to recall at least some of the specific activity data corresponding to those periods in which predicted costs were inconsistent with actual costs. This would suggest that decision makers with incorrect prior cost information would make significant adjustments from their incorrect prior cost information, thereby increasing cost estimation accuracy. Thus, if decision makers exhibit a disconfirmation bias, then relying on memory of previously encountered data would not adversely affect cost estimation accuracy.

Alternately, several studies suggest that a prior information-confirmation bias might be displayed in a cost estimation setting. These studies point to factors that influence whether consistent or inconsistent evidence is more likely to be recalled (Stangor and McMillan 1992). Stangor and McMillan's (1992) meta-analysis identified several variables, such as task complexity and the number of independent variables (e.g., activities) contained in prior information, that moderated the typical finding of inconsistent evidence being favored in recall.

The recall literature contains both associative and schematic theories of whether and how consistent or inconsistent behavioral evidence is favored in recall (Srull et al. 1985; Crocker, Hannah, and Weber 1983; Taylor and Crocker 1981). As the task becomes more complex and processing demands increase, both schema and associative models of memory recall predict that decision makers make greater use of their prior information in an effort to reduce cognitive complexity. As reference to and use of prior information increases, recall increasingly favors consistent over inconsistent evidence (Stangor and McMillan 1992; Srull et al.1985). Also, other studies find that as the number of independent variables (e.g., activities) contained in prior information increases the propensity to over recall inconsistent evidence is eliminated and a greater proportion of consistent evidence is recalled (Driscoll and Gingrich 1997; Stangor and McMillan 1992; Stangor and Duan 1991).

The role assumed by the decision maker also might influence whether consistent or inconsistent evidence is favored in recall. Libby and Trotman (1993) find that auditors assuming the role of reviewer overrecall inconsistent evidence when reviewing others' working papers. It might be that the objective or role played by reviewers of critically assessing preparers' work, rather than a more developed reviewer knowledge structure as argued in Choo and Trotman (1991), is what lead reviewers to focus on inconsistent evidence. For instance, experienced auditors given a list of 20 evidence items relating to a particular company and asked to make a judgment about the company's future viability or failure later recalled a greater proportion of evidence consistent with their judgments. Another group of experienced auditors was given the same list, but also provided with the preparer's judgment about the company's future viability or failure. The latter group of experienced auditors, who had the objective or role of reviewers, recalled a greater proportion of evidence inconsistent with the judgments. In contrast to the somewhat unique objective of reviewers, decision makers in activity cost estimation settings are not expected to perceive their role as one of focusing on inconsistent data. Instead, decision makers are likely to refer to cost reports to check and verify the accuracy of their prior cost information (Bruns and McKinnon 1993), suggesting a prior information-confirmation bias.

Finally, randomness in actual costs is expected to affect decision makers' memory in a cost estimation setting. The typical evidence recall task used by previous researchers contains no such random element. Decision makers in reality must determine whether a difference between actual costs and predicted costs is due to randomness in actual costs or to the fact that prior cost information used in calculating predicted costs is incorrect.

Attributing the difference to randomness suggests that prior cost information does not need to be adjusted significantly. However, attributing the difference to prior cost information being incorrect suggests that significant adjustments from such prior information are needed to estimate activity costs accurately. Therefore, the determination of whether randomness or incorrectness of prior cost information is the cause of differences between actual and predicted costs has important implications for the extent to which adjustments are made from prior cost information.

Randomness in actual costs is expected to lead decision makers to perceive actual costs as being more consistent with their prior cost information's predicted costs than they are in reality. Randomness provides decision makers with an easy way to reconcile or partially explain why there are differences between predicted and actual costs without abandoning their prior cost information. Srull et al. (1985) provide support for this "explaining away" effect. Srull et al. (1985) speculate that in certain cases weaker beliefs, such as "most girls are taller than boys", might be less apt to change than stronger beliefs, such as "all girls are taller than boys". By allowing for some girls to be shorter than boys the weaker set of beliefs contains a potential explanation for inconsistent evidence. The potential explanation for inconsistent evidence makes the initial weaker belief less resistant to change from new evidence than the initial stronger belief. The result can be a final estimate of the percentage of girls that are taller than boys that is greater for the weaker "most" belief than for the stronger "all" belief.

The "explaining away" phenomenon is expected to prevent decision makers from sufficiently recognizing the amount of the differences between actual and predicted costs and that such differences are systematic and largely driven by their use of incorrect prior cost information. As a result, the differences between actual and predicted costs appear smaller and thus more consistent with prior cost information than in reality. Thus, the presence of randomness in actual costs is expected to reduce the extent to which decision makers adjust from their prior cost information, which translates into reduced cost estimation accuracy when prior cost information is incorrect.

In summary, high task complexity, the presence of prior information about multiple activity costs, decision makers' assumed role of using cost reports to verify and check prior cost information, and the existence of a random element in actual costs all lead to the prediction that decision makers exhibit a prior information-confirming bias. The bias is expected to reduce decision makers' adjustments from their prior cost information. Lack of adjustment from prior cost information is detrimental to cost estimation accuracy when prior cost information is incorrect. Decision makers with correct prior cost information do not need to adjust such information to estimate costs accurately. Thus, a prior information-confirming bias does not adversely affect cost estimation accuracy when prior cost information is correct. Therefore, Hypotheses 1a through 1d focus on decision makers with incorrect prior cost information.

Decision makers are predicted to exhibit a prior information-confirming bias in two specific ways. First, decision makers are expected to perceive predicted costs as being more consistent with actual costs than they are in reality. This paper's experiment captures decision makers' perceived consistency between predicted costs and actual costs with two estimates. Decision makers make comparisons each period between the actual cost change and the predicted cost change calculated using their prior cost information. After the final period decision makers estimate from memory both the average and greatest difference across all periods between the actual cost change and the predicted cost change. The estimated average (greatest) difference is AVGD (GRTD). Chapter Three contains detailed definitions of the independent and dependent variables and an explanation of the tasks, procedures, and materials employed in the experiment. If decision makers perceive predicted costs as being more consistent with actual costs than they really are then they would underestimate AVGD and GRTD. Therefore, decision makers are predicted to underestimate AVGD and GRTD.

H1a: Decision makers with incorrect prior information underestimate AVGD relative to the actual AVGD.

H1b: Decision makers with incorrect prior information underestimate GRTD relative to the actual GRTD.

Second, a prior information-confirming bias is expected to be exhibited in the periodic activity data recalled by decision makers when activity costs are estimated. Specifically, decision makers are predicted to be unable to recall any of the activity data associated with those periods in which the predicted cost change was inconsistent with the actual cost change. Failing to recall the activity data associated with these inconsistent periods has important implications for decision makers' adjustments from their incorrect prior cost information. The availability of such inconsistent periods' activity data is necessary if decision makers are to discover which further adjustments from their incorrect prior cost information, combined with these periodic activity data, best predict actual costs. Thus, it is important to examine which activity data - consistent or inconsistent - decision makers recall when estimating activity costs. Decision makers in the experiment are asked to recall the change in activity data for as many of the previously encountered periods as possible.

> *H1c: Decision makers with incorrect prior information cannot recall the change in the activity data for the months in which the actual cost change is inconsistent with their prior information's predicted cost change.*

Hypotheses 1a through 1c predict that decision makers exhibit a prior information-confirming bias when estimating and recalling previously encountered activity and cost data from memory.

Decision makers' perception of how similar their prior cost information's predicted costs are to actual costs is expected to affect the extent to which they accurately adjust from their incorrect prior cost information. The greater the perceived similarity between predicted costs and actual costs, the less that decision makers should feel that adjustments from their incorrect prior cost information must be made to estimate activity costs accurately. In other words, the more that decision makers underestimate AVGD, the less they are expected to adjust from their prior cost information. Less adjustment from incorrect prior cost information translates into less accurate cost estimation. Thus, for decision makers with incorrect prior cost information, the more they underestimate AVGD, the less accurately they are predicted to estimate activity costs.

> *H1d: For decision makers with incorrect prior information, cost estimation accuracy is negatively associated with the AVGD underestimation.*

In summary, evidence supporting Hypotheses 1a through 1c suggests that decision makers' memory-based consideration of previously encountered activity and cost data is biased in favor of their prior cost information. Support for Hypothesis 1d suggests that the prior information-confirming bias has deleterious implications for cost estimation accuracy when decision makers possess incorrect prior cost information. This support is important because it demonstrates that decision makers' biased perception of the similarity between predicted and actual costs plays a significant role in the cost estimation process.

2.4 Two Multiple Cost Pool System Elements and Their Effects on Cost Estimation Accuracy

Single cost pool systems have been prevalent in many firms. For example, Dayton Technologies, a business unit of Alcoa, reports that "like many other manufacturers, [before implementing an ABC system we] relied on a single-driver, traditional overhead costing system" (Pemberton et al. 1996, p. 20). Some firms refine their single cost pool system into a multiple cost pool system under the assumption that such refinements lead to improved product cost accuracy (Datar and Gupta 1994). Multiple cost pool systems provide decision makers with two cost system elements not provided by single cost pool systems. The first element is that at the time decision makers estimate activity costs multiple cost pool systems provide decision makers with previously encountered periodic data for multiple activities, rather than only a single activity (see Figure 1, step G)[5]. The provision of previous periods' data for multiple, rather than only a single, activity represents the incremental data of multiple cost pool systems over single cost pool systems examined in this paper. The second element is that multiple cost pool systems generate a cost rate for multiple activities, whereas single cost pool systems generate a cost rate only for a single activity (see Figure 1, step H).

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[5] Both single and multiple cost pool systems are capable of providing decision makers with previous periods' total costs.

An accurate multiple cost pool system generates accurate activity cost rates, which are useful because they inform decision makers of the relationship between overhead costs and each activity. However, many multiple cost pool systems suffer from design problems, such as error in measuring overhead costs, that lead to the generation of inaccurate cost rates (Datar and Gupta 1994; Noreen and Soderstrom 1994; Noreen 1991). Inaccurate cost rates might be deleterious to decision makers' cost estimation accuracy (see Section 2.4.2 for a detailed discussion of error in measuring overhead costs and resulting inaccurate cost rates).

Multiple cost pool systems must generate accurate cost rates to be of use to decision makers (Noreen and Soderstrom 1994; Datar and Gupta 1994; Noreen 1991). However, despite the production of inaccurate cost rates multiple cost pool systems still are capable of providing decision makers with accurate previous periods' actual activity data. This research examines whether the incremental activity data content of multiple cost pool systems is associated with a decision maker's activity cost estimation accuracy. Of particular interest is whether provision of incremental activity data is associated with increased cost estimation accuracy for decision makers with incorrect prior cost information. A positive association suggests that multiple cost pool (i.e., ABC) systems can improve cost estimation accuracy for decision makers with incorrect prior cost information even if such systems do not generate accurate activity cost rates.

2.4.1 Providing Previous Periods' Activity and Cost Data

When estimating activity costs (see Figure 1, step I) decision makers consider previous periods' activity and cost data. Consideration of previously encountered data is especially important for decision makers with incorrect prior cost information, because such information must be adjusted to estimate activity costs accurately. However, as predicted in Hypotheses 1a through 1c, decision makers' memory-based consideration of previous periods' activity and cost data is expected to be biased in favor of their prior cost information. This prior information-confirming bias is anticipated to reduce the extent to which decision makers adjust from their prior cost information, which translates into decreased cost estimation accuracy when prior cost information is incorrect, as predicted in Hypothesis 1d.

Support for Hypothesis 1d means that for decision makers with incorrect prior cost information increases in activity cost estimation accuracy are associated with decreases in the perceived similarity between predicted and actual costs. This suggests that activity cost estimation accuracy might be increased if decision makers' prior information-confirming bias were mitigated. The provision of previous periods' activity data is expected to improve cost estimation accuracy for decision makers with incorrect prior cost information by mitigating the extent of their confirmation bias.

The activity data decision makers periodically observe (see Figure 1, step B) are obtained from various formal or informal sources, such as face-to-face or telephone conversations with shop floor personnel (Bruns and McKinnon 1993). The informal nature of activity data sources and the design of many information systems often make it difficult or impossible to reference previous activity data when costs are estimated. As Cooper et al. (1992) point out, obtaining previous periods' activity data can be very time consuming and if attempted requires "a considerable amount of programming or manual effort" (p. 169).

In addition to the sometimes prohibitively high cost of obtaining previous periods' activity data, sometimes such data simply are not available (McCarthy 1998). For instance, some firms' information systems do not tie to the accounting system in any fashion or do not measure the relevant activity data (McCarthy 1998). Obtaining previous periods' activity data from nonaccounting information sources can be difficult or impossible, because they are not collected in any formal manner or their records are incomplete (Pemberton et al. 1996). Many firms have encountered trouble implementing ABC because they "did not have the groundwork in our systems to provide the information for many of the selected drivers (activities)" (Cooper et al. 1992, p. 191). Thus, previous periods' activity data often are unavailable from nonaccounting sources when decision makers need to estimate activity costs.

Decision makers occasionally estimate activity costs for multiple activities regardless of whether their cost system is a single or multiple cost pool system. If previous periods' activity data are unavailable from nonaccounting sources, then decision makers operating under a single cost pool system often must rely on memory recall of such activity data. A multiple cost pool system imposes no such memory requirement on decision makers. Unlike a single cost pool system, a multiple cost pool system is capable of providing previously encountered periodic data for each activity. A multiple cost pool system's provision of previous periods' activity and cost data at the time decision makers estimate activity costs eliminates the need for them to rely on memory of such data when adjusting their prior cost information. Therefore, a multiple cost pool system serves a potentially important function by providing decision makers with previous periods' data for each activity. The provision of periods' activity data is predicted to have different effects on decision makers' cost estimation accuracy, depending on whether their prior cost information is correct or incorrect. The effect predicted for decision makers with incorrect prior cost information is discussed first followed by the effect predicted for those with correct prior cost information.

The provision of previous periods' activity data (see Figure 1, step G) is proposed to affect decision makers' adjustments from incorrect prior cost information, and thus activity cost estimation accuracy (see Figure 1, step I), in two ways. The first way is through the provision's effect on the availability of previous periods' activity data. At the time activity costs are estimated previous periods' activity data are made available to decision makers either from the multiple cost pool system's provision or from decision makers' recall. Decision makers are predicted to exhibit a confirmation bias by not recalling any activity data associated with the periods in which actual costs were inconsistent with predicted costs (Hypothesis 1c). Having these inconsistent periods' activity data available is important for decision makers to notice that other activity costs systematically predict actual costs more closely than do the activity costs contained in their incorrect prior cost information. A decision maker's recall that excludes the inconsistent periods' activity data is expected to reduce the accuracy of their adjustments from incorrect prior cost information relative to when such data are provided. Thus, providing previous periods' activity data when costs are estimated makes such data available, thereby allowing decision makers to make more accurate adjustments from incorrect prior cost information than when such data are not provided.

The second way in which the provision is posited to affect activity cost estimation accuracy is through its effect on decision makers' perception of how similar predicted costs were to actual costs. Decision makers are predicted to perceive predicted costs as being more similar to actual costs than they were in reality (e.g., underestimate AVGD and GRTD in Hypotheses 1a and 1b, respectively). Perceiving predicted costs as being more consistent with actual costs than they were in reality is predicted to be negatively associated with the extent to which decision makers accurately adjust from their incorrect prior cost information (Hypothesis 1d). The provision of previous periods' data for each activity is expected to reduce decision makers' underestimation of the differences between predicted and actual costs, thereby increasing decision makers' activity cost estimation accuracy. Thus, the provision of previous periods' activity data when activity costs are estimated is expected to: (1) make available to decision makers activity data that are not available from their memory recall, and (2) reduce the extent of the bias in decision makers' perceived similarity between actual costs and their prior cost information's predicted costs. Each of these is expected to increase activity cost estimation accuracy for decision makers with incorrect prior cost information.

Decision makers with correct prior cost information do not need to adjust from their prior information to estimate costs accurately. Difficulty in accurately recalling previous periods' activity data and the resulting reduced ability to make adjustments from prior cost information is predicted not to affect cost estimation accuracy for decision makers with correct prior cost information. Also, for these decision makers actual costs differ from predicted costs only by random error, and thus differences between predicted and actual costs are relatively quite small. The predicted underestimation of these small differences and the resulting reduction in adjustments from prior cost information is not expected to have an adverse effect on cost estimation accuracy because their prior cost information is correct. Thus, the provision of previous periods' activity data when activity costs are being estimated is expected to have no effect on cost estimation accuracy for decision makers with correct prior cost information.

2.4.2 Providing a Cost Rate for Each Activity

As discussed briefly in Section 2.4, multiple cost pool systems sometimes suffer from design problems that lead to the generation of inaccurate cost rates. One common problem receiving attention in the cost accounting literature is error in measuring overhead costs (Datar and Gupta 1994; Noreen and Soderstrom 1994; Noreen 1993). Error in measuring overhead costs occurs when the cost of resources devoted specifically to an activity's cost pool is inaccurately determined (Datar and Gupta 1994). Datar and Gupta (1994) demonstrate analytically that error in measuring overhead costs is likely to increase as firms disaggregate their costs system. Disaggregation occurs when a single cost pool system is refined into a multiple cost pool system. Error often arises from decision makers' inaccurate estimates of the percentage of their time spent on various activities (Datar and Gupta 1994)[6]. Such time estimates frequently are used in multiple cost pool (e.g., ABC) system implementation. Cooper et al. (1992) detail the common use of managerial surveys and interviews in estimating the time and cost of resources associated with each activity's cost pool. Significant cost and time is required to implement multiple cost pool systems and subsequently maintain such systems. These

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[6] Errors also have been documented in decision makers' estimates of the amount of time spent on particular activities by their employees, such as supervisors, maintenance engineers, and quality control specialists (Cooper et al. 1992).

costs increase when the production process changes, which exacerbates the problem of accurately assigning overhead costs to the appropriate pool (Krumwiede 1998; Cooper et al. 1992).

Error in measuring overhead costs often results in the generation of inaccurate activity cost rates. Prior research examines the effect on parameter estimation accuracy of providing decision makers with accurate feedback concerning the change in the dependent variable that results from each one-unit change in the independent variable(s) (Klayman 1988; Libby 1981). Although such research has not been conducted within cost estimation settings, this feedback is similar in type to the activity cost rates that multiple cost pool systems provide decision makers. Existing studies find that accurate feedback of this type increases parameter estimation accuracy relative to when such feedback is not provided (Klayman 1988). Improved performance is argued to occur because decision makers no longer have to look solely at periodic data on the dependent and independent variables to figure out how the dependent variable changes for an one-unit change in each independent variable (Klayman 1988; Sniezek 1986). Thus, decision makers in a cost estimation setting are expected to place some emphasis on activity cost rates.

In typical studies, the feedback provided to decision makers is accurate. Many real world settings, such as the cost estimation setting examined here, require decision makers to work with inaccurate feedback. This study extends existing literature by examining the effect of providing inaccurate activity cost rates on cost estimation accuracy.

The effect of providing an activity cost rate for each activity (see Figure 1, step H) on decision makers' cost estimation accuracy is expected to depend on the accuracy of the cost rates relative to decision makers' prior cost information. For example, if the cost rates are less accurate than decision makers' prior cost information, then any emphasis placed on the relatively less accurate cost rates when adjusting from their prior cost information results in decreased cost estimation accuracy. However, if the cost rates are more accurate than decision makers' prior cost information, then any emphasis placed on the relatively more accurate cost rates when adjusting prior cost information results in increased cost estimation accuracy. As explained in Chapter Three, the biased cost rates provided in this experiment's multiple cost pool system are less accurate than the correct prior cost information and more accurate than the incorrect prior cost information. Therefore, the multiple cost pool system's provision of a biased cost rate for each activity (see Figure 1, step H) is expected to decrease (increase) cost estimation accuracy for decision makers with correct (incorrect) prior cost information.

In this research, the experiment employs three cost system types – single cost pool, multiple rates with single year-end activity, and multiple cost pool. Figure 2 displays for each cost system type the cost rate(s) and activity and cost data provided to decision makers each period (e.g., month), as well as when they estimate activity costs (e.g., at year-end). Figure 3 shows whether each cost system type contains neither, one, or both of the two multiple cost pool system elements – (1) provision of previous periods' data for each activity and (2) provision of a cost rate for each activity – discussed in this section. Thus, Figure 3 illustrates each cost system type's incremental provision of these two multiple cost pool system elements.

To summarize, cost estimation accuracy is predicted to be greater for decision makers with correct prior cost information than for decision makers with incorrect prior cost information. The multiple cost pool system's provision of previous periods' activity data is predicted to have no effect on (increase) cost estimation accuracy for decision makers with correct (incorrect) prior cost information. The multiple cost pool system's provision of an inaccurate cost rate for each activity is predicted to decrease (increase) cost estimation accuracy for decision makers with correct (incorrect) prior cost information. Therefore, the following noncrossover interaction between cost system type and prior information is predicted (see Figure 4, Panel A)[7].

> *H2: Relative to the single cost pool system, the multiple cost pool system is associated with increased accuracy of decision makers' cost estimates when their prior information is incorrect and decreased accuracy of decision makers' cost estimates when their prior information is correct.*

The main focus of this research is to determine whether the multiple cost pool system's provision of previous periods' activity data is associated with increased cost estimation accuracy, relative to the single cost pool system, for decision makers with incorrect prior cost information. As discussed earlier, multiple cost pool systems often suffer from various design problems, such as error in measuring overhead costs. The result of these design problems can be that the multiple cost pool system generates biased activity cost rates. The implication of most cost system research is that multiple cost pool systems must generate accurate cost rates to be of use to decision makers.

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[7] Chapter Three formally defines activity cost estimation accuracy.

	Monthly Report (Jan - Dec)				**Year-end Cost Report**		
	Production Control (units only)	**Single Cost Pool**	**Multiple Rates With Single Year-End Activity**	**Multiple Cost Pool**	**Single Cost Pool**	**Multiple Rates With Single Year-End Activity**	**Multiple Cost Pool**
Activity Data Provided:	Current and Preceding Month: MH Parts PRuns	Current and Preceding Month: MH	Current and Preceding Month: MH Parts PRuns	Current and Preceding Month: MH Parts PRuns	All Months: MH	All Months: MH	All Months: MH Parts PRuns
Cost Rates Provided:	None	MH	MH Parts PRuns	MH Parts PRuns	None	None	None
Cost Data Provided:	None	Current and Preceding Month: Actual Total Costs	Current and Preceding Month: Actual Total Costs	Current and Preceding Month: Actual Total Costs	All Months: Actual Total Costs	All Months: Actual Total Costs	All Months: Actual Total Costs

Figure 2
Activity Data, Cost Rates and Cost Data Provided by Monthly Production Reports, Monthly Cost Reports, and Year-end Cost Report

COST SYSTEM TYPE / ELEMENTS	SINGLE COST POOL	MULTIPLE RATES WITH SINGLE YEAR-END ACTIVITY	MULTIPLE COST POOL
COST RATES PROVIDED (for all activities: MHs, PARTS and PRUNS)	NO	YES	YES
ALL PERIODS' ACTIVITY DATA (for all activities: MHs, PARTS and PRUNS) PROVIDED on Year-end Cost Report	NO	NO	YES

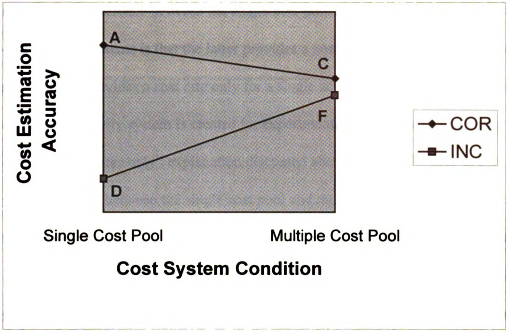
Figure 3
Incremental Elements of Each Cost System Type

Despite the production of biased cost rates, many such inaccurate cost systems still are capable of providing accurate actual activity data to decision makers. Evidence suggesting that the provision of previous periods' activity data is beneficial to decision makers' cost estimation accuracy has potentially promising implications for the manner in which cost systems help decision makers estimate activity costs more accurately. Therefore, it is imperative that the current paper be able to answer, at least in this particular experimental setting, what if any effect the provision of previous periods' activity data has on cost estimation accuracy.

The multiple cost pool system differs from the single cost pool system in the two ways displayed in Figures 2 and 3. The multiple cost pool system contains two cost system elements – the provision of an inaccurate cost rate for each activity and the provision of previous periods' activity data when decision makers estimate activity costs – whereas the single cost pool system contains neither of these two elements. Therefore, any difference in decision makers' cost estimation accuracy between the single and multiple cost pool systems could be due to the multiple cost pool system's provision of either one, or both, of these two elements. Given the main focus of this paper, the explanation that must be ruled out is that the *only* reason for any difference in cost estimation accuracy between the single and multiple cost pool systems is the provision of the cost rates.

A third cost system condition controls for the effect of providing a cost rate for each activity, thereby allowing a test of the incremental effect of providing previous periods' activity data on activity cost estimation accuracy. This third cost system

Panel A: Hypothesis 2



Panel B: Hypothesis 3

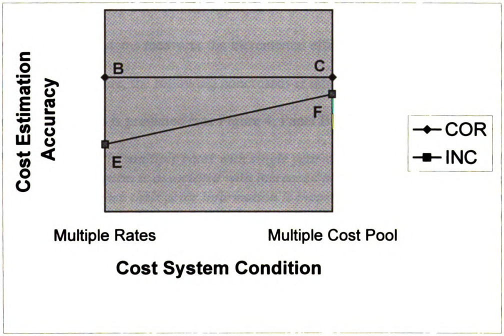


Figure 4
Individual Graphs of Hypotheses 2 and 3

provides a cost rate for each activity but previous periods' activity data only for machine hours. The only difference between the single cost pool and the multiple rates with single year-end activity systems is that the latter provides a cost rate for all (three) activities, while the former provides a cost rate only for a single activity. The multiple rates with single year-end activity system is created for experimental control purposes to rule out the potential "cost rates only" explanation discussed above. Any difference in cost estimation accuracy between the single cost pool and multiple rates with single year-end activity systems measures the effect of providing a cost rate for all (three) activities. The only difference between the multiple rates with single year-end activity and the multiple cost pool systems is that the latter provides previous periods' data for all activities at the time decision makers estimate costs, while the former does not. Thus, any difference in cost estimation accuracy between the multiple rates with single year-end activity and the multiple cost pool systems measures the incremental effect of providing previous periods' activity data. Therefore, the following noncrossover interaction between cost system type and prior information is predicted (see Figure 4, Panel B).

> *H3: Relative to the multiple rates with single year-end activity system, the multiple cost pool system is associated with increased accuracy of decision makers' cost estimates when their prior information is incorrect and has no association with the accuracy of decision makers' cost estimates when their prior information is correct.*

Figure 5 presents a combined graph of Hypotheses 2 and 3.

Results supporting Hypotheses 2 and 3 suggest that consideration should be given to how much emphasis cost reports place on generating accurate cost rates versus providing decision makers with relevant detailed previous periods' activity data.

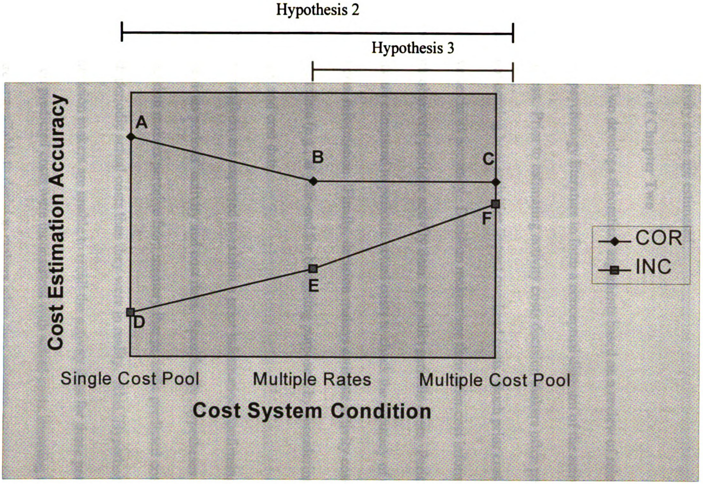


Figure 5
Combined Graph of Hypotheses 2 and 3

Multiple cost pool systems should in general continue to generate cost rates that are as accurate as possible given available resources. However, multiple cost pool systems also might focus on making previous periods' activity data readily available to decision makers when activity costs are estimated.

2.5 Summary of Chapter Two

Chapter Two develops theoretical arguments based on a review of relevant cost accounting and psychology literature to form a conceptual diagram of the activity cost estimation process. Prior to estimating activity costs decision makers often possess information concerning how activities impact overhead costs. Such prior cost information varies in its accuracy. Decision makers use their prior cost information, combined with observed periodic activity data, to predict periodic costs. Periodic predicted costs are compared to periodic actual costs to check the accuracy of decision makers' prior cost information. Finally, decision makers estimate activity costs at various points in time (e.g., at year-end for budgeting purposes) by considering previous periods' activity and cost data.

Decision makers are expected to exhibit a prior information-confirming bias when considering previous periods' activity and cost data. Specifically, hypotheses 1a and 1b predict that decision makers perceive from memory that periodic predicted costs are more consistent with periodic actual costs than they were in reality. Also, Hypothesis 1c predicts that decision makers are unable to recall the activity data for those previous periods in which predicted costs were inconsistent with actual costs, meaning that such activity data are unavailable to decision makers when they estimate activity costs. The expected result of the confirmation bias is that decision makers' adjustments from their prior cost information are reduced. Reduced adjustments from prior cost information translates into reduced cost estimation accuracy when prior cost information is incorrect. Thus, Hypothesis 1d predicts that the extent of the confirmation bias is negatively associated with cost estimation accuracy for decision makers with incorrect prior cost information.

Of particular importance is the ability of decision makers with incorrect prior cost information to recognize that adjustments should be made from their incorrect information if activity costs are to be estimated accurately. Multiple cost pool systems, even many that suffer from various design problems, provide decision makers with previous periods' data for multiple activities, rather than only a single activity as provided by single cost pool systems. The multiple cost pool system's provision of these incremental activity data is expected to mitigate the extent of the prior information-confirming bias, thereby increasing cost estimation accuracy for decision makers with incorrect prior cost information. Thus, Hypothesis 2 predicts that, relative to the single cost pool system, the multiple cost pool system is associated with increased cost estimation accuracy when decision makers' prior cost information is incorrect.

Most cost system research implies that multiple cost pool systems must generate accurate activity cost rates to be of use to decision makers. The effect of providing previous periods' activity data on cost estimation accuracy has received little, if any, research attention. This paper posits that multiple cost pool systems' provision of previous periods' activity data serves as a partial solution to the confirmation bias' deleterious effects on cost estimation accuracy for decision makers with incorrect prior cost information. Evidence supporting this prediction has potential implications for cost system design. For example, firms might place more emphasis on providing decision makers with previous periods' activity data at the time activity costs are estimated. Also, such evidence suggests that multiple cost pool systems that fail to generate accurate cost rates still might benefit decision makers' cost estimation accuracy by providing previous periods' activity data.

Chapter Three

RESEARCH METHOD

This chapter describes the research method employed to gather the data used to test the hypotheses developed in Chapter Two. Section 3.1 presents the research design and the data set employed in the experiment. Section 3.2 describes the experimental procedures followed in collecting the data. Section 3.3 explains the independent variables and describes the decision makers who participated in the experiment. Section 3.4 explains the experiment's three tasks and the associated dependent variables. Section 3.5 summarizes the chapter.

3.1 Research Design and the Data Set Employed in the Experiment

This research used a laboratory experiment to test the hypotheses. The experiment manipulates the prior cost information - correct or incorrect - and the cost system type - single cost pool, multiple rates with single year-end activity, or multiple cost pool - provided to decision makers. Thus, prior cost information and cost system serve as the two independent variables in the 2 x 3 between-subjects research design. Table 1 displays the 2 x 3 design and the predicted relative cell means for cost estimation accuracy.

Empirical studies have documented significant positive linear associations between activities and overhead costs in a variety of industries (Banker, Potter, and

Table 1
Hypothesized Relative Cell Means and *A Priori* Contrast Weights:
Total Activity Cost Estimation Accuracy

		COST SYSTEM		
		SINGLE COST POOL	MULTIPLE RATES WITH SINGLE YEAR-END ACTIVITY	MULTIPLE COST POOL
PRIOR INFO	COR	A 9,000 [7]	B 8,000 [3]	C 8,000 [3]
	INC	D 5,000 [-9]	E 6,000 [-5]	F 7,500 [1]

Numbers in [] are the *a priori* contrast weights used to test the predicted relationship between cell means shown in A through F and graphically depicted in Figures 4 and 5.

The rows represent the two prior cost information conditions: COR = Correct Prior Cost Information; INC = Incorrect Prior Cost Information.

The columns represent the three cost system conditions.

Hypothesis 2 predicts the following interaction concerning activity cost estimation accuracy:

A > C > F > D

Hypothesis 3 predicts the following interaction concerning activity cost estimation accuracy:

B = C > F > E

Schroeder 1995; Banker and Johnston 1993). The model adopted in the present study defines a linear relationship between each activity and overhead costs[8]. The activity cost estimation task (see Section 3.4.3) examines the accuracy of decision makers' estimates of the amount by which total overhead costs change for a one-unit change in each of three activities. The following linear model is used:

(1) $y = b_o + b_1x_1 + b_2x_2 + b_3x_3 + \varepsilon$,

where y = total overhead costs, b_o = fixed costs, x_1, x_2, and x_3 = the number of machine hours (MHs) , parts in production (Parts), and production runs (PRuns), respectively, for all products during the period, and b_1, b_2, and b_3 = the cost of a machine hour, part in production, and production run, respectively, for all products during the period. Random error is represented by ε. The three activities in this model are independent. Table 2 presents the cost function and activity levels used in the monthly production reports and the monthly and year-end cost reports.

The inability to determine that one set of cost estimates derived from a particular cost system is more or less accurate than a second set of cost estimates derived from a different cost system is a weakness of some empirical studies in the cost literature (Dopuch 1993). An advantage of using the experimental approach is that it allows one to

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[8] If the relationship cannot be approximated by a linear model, for example an U or inverted U-shaped relationship, then decision makers' ability to estimate the relationships would need to be addressed in a different task where the experimental relationships were modeled as such.

Table 2
Cost Function and Activity Levels Used in Creating Production and Cost System Reports

Month	Round	MH X_1	PARTS X_2	PRUNS X_3	Fixed Costs	Random Error	TOTAL COSTS
Jan	1	480	30	30	$15,000	-$2,000	$163,000
Feb	2	360	30	30	$15,000	$3,000	$153,000
Mar	3	300	42	12	$15,000	$2,000	$165,500
Apr	4	480	30	30	$15,000	-$2,000	$163,000
May	5	300	48	48	$15,000	-$1,000	$195,500
Jun	6	360	30	30	$15,000	$3,000	$153,000
Jul	7	300	24	18	$15,000	-$3,000	$118,500
Aug	8	300	12	42	$15,000	$1,000	$104,500
Sep	9	300	30	36	$15,000	$2,000	$147,500
Oct	10	240	30	30	$15,000	-$3,000	$132,000
Nov	11	300	24	24	$15,000	$1,000	$125,500
Dec	12	120	30	30	$15,000	-$1,000	$119,000

Notes:

The cost function used to generate TOTAL COSTS is:
$= \$15,000 + \$125X_1 + \$2,500X_2 + \$500X_3 + R$,

where R represents random error, which is normally distributed and varies independently of the level of X_1, X_2, and X_3

The OLS estimate of the cost function is:
$= \$15,000 + \$125X_1 + \$2,500X_2 + \$500X_3 + e$, where e represents the independent random error term

$R_2 = .989$

determine the true cost function concerning activities and overhead costs. Knowing the true cost function permits one to measure whether decision makers' cost estimates under one type of cost system are more accurate than under a different type of cost system.

3.2 Experimental Procedures

Appendix F contains the task procedures list and script read during the administration of the experiment. Figure 6 contains a summary of experimental procedures. Decision makers were required to read and sign an informed consent form containing a statement that their responses would be kept confidential. They were also provided a range of potential earnings from participating in the experiment. The session began with an introduction and brief discussion of overhead costs, cost drivers, and real-world decision makers' desires to estimate activity costs accurately for use in predicting total overhead costs. A practice session followed that contained two practice rounds. The practice rounds familiarized decision makers with the types of cost and production reports they subsequently encountered in the actual experiment. The practice rounds also familiarized decision makers with calculating predicted cost changes and comparing such predictions to actual cost changes on the practice cost report. The type of cost system - either a single cost pool or a multiple cost pool - in the practice session matched the type of cost system the decision maker subsequently encountered in the actual experiment.

Appendix I contains the practice rounds' materials, including two practice production department reports and two practice monthly cost reports. Appendix F, Step 3 contains the prior cost information-equivalent numbers given to decision makers concerning the expected impact on total overhead costs of the three practice rounds'

1. Introduction and General Explanation of Exercise

↓

2. Performance and Explanation of Practice Rounds

↓

3. Prior Cost Information Manipulation (Information Sheet - App A)

↓

4. Administration of Periodic (e.g., Monthly) Production Reports and appropriate Periodic (e.g., Monthly) Cost System Reports

↓

5. Brief Distractor Task (App B)

↓

6. Performance of Cost Differences Estimation and Activity Data Recall Tasks (App C)

↓

7. Administration of appropriate Year-End Cost Report and Performance of Activity Cost Estimation Task (App D)

↓

8. Collection of Information Sheet, Activity Cost Estimation Form, and Year-End Cost Report

↓

9. Administration of Exit Questionnaire (App E)

Note: The order of steps 6 and 7 is counterbalanced, such that half of the decision makers perform step 6 AFTER step 7.

Figure 6
Summary of Experimental Procedures

activity drivers, X_1 (\$20), X_2 (\$10), and X_3 (\$5). The numbers used in the practice rounds are small (e.g., a \$20 impact of X_1 on total overhead costs) and very different from the activity cost numbers used as the prior cost information in the actual experiment. Using an overhead projector, decision makers were instructed how to use the "prior information" and the changes in the level of each activity (X_1, X_2, and X_3) to predict the change in costs. Decision makers were told that the predicted change in costs should be compared to the actual change in costs to see how different the two cost changes are and to obtain an indication of the accuracy of the prior cost information. The cost system's budgeted costing rate(s) was explained to be the cost system's approximation of each activity's impact on total overhead costs (see Appendices A and F). Participants also were told that the costing rates might not be accurate due to various assumptions made by the cost system. The practice rounds' materials were then distributed to decision makers for use in predicting the cost change for each round and comparing it to the actual cost change. Decision makers were given several minutes to use the practice materials to calculate the predicted cost changes, compare predicted cost changes to the actual cost changes, and to observe the cost system's costing rate(s)[9].

Using the practice materials and an overhead projector, the researcher demonstrated the process of predicting the cost changes and comparing them to the actual cost changes. The difference between the predicted cost change and the actual cost

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[9] Decision makers were provided with simple calculators for use in calculating each rounds' predicted cost change and the difference between each rounds' predicted and actual cost change.

change was pointed out by the researcher (see Appendix F). Decision makers were told that differences between predicted cost changes and actual cost changes might be due to random variation in actual costs, incorrect prior cost information about one or more activities, or a combination of the two. They were informed that determining why predicted and actual cost changes are different often requires examination of multiple periods of cost and activity data. Decision makers were given the opportunity to ask questions during and after the practice rounds.

After the practice session, the experiment began by providing decision makers with the information sheet (see Appendix A and Appendix F, Step 4). The information sheet contains a general description of the experimental plant setting, management's decision to change the plant's production process for the upcoming year, the decision makers' role as plant manager, and the prior information for each activity cost (see Section 3.3.1 for a discussion of prior cost information). The current experiment correctly informed decision makers that actual costs contain an element of randomness and provided them with an example of randomness in actual costs (see Appendix A). Specifically, the information sheet explained that the costs associated with each activity vary somewhat from month to month due to the random influence of various factors. An example of randomness involving electricity costs was given. The degree of randomness in the present experiment is small (see the random error column and the task's high R^2 of .989 displayed in Table 2). Existing studies demonstrate that decision makers can estimate parameters (e.g., activity costs) rather accurately when randomness is sufficiently low (Klayman 1988). The information sheet explains that as a result of random variation, the actual change in costs might not be exactly equal to the change in costs predicted from the prior information.

In addition, the information sheet describes that total overhead costs each month contain some amount of fixed costs that do not vary with the level of the activities. Finally, decision makers were informed that the plant's cost system accurately measures actual total overhead costs and the changes in the levels of the activities from month to month. They also were informed that the cost system does a poor job of determining exactly which of the individual costs that comprise total overhead costs are associated with each of the three activities. Decision makers were instructed that the cost system generates a costing rate(s) for the cost pool(s) that might not be accurate. Decision makers maintained possession of the information sheet until all other experimental forms were collected and the exit questionnaire was administered.

After questions concerning the information sheet were answered, decision makers were told that they would be provided several months' production reports and cost reports and that they should follow the same procedure as in the practice rounds, but using the information on the information sheet (Appendix F, Step 5). They were instructed to pay attention to the reports because later they would be asked several questions regarding the reports and their contents[10]. Each monthly production report contains the actual number

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[10] This statement was provided to decision makers to be consistent with experimental tasks in other accounting and psychology studies examining memory recall (Libby and Trotman 1993; Choo and Trotman 1991; Dellarosa and Bourne 1984; Graesser et al. 1980; Srull 1981).

of MHs, Parts, and PRuns for the current month and the one month prior to the current month. The change in the level of each of the three activities also is included on each monthly production report. The monthly production reports represent the nonaccounting information source from which decision makers periodically observe activity data (Figure 1, step B). Figure 7 presents February's monthly production report. Appendix J contains all monthly production reports.

Decision makers were instructed that for each month they should calculate the predicted cost change given the information about MHs, Parts, and PRuns provided on the information sheet. Each monthly production report asks decision makers to calculate and write down on the line provided the predicted change in costs from the last month to the current month using the prior cost information and the actual monthly change in the activities. They also were instructed to compare the predicted cost change to the actual cost change contained on the cost report and to observe how different the predicted cost change was from the actual cost change. Decision makers were informed that when they were finished examining the production report and cost report they should raise their hand and the next months' reports would be distributed. Decision makers then were given February's monthly production report and February's monthly cost report from whichever cost system condition they have been randomly assigned (Appendix F, Step 6). When finished, February's monthly production report and monthly cost report were collected and March's monthly production report and monthly cost report were distributed to the decision maker. This procedure was followed until December's reports were collected (Appendix F, Step 7).

Production Department Report
February 1998

Activity	Totals		Changes in Activity Levels
	Jan98	Feb98	
Number of machine hours	480	360	-120
Number of parts in production	30	30	0
Number of production runs	30	30	0

Given the change in the level of each of the three activities and the beliefs provided on the Information Sheet about each of the activities' impact on total overhead costs, what should be the predicted change in total overhead costs? $__________

Figure 7
February's Monthly Production Department Report

Next, a brief distractor task was employed to clear decision makers' working memory (Appendix B and Appendix F, Step 8). The distractor task collects demographic information, such as the decision maker's gender, years of professional business experience, SAT score, ACT score, GMAT score, GPA, educational level, and number of completed statistics courses. These data are used in covariate analyses.

Decision makers then were provided with the experimental form for the cost differences estimation task and the activity data recall task (Appendix C), each of which is described in Section 3.4. The form for these two tasks was collected (Appendix F, Step 9). Next, decision makers were provided with the appropriate year-end cost report (Figure 8 or 9) and the experimental form for the activity cost estimation task (Appendix D), which is described in Section 3.4. Decision makers were told that the numbers on the year-end cost report are exactly the same numbers that appeared on each monthly cost report and that the cost system simply condenses the monthly reports at year-end by putting the monthly data on one page. Decision makers were told to take as much time as they wish in performing the activity cost estimation task (Appendix F, Step 10). The year-end cost report, activity cost estimation form, and the information sheet then were collected from the decision maker (Appendix F, Step 11).

As noted at the bottom of Figure 6, the order of the cost differences estimation/activity data recall tasks and the activity cost estimation task is counterbalanced. Thus, half of the decision makers performed the cost differences estimation/activity data recall tasks before the activity cost estimation task and the other half of decision makers performed the cost differences estimation/activity data recall

	Activity: # of MHs	Actual Total OH Costs
MONTH:		
Jan	480	$163,000
Feb	360	$153,000
actual monthly change:	**-120**	**-$10,000**
Mar	300	$165,500
actual monthly change:	**-60**	**$12,500**
Apr	480	$163,000
actual monthly change:	**180**	**-$2,500**
May	300	$195,500
actual monthly change:	**-180**	**$32,500**
Jun	360	$153,000
actual monthly change:	**60**	**-$42,500**
Jul	300	$118,500
actual monthly change:	**-60**	**-$34,500**
Aug	300	$104,500
actual monthly change:	**0**	**-$14,000**
Sep	300	$147,500
actual monthly change:	**0**	**$43,000**
Oct	240	$132,000
actual monthly change:	**-60**	**-$15,500**
Nov	300	$125,500
actual monthly change:	**60**	**-$6,500**
Dec	120	$119,000
actual monthly change:	**-180**	**-$6,500**

Figure 8
Year-end Cost Report from Single Cost Pool System and Multiple Rates with Single Year-end Activity System

	Activity			Actual Total OH Costs
	# of MHs	# PARTs	# PRUNs	
MONTH:				
Jan	480	30	30	$163,000
Feb	360	30	30	$153,000
actual monthly change:	**-120**	**0**	**0**	**-$10,000**
Mar	300	42	12	$165,500
actual monthly change:	**-60**	**12**	**-18**	**$12,500**
Apr	480	30	30	$163,000
actual monthly change:	**180**	**-12**	**18**	**-$2,500**
May	300	48	48	$195,500
actual monthly change:	**-180**	**18**	**18**	**$32,500**
Jun	360	30	30	$153,000
actual monthly change:	**60**	**-18**	**-18**	**-$42,500**
Jul	300	24	18	$118,500
actual monthly change:	**-60**	**-6**	**-12**	**-$34,500**
Aug	300	12	42	$104,500
actual monthly change:	**0**	**-12**	**24**	**-$14,000**
Sep	300	30	36	$147,500
actual monthly change:	**0**	**18**	**-6**	**$43,000**
Oct	240	30	30	$132,000
actual monthly change:	**-60**	**0**	**-6**	**-$15,500**
Nov	300	24	24	$125,500
actual monthly change:	**60**	**-6**	**-6**	**-$6,500**
Dec	120	30	30	$119,000
actual monthly change:	**-180**	**6**	**6**	**-$6,500**

Figure 9
Year-end Cost Report from Multiple Cost Pool System

tasks after the activity cost estimation task. The decision makers who performed the cost differences estimation/activity data recall tasks before the activity cost estimation task then performed the cost differences estimation task a second time after completing the activity cost estimation task. Thus, after the activity cost estimation form was collected, these decision makers were provided with a cost differences estimation task form that is exactly the same as the first cost differences estimation task form. Decision makers performed the cost differences estimation task a second time by again estimating the AVGD and GRTD for the same eleven monthly differences between predicted and actual cost changes (Appendix K and Appendix F, Step 12). The second cost differences estimation task form then was collected. As explained in Chapter Four, the same cost differences estimation task was performed a second time after performing the activity cost estimation task to test whether decision makers' UAVGD was reduced after seeing the year-end cost report. The multiple cost pool system's year-end cost report contains all months' activity data, which is expected to reduce decision makers' UAVGD, thereby increasing their cost estimation accuracy.

To conclude the experiment, decision makers were provided with the exit questionnaire (Appendix E and Appendix F, Step 13). The exit questionnaire collects data for use in manipulation check and control variable analyses. Decision makers were asked not to discuss the exercise with other students until after all students have had the opportunity to participate. Finally, decision makers were provided with a time and location for collecting their earnings.

3.3 Independent Variables

3.3.1 Prior Cost Information

The prior cost information independent variable is manipulated with the information provided to decision makers concerning the impact on total overhead costs that should result from each one-unit change in each of the three activities - MHs, Parts, and PRuns. Prior cost information is provided to decision makers on the information sheet (see Appendix A). Decision makers were told that their plant has changed its production process for the upcoming year as a result of a strategic decision made by the company. They were further instructed that discussions with experienced and successful managers of other plants with a similar production process clearly indicate that three activities – MHs, Parts, and PRuns - drive total overhead costs. Decision makers then were informed of the change in total overhead costs that should result from each one-unit change in each of the three activities – MHs, Parts, and PRuns. Prior cost information is manipulated in this manner because information from or discussions about other similar plants within the firm is a source from which decision makers obtain prior cost information about their own plant environment (Krumwiede 1998).

Prior cost information has two conditions – correct and incorrect. Half of the decision makers were provided with correct prior cost information and the other half were provided with incorrect prior cost information. Decision makers were randomly assigned to the prior cost information and cost system conditions. Table 3 provides the correct prior cost information, the incorrect prior cost information, the actual activity costs, and the activity cost rates provided by each cost system. As shown in Table 3, correct prior

Table 3

Comparison of Prior Cost Information, Activity Cost Rates, and Actual Activity Costs for each Activity

		Prior Info		Cost Rates		
Activity	Actual Activity Cost	COR[a]	INC	SINGLE COST POOL	MULTIPLE RATES WITH SINGLE YEAR-END ACTIVITY	MULTIPLE COST POOL
MH	$125	$125	$125	$453	$162	$162
Part	$2,500	$2,500	$500	-	$1,500	$1,500
PRun	$500	$500	$2,500	-	$,1600	$1,600

[a] COR = decision makers with correct prior information; INC = decision makers with incorrect prior information.

cost information is correct for all three activities - MHs, Parts, and PRuns. Incorrect prior cost information is incorrect for Parts and PRuns and correct for MHs.

3.3.2 Cost System Type

The cost system independent variable is manipulated with the two multiple cost pool system elements – year-end provision of previous periods' data for all activities and provision of a cost rate for each activity – contained on decision makers' monthly and year-end cost reports. Monthly time periods (and thus monthly reports) are chosen to represent the periodic observation of activity and cost data discussed in Chapter Two and Figure 1 (steps B through D). Also, year-end is chosen to represent the point in time at which decision makers estimate activity costs as discussed in Chapter Two and Figure 1 (step I)[11]. Cost system has three conditions – single cost pool, multiple rates with single year-end activity, and multiple cost pool. Figures 2 and 3 display the cost system elements provided in each cost system condition. All activity data in the experiment, whether appearing on a cost report or a production report, are accurate. Thus, the experiment does not incorporate error in measuring activity data.

The cost system provides decision makers with a monthly cost report each month and a year-end cost report at year-end. The monthly cost report for each cost system condition is described first followed by the year-end cost report for each cost system condition. Monthly cost reports in each condition contain the total overhead costs for the

[11] As discussed in Chapter One, cost estimates might be made at any time for various reasons. In any case, accurate cost estimation requires consideration of all previous periods' activity and cost data.

current month and for the one month prior to the current month, along with the monthly change in total overhead costs. Monthly cost reports also contain an activity cost rate either for one or all three activities, depending on the cost system condition (see Table 3). For each cost system the cost rate(s) is determined at the beginning of the year based on budgeted annual total overhead costs and the total budgeted level of the activity(s). For simplicity, actual activity data and actual total annual fixed costs are assumed to equal budgeted activity data and budgeted total annual fixed costs, respectively.

Each monthly cost report from the single cost pool system contains the actual number of MHs for the current month and for the one month prior to the current month, along with the monthly change in the number of MHs. The single cost pool system provides a cost rate for the single activity – MHs. The single cost pool system aggregates the total overhead costs associated with the three independent activities into a single cost pool using MHs as the pool's activity. The result is a biased cost rate for MHs ($453 cost rate for MH versus actual MH cost of $125; see Table 3). Figure 10 displays February's monthly cost report from the single cost pool system. Appendix G contains all monthly cost reports from the single cost pool system.

Each monthly cost report from the multiple cost pool and multiple rates with single year-end activity systems contain the actual number of MHs, Parts, and PRuns for the current month and for the one month prior to the current month. Each monthly cost report from these two systems also contains the monthly change in MHs, Parts, and PRuns. The multiple cost pool and multiple rates with single year-end activity systems provide a cost rate for each of the three activities – MHs, Parts, and PRuns. An accurate

Cost Report
February 1998

Activity	Applied Manufacturing OH Costs		Actual Change in Total OH Costs	Activity Level		Change in Activity Levels	Budgeted Costing Rate
	Jan98	Feb98		Jan98	Feb98		
Machine Hours	$217,502	$163,127		480	360	-120	$453
variance from budget =	-$54,502	-$10,127					
Actual Total OH Costs =	$163,000	$153,000	-$10,000				

Figure 10
February's Monthly Cost Report from Single Cost Pool System

Table 4
Cost Rates for Each Cost System Type

	Activity	Budgeted Total Overhead Costs	Budgeted Activity Level	Budgeted Cost Rate
SINGLE COST POOL SYSTEM:	MH	$1,740,000	3,840	$453

Notes:
To arrive at the cost rate for the single activit
budgeted annual machine hours.

Budgeted total annual overhead costs, budgeted total fixed costs, and budgeted total annual machine hours are assumed to equal actual total annual overhead costs, actual total annual fixed costs, and actual annual machine hours, respectively.

	Activity	Assigned portion of Budgeted Total Overhead Costs	Budgeted Activity Level	Budgeted Cost Rate
MULTIPLE COST POOL & MULTIPLE RATES WITH SINGLE YR-END ACTIVITY SYSTEMS:	MH	$623,784	3,840	$162
	Part	$540,168	360	$1,500
	Prun	$576,048	360	$1,600
		$1,740,000		

Notes:
To arrive at the cost rate for each activity, budgeted total annual overhead costs minus budgeted total annual fixed costs are assigned to the three cost pools in the following erroneous manner: approximately 36% are assigned to the MH pool, 31% to the Parts pool, and 33% to the Production Runs pool.
The accurate assignment of costs would be 31% to MH, 58% to parts, and 11% to production runs.
Finally, budgeted total annual fixed costs are assigned evenly to each of the three cost pools.
[for example: [($1,740,000 - $180,000) x .3614] + [(1/3) x $180,000] = portion of budgeted total overhead costs (variable + fixed) assigned to the MH cost pool under the multiple cost pool and multiple rates with single year-end activity systems].

Budgeted total annual overhead costs, budgeted total annual fixed costs, and budgeted total annual machine hours, parts, and production runs, are assumed to equal actual total annual overhead costs, actual total annual fixed costs, and actual annual machine hours, parts, and production runs, respectively.

assignment of total variable overhead costs ($1,740,000 - $180,000; see Table 4) to each pool would be to assign $125 of total budgeted variable overhead costs for each budgeted MH to the MH pool, $2,500 of total budgeted variable overhead costs for each budgeted Part to the Parts pool, and $500 of total budgeted variable overhead costs for each budgeted PRun to the PRuns pool.

However, these two cost systems incorporate error in measuring overhead costs by erroneously allocating total budgeted variable overhead costs to each of the three cost pools. These two cost systems erroneously assign total budgeted variable overhead costs to the three cost pools such that approximately 36% of costs are assigned to the MH pool, 31% of costs are assigned to the Parts pool, and 33% of costs are assigned to the PRuns pool (Table 4 contains the percentages that should be assigned if the system did not contain error in measuring overhead costs). Total budgeted fixed overhead costs are evenly allocated to each of the three cost pools.

The result of the erroneous allocation is a biased cost rate for each activity – $162 cost rate for MH versus actual MH cost of $125, $1,500 cost rate for Part versus actual Part cost of $2,500, and $1,600 cost rate for PRun versus actual PRun cost of $500. The cost rates for Parts and PRuns are more accurate than the incorrect prior cost information but less accurate than the correct prior cost information. For example, the cost rate for Parts is $1,500, which is more accurate than the $500 cost for Parts that is contained in the incorrect prior cost information but less accurate than the $2,500 cost for PRuns that is contained in the correct prior cost information. Therefore, any adjustments from prior cost information in the direction of the cost rates will decrease cost estimation accuracy for decision makers with correct prior cost information. Conversely, adjustments from prior cost information in the direction of the cost rates will increase cost estimation accuracy for decision makers with incorrect prior cost information.

The monthly cost reports from the multiple cost pool and multiple rates with single year-end activity systems contain the same information. Figure 11 displays February's monthly cost report from the multiple cost pool and multiple rates with single year-end activity systems. Appendix H contains all monthly cost reports from the multiple cost pool and multiple rates with single year-end activity systems.

Each cost system's year-end cost report contains all months' actual total overhead costs and all monthly changes in actual total overhead costs. The year-end cost report from the single cost pool and multiple rates with single year-end activity systems contains all months' data only for a single activity (MH). Thus, the year-end cost report from the single cost pool system contains the same information as the year-end cost report from the multiple rates with single year-end activity system. Figure 8 displays the year-end cost report from the single cost pool and multiple rates with single year-end activity systems.

The year-end cost report from the multiple cost pool system contains all months' data for each of the three activities (MH, Parts, and PRuns). Figure 9 displays the year-end cost report from the multiple cost pool system. The provision of all months' data for the Parts and PRuns activities represents the incremental information content of multiple cost pool systems over single cost pool systems examined in this paper.

Cost Report
February 1998

Activity Center	Activity	Applied Manufacturing OH Costs		Actual Change i Total OH Costs	Activity Level		Change in Activity Level	Budgeted Costing Rate
		Jan98	Feb98		Jan98	Feb98		
Machine Maintenance	# of MHs	$77,971	$58,478		480	360	-120	$162
Material handling	# of Parts	$45,014	$45,014		30	30	0	$1,500
Production scheduling	# of Prod. runs	$48,004	$48,004		30	30	0	$1,600
	variance from budget	-$7,989	$1,504					
	Actual Total OH Costs	$163,000	$153,000	-$10,000				

Figure 11
February's Monthly Cost Report from Multiple Cost Pool System and Multiple Rates with Single Year-end Activity Cost System

3.3.3 Decision Makers Who Participated in the Experiment

A total of 107 decision makers participated in the experiment. Of the 107 decision makers, 50 were MBA students and the remaining 57 were undergraduate accounting majors who had completed an intermediate cost accounting course. All decision makers were enrolled at a large Midwestern university.

3.4 The Experiment's Three Tasks and Dependent Variables

The experiment involves three tasks: a memory-based task in which decision makers estimate the differences between predicted monthly cost changes and actual monthly cost changes (referred to subsequently as the cost differences estimation task), an activity data recall task, and an activity cost estimation task. Figure 6 presents a summary of the experimental procedures showing the order in which decision makers performed the three tasks.

3.4.1 Cost Differences Estimation Task

The cost differences estimation task is performed at year-end and requires decision makers to estimate from memory AVGD and GRTD. AVGD (GRTD) is the average (greatest) of the eleven differences between predicted monthly cost changes and actual monthly cost changes that were encountered during the experiment. Decision makers were instructed to disregard the sign of the difference and consider the absolute value of the difference each month. The cost differences estimation task measures decision makers' perception of the similarity, or degree of consistency, between periodic actual costs and periodic predicted costs based on their prior cost information. Appendix C contains the experimental form for the cost differences estimation task. Table 5,

Table 5

Differences Between Predicted and Actual Monthly Cost Changes for COR and INC Prior Information

1	2	3	4	5	6
INCORRECT PRIOR COST INFORMATION		**MONTH**	**ACTUAL CHANGE**	*CORRECT PRIOR COST INFORMATION*	
INC PRED	**INC PRED - ACT CH**			**COR PRED**	**COR PRED - ACT CH**
-$15,000	-$5,000	Feb	**-$10,000**	-$15,000	-$5,000
-$46,500	-$59,000	Mar	**$12,500**	$13,500	$1,000
$61,500	$64,000	Apr	**-$2,500**	$1,500	$4,000
$31,500	-$1,000	May	**$32,500**	$31,500	-$1,000
-$46,500	-$4,000	Jun	**-$42,500**	-$46,500	-$4,000
-$40,500	-$6,000	Jul	**-$34,500**	-$28,500	$6,000
$54,000	$68,000	Aug	**-$14,000**	-$18,000	-$4,000
-$6,000	-$49,000	Sep	**$43,000**	$42,000	-$1,000
-$22,500	-$7,000	Oct	**-$15,500**	-$10,500	$5,000
-$10,500	-$4,000	Nov	**-$6,500**	-$10,500	-$4,000
-$4,500	$2,000	Dec	**-$6,500**	-$4,500	$2,000
# consistent (within $10,000) changes = 7 # inconsist. (off by more than $10,000) changes = 4 ***Average Difference (AVGD)*** between *INC* DMs' predicted cost change and actual cost changes across all months: = $24,455. ***Greatest Difference (GRTD)*** between *INC* DMs' predicted cost change and actual cost change: = $68,000				# consistent (within $10,000) changes = 11 # inconsist. (off by more than $10,000) changes = 0 ***Average Difference*** **(AVGD)** between *COR* DMs' predicted cost change and actual cost changes across all months: = $3,364. ***Greatest Difference*** **(GRTD)** between *COR* DMs' predicted cost change and actual cost change: = $6,000	

*INC PRED is the predicted change in total overhead costs given the incorrect prior cost information.
*COR PRED is the predicted change in total overhead costs given the correct prior cost information.
*ACTUAL CHANGE is the actual change in monthly total overhead costs.
*INC PRED - ACT CH and COR PRED - ACT CH represent the difference between the predicted monthly cost change and the actual monthly cost change.
*A consistent (inconsistent) difference between the predicted monthly cost change and the actual monthly cost change is defined as one in which the difference is less (more) than $10,000.

Column 6 (2) displays each of the eleven differences between the predicted cost change derived from correct (incorrect) prior cost information and the actual cost change. The actual AVGD is $3,364 ($24,455) for decision makers with correct (incorrect) prior cost information (see Table 5). The actual GRTD is $6,000 ($68,000) for decision makers with correct (incorrect) prior cost information (see Table 5). The decision maker's AVGD estimate and GRTD estimate serve as the dependent variables for this task and are used in tests of Hypothesis 1a and Hypothesis 1b, respectively.

Hypothesis 1d concerns the relationship between decision makers' AVGD underestimation and total activity cost estimation accuracy. UAVGD is the extent of decision makers' bias in perceiving the actual costs changes as being more consistent with their prior information's predicted cost changes than they were in reality. UAVGD is defined for each decision maker by subtracting their AVGD estimate from the actual AVGD. Thus, a positive UAVGD indicates that the decision maker underestimates AVGD. UAVGD is used in tests of Hypothesis 1d.

3.4.2 Activity Data Recall Task

The activity data recall task presents decision makers at year-end with actual total costs and MHs for each month, as well as the monthly changes, and requires them to recall, if possible, the change in the Parts and PRuns activity data for each month. Appendix C contains the experimental form for the activity data recall task. Hypothesis 1c predicts that decision makers with incorrect prior cost information will not be able to recall the change in Parts and PRuns for the months in which the actual cost change was inconsistent with the predicted cost change. The activity data recall task measures which activity data decision makers have available from memory recall when they estimate activity costs. For decision makers not in the multiple cost pool condition, the only previous periods' activity data available when they estimate activity costs are those activity data that they are able to recall.

This paper defines a consistent (inconsistent) difference in cost changes as one in which the difference between the predicted monthly cost change and the actual monthly cost change is less (greater) than $10,000. The activity data corresponding to each consistent (inconsistent) difference in cost changes are referred to as consistent (inconsistent) activity data. Table 5 contains each month's actual change in costs and each month's predicted change in costs for both correct and incorrect prior cost information.

A $10,000 cutoff value is chosen to differentiate clearly between the differences in cost changes that are relatively small (consistent with prior cost information) from the differences in cost changes that are relatively large (inconsistent with prior cost information). Adopting this cutoff, there are seven consistent and four inconsistent differences in cost changes for decision makers with incorrect prior cost information (see Table 5, column 2). For decision makers with incorrect prior cost information, the inconsistent differences in cost changes adopting the $10,000 cutoff range from $49,000 to $68,000. The smallest inconsistent difference is therefore $39,000 above the $10,000 cutoff. The consistent differences in cost changes range from $1,000 to $7,000. Thus, the cutoff appears to differentiate clearly between the one group of relatively small differences in cost changes and the other group of relatively large differences in cost changes. The greatest difference in cost changes for decision makers with correct prior cost information is $6,000 (see Table 5, column 6). Therefore, all differences in cost changes, and thus all activity data, are defined as consistent for decision makers with correct prior cost information. The number of inconsistent actual cost changes for which the decision maker accurately recalls the corresponding changes in both Parts and PRuns serves as the dependent variable for the activity data recall task and is used in tests of Hypothesis 1c.

Examining which, if any, activity data decision makers recall when they estimate activity costs is important. As discussed in Chapter Two, the typical finding in studies of evidence recall is that decision makers demonstrate a disconfirmation bias (e.g., Purohit 1989). For example, Purohit (1989) finds the strongest disconfirmatory evidence recall bias with an evidence mix consisting of eight consistent and four inconsistent evidence items, which is very similar to the relative mix in the current paper. Evidence supporting a confirmatory bias in the current paper would directly conflict with Purohit's (1989) findings. However, as described in Chapter Two, this conflict is expected because of the quantifiable nature of the numerical evidence examined in this paper.

A disconfirmation bias suggests that decision makers in the current cost estimation task might recall the activity data corresponding to the months in which the actual cost change is inconsistent with the predicted cost change. The activity data corresponding to these inconsistent actual cost changes are the data suggesting that adjustments from incorrect prior cost information are required to estimate costs more accurately. If decision makers accurately recall the activity data corresponding to the inconsistent actual cost changes, then they should incorporate these activity data into their cost estimates as appropriately as do decision makers who are provided with these activity data on the year-end cost report.

As indicated earlier, there are four inconsistent actual cost changes for decision makers with incorrect prior cost information. A multiple regression analysis can be performed using only the six months of activity data corresponding to the four inconsistent actual cost changes. The resulting cost estimation accuracy of approximately 8,500 is quite close to the maximum normative accuracy score of 9,000 obtained using all 12 months of data. Recalling these activity data requires the decision maker to remember only 12 data items (6 months x 2 activities), because all months' actual total costs and MHs are provided on all year-end cost reports. Thus, if these activity data are accurately recalled for consideration in cost estimation, then provision of previous months' activity data should not significantly increase cost estimation accuracy for decision makers with incorrect prior cost information.

Decision makers in the present experiment were asked to estimate three activity costs in predicting budgeted costs for the following year's overhead cost budget. Some evidence exists that decision makers attempt to "pad" their budgets by overestimating costs [i.e., by predicting costs to be greater than expected] (Merchant and Manzoni 1989). In other words, decision makers do not want actual costs to be greater then their predicted costs. Decision makers' tendency to overestimate costs might suggest for the present experiment that the months in which total actual costs are greater than predicted costs will be very salient and, thus, easily recalled for use in the subsequent activity cost estimation task. When the actual cost change is subtracted from the predicted cost change and a negative difference results, then it means that total actual costs are greater than total predicted costs. For decision makers with incorrect prior cost information, there are more negative (eight) than positive (three) differences between the predicted monthly cost change and the actual monthly cost change (see Table 5, column 2). Thus, the budgeting literature might predict that for this majority (eight of the eleven) of the monthly cost changes, the differences between predicted and actual cost changes would be overestimated and/or the corresponding activity data be easily recalled. Based on the earlier review, however, it is hypothesized that the differences between predicted and actual cost changes are under estimated and that decision makers have difficulty recalling the activity data corresponding to the inconsistent actual cost changes. Thus, support for Hypotheses 1a, 1b, and 1c would exist in spite of the finding in the budgeting literature that might suggest the opposite results for estimating cost differences and recalling activity data.

3.4.3 Activity Cost Estimation Task

The activity cost estimation task requires decision makers at year-end to estimate three activity costs (MH, Parts, and PRuns) based on the twelve months of activity and cost data previously encountered. Appendix D contains the experimental form for the activity cost estimation task. The three costs are estimated after December's monthly cost report and December's monthly production report are removed and the year-end cost report is provided. Decision makers possess only the information sheet and the year-end cost report while performing the activity cost estimation task.

Decision makers are told that cost predictions are made at the end of December for January's overhead cost budget. Decision makers are instructed to base their cost predictions solely on the twelve months of activity and cost data and to ignore the prior cost information provided on the information sheet. Decision makers performed three separate cost estimates, one for each activity. For each cost estimate, the level of only the activity whose cost was being estimated changed from December to January, while the level of the other two activities remained unchanged from December to January. Decision makers were told that fixed costs were projected to remain unchanged from December to January. For the MH estimate, decision makers were asked to provide the best prediction of the increase in total overhead costs that would result from December to January if the number of MHs increased by one from December to January (see Appendix D, question 1). The questions regarding decision makers' cost predictions for Parts and PRuns are identical except that MHs is replaced with Parts and PRuns, respectively (see Appendix D, questions 2 and 3). The best or normative prediction for activity costs was explained to decision makers on the task form as the impact on total costs of MH, Parts, and PRuns that each month produces the predicted cost change that is the closest to the actual cost change. The method employed to measure decision makers' cost predictions is acceptable for this type of activity cost estimation task (Cooksey 1996).

For each activity, the decision maker's activity cost estimate is subtracted from the actual activity cost. This difference represents the decision maker's error in estimating the particular activity cost. The absolute value of this difference then is calculated so that errors in overestimating an activity cost have the same effect on total activity cost estimation accuracy as errors in underestimating an activity cost. The absolute value of the difference is then subtracted from a large constant (3,000) in order to generate a positive accuracy score for each activity. Thus, cost estimation accuracy for each activity cost estimate was calculated as follows:

(2) $3{,}000 - |\text{actual activity cost} - \text{activity cost estimate}|$.

Total activity cost estimation accuracy is defined as the sum of the three individual cost estimation accuracy scores. Thus, the maximum accuracy score is 9,000. Total activity cost estimation accuracy serves as the dependent variable for the activity cost estimation task and is used in tests of Hypotheses 2 and 3.

In an attempt to elicit a reasonable effort level, decision makers were informed correctly that their "take home" pay was based partly on the accuracy of their cost estimates (see Appendix D). Accurately estimating activity costs is more difficult in certain experimental conditions than in other conditions due to differing prior cost information and whether or not previous months' activity data are provided at year-end. As a result, the mean of the accuracy scores in each experimental condition was compared to one another and an adjusted mean accuracy score for each condition was calculated. Decision makers were paid more or less based on their adjusted total cost estimation accuracy score relative to the mean adjusted score for their condition. The cost estimation accuracy score adjustment ensured that the final earnings were approximately equal across experimental conditions. The adjusted cost estimation accuracy scores were used only for calculating decision makers' compensation and are not used in any hypothesis analyses.

The diagram in Figure 12 summarizes the predicted relationships between the independent variable manipulations - prior cost information, the provision of multiple

Manipulations	Dependent Variables
Prior Cost Info (PI): 1 = Correct; 0 = Incorrect	CEA = Cost Estimation Accuracy
Provision of Cost Rate(s): 0 = 1 rate; 1 = 3 rates	UAVGD = AVGD underestimation
Provision of All Activity Data: 0 = no; 1 = yes	

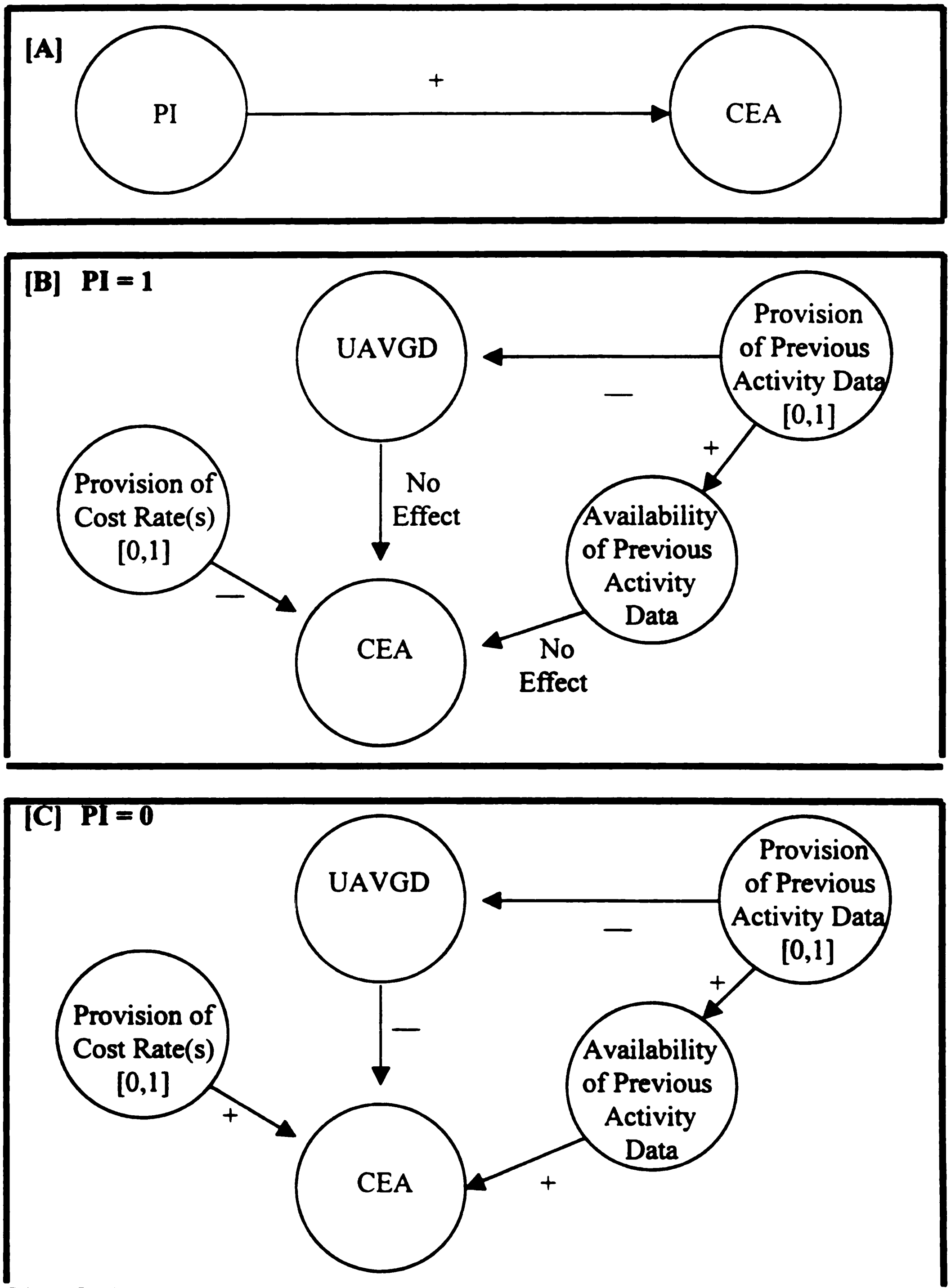

Figure 12
Diagram of the Variable Relationships Underlying the Hypotheses

cost rates, and the provision of previous months' activity data - and the dependent variables - AVGD underestimation (UAVGD) and activity cost estimation accuracy. Figure 12 separates the correct [B] and incorrect [C] prior cost information conditions. Consider first the incorrect [C] prior cost information condition. The two sets of arrows from provision of previous months' activity data to cost estimation accuracy represent the two ways in which the multiple cost pool system's provision of previous months' activity data is expected to increase cost estimation accuracy relative to when no such provision is made. The first set of arrows goes from activity data provision to UAVGD and then to cost estimation accuracy. These arrows represent the provision's proposed increasing effect on cost estimation accuracy resulting from a reduction in UAVGD that, in turn, increases the extent of adjustment from incorrect prior cost information. Increasing adjustment from incorrect prior cost information translates into increased cost estimation accuracy. The second set of arrows goes from activity data provision to availability of activity data and then to cost estimation accuracy. These arrows represent the provision's proposed increasing effect on cost estimation accuracy resulting from making available previous months' activity data (rather than only a small subset of recalled activity data if no provision is made) for consideration in year-end activity cost estimation. Thus, the diagram shows that the provision of previous months' activity data is predicted to increase cost estimation accuracy for decision makers with incorrect prior cost information.

Next consider the correct [B] prior cost information condition. Again, the first set of arrows goes from activity data provision to UAVGD and then to cost estimation accuracy. Although the differences in cost changes are relatively quite small for decision makers with correct prior cost information, providing previous months' activity data also is expected to reduce UAVGD for decision makers with correct prior information. This reduction in UAVGD might, in turn, potentially increase adjustments made from prior cost information as well. However, any adjustments made from correct prior cost information decrease cost estimation accuracy. Providing previous months' activity data shows decision makers that any potential increase in adjustments that arise from reducing their UAVGD do not more closely predict actual cost changes. Therefore, underestimating AVGD is expected to have no effect on cost estimation accuracy for decision makers with correct prior cost information. The second set of arrows goes from activity data provision to availability of activity data and then to cost estimation accuracy. Making previous months' activity data available for consideration in year-end cost estimation is predicted not to affect cost estimation accuracy because no adjustments from correct prior cost information are needed when estimating costs. Therefore, the inability to recall previous months' activity data, and the resulting decrease in adjustments from prior cost information, does not affect cost estimation accuracy relative to when such data are provided. Thus, the diagram shows that the provision of previous months' activity data is predicted to have no effect on cost estimation accuracy for decision makers with correct prior cost information.

3.5 Summary of Chapter Three

The experiment employs a 2 x 3 between-subjects design with prior cost information and cost system type serving as the independent variables. The experiment is comprised of three tasks: a cost differences estimation task, an activity data recall task, and an activity cost estimation task. The decision maker's AVGD estimate and GRTD estimate serve as the dependent variables for the cost differences estimation task and are used in tests of Hypothesis 1a and Hypothesis 1b, respectively. UAVGD, which is decision makers' mean AVGD underestimation, is used in tests of Hypothesis 1d. The number of inconsistent actual cost changes for which the decision maker accurately recalls the corresponding changes in both Parts and PRuns serves as the dependent variable for the activity data recall task and is used in tests of Hypothesis 1c. Finally, the decision maker's activity cost estimation accuracy is the dependent variable for the activity cost estimation task and is used in tests of Hypotheses 2 and 3.

Chapter Four

EXPERIMENTAL TESTS AND RESULTS

This chapter describes the procedures employed to test the hypotheses developed in Chapter Two. The data used in these tests were collected from undergraduate cost accounting students and MBA students at Michigan State University using the research method described in Chapter Three. This chapter also discusses the results of the manipulation checks, tests of the hypotheses, and tests of potential covariates.

Section 4.1 reports the results of tests of the manipulations. Section 4.2 discusses the experimental tests of the hypotheses and their results. Section 4.3 provides the results of analyses conducted to test for possible covariates. Section 4.4 summarizes the chapter.

4.1 Manipulation Checks

In the interest of easier exposition decision makers with correct (incorrect) prior cost information are referred to as COR (INC) decision makers in this section. Manipulation checks are performed to ensure that prior cost information and cost system are understood by decision makers and have the intended effects. Manipulation check data were collected on the post experiment exit questionnaire (see Appendix E). Appendix E contains all questions referenced in this section. Table 6 presents results of the manipulation check t-tests.

Table 3 contains the prior cost information provided to decision makers in each prior cost information condition. Questions 1 through 3 of the exit questionnaire test whether decision makers understand the prior cost information about machine hours, parts, and production runs given to them at the beginning of the experiment. Each question presented decision makers with four alternatives regarding the change in total overhead costs that they were told should result from each one-unit change in the respective activity (machine hours, parts, or production runs). Decision makers were asked to select the appropriate alternative. Ninety-nine percent (106 out of 107) of decision makers selected the appropriate alternative for all three activities. Thus, decision makers appear to have understood the information provided at the beginning of the experiment about the change in costs that should result from each one-unit change in each of the three activities.

Furthermore, decision makers were asked to recall the experiment's first month and report the amount they expected total overhead costs to change for each one-unit change in the respective activity (machine hours, parts, and production runs) [see Table 6, questions 5, 6, and 7, respectively]. Questions 5 through 7 are scaled from $0 to $2,500. As intended, there is no difference in the reported expected impact of machine hours on costs between COR and INC decision makers (question 5: $192 vs. $170; $t = .881$; $p = .381$). Also, COR decision makers expected parts to have a larger impact on costs than do INC decision makers (question 6: $2,296 vs. $585; $t = 20.280$; $p = .000$) and expected production runs to have a smaller impact on costs than do INC decision makers (question 7: $607 vs. $2,283; $t = -17.188$; $p = .000$). COR and INC decision makers appear at the beginning of the first month to have expected the different relative activity costs for parts and production runs intended by the prior cost information manipulation. Therefore, the prior cost information manipulation appears to have been understood by decision makers

Table 6
Results of Manipulation Checks

1	2	3[a]		4	5	6	7[b]
Ques. # (App E)	**Question**	**Mean Comparison Between:**		**t-stat.[c]**	**p-value**	**df**	**r**
5	At the beginning of the first month, by what amount did you expect total overhead costs would change for each one-unit change in **Machine Hours**? (scaled from $0 to $2,500)	COR[d] $192 (116) [54]	INC $170 (139) [53]	.881	.381	105	.086
6	At the beginning of the first month, by what amount did you expect total overhead costs would change for each one-unit change in **Parts**? (scaled from $0 to $2,500)	COR $2,296 (556) [54]	INC $585 (263) [53]	20.280	.000	105	.893
7	At the beginning of the first month, by what amount did you expect total overhead costs would change for each one-unit change in **Production Runs**? (scaled from $0 to $2,500)	COR $607 (406) [54]	INC $2,283 (588) [53]	-17.188	.000	105	-.859
11	My Year-end Cost Report contained the actual number of MHs for each month. (scaled from 0 to 100)	MULTIPLE 74.57 (34.59) [35]	SINGLE 81.94 (29.45) [36]	.968	.336	69	.116

Table 6 (cont'd)

1	2	3[a]		4	5	6	7[b]
Ques. # (App E)	**Question**	**Mean Comparison Between:**		**t-stat.[c]**	**p-value**	**df**	**r**
11	My Year-end Cost Report contained the actual number of MHs for each month. (scaled from 0 to 100)	MULTIPLE 74.57 (34.59) [35]	MRSYA 84.94 (25.63) [36]	-1.439	.155	69	-.171
12	My Year-end Cost Report contained the actual number of Parts for each month. (scaled from 0 to 100)	MULTIPLE 69.43 (38.80) [35]	SINGLE 21.94 (32.14) [36]	5.622	.000	69	.561
12	My Year-end Cost Report contained the actual number of Parts for each month. (scaled from 0 to 100)	MULTIPLE 69.43 (38.80) [35]	MRSYA 24.39 (38.00) [36]	4.941	.000	69	.511
13	My Year-end Cost Report contained the actual number of Production Runs for each month. (scaled from 0 to 100)	MULTIPLE 69.71 (38.46) [35]	SINLGE 25.56 (35.01) [36]	5.062	.000	69	.520
13	My Year-end Cost Report contained the actual number of Production Runs for each month. (scaled from 0 to 100)	MULTIPLE 69.71 (38.46) [35]	MRSYA 24.39 (38.00) [36]	4.995	.000	69	.515

Table 6 (cont'd)

1	2	3[a]		4	5	6	7[b]
Ques. # (App E)	Question	Mean Comparison Between:		t-stat.[c]	p-value	df	r
14	My Monthly Cost Reports contained a budgeted Costing Rate for MHs. (scaled from 0 to 100)	SINGLE 92.92 (16.92) [36]	50	15.220	.000	35	.932
14	My Monthly Cost Reports contained a budgeted Costing Rate for MHs. (scaled from 0 to 100)	MRSYA 85.81 (27.11) [36]	50	7.925	.000	35	.801
14	My Monthly Cost Reports contained a budgeted Costing Rate for MHs. (scaled from 0 to 100)	MULTIPLE 78.86 (29.08) [35]	50	5.871	.000	34	.710
15	My Monthly Cost Reports contained a budgeted Costing Rate for Parts. (scaled from 0 to 100)	SINGLE 28.47 (38.49) [36]	MULTIPLE 78.86 (29.08) [35]	-6.210	.000	69	-.599
15	My Monthly Cost Reports contained a budgeted Costing Rate for Parts. (scaled from 0 to 100)	SINGLE 28.47 (38.49) [36]	MRSYA 85.81 (26.58) [36]	-7.355	.000	70	-.660

Table 6 (cont'd)

1	2	3[a]		4	5	6	7[b]
Ques. # (App E)	**Question**	**Mean Comparison Between:**		**t-stat.[c]**	**p-value**	**df**	**r**
16	My Monthly Cost Reports contained a budgeted Costing Rate for PRuns. (scaled from 0 to 100)	SINGLE 29.03 (39.09) [36]	MULTIPLE 78.86 (29.08) [35]	-6.080	.000	69	-.591
16	My Monthly Cost Reports contained a budgeted Costing Rate for PRuns. (scaled from 0 to 100)	SINGLE 29.03 (39.09) [36]	MRSYA 85.81 (26.58) [36]	-7.207	.000	70	-.653

[a] Column 3 contains means, (standard deviations), and [number of observations].

[b] Every significance test is made up of two components: the size of the effect and the size of the study (Rosenthal and Rosnow 1985). Column 7 presents r as a measure of the size of the effect.

[c] All t-tests are two-tailed except for those pertaining to question 14, which are one-tailed.

[d] COR = decision makers with correct prior information; INC = decision makers with incorrect prior information; MULTIPLE = decision makers in the multiple cost pool condition; MRSYA = decision makers in the multiple rates with single year-end activity condition; SINGLE = decision makers in the single cost pool condition.

and had the intended effect.

To test the cost system manipulation, decision makers were asked whether their year-end cost report contained the actual number of monthly machine hours, parts, and production runs (see Table 6, questions 11, 12, and 13, respectively). The year-end cost report in the multiple cost pool system contains the actual number of machine hours, parts, and production runs for each month. The year-end cost report in the single cost pool and multiple rates with single year-end activity systems contains only the actual number of machine hours for each month. Thus, for questions 11 through 13, mean responses from decision makers in the multiple cost pool system are compared to mean responses from decision makers in the single cost pool system and to mean responses from decision makers in the multiple rates with single year-end activity system. Questions 11 through 17 are scaled from 0 (strongly disagree) to 100 (strongly agree).

As intended, decision makers in the multiple cost pool system reported no different likelihood that the year-end cost report contained the actual number of machine hours for each month than did decision makers in either the single cost pool system (question 11: 74.57 vs. 81.94; $t = .968$; $p = .336$) or multiple rates with single year-end activity cost system (question 11: 74.57 vs. 84.94; $t = -1.439$; $p = .155$). Also as intended, decision makers in the multiple cost pool system correctly reported a greater likelihood that the year-end cost report contained the actual number of parts for each month than did decision makers in either the single cost pool system (question 12: 69.43 vs. 21.94; $t = 5.622$; $p = .000$) or the multiple rates with single year-end activity cost system (question 12: 69.43 vs. 24.39; $t = 4.941$; $p = .000$). Again, as intended decision makers in the multiple cost pool system correctly reported a greater likelihood that the year-end cost report contained the actual number of production runs for each month than did decision makers in either the single cost pool system (question 13: 69.71 vs. 25.56; $t = 5.062$; $p = .000$) or the multiple rates with single year-end activity system (question 13: 69.71 vs. 24.39; $t = 4.995$; $p = .000$). In addition, decision makers reported that they understood the monthly activity data provided on the production reports and cost reports were accurate (mean response of 72.05; question 17). Thus, decision makers' responses to questions 11 through 13 and 17 verified that they understood which activity data were and were not contained on their year-end cost report. Such verification is necessary before one can argue that the multiple cost pool system's year-end cost report is associated with increased activity cost estimation accuracy because it provides decision makers with previous months' data for each activity.

Decision makers also were asked whether their monthly cost reports contained a budgeted costing rate for machine hours, parts, and production runs (see Table 6, questions 14, 15, and 16, respectively). The monthly cost reports in the single cost pool system contain a cost rate only for machine hours. The monthly cost reports in the multiple cost pool and multiple rates with single year-end activity systems contain a costing rate for machine hours, parts, and production runs. Thus, for question 14 mean responses from decision makers in each cost system are compared to the median (50) of the likelihood scale to verify that all decision makers realized that their monthly cost reports contained a costing rate for machine hours. For questions 15 and 16, mean responses from decision makers in the single cost pool system are compared to mean responses from decision makers in the multiple cost pool system and to mean responses from decision makers in the multiple rates with single year-end activity system.

As intended, the mean likelihood reported by decision makers in the single cost pool (question 14: 92.92; t = 15.22; p = .000), multiple rates with single year-end activity (question 14: 85.81; t = 7.925; p = .000), and multiple cost pool systems (question 14: 78.86; t = 5.871; p = .000) that their monthly cost reports contained a costing rate for machine hours is significantly greater than the median likelihood of 50. Thus, decision makers in each cost system correctly reported that the monthly cost reports contained a costing rate for machine hours. Again, as intended, decision makers in the single cost pool system reported a smaller likelihood that the monthly cost reports contained a costing rate for parts than did decision makers in either the multiple cost pool system (question 15: 28.47 vs. 78.86; t = -6.210; p = .000) or the multiple rates with single year-end activity cost system (question 15: 28.47 vs. 85.81; t = -7.355; p = .000). Also as intended, decision makers in the single cost pool system correctly reported a smaller likelihood that the monthly cost reports contained a costing rate for production runs than did decision makers in either the multiple cost pool system (question 16: 29.03 vs. 78.86; t = -6.080; p = .000) or the multiple rates with single year-end activity cost system (question 16: 29.03 vs. 85.81; t = -7.207; p = .000). In addition, decision makers correctly reported that they understood the cost rate(s) provided by the cost system might not have been accurate (mean response of 75.82; question 8). Therefore, it appears that decision makers understood the costing rate(s) provided to them and were aware of which activities did and did not have a costing rate provided by the cost system. Thus, the manipulations of prior cost information and cost system appear to have been effective.

4.2 Tests of Hypotheses

4.2.1 Existence of a Prior Cost Information-Confirming Bias in Considering Previous Periods' Activity and Cost Data

4.2.1.1 Cost Differences Estimation: Hypotheses 1a and 1b

Hypothesis 1a and 1b predict that decision makers perceive costs derived from their incorrect prior cost information as more consistent (e.g., similar) with actual costs than they are in reality. Specifically, Hypothesis 1a predicts that decision makers with incorrect prior cost information underestimate AVGD relative to the actual AVGD. The average of the differences between predicted monthly cost changes and actual monthly cost changes is defined as AVGD (see Chapter Three and Table 5 for a detailed definition). Table 7 displays the descriptive statistics for the mean AVGD estimation. Table 8 displays the descriptive statistics for mean UAVGD, which is the mean underestimation of AVGD across decision makers. UAVGD is defined for each decision maker as the actual AVGD minus the decision maker's AVGD estimation. A positive UAVGD indicates that the decision maker underestimates AVGD. Table 5 presents each of the eleven differences between predicted and actual monthly cost changes for both prior cost information conditions. The mean AVGD estimation for decision makers with incorrect prior cost information is $12,463. Thus, decision makers with incorrect prior cost information estimated AVGD to be only about half as large as the actual AVGD of $24,455. Also, over 94% (49 out of 52) of decision makers with incorrect prior cost information underestimated AVGD. Results indicate that the mean AVGD

Table 7
AVGD[a] Estimation and GRTD[b] Estimation: Descriptive Statistics

		COST SYSTEM		
		SINGLE COST POOL	MULTIPLE RATES WITH SINGLE YEAR-END ACTIVITY	MULTIPLE COST POOL
PRIOR INFO	COR	A AVGD[c]: 2,992 (1,669) GRTD: 8,139 (5,067) [18]	B AVGD: 3,085 (1,538) GRTD: 7,444 (4,728) [18]	C AVGD: 3,206 (2,101) GRTD: 10,156 (9,387) [16]
	INC	D AVGD: 11,859 (6,240) GRTD: 50,000 (15,379) [17]	E AVGD: 14,306 (8,568) GRTD: 44,778 (18,448) [18]	F AVGD: 11,118 (5,064) GRTD: 49,912 (17,472) [17]

[a] The AVGD is the average difference between the predicted monthly cost change and the actual monthly cost change across all months. The actual AVGD is $3,364 (COR) and $24,455 (INC). The estimated AVGD is $3,090 (COR) and $12,463 (INC).

[b] GRTD is the greatest difference between the predicted monthly cost change and the actual monthly cost change across all months. The actual GRTD is $6,000 (COR) and $68,000 (INC). The estimated GRTD is $8,519 (COR) and $48,163 (INC).

[c] Cells contain means, (standard deviations), and [number of observations].

Table 8
AVGD Underestimation (UAVGD[a]) and GRTD Underestimation (UGRTD[b]): Descriptive Statistics

PRIOR INFO	COST SYSTEM: SINGLE COST POOL	COST SYSTEM: MULTIPLE RATES WITH SINGLE YEAR-END ACTIVITY	COST SYSTEM: MULTIPLE COST POOL
COR	A	B	C
	UAVGD[c]: 372 (1,669)	UAVGD: 279 (1,538)	UAVGD: 158 (2,101)
	UGRTD: -2,139 (5,067)	UGRTD: -1,444 (4,728)	UGRTD: -4,156 (9,387)
	[18]	[18]	[16]
INC	D	E	F
	UAVGD: 12,596 (6,240)	UAVGD: 10,149 (8,568)	UAVGD: 13,337 (5,064)
	UGRTD: 18,000 (15,379)	UGRTD: 23,222 (18,448)	UGRTD: 18,088 (17,472)
	[17]	[18]	[17]

[a] UAVGD is the mean underestimation of AVGD. UAVGD is $274 (COR) and $11,992 (INC). UAVGD for each decision maker is calculated as follows:
⇨ actual AVGD - estimated AVGD difference

[b] UGRTD is the mean underestimation of GRTD. UGRTD is $-2.519 (COR) and $19,837 (INC). UGRTD for each decision maker is calculated as follows:
⇨ actual GRTD - estimated GRTD

[c] Cells contain means, (standard deviations), and [number of observations].

estimation of $12,463 is significantly less than the actual AVGD of $24,455 (t = -12.660; p = .000; Table 9)[12]. Thus, Hypothesis 1a is supported, because decision makers with incorrect prior cost information significantly underestimated AVGD.

Also, Hypothesis 1b predicts that decision makers with incorrect prior cost information underestimate GRTD relative to the actual GRTD. The greatest of the differences between predicted monthly cost changes and actual monthly cost changes is defined as GRTD (see Chapter Three and Table 5 for a detailed definition). Table 7 displays the descriptive statistics for the mean GRTD estimation. Table 8 displays the descriptive statistics for mean UGRTD, which is the mean underestimation of GRTD across decision makers. UGRTD is defined for each decision maker as the actual GRTD minus the decision maker's GRTD estimation. A positive UGRTD indicates that the decision maker underestimates GRTD. The mean GRTD estimation for decision makers with incorrect prior cost information is $48,163. Over 92% (48 out of 52) of decision makers with incorrect prior cost information underestimated GRTD. Results indicate that the mean GRTD estimation of $48,163 is significantly less than the actual GRTD of $68,000 (t = -8.406; p = .000; Table 9)[13]. Thus, Hypothesis 1b is supported, because decision makers with incorrect prior cost information significantly underestimated GRTD.

[12] An alternate view of this result is that the mean UAVGD of $11,992 is significantly different from zero (t = 12.660; p = .000), which also supports Hypothesis 1a.

[13] An alternate view of this result is that the mean UGRTD of $19,837 is significantly different from zero (t = 8.406; p = .000), which also supports Hypothesis 1b.

Table 9
Results of t-tests of Hypotheses 1a, 1b, and 1c

1	2[a]		3	4	5	6[b]
Hypothesis:	**Mean Comparison Between:**		**t-stat. (2-tailed test)**	**p-value**	**df**	**r**
1a	AVGD estimate (cells D- F): $12,463 (6,830) [52]	Actual AVGD (cells D-F): $24,455	- 12.660	.000	51	-.871
1b	GRTD estimate (cells D-F): $48,163 (17,018) [52]	Actual GRTD (cells D-F): $68,000	-8.406	.000	51	-.762
1c	# *consistent* actual cost changes for which the change in Parts and PRuns is *accurately* recalled: .386 (.690) [52]	# *inconsistent* actual cost changes for which the change in Parts and Pruns is *accurately* recalled: 0 (.000) [52]	4.017	.000	51	.490

[a] The letters in Column 2 refer to Tables 1 and 11. Column 2 contains means, (standard deviations), and [number of observations].

[b] Every significance test is made up of two components: the size of the effect and the size of the study (Rosenthal and Rosnow 1985). Column 6 presents r as a measure of the size of the effect.

4.2.1.2 Recall of Previous Months' Activity Data: Hypothesis 1c

Hypothesis 1c predicts that decision makers with incorrect prior cost information are unable to recall the changes in the activity data that correspond to the months in which the actual cost change is inconsistent with their prior information's predicted cost change. Having available the monthly changes in activity data that correspond to each actual monthly cost change is important for accurately adjusting incorrect prior cost information. Especially important for adjusting incorrect prior cost information are those changes in activity data that correspond to actual cost changes that are inconsistent with predicted cost changes. Therefore, an inability to recall the changes in the activity data, especially those changes corresponding to the inconsistent actual cost changes, is expected to be negatively associated with activity cost estimation accuracy.

Each of the eleven actual monthly cost changes has a corresponding change in the parts and production runs activity data. For example, the changes in parts and production runs from February to March correspond to March's cost change. There are four inconsistent actual monthly cost changes (March, April, August, and September; see Table 5, Column 2) for decision makers with incorrect prior cost information. An actual monthly cost change is defined as being inconsistent with prior cost information if the difference between the predicted monthly cost change and the actual monthly cost change is greater than $10,000. For example, March's actual cost change (an increase of $12,500) differs from the predicted cost change (a decrease of $46,500) by $59,000 (see Table 5, Columns 1-4). Chapter Three discusses consistent and inconsistent cost changes in detail.

The test of Hypothesis 1c examines whether decision makers accurately recall the changes in parts and production runs that correspond to any of the four inconsistent actual monthly cost changes. In order for the changes in parts and production runs that correspond to an actual cost change to be counted as accurately recalled, the change in both parts and production runs that correspond to the actual cost change must be accurately recalled. For example, for the changes in parts and production runs corresponding to March's cost change (increase of $12,500) to be counted as accurately recalled, the change in both parts and production runs from February to March (increase of 12 and decrease of 18, respectively) must also be accurately recalled (see Table 2).

The mean number of inconsistent actual cost changes for which the corresponding changes in both parts and production runs is recalled accurately is 0, which is not significantly different from zero. In other words, decision makers were unable to recall the changes in parts and production runs that corresponded to any of the four inconsistent actual cost changes. Thus, Hypothesis 1c is supported.

There are seven actual cost changes that are consistent (within $10,000) with the incorrect prior information's corresponding predicted cost change (see Table 5, Column 2). The mean number of consistent actual cost changes for which the corresponding changes in both parts and production runs is recalled accurately is .386. Thus, decision makers accurately recalled the corresponding changes in parts and production runs for a significantly greater number of consistent actual cost changes than inconsistent actual cost changes ($t = 4.017$; $p = .000$; Table 9). The largest number of consistent actual cost changes for which the corresponding changes in both parts and production runs actually was recalled accurately is 3.

However, although significantly greater than zero, the mean number of consistent actual cost changes for which the corresponding changes in both parts and production runs was recalled accurately (.386) is less than one. Taken together, these results suggest that decision makers were unable to recall changes in previously encountered activity data for either type of actual cost change, consistent or inconsistent. Thus, in contrast to the typical finding in recall studies of consistent/inconsistent qualitative evidence, the activity data corresponding to the inconsistent actual cost changes did not become salient enough to be recalled accurately. Therefore, previous periods' activity data were not available from memory recall when decision makers estimated activity costs at year-end.

4.2.2 The Relationship Between Cost Differences Underestimation and Activity Cost Estimation Accuracy: Hypothesis 1d

Results of Hypotheses 1a and 1b indicate that decision makers with incorrect prior cost information exhibited a prior information-confirming bias in underestimating the differences between predicted and actual monthly cost changes. The more that decision makers underestimate AVGD, the less they are expected to adjust from their incorrect prior cost information. Less adjustment from incorrect prior cost information translates into reduced activity cost estimation accuracy. Thus, Hypothesis 1d predicts that AVGD underestimation (UAVGD) is negatively correlated with activity cost estimation accuracy for decision makers with incorrect prior cost information. The results indicate that for decision makers with incorrect prior cost information, there was a significant negative correlation between activity cost estimation accuracy and UAVGD [Pearson $r = -.203$; $p = .074$ (one-tailed); $n = 52$]. Therefore, the more that decision makers underestimated AVGD, the less accurate were their activity cost estimates. Thus, Hypothesis 1d is supported. The finding that AVGD underestimation is significantly associated with activity cost estimation accuracy is important because it establishes the cost differences estimation task (Figure 1, step E) as an important part of the activity cost estimation process.

4.2.3 The Relationship Between Prior Cost Information, Cost System Type, and Activity Cost Estimation Accuracy: Hypotheses 2 and 3

Hypothesis 2 predicts that, relative to the single cost pool system, the multiple cost pool system is associated with increased decision maker cost estimation accuracy when their prior information is incorrect, but is associated with decreased cost estimation accuracy when their prior information is correct. Hypothesis 3 predicts that, relative to the multiple rates with single year-end activity system, the multiple cost pool system is associated with increased decision maker cost estimation accuracy when their prior information is incorrect, but has no association with decision maker cost estimation accuracy when their prior information is correct. Figure 5 and Table 1 present the hypothesized relationships between cell means.

Because there is a possibility that performing the cost differences estimation and recall tasks prior to performing the activity cost estimation task might affect how one responds on the activity cost estimation task, it is necessary to control for potential order effects. Thus, the order of task performance was counterbalanced. Approximately half of the decision makers executed the cost differences estimation and recall tasks prior to the activity cost estimation task while the other half performed the activity cost estimation task prior to the cost differences estimation and recall tasks. Figure 6 summarizes the order of experimental procedures. To test for order effects a 2 x 3 x 2 (prior cost information x cost system x order) between-subjects ANOVA is performed in which the order of task performance serves as a control variable. Results indicate that the order of task performance has no systematic association with activity cost estimation accuracy, as evidenced by the lack of a main effect for order ($F = .92$; $p = .339$; Table 10, Panel A) and a lack of an interaction between order and either prior cost information ($F = .23$; $p = .635$; Table 10, Panel A) or cost system ($F = .13$, $p = .882$; Table 10, Panel A). Two additional ANOVAs are run replacing activity cost estimation accuracy with decision makers' estimates of AVGD and GRTD, which are the dependent variables involved in Hypotheses 1a, 1b, and 1d. As with activity cost estimation accuracy, order is insignificant ($F = .14$; $p = .714$ Table 10, Panel B for AVGD: $F = .08$; $p = .784$ Table 10, Panel C for GRTD) and does not interact with prior cost information ($F = .31$; $p = .578$ Table 10, Panel B for AVGD: $F = .21$; $p = .650$ Table 10, Panel C for GRTD) or cost system ($F = 2.26$; $p = .110$ Table 10, Panel B for AVGD: $F = .40$; $p = .673$ Table 10, Panel C for GRTD). Therefore, all data are combined and analyzed collectively regardless of task order.

Buckless and Ravenscroft (1990) note that a conventional ANOVA examines whether cell means are different from one another by testing only for a standard crossover interaction pattern between cell means. By assigning to the cells the default weights of 1, -1, -1, and 1 ANOVA tests for a crossover disordinal interaction, which is different from the set of interactions proposed in Hypotheses 2 and 3. In addition, Rosenthal and Rosnow (1985) note that if a variable has more than two levels, as does cost system in the present study, the use of conventional ANOVA is inappropriate when testing for a predicted pattern of cell means other than a standard crossover interaction.

Table 10
Results of ANOVA tests of Potential Order Effects

Panel A: Dependent variable = activity cost estimation accuracy

Factor	Sum of Squares	df	Mean Square	F-stat	p-value
PI[a]	119,485,212	1	119,485,212	218.08	.000
CSYS	7,587,021	2	3,793,510	6.92	.002
ORD	505,615	1	505,615	.92	.339
PI x CSYS	20,408,039	2	10,204,019	18.62	.000
PI x ORD	124,086	1	124,086	.23	.635
CSYS x ORD	137,301	2	68,650	.13	.882
PI x CSYS x ORD	607,844	2	303,922	.56	.576
Explained	148,855,118	11	13,532,283	24.70	.000
Residual	52,050,562	95	547,900		
Total	200,905,680	106	1,895,337		

Panel B: Dependent variable = AVGD estimation

Factor	Sum of Squares	df	Mean Square	F-stat	p-value
PI	2,178,719,908	1	2,178,719,908	89.07	.000
CSYS	44,493,258	2	22,246,629	.91	.406
ORD	3,307,611	1	3,307,611	.14	.714
PI x CSYS	54,794,400	2	27,397,200	1.12	.331
PI x ORD	7,609,115	1	7,609,115	.31	.578
CSYS x ORD	110,416,657	2	55,208,329	2.26	.110
PI x CSYS x ORD	56,559,753	2	28,279,877	1.16	.319
Explained	2,455,900,702	11	223,263,700	9.13	.000
Residual	2,250,483,126	92	24,461,773		
Total	4,706,383,828	103	45,693,046		

Table 10 (cont'd)

Panel C : Dependent variable = GRTD estimation

Factor	Sum of Squares	df	Mean Square	F-stat	p-value
PI	39,379,839,009	1	39,379,839,009	220.86	.000
CSYS	319,149,326	2	159,574,663	.90	.412
ORD	13,484,503	1	13,484,503	.08	.784
PI x CSYS	79,335,060	2	39,667,530	.22	.801
PI x ORD	37,014,555	1	37,014,555	.21	.650
CSYS x ORD	141,586,363	2	70,793,181	.40	.673
PI x CSYS x ORD	5,601,336	2	2,800,668	.02	.984
Explained	39,976,010,152	11	3,634,182,741	20.38	.000
Residual	16,403,965,476	92	178,303,972		
Total	56,379,975,628	103	547,378,404		

[a] PI = prior cost information; CSYS = cost system; ORD = order of performance of cost differences estimation/activity data recall tasks and activity cost estimation task.

Contrast coding involves the assignment of weights, which must sum to zero, to each cell. The use of contrast coding allows one to test a specific *a priori* prediction concerning the relationships or patterns between cell means, thereby increasing statistical power without increasing the likelihood of Type I errors (Buckless and Ravenscroft 1990; Keppel 1991). Therefore, this research employs contrast coding to test the specific cell to cell relationships that Hypotheses 2 and 3 predict.

To test the specific relationships that Hypotheses 2 and 3 predict, the appropriate *a priori* contrast weights to assign to cells A, B, C, D, E, and F are 7, 3, 3, -9, -5, and 1, respectively[14]. Table 1 displays the hypothesized relationships between cell means along with the assigned contrast weights. This *a priori* set of contrast weights tests for the predicted relative mathematical differences between cell means. Analyzing this model simultaneously tests Hypotheses 2 and 3. Table 11 presents descriptive statistics for activity cost estimation accuracy.

Table 12, Panel A reports the 2 x 3 (prior cost information x cost system) ANOVA results. Table 12, Panel B displays the results of the contrast model analysis. The contrast model analysis demonstrates that the model is significant ($F = 271.48$; $p = .000$; Table 12, Panel B). Also, the model's η^2 (eta-squared) is .711, indicating a large degree of linear association ($r = .843$) between the model and activity cost estimation accuracy. The test results provide simultaneous support for both Hypothesis 2 and Hypothesis 3. The model residual is statistically insignificant ($F = 2.34$; $p = .060$; Table

[14] As required by ANOVA, these assigned contrasts sum to zero (Buckless and Ravenscroft 1990; Keppel 1991).

12, Panel B) with a trivially small η^2 of .03. Thus, it appears unlikely that there is a model that fits the data better than the dissertation's *a priori* contrast model.

Table 12, Panel C reports the net contrast benefit measure for the applied *a priori* contrast weights. The purpose of the net contrast benefit measure is to quantify the gains in explanatory power that arise from employing a particular *a priori* chosen set of contrast weights rather than an unfocused, random set of contrast weights (Rosenthal and Rosnow, 1985). According to Rosenthal and Rosnow (1985), the benefit of a planned contrast is indexed "by the proportion of variance it accounts for that exceeds the expected value of the average contrast (1/*df*)" (p. 86). The proportion of variance accounted for by the *a priori* contrast model is defined as the squared correlation between the cell means and the contrast weights (Rosenthal and Rosnow, 1985). Table 12, Panel C reports the squared correlation between the cell means and the *a priori* contrast weights of .956. Rosenthal and Rosnow (1985) define the expected value of the squared correlation between cell means and the average contrast as 1/*df*. Rosenthal and Rosnow (1985) state that "if it is assumed that any contrast is as good as any other, we would expect any randomly constituted contrast to absorb its 'fair share' of the SS of the total effect" (Rosenthal and Rosnow 1985, p.85). The expected value of the average contrast, or fair share, in this dissertation is 1/5 or .20. Thus, the net benefit of the proposed contrast model is .956 - .20 = .756, as shown in Table 12, Panel C. The maximum possible benefit from employing contrast analysis for a 2 x 3 design is (*df* - 1)/*df*, or .80 (see Rosenthal and Rosnow 1985, Table 8.2, p. 87). The resulting proportion of possible benefit score for the

Table 11
Total Activity Cost Estimation Accuracy:[a]
Descriptive Statistics[b]

		COST SYSTEM		
		SINGLE COST POOL	**MULTIPLE RATES WITH SINGLE YEAR-END ACTIVITY**	**MULTIPLE COST POOL**
PRIOR INFO	**COR**	A 8,641.39 (286.94) [18] {7}	B 8,322.61 (660.60) [18] {3}	C 8,200.79 (613.29) [18] {3}
	INC	D 5,497.78 (716.92) [18] {-9}	E 6,105.33 (823.69) [18] {-5}	F 7,192.20 (1,057.89) [17] {1}

[a] Total activity cost estimation accuracy is the sum of the accuracy of each of the three individual activity cost estimates, with each being calculated as follows:
3,000 - | actual activity cost - activity cost estimate |.

[b] Cells contain means, (standard deviations), and [number of observations], and {the *a priori* contrast weights}.

Table 12
Total Activity Cost Estimation Accuracy:
Contrast Model Analysis

Panel A - ANOVA Results:

Factor	Sum of Squares	df	Mean Square	F-stat	p-value
PI[a]	120,529,294	1	120,529,294	228.01	.000
CSYS	7,618,373	2	3,809,187	7.21	.001
PI x CSYS	20,309,406	2	10,154,703	19.21	.000
Explained	148,457,073	5	29,691,415	56.17	.000
Residual	53,390,134	101	528,615		
Total	201,847,207	106	1,904,219		

Panel B - Contrast Model:

Factor	Sum of Squares	df	Mean Square	F-stat	p-value	η^2
Model	143,506,181	1	143,506,181	271.48	.000	.711
Model Residual	4,950,892	4	1,237,723	2.34	.060	.025
Explained	148,457,073	5	29,691,415	56.17	.000	

Panel C - Net Contrast Benefit Measure:

Squared Correlation Between Means and Contrast Weights	1/df	Net Contrast Benefit	F-stat	p-value
.956	.20	.756	86.91	.001

[a] PI = prior cost information; CSYS = cost system.

present dissertation is .756/.80, or .945, indicating that the *a priori* contrast model achieves 94.5% of the maximum benefits possible from employing contrasts. The F-statistic of 86.90 associated with the net contrast benefit measure is significant at the .001 level (see Table 12, Panel C). Therefore, the *a priori* contrast model employed in this research results in significant gains in explanatory power relative to a randomly selected set of contrast weights.

In addition to the contrast model analysis, four two-sample, two-tailed t-tests are conducted to examine the individual two-cell comparisons involved in Hypotheses 2 and 3. Specifically, the mean accuracy in cell C is significantly less than in cell A (t = -2.761; p = .009). Table 13 presents the t-test results regarding the four two-cell comparisons involved in Hypotheses 2 and 3. Furthermore, the mean accuracy in cell B is not significantly different from that in cell C (t = - .573; p = .570). This indicates that the provision of previous months' activity data is not associated with activity cost estimation accuracy for decision makers with correct prior cost information. Therefore, for decision makers with correct prior cost information, activity cost estimation accuracy is negatively associated with the multiple cost pool system's provision of a biased cost rate for each activity, but not associated with its provision of previous months' data for each activity.

Decision makers made significant accuracy-increasing adjustments from their incorrect prior cost information even when they were not provided with previous months'

Table 13
Results of t-tests of Hypotheses 2 and 3

1[a]		2	3	4	5[b]
Mean Activity Cost Estimation Accuracy Comparison Between Cells:		**t-stat. (2-tailed test)**	**p-value**	**df**	**r**
C (COR, MULTIPLE)[c] 8,201 (613) [18]	A (COR, SINGLE) 8,641 (287) [18]	- 2.761	.009	34	-.428
F (INC, MULTIPLE) 7,192 (1,058) [17]	D (INC,SINGLE) 5,498 (717) [18]	5.576	.000	33	.700
C (COR, MULTIPLE) 8,201 (613) [18]	B (COR, MRSYA) 8,323 (661) [18]	-.573	.570	34	-.098
F (INC, MULTIPLE) 7,192 (1,058) [17]	E (INC, MRSYA) 6,105 (824) [18]	3.402	.002	33	.510

[a] The letters in Column 1 refer to Tables 1 and 11. Column 1 contains means, (standard deviations), and [number of observations].

[b] Every significance test is made up of two components: the size of the effect and the size of the study (Rosenthal and Rosnow 1985). Column 5 presents r as a measure of the size of the effect.

[c] COR = decision makers with correct prior cost information; INC = decision makers with incorrect prior cost information; MULTIPLE = decision makers in the multiple cost pool condition; MRSYA = decision makers in the multiple rates with single year-end activity condition; SINGLE = decision makers in the single cost pool condition.

activity data or a biased cost rate for each activity[15]. For example, activity cost estimation accuracy in cell D (5,498) is greater than the 5,000 accuracy score that results if the incorrect prior cost information is used as the cost estimates [t = 2.946 (2-tailed); p = .009; df = 16; r = .581]. However, activity cost estimation accuracy for decision makers with incorrect prior cost information is greater when previous months' activity data are provided than when no such data are provided. The mean accuracy in cell F is significantly greater than in cell D (t = 5.576; p = .000). Also, the mean accuracy in cell F is significantly greater than in cell E (t = 3.402; p = .002)[16]. Therefore, for decision

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[15] Only five out of the 52 decision makers in the incorrect prior cost information condition made adjustments that decreased cost estimation accuracy relative to the 5,000 accuracy score that results from using the incorrect prior cost information as activity cost estimates.

[16] Some researchers argue that when performing cell-to-cell comparisons the per-comparison (PC) error should be adjusted to control the familywise (FW) error (Keppel 1991). Others, such as Keppel (1991), argue that adjustments or corrections are not necessary for a reasonable number of theoretically-driven planned comparisons (p. 167). To be conservative, this research corrects the per-comparison error by performing the Bonferroni correction (Keppel 1991). The Bonferroni correction is accomplished by dividing the desired familywise error of .05 by the number of comparisons (4) to arrive at a more conservative per-comparison significance level of .0125. The p-value for each of the three two-cell comparisons where a difference is predicted is less than the corrected

makers with incorrect prior cost information, activity cost estimation accuracy is positively associated with the multiple cost pool system's provision of previous months' data for each activity. Thus, both the contrast model results and individual t-test results indicate that decision makers' relative activity cost estimation accuracy is as Hypotheses 2 and 3 predict.

Results of Hypothesis 1c suggest that previous periods' activity data were not available from memory recall when decision makers estimated activity costs at year-end. Thus, the multiple cost pool system's year-end provision of previous months' activity data makes available to decision makers activity data that are unavailable from memory recall. Increased availability of activity data is one of the two reasons that the multiple cost pool system's provision of previous months' activity data is argued to be positively associated with activity cost estimation accuracy for decision makers with incorrect prior cost information. Results supporting Hypothesis 1c and Hypotheses 2 and 3 concerning the positive association between providing previous months' activity data and activity cost estimation accuracy are consistent with this argument.

The finding that AVGD underestimation is significantly negatively associated with activity cost estimation accuracy is important because it establishes the cost differences estimation task (Figure 1, step E) as an important part of the activity cost estimation process. This negative association suggests that it might be possible to increase activity cost estimation accuracy by reducing AVGD underestimation. Reducing

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significance level of .0125. Therefore, performing the Bonferroni correction does not affect the t-test results involving Hypotheses 2 and 3.

decision makers' AVGD underestimation is the second reason that the multiple cost pool system's provision of previous months' activity data is argued to be positively associated with activity cost estimation accuracy for decision makers with incorrect prior cost information (see Figure 12, panel C). However, the mean UAVGD for decision makers provided with previous months' activity data is no different from the mean UAVGD for decision makers not provided with previous months' activity data. For example, for decision makers with incorrect prior cost information, mean UAVGD in the multiple cost pool system is no different than in either the single cost pool system ($t = .380$; $p = .706$; Table 14) or the multiple rates with single year-end activity system ($t = 1.330$; $p = .193$; Table 14).

AVGD estimation might be affected by additional factors other than whether or not previous months' activity data are provided at year-end. For example, certain decision makers might for some reason attribute less of the difference between predicted and actual cost changes to randomness in actual costs and, therefore, increase their estimation of AVGD. It is possible that the relationship between the provision of previous months' activity data and AVGD estimation might be masked by such other factors. Therefore, a more direct test of whether the provision of previous months' activity data is associated with AVGD estimation is performed.

Decision makers were given their year-end cost report for use in estimating activity costs (see Figure 6, step 7). After estimating activity costs, the year-end cost report was removed from the decision maker (see Chapter Three for a complete description of experimental procedures). To counterbalance task order, half of the

Table 14
Results of t-tests of the Association Between Providing All Months' Activity Data and UAVGD

1[a]		2	3	4	5[b]
Mean Comparison Between:		**t-stat. (2-tailed test)**	**p-value**	**df**	**r**
UAVGD (cell F) $13,337 (5,064) [17]	UAVGD (cell D): $12,596 (6,240) [17]	.380	.706	32	.067
UAVGD (cell F) $13,337 (5,064) [17]	UAVGD (cell E): $10,149 (8,568) [18]	1.330	.193	33	.266

[a] The letters in Column 1 refer to Tables 1 and 11. Column 1 contains means, (standard deviations), and [number of observations].

[b] Every significance test is made up of two components: the size of the effect and the size of the study (Rosenthal and Rosnow 1985). Column 5 presents r as a measure of the size of the effect.

decision makers performed the cost differences estimation task prior to performing the activity cost estimation task. After removing the year-end cost report, these decision makers performed the same cost differences estimation task again. They were provided with an experimental form that was identical to the form used in their first cost differences estimation task (see Appendix H). The second cost differences estimation task asked decision makers the same questions regarding the same data as the first cost differences estimation task. Thus, decision makers again were asked to estimate the average difference across all months between the predicted monthly cost change calculated using their prior cost information and the actual monthly cost change. As in the first cost differences estimation task, decision makers were told to disregard the sign of the difference and consider the absolute value of the difference each month (see Appendix H).

The two AVGD estimates are referred to as the pre-year-end cost report AVGD estimate and the post-year-end cost report AVGD estimate. The pre- and post- AVGD estimates are compared to one another to determine whether decision makers underestimate AVGD to a lesser extent after having been presented with (and then removed) their year-end cost report. Only decision makers in the multiple cost pool system are provided with previous months' activity data on the year-end cost report. If the provision of previous months' activity data is associated with AVGD underestimation, then in the multiple cost pool system the post-year-end cost report AVGD estimate should be greater than the pre-year-end cost report AVGD estimate. Thus, post-year-end cost report UAVGD should be smaller than pre-year-end cost report UAVGD. This within-subjects measure is a more direct test of whether the provision of previous months' activity data is associated with reduced UAVGD than is comparing aggregate cell means of UAVGD.

CHUAVGD represents the change in decision makers' underestimation of AVGD. CHUAVGD is defined as the pre-year-end cost report UAVGD minus the post-year-end cost report UAVGD. A positive CHUAVGD indicates that the extent to which decision makers underestimated AVGD is less after seeing (post) the year-end cost report than before seeing (pre) the year-end cost report. A positive CHUAVGD is expected only for the multiple cost pool system, because the multiple cost pool system is the only system that provides previous months' activity data on the year-end cost report.

Table 15 presents CHUAVGD for each condition. As expected, the results indicate that only decision makers with incorrect prior cost information in the multiple cost pool system demonstrated a difference in pre- and post-year-end cost report UAVGD. Thus, only these decision makers show a significant CHUAVGD ($t = 2.966$; $p = .018$; Table 15). CHUAVGD is insignificant for all other conditions. Table 15 presents the insignificant CHUAVGD for these other five cells (A through E). Thus, decision makers with incorrect prior cost information in the multiple cost pool system are the only decision makers who demonstrated a significant difference in pre- and post-year-end cost report UAVGD. The results of mean CHUAVGD for each cell (A through F) suggest that year-end provision of previous months' activity data is negatively associated with UAVGD. In other words, the provision of previous months' activity data is associated with a reduction in the extent of the prior information-confirming bias. This finding, along with the finding that UAVGD is negatively correlated with activity cost

Table 15
Change in UAVGD: CHUAVGD[a,b]

		COST SYSTEM		
		SINGLE COST POOL	MULTIPLE RATES WITH SINGLE YEAR-END ACTIVITY	MULTIPLE COST POOL
PRIOR INFO	COR	A 3,000[c] (5,963) [t = 1.509] {p = .170} <8>	B 2,955 (6,753) [t = 1.384] {p = .200} <9>	C 40 (1,970) [t = .064] {p = .950} <9>
	INC	D -250 (2,937) [t = -.269] {p = .794} <9>	E -5,389 (11,033) [t = -1.465] {p = .181} <8>	F 4,722 (4,777) [t = 2.966] {p = .018} <8>

[a] CHUAVGD is the change in the underestimation of AVGD measured before (Pre) the activity cost estimation task and the underestimation of AVGD measured after (Post) the activity cost estimation task.

[b] CHUAVGD = Pre Year-end Cost Report UAVGD
                    – Post Year-end Cost Report UAVGD

[c] Cells contain mean CHUAVGD, (standard deviations), [t-statistics], {p-values}, and <degrees of freedom>.

<u>Notes</u>:

- ⇨ All t-tests are one-sample, 2-tailed tests.
- ⇨ CHUAVGD is a within-subjects measure and pertains only to decision makers who perform the cost differences estimation task before the activity cost estimation task.
- ⇨ A significantly positive CHUAVGD indicates that UAVGD is smaller after seeing the year-end cost report than before seeing the year-end cost report.

estimation accuracy, is consistent with the argument that the provision of previous months' activity data increases activity cost estimation accuracy by decreasing decision makers' confirmation bias.

4.3 Results of Tests of Potential Covariates

The following section describes test results of prior influence and concomitant variables. It is possible that decision makers' accuracy in performing the activity cost estimation task is influenced by their mathematical ability. Commonly used proxies for mathematical ability are decision makers' grade point average (GPA), SAT scores, ACT scores, and GMAT scores. All four were measured as potential proxies of mathematical ability and included as a control in ANCOVA analyses. Results reveal that GPA is insignificant (F = .27; p = .605; Table 16, Panel A). GPA also is examined separately for undergraduate and MBA students. GPA is examined separately for these two groups because the variance in GPA typically is much smaller for MBA students than for undergraduate students. Again, results reveal that GPA is insignificant for both undergraduates students (F = .01; p = .919; Table 16, Panel B) and MBA students (F = .26; p = .613; Table 16, Panel C). SAT and ACT are examined using only undergraduate students, while GMAT is examined using only MBA students. Results indicate that each covariate is insignificant [SAT (F = 2.13; p = .168; Table 16, Panel D), ACT (F = .00; p = .963; Table 16, Panel E), GMAT (F = .56; p = .460; Table 16, Panel F)]. Using the above proxies, mathematical ability is not found to be significantly associated with activity cost estimation accuracy or to alter the relationship between activity cost estimation accuracy and either prior cost information or cost system. It is possible that

Table 16
Results of ANCOVA Tests of Potential Covariates
Total Activity Cost Estimation Accuracy

Panel A:

Factor	Sum of Squares	df	Mean Square	F-stat	p-value
GPA[a]	128,345	1	128,345	.27	.605
PI	110,001,722	1	110,001,722	230.41	.000
CSYS	7,004,532	2	3,502,266	7.34	.001
PI x CSYS	13,410,316	2	6,705,158	14.05	.000
Explained	130,544,915	6	21,757,486	45.57	.000
Residual	42,013,153	88	477,422		
Total	172,558,068	94	1,835,724		

Panel B: (undergraduates only)

Factor	Sum of Squares	df	Mean Square	F-stat	p-value
GPA	4,527	1	4,527	.01	.919
PI	70,401,161	1	70,401,161	164.33	.000
CSYS	4,801,654	2	2,400,827	5.60	.007
PI x CSYS	8,400,971	2	4,200,486	9.81	.000
Explained	83,608,313	6	13,934,719	32.53	.000
Residual	19,707,084	46	428,415		
Total	103,315,397	52	1,986,835		

Panel C : (MBAs only)

Factor	Sum of Squares	df	Mean Square	F-stat	p-value
GPA	135,829	1	135,829	.26	.613
PI	40,506,978	1	40,506,978	77.48	.000
CSYS	1,779,976	2	889,988	1.70	.197
PI x CSYS	7,145,587	2	3,572,794	6.83	.003
Explained	49,568,370	6	8,261,395	15.80	.000
Residual	18,298,311	35	522,809		
Total	67,866,681	41	1,655,285		

Table 16 (cont'd)

Panel D : (undergraduates only)

Factor	Sum of Squares	df	Mean Square	F-stat	p-value
SAT	836,845	1	836,845	2.13	.168
PI	20,585,435	1	20,585,435	52.46	.000
CSYS	1,367,689	2	683,845	1.74	.214
PI x CSYS	4,676,669	2	2,338,335	5.96	.015
Explained	27,466,638	6	4,577,773	11.67	.003
Residual	5,101,372	13	392,413		
Total	32,568,010	19	1,714,106		

Panel E : (undergraduates only)

Factor	Sum of Squares	df	Mean Square	F-stat	p-value
ACT	1,573	1	1,573	.00	.963
PI	8,707,735	1	8,707,735	12.33	.006
CSYS	2,296,930	2	1,148,465	1.63	.245
PI x CSYS	86,685	2	43,343	.12	.733
Explained	11,092,923	6	1,848,821	2.36	.145
Residual	7,063,647	9	784,850		
Total	18,156,570	15	1,210,438		

Panel F : (MBAs only)

Factor	Sum of Squares	df	Mean Square	F-stat	p-value
GMAT	264,591	1	264,591	.56	.460
PI	51,628,710	1	51,628,710	108.62	.000
CSYS	392,685	2	196,343	.41	.664
PI x CSYS	7,509,497	2	3,754,749	7.90	.001
Explained	59,795,483	6	9,965,914	20.97	.000
Residual	19,487,624	41	475,308		
Total	79,283,107	47	1,686,875		

Table 16 (cont'd)

Panel G :

Factor	Sum of Squares	df	Mean Square	F-stat	p-value
STATS	23,736	1	264,591	.04	.834
PI	119,494.639	1	51,628,710	222.22	.000
CSYS	7,546.249	2	196,343	7.02	.001
PI x CSYS	20,419,888	2	3,754,749	18.99	.000
Explained	147,484,512	6	24,580,752	46.17	.000
Residual	53,235,040	100	532,350		
Total	200,719,552	106	1,893,581		

Panel H :

Factor	Sum of Squares	df	Mean Square	F-stat	p-value
YEARSEXP	239,991	1	239,991	.45	.503
PI	120,657,355	1	120,657,355	227.01	.000
CSYS	7,625,894	2	3,812,947	7.17	.001
PI x CSYS	20,280,621	2	10,140,311	19.08	.000
Explained	148,803,861	6	24,800,644	46.66	.000
Residual	53,150,143	100	531,501		
Total	201,954,004	106	1,905,227		

[a] GPA = grade-point average; PI = prior cost information; CSYS = cost system; STATS = number of statistics courses; YEARSEXP = number of years of professional business experience.

mathematical ability influences the cost estimation process but is not detected in the analyses because the proxies employed do not capture decision makers' mathematical ability for this task. It also could be that the proxies do not sufficiently capture the variability in decision makers' mathematical ability, thereby resulting in floor or ceiling effects.

Activity cost estimation accuracy might be influenced by decision makers' familiarity with statistical issues. Decision makers were asked to report the number of statistics courses they had successfully completed. Results indicate that the number of statistics courses is not significantly associated with activity cost estimation accuracy ($F = .04$, $p = .834$; Table 16, Panel G).

Years of professional business experience also is not significantly associated with activity cost estimation accuracy ($F = .45$; $p = .503$; Table 16, Panel H). Also, decision makers' academic degree is not significantly associated with activity cost estimation accuracy. For example, analysis reveals no significant main effect for degree ($F = .20$; $p = .659$; Table 17, Panel A). Furthermore, degree does not interact with prior cost information ($F = .01$; $p = .931$; Table 17, Panel A), cost system ($F = 1.87$; $p = .160$; Table 17, Panel A), or prior cost information and cost system together ($F = 2.31$; $p = .105$; Table 17, Panel A). Thus, there appears to be no difference in activity cost estimation performance between undergraduate decision makers and MBA decision makers. The two groups are examined collectively in other analyses. Finally, decision makers' gender is not significantly associated with activity cost estimation accuracy. For example, analysis reveals no significant main effect for gender ($F = .09$, $p = .768$; Table 17, Panel

Table 17
Results of ANOVA Tests of Control Variables
Total Activity Cost Estimation Accuracy

Panel A:

Factor	Sum of Squares	df	Mean Square	F-stat	p-value
PI[a]	121,025,127	1	121,025,127	234.66	.000
CSYS	6,996,618	2	3,498,309	6.78	.002
DEG	100,914	1	100,914	.20	.659
PI x CSYS	19,765,545	2	9,882,773	19.16	.000
PI x DEG	3,859	1	3,859	.01	.931
CSYS x DEG	1,923,970	2	961,985	1.87	.160
PI x CSYS x DEG	2,381,754	2	1,190,877	2.31	.105
Explained	152,197,787	11	13,836,162	26.83	.000
Residual	48,996,630	95	515,754		
Total	201,194,417	106	1,898,061		

Panel B:

Factor	Sum of Squares	df	Mean Square	F-stat	p-value
PI	109,411,341	1	109,411,341	202.47	.000
CSYS	8,125,918	2	4,062,959	7.52	.001
GEN	47,345	1	47,345	.09	.768
PI x CSYS	19,787,089	2	9,893,545	18.31	.000
PI x GEN	25,457	1	25,457	.05	.829
CSYS x GEN	203,227	2	101,614	.19	.829
PI x CSYS x GEN	1,837,690	2	918,845	1.70	.188
Explained	139,438,067	11	12,676,188	23.46	.000
Residual	51,335,332	95	540,372		
Total	190,773,399	106	1,799,749		

[a] PI = prior cost information; CSYS = cost system; DEG = degree; GEN = gender.

B). Furthermore, gender does not interact with prior cost information (F = .05; p = .829; Table 17, Panel B), cost system (F = .19; p = .829; Table 17, Panel B), or prior cost information and cost system together (F = 1.70; p = .188; Table 17, Panel B). The above analyses suggest that the activity cost estimation accuracy results involving prior cost information and cost system type are not driven by any of the potential covariates or other control variables examined in this section.

4.4 Summary of Chapter Four

This chapter describes the results of statistical tests employed to examine the hypotheses developed in Chapter Two. Hypotheses 1a and 1b predict that decision makers with incorrect prior cost information exhibit a prior cost information-confirming bias in underestimating AVGD and GRTD, respectively, relative to their actual values. Hypotheses 1a and 1b each are supported. Hypothesis 1c predicts that decision makers with incorrect prior cost information are unable to recall the changes in activity data for the months in which the actual cost change is inconsistent with their prior cost information's predicted cost change. Hypothesis 1c is supported. However, decision makers appear to be unable to recall the changes in activity data for any actual monthly cost change, regardless of whether the actual cost change is consistent or inconsistent with their prior cost information's predicted cost change. Thus, decision makers estimated from memory that their incorrect prior information's predicted costs were more consistent with (i.e., closer to) actual costs than they were in reality. Also, previous months' activity data were not available from decision makers' memory recall when they estimated activity costs.

Biased consideration of previous months' activity and cost data is expected to be associated with decreased activity cost estimation accuracy for decision makers with incorrect prior cost information. Hypothesis 1d predicts that for decision makers with incorrect prior cost information AVGD underestimation is negatively associated with activity cost estimation accuracy. Hypothesis 1d is supported. Thus, the extent of decision makers' prior cost information-confirming bias is negatively associated with their activity cost estimation accuracy.

Hypothesis 2 predicts that, relative to the single cost pool system, the multiple cost pool system is associated with increased decision maker cost estimation accuracy when prior information is incorrect, but is associated with decreased cost estimation accuracy when prior information is correct. Hypothesis 3 predicts that, relative to the multiple rates with single year-end activity system, the multiple cost pool system is associated with increased decision maker cost estimation accuracy when prior information is incorrect, but is not associated with cost estimation accuracy when prior information is correct. The contrast model test results support Hypothesis 2 and Hypothesis 3.

The two multiple cost pool system elements contained in the cost system manipulation are the provision of an inaccurate cost rate for each activity and the year-end provision of previous months' data for each activity (see Figure 2). Given the cost system manipulation and the support found for Hypotheses 2 and 3, conclusions can be drawn concerning the association between each of these two cost system elements and activity cost estimation accuracy in the present experiment. The provision of inaccurate cost rates is associated with decreased (increased) activity cost estimation accuracy for decision makers with correct (incorrect) prior cost information. More importantly, the provision of previous months' activity data is associated with increased activity cost estimation accuracy for decision makers with incorrect prior cost information and not associated with cost estimation accuracy for decision makers with correct prior cost information. Also, some evidence is found suggesting that the provision of previous months' activity data is associated with decreased AVGD underestimation.

The cost estimation diagram developed in Chapter Two argues that the year-end provision of previous months' activity data improves activity cost estimation accuracy for decision makers with incorrect prior cost information by reducing their prior cost information-confirming bias. The diagram also argues that this provision improves activity cost estimation accuracy by making previous months' activity data available to decision makers for use in adjusting their incorrect prior cost information. The results summarized above are consistent with the argument that the provision of previous months' activity data is associated with increased activity cost estimation accuracy because it reduces decision makers' AVGD underestimation bias. Also, the results are consistent with the argument that this provision is associated with increased activity cost estimation accuracy because it makes available at the time of activity cost estimation activity data that are not available from decision makers' memory recall. These results help explain the way cost systems help decision makers estimate activity costs more accurately.

The final chapter summarizes the paper's research questions, hypotheses, and results and presents a discussion of its contributions, limitations, and suggested directions for future research.

Chapter Five

CONCLUSION

This chapter contains a summary of research questions and hypotheses in Section 5.1, a summary of the research method and results in Section 5.2, a discussion of the contributions in Section 5.3, a consideration of the limitations in Section 5.4, and suggestions for future research directions in Section 5.5.

5.1 Summary of Research Questions and Hypotheses

A component of effective cost control is decision makers' ability to estimate accurately the relationships between activities and overhead costs (i.e., activity costs) [Bruns and McKinnon 1993; Cooper et al. 1992]. The purpose of this research is to investigate whether an inaccurate multiple cost pool system's provision of incremental activity data, over and above that provided by an inaccurate single cost pool system, is associated with increased cost estimation accuracy. Decision makers observe activity data on a periodic basis often from informal, nonaccounting system sources (Bruns and McKinnon 1993; Simon et al. 1954). Periodic activity data are combined with decision makers' prior information about how changes in each activity level translate into cost changes to form periodic predicted costs. Periodic (e.g., monthly) cost reports then are used to compare their prior cost information's predicted costs to actual costs.

In estimating activity costs decision makers consider previously encountered periodic activity and cost data. Specifically, previous periods' data are considered to determine how costs have changed from period to period in response to changes in each activity for those periods. Consideration of such previous periods' data is important especially for decision makers who possess incorrect prior cost information, because adjustments should be made from incorrect prior cost information to estimate activity costs accurately. When operating under a single cost pool system, decision makers' consideration of previously encountered activity and cost data often is based on memory, because previous periods' activity data are unavailable from their original nonaccounting system source(s). Therefore, the following research question is examined: (1) At the time activity costs are estimated, do decision makers provided with incorrect prior cost information exhibit a bias when considering from memory previously encountered periodic activity and cost data?

The cost system literature implies that multiple cost pool systems (e.g., ABC) that generate inaccurate cost rates do not improve decision makers' activity cost estimation accuracy. An important distinction between single and multiple cost pool systems receiving little attention in the literature is the difference in the activity data provided by the two systems, including systems that generate inaccurate cost rates. Single cost pool systems provide activity data only for a single activity, whereas multiple cost pool systems provide activity data for multiple activities. Thus, at the time decision makers estimate the activity cost for multiple activities, multiple cost pool systems provide previous periods' data for these additional activities. The provision of previous periods' data for these additional activities represents the incremental information content of multiple cost pool systems over single cost pool systems examined in this paper. Providing these incremental activity data when activity costs are estimated means that decision makers' consideration of such data does not depend on memory. Therefore, the following research question also is examined: (2) Can the incremental activity data provided by an inaccurate multiple cost pool system improve decision makers' cost estimation accuracy over the activity data from an inaccurate single cost pool system?

Chapter Two develops theoretical arguments based on a review of relevant cost accounting and psychology literature to form a conceptual diagram of the activity cost estimation process. Hypotheses are derived from the theoretical-based conceptual diagram and are designed to help answer the two research questions. Decision makers are expected to exhibit a prior information-confirming bias when considering from memory previous periods' activity and cost data. Specifically, decision makers are expected to perceive from memory that periodic predicted costs, calculated using their prior cost information, are more consistent with periodic actual costs than they are in reality. Hypothesis 1a and 1b predict that decision makers with incorrect prior cost information underestimate AVGD and GRTD relative to the actual AVGD and GRTD, respectively. Also, decision makers are expected to be unable to recall the activity data for those previous periods in which predicted costs are inconsistent with actual costs, meaning that such activity data are unavailable to decision makers when they estimate activity costs. Hypothesis 1c predicts that decision makers with incorrect prior cost information cannot recall the change in the activity data for the months in which the actual cost change is inconsistent with their prior information's predicted cost change. The expected result of the confirmation bias is that decision makers' adjustments from their prior cost information are reduced. Reduced adjustments from prior cost information translates into reduced cost estimation accuracy when prior cost information is incorrect. Thus, the extent of the confirmation bias is expected to be negatively associated with activity cost estimation accuracy for decision makers with incorrect prior cost information. Hypothesis 1d predicts that activity cost estimation accuracy is negatively associated with AVGD underestimation for decision makers with incorrect prior cost information.

Of particular importance is the ability of decision makers with incorrect prior cost information to recognize that adjustments from their incorrect information should be made if activity costs are to be estimated accurately. Multiple cost pool systems, including many that suffer from various design problems, can provide decision makers with previous periods' data for multiple activities, rather than only a single activity as provided by single cost pool systems. The multiple cost pool system's provision of these incremental activity data is expected to mitigate the extent of the prior information-confirming bias, thereby increasing cost estimation accuracy for decision makers with incorrect prior cost information. The multiple cost pool system's biased cost rates are relatively more accurate than the incorrect prior cost information and relatively less accurate than the correct prior cost information. Thus, Hypothesis 2 predicts that relative to the single cost pool system, the multiple cost pool system is associated with increased decision maker cost estimation accuracy when their prior information is incorrect and decreased decision maker cost estimation accuracy when their prior information is correct.

A third cost system, multiple rates with single year-end activity, controls for the influence of providing biased cost rates on cost estimation accuracy. This cost system condition permits a direct test of the association between providing previous periods' activity data and cost estimation accuracy. Thus, Hypothesis 3 predicts that relative to the multiple rates with single year-end activity system, the multiple cost pool system is associated with increased decision maker cost estimation accuracy when their prior information is incorrect and has no association with decision maker cost estimation accuracy when their prior information is correct.

5.2 Summary of Research Method and Results

This research employs a laboratory experiment to test the hypotheses. A total of 107 MBA and undergraduate accounting students participated in the experiment. The experiment manipulates the prior cost information - correct or incorrect – provided to decision makers concerning the activity costs to be expected in the subsequently presented data set. The experiment also manipulates the cost system type - single cost pool, multiple rates with single year-end activity, or multiple cost pool - to which decision makers are assigned. Cost system type determines whether decision makers are provided with a cost rate for a single or multiple activities and whether decision makers are provided with previous periods' data for a single or multiple activities when they estimate activity costs. Thus, prior cost information and cost system type serve as the two independent variables in the 2 x 3 between-subjects design.

The experiment contains three tasks – a cost differences estimation task, an activity data recall task, and an activity cost estimation task. The first two tasks are memory-based and examine whether decision makers exhibit a prior cost information-confirmation bias when considering previously encountered periodic activity and cost data. The decision maker's AVGD estimate and GRTD estimate serve as the dependent variables for the cost differences estimation task and are used in tests of Hypothesis 1a and Hypothesis 1b, respectively. The number of inconsistent actual cost changes for which the decision maker accurately recalls the corresponding changes in both Parts and PRuns serves as the dependent variable for the activity data recall task and is used in tests of Hypothesis 1c. The third task examines decision makers' ability under various prior cost information and cost system conditions to estimate the activity cost for each of the three activities contained in the previously encountered data set. Total activity cost estimation accuracy serves as the dependent variable for the activity cost estimation task and is used in tests of Hypotheses 2 and 3.

Hypotheses 1a and 1b are supported, because decision makers with incorrect prior cost information underestimated AVGD and GRTD relative to the actual AVGD and GRTD. Also, Hypothesis 1c is supported, because decision makers with incorrect prior cost information were unable to recall the changes in activity data for the months in which the actual cost change is inconsistent with their prior cost information's predicted cost change. However, further analysis reveals that decision makers were unable to recall the change in activity data for any month, regardless of whether the month's actual cost change is consistent or inconsistent with their prior cost information's predicted cost change. Thus, decision makers estimate from memory that their incorrect prior information's predicted costs were more consistent with (i.e., closer to) actual costs than they were in reality. Also, previous months' activity data were not available from decision makers' memory recall when they estimated activity costs. Hypothesis 1d is supported, as evidenced by a negative association between decision makers' AVGD underestimation and their activity cost estimation accuracy. Thus, the extent of decision makers' prior cost information-confirmation bias is negatively associated with their activity cost estimation accuracy.

The contrast model test results support Hypothesis 2 and Hypothesis 3. The two multiple cost pool system elements contained in the cost system manipulation are the provision of a biased cost rate for each activity and the year-end provision of previous months' data for each activity (see Figure 2). Given the cost system manipulation and the support found for Hypotheses 2 and 3, conclusions can be drawn concerning the association between each of these two cost system elements and activity cost estimation accuracy in the present experiment. The provision of biased cost rates is associated with decreased (increased) activity cost estimation accuracy for decision makers with correct (incorrect) prior cost information. More importantly, the provision of previous months' activity data is associated with increased activity cost estimation accuracy for decision makers with incorrect prior cost information and not associated with cost estimation accuracy for decision makers with correct prior cost information. Also, some evidence is found suggesting that the provision of previous months' activity data is associated with decreased AVGD underestimation.

This research argues that the year-end provision of previous months' activity data improves activity cost estimation accuracy for decision makers with incorrect prior cost information by reducing their prior cost information-confirming bias. This research also argues that this provision improves activity cost estimation accuracy by making previous months' activity data available to decision makers for use in adjusting their incorrect prior cost information. These argument are displayed in the conceptual diagram of the activity cost estimation process (Figure 1) and the operationalized construct diagram of this process (Figure 12). The results summarized above are consistent with the argument that the provision of previous months' activity data is associated with increased activity cost estimation accuracy because it reduces decision makers' AVGD underestimation bias. Also, the results are consistent with the argument that this provision is associated with increased activity cost estimation accuracy because it makes available at the time of activity cost estimation activity data that are not available from decision makers' memory recall. Overall, these results help explain the way cost systems help decision makers estimate activity costs more accurately.

5.3 Contributions

This research provides insight on decision makers' memory-based estimation and recall involving quantitative numerical data that either are consistent or inconsistent with their prior information. Recall research focuses primarily on the number of pieces of qualitative evidence individuals recall that either are consistent or inconsistent with their prior information. Such studies do not capture decision makers' estimates of the extent to which quantitative evidence is inconsistent with their prior information. Accurate estimation of the extent of inconsistency of quantitative evidence is argued to be important in many settings, such as activity cost estimation. For example, this research provides evidence that decision makers exhibit a prior cost information-confirming bias in estimating that their prior cost information more accurately predicts actual costs (i.e., underestimate actual and predicted cost differences) than it does in reality (Hypotheses 1a and 1b). Also, the extent of this confirmation bias is shown to play an important part in the activity cost estimation process (Hypothesis 1d). Therefore, this research contributes to the literature by examining whether decision makers' memory-based estimation and recall of quantitative numerical data favors data that are consistent or inconsistent with their prior cost information.

The ability of individuals to use simultaneously provided accurate and inaccurate feedback in estimating parameters (e.g., activity costs) has received little research attention even though inaccurate feedback is common in reality. Because of the prevalence of inaccurate activity cost rates generated by flawed cost systems, the activity cost estimation task provides an effective opportunity for studying this feedback combination. Decision makers with incorrect prior cost information and biased activity cost rates are able to estimate activity costs more accurately when previous months' accurate total cost and activity data are provided than when such data are not provided. Thus, this research demonstrates that inaccurate feedback (e.g., biased cost rates) does not necessarily render accurate feedback (e.g., previous periods' activity data) useless to decision makers when estimating activity costs.

Finally, the most important contribution of this research is the finding that providing previous months' data for each activity is associated with increased activity cost estimation accuracy for decision makers with incorrect prior cost information (Hypotheses 2 and 3). This provision is associated with increased activity cost estimation accuracy even though decision makers are given biased cost rates from their flawed multiple cost pool system. Thus, multiple cost pool systems, even those that generate inaccurate activity cost rates, can help decision makers with incorrect prior cost information improve their activity cost estimation accuracy.

The type of data provided to decision makers and data availability for decision makers are important issues to designers of cost information systems and particularly for system integration (Kaplan and Cooper 1998; Libby 1981). The finding that the provision of previous periods' activity data is associated with increased cost estimation accuracy helps explain the way cost systems help decision makers estimate activity costs more accurately. This finding has implications for how cost systems might be designed to improve decision makers' activity cost estimation accuracy. Multiple cost pool systems should attempt to generate cost rates that are as accurate as possible given available resources. However, multiple cost pool systems also should focus on making previous periods' activity data readily available to decision makers when accurate estimates of activity costs are important decision inputs. Despite generating biased cost rates, many inaccurate multiple cost pool systems are still capable of providing decision makers with accurate previous periods' activity data. Providing historical activity data might require effort in integrating the firm's cost system and information system. Therefore, as discussed in the following section, the cost of providing such activity data must be considered.

5.4 Limitations

As with any laboratory experiment, limitations should be considered when generalizing the results to environments different from the setting designed in the paper's experiment. For example, extremely inaccurate cost rates might be so detrimental to activity cost estimation accuracy for decision makers with incorrect prior cost information that they more than offset any estimation benefit arising from the provision of previous periods' activity data. In such a case, an inaccurate multiple cost pool system's provision of previous periods' activity data might not have the positive association with activity cost estimation accuracy found in this paper.

Also, the cost of storing, accessing, and then providing previous periods' data for each activity when decision makers estimate activity costs might be considerable depending on the firm's cost information system. The combined cost of storing, accessing, and providing previous periods' activity data must be calculated and weighed against the benefit of improved activity cost estimation demonstrated in this paper. However, these potentially significant activity data provision costs are ignored in this paper.

Furthermore, this research assumes that the activity data provided to decision makers is accurate. In reality, the activity data provided to decision makers might not be accurate. For example, measuring activity data accurately might be too costly or technologically unfeasible.

In addition, tests of association are employed to evaluate the experimental data collected in this paper's experiment. Therefore, causality cannot be concluded. Instead, results can only be interpreted as being consistent or inconsistent with the developed theoretical arguments. A causal approach would be beneficial for inferring causality and perhaps for continuing to develop a better understanding of the cost estimation process.

Finally, this paper uses students as surrogates for real-world decision makers, which can lead to potential external validity problems. To address this issue, this paper uses MBA students with considerable business experience and attempts to control for, among other factors, the effect of experience, mathematical ability, and level of education on task performance. However, caution should still be used when attempting to generalize results obtained using student decision makers to the population of real-world decision makers estimating activity costs.

5.5 Future Research Directions

Cost system research demonstrates that for various reasons generating accurate activity cost rates from multiple cost pool systems can be difficult or even impossible. This paper finds that the provision of previous periods' activity data at the time activity costs are estimated is associated with increased activity cost estimation accuracy for decision makers with incorrect prior cost information. Thus, this provision is identified as a possible alternate mechanism by which multiple cost pool systems can improve activity cost estimation accuracy for decision makers possessing incorrect prior cost information. Future research might examine other cost system mechanisms by which activity cost estimation accuracy can be improved. Other mechanisms might comprise studying whether the actual process of developing a multiple cost pool system, including the assignment of costs to pools, helps those involved better understand their environment and thus improve their activity cost estimation.

Future research also might examine how accurately firms measure activity data. The costs and technology necessary to measure activity data accurately should be addressed as well. Knowledge of such issues would be helpful to firms deciding how to spend limited time and other resources to provide decision makes with accurate activity data versus accurate cost rates.

Also, the multiple cost pool system's biased cost rates are associated with increased activity cost estimation accuracy for decision makers with incorrect prior cost information. This association is expected because the rates are relatively more accurate than the incorrect prior cost information. The provision of previous months' activity data for decision makers with incorrect prior cost information is associated with even greater activity cost estimation accuracy than when only the biased cost rates are provided to decision makers. This latter association is expected because the provision of previous months' activity data demonstrates that the biased cost rates more accurately predict actual costs across all months than does their incorrect prior cost information. This allows decision makers to adjust even further from their incorrect prior cost information thereby resulting in more accurate activity cost estimates than when such data are not provided. Thus, these decision makers appear to understand how to use the provision of previous periods' activity data to improve the accuracy of their activity cost estimates relative to their incorrect prior cost information.

However, the multiple cost pool system's biased cost rates are associated with decreased activity cost estimation accuracy for decision makers with correct prior cost information. This association is expected because existing research shows that decision makers place some emphasis on feedback provided in the form of cost rates. However, decision makers' correct prior cost information more accurately predicts actual costs each month than do the biased cost rates. Although decision makers reported that they understood that the cost rates provided by the cost system might not be accurate they still placed some emphasis on the biased, relatively less accurate cost rates. Also, the provision of previous months' activity data when cost were estimated again demonstrated that the correct prior information more accurately predicts actual costs each month than did the biased cost rates. Despite this, however, the provision of previous months' activity data for decision makers with correct prior cost information is not associated with cost estimation accuracy. Decision makers still placed some emphasis on the relatively less accurate cost rates as evidenced by a negative association between cost rates provision and activity cost estimation accuracy for decision makers with correct prior cost information.

A continued examination of the relationship between activity cost estimation accuracy and inaccurate activity cost rates would be beneficial to understanding how cost rates affect decision makers' activity cost estimation accuracy. For example, under what task conditions do decision makers with a correct understanding of their environment (correct prior information) realize that the provision of previous periods' accurate total costs and activity data indicates that the cost rates are inaccurate and should be ignored? Is there a point at which the cost rates become so inaccurate that the provision of previous periods' activity data is erroneously ignored? Alternatively, do decision makers realize when the cost rates eventually become extremely inaccurate and correctly ignore such cost rates in favor of the provision of previous periods' accurate total cost and activity data? Answers to such questions and an understanding of how to get decision makers to focus on accurate data and ignore inaccurate data is an important issue given the prevalence of inaccurate data (e.g., biased activity cost rates) from cost systems. Future research also should examine how cost systems might help decision makers accomplish the objective of appropriately attending to or ignoring accurate and inaccurate cost system data.

APPENDICES

APPENDIX A

Information Sheet
Incorrect Prior Cost Information condition
Multiple Cost Pool or Multiple Rates with Single Year-end Activity condition

You are the manager of one of several manufacturing plants within the Reynolds Corporation. In order to adapt to customer demands, management has decided to change your plant's production process for the upcoming year. The plant will upgrade its products, focusing on producing more complex products, with each possessing unique features. Several other plants within the Reynolds Corporation have recently adopted similar production processing change strategies. After discussion with the experienced managers of these other plants, each of whom has proven to be very successful and insightful, it is clear that there are three important activities that drive total overhead costs in the new production process your plant has adopted: (1) the number of Machine Hours incurred each month, (2) the number of Parts used in production each month, and (3) the number of Production Runs incurred each month. Specifically, each one-unit change in **Machine Hours** incurred during the month should lead to about a **$125** change in total overhead costs. Also, each one-unit change in **Parts** used in production during the month should lead to about a **$500** change in total overhead costs. Finally, each one-unit change in **Production Runs** incurred during the month should lead to about a **$2,500** change in total overhead costs, due mainly to the scheduling activities for machinery and workers that must be performed for each production run. Thus,

COST DRIVER:	IMPACT ON COSTS:
each **Machine Hour**	**$125**
each **Part**	**$500**
each **Production Run**	**$2,500**

The individual activity costs that comprise the costs associated with each of the three activities - number of Machine Hours incurred each month, number of Parts used in production each month, and number of Production Runs incurred each month - vary somewhat from month to month due to the random influence of various factors. For example, the cost of electricity, which affects certain activity costs for each of the three activities, can increase or decrease from month to month. *This random variation can cause the cost of incurring an additional Machine Hour, Part in production, or Production Run for particular months to be greater or less than predicted. As a result, the actual change in total overhead costs from one month to the next might not be exactly equal to the change in total overhead costs predicted from the changes in the levels of each of the three activities.* Therefore, the believed impact on costs of each activity ($125

APPENDIX A (cont'd)

for Machine Hours, $500 for Parts, and $2,500 for Production Runs) is the average belief over a number of months.

In addition to the costs associated with the three activities listed above, total overhead costs each month also contain some amount of fixed costs that do not vary with the level of any of the three activities identified above. These capacity-related costs are costs to which the company is committed, regardless of how many Machine Hours, Parts, or Production Runs are incurred or used.

Also, your plant's **cost system**, employed by all plants of Reynolds Corporation, accurately measures actual total overhead costs (and the actual change in total overhead costs from month to month) and the changes in the levels of the three activities from month to month. However, the cost system has a difficult time determining exactly which of the individual activity costs that comprise total overhead costs are associated with each of the three activities. *In other words, the exact portion of total overhead cost that relates to or arises from the number of Machine Hours incurred, the number of Parts in production, and the number of Production Runs incurred might not be perfectly determined by the cost system.* As a result, the portion of total overhead costs assigned to each of the three cost pools in the cost system, and therefore the resulting costing rate for each of the three cost pools, might not be accurate.

APPENDIX B

Brief Distractor Task
All conditions

1. What is your sex? Male ____; Female ____

2. How many years of professional business experience do you possess? ____

3. Do you have any professional experience in using cost accounting information?
   Please circle one: Yes No
   If YES, how many years of such experience? ____
   If YES, please explain your experience
   briefly:______________________________________

4. What was your SAT score? _______ What was your GMAT score? _______

   What is your GPA? _______

5. What degree are you currently pursuing? (please check one)

   Undergraduate ______ M.B.A. ______ Ph.D. ______

6. How many statistics courses have you completed? ______

APPENDIX C

Cost Differences Estimation Task and Activity Data Recall Task
Incorrect Prior Cost Information condition
All Cost System conditions

For each of the previous months, you calculated the predicted (given the information sheet) monthly change in total overhead costs. The actual monthly change in total overhead costs was provided on each associated monthly cost report. Consider the *difference* each month between the predicted monthly change in total overhead costs and the associated actual monthly change in total overhead costs (there were eleven monthly changes).

1. What was the **average** *difference* between the predicted change in total overhead costs and the actual change in total overhead costs across all eleven monthly changes? Disregard the sign of the difference - i.e., consider the absolute value of the difference each month.

   Average *difference* = $________

2. What was the **greatest** *difference* between the predicted change in total overhead costs and the actual change in total overhead costs across all eleven monthly changes? Disregard the sign of the difference - i.e., consider the absolute value of the difference each month.

   Greatest *difference* = $________

APPENDIX C (cont'd)

Again, consider the *difference* each month between the predicted monthly change in total overhead costs and the associated actual monthly change in total overhead costs (there were eleven monthly changes).

3. In how many months was the actual change in total overhead costs **approximately equal (within $0 - $10,000)** to the predicted change in total overhead costs? That is, approximately equal to a $125 change in total costs per Machine Hour, a $500 change in total costs per Part, and a $2,500 change in total costs per Production Run? (there were eleven monthly changes in total)

Number of such months = ________

4. In how many months was the actual change in total overhead costs **different (more than $10,000)** from the predicted change in total overhead costs? That is, different by more than $10,000 from a $125 change in total costs per Machine Hour, a $500 change in total costs per Part, and a $2,500 change in total costs per Production Run? (there were eleven monthly changes in total)

Number of such months = ________

APPENDIX C (cont'd)

Below is a partial list of the twelve months of actual data concerning the three activities (MH, Parts, and Production Runs) and Actual Total Costs you saw earlier.

Please fill in the data that you can remember on the blank lines below. Thus, for each month, fill in the # of Parts and the # of Production Runs and then calculate the monthly change on each double line immediately below each blank single line as has been provided each month for MH.

MONTH	# MH	# PARTS	# PRUNS	ACTUAL TOTAL COSTS
Jan	480	____	____	$163,000
Feb	360	____	____	$153,000
actual monthly change =	-120	____	____	-$10,000
Mar	300	____	____	$165,500
actual monthly change =	-60	____	____	$12,500
Apr	480	____	____	$163,000
actual monthly change =	180	____	____	-$2,500
May	300	____	____	$195,500
actual monthly change =	-180	____	____	$32,500
Jun	360	____	____	$153,000
actual monthly change =	60	____	____	-$42,500
Jul	300	____	____	$118,500
actual monthly change =	-60	____	____	-$34,500
Aug	300	____	____	$104,500
actual monthly change =	0	____	____	-$14,000
Sep	300	____	____	$147,500
actual monthly change =	0	____	____	$43,000
Oct	240	____	____	$132,000
actual monthly change =	-60	____	____	-$15,500
Nov	300	____	____	$125,500
actual monthly change =	60	____	____	-$6,500
Dec	120	____	____	$119,000
actual monthly change =	-180	____	____	-$6,500

APPENDIX D

Activity Cost Estimation Task
All conditions

It is the end of the year (1998) and time to make predictions for the following month's (January, 1999) budget for total overhead costs. **Your "take home" pay for this exercise will be based on the accuracy of your cost predictions. Also, the top performers will receive an additional monetary bonus** . *Fixed costs* (i.e., any portion of total overhead costs that do not change as the three activities change) are projected to remain *unchanged* from December 1998 to January 1999. The data on the year-end cost report are exactly the same as the data that were contained on each monthly cost report. The year-end cost report simply condenses the data onto one page to make them easier to use in making cost predictions for January (1999).

As you did previously, calculate for each month the predicted change in costs given the beliefs about each activity's impact on costs provided on the information sheet. Then, compare the predicted change in costs to the actual change in costs as was provided on each monthly cost report and the year-end cost report. Ignoring the beliefs provided on the information sheet about the impact of each activity on total overhead costs, and based solely on the twelve months of data concerning the month to month changes in each activity and in total overhead costs, what is the best prediction of the impact of Machine Hours, Parts, and Production Runs on costs (i.e., the impact on total costs of MH, Parts, and Production Runs that each month produces the predicted change in costs that is the closest to the actual change in costs)? In other words:

1. by how much should total overhead costs increase from December (1998) to January (1999) if the # of **MHs** increases by 1 from December (1998) to January (1999)?$____

2. by how much should total overhead costs increase from December (1998) to January (1999) if the # of **Parts** increases by 1 from December (1998) to January (1999)?$____

3. by how much should total overhead costs increase from December (1998) to January (1999) if the # of **PRuns** increases by 1 from December (1998) to January (1999)?$____

APPENDIX D (cont'd)

4. How confident were you in the accuracy of your cost prediction involving **Machine Hours**?

|------- |-------- |-------- |-------- |-------- |-------- |-------- |-------- |-------- |--------- |

0	10	20	30	40	50	60	70	80	90	100
Not confident at all					Somewhat confident					Very confident

5. How confident were you in the accuracy of your cost prediction involving **Parts**?

|------- |-------- |-------- |-------- |-------- |-------- |-------- |-------- |-------- |--------- |

0	10	20	30	40	50	60	70	80	90	100
Not confident at all					Somewhat confident					Very confident

6. How confident were you in the accuracy of your cost prediction involving **Production Runs**?

|------- |-------- |-------- |-------- |-------- |-------- |-------- |-------- |-------- |--------- |

0	10	20	30	40	50	60	70	80	90	100
Not confident at all					Somewhat confident					Very confident

End Time: ____________

APPENDIX E

Exit Questionnaire

1. At the **beginning** of the experiment, you were told that each one-unit change in **Machine Hours** incurred during the month should lead to a change in total overhead costs of: (check the appropriate response)

_____ about $125

_____ about $500

_____ about $2,500

_____ unsure

2. At the **beginning** of the experiment, you were told that each one-unit change in **Parts** used in production during the month should lead to a change in total overhead costs of: (check the appropriate response)

_____ about $125

_____ about $500

_____ about $2,500

_____ unsure

3. At the **beginning** of the experiment, you were told that each one-unit change in **Production Runs** incurred during the month should lead to a change in total overhead costs of: (check the appropriate response)

_____ about $125

_____ about $500

_____ about $2,500

_____ unsure

4. A portion of my total earnings was based upon the accuracy of my predictions concerning the impact of each of the three activities on total overhead costs: (please check ONE)

    ____ True
    ____ False
    ____ Unsure

5. At the beginning of the first month, by what amount did you expect total overhead costs would change for each one-unit change in **Machine Hours?**

|-------|--------|--------|--------|---------|---------|--------|--------|--------|--------|

$0 $250 $500 $750 $1,000 $1,250 $1,500 $1,750 $2,000 $2,250 $2,500

6. At the beginning of the first month, by what amount did you expect overhead costs would change for each one-unit change in **Parts**?

|-------|--------|--------|--------|---------|---------|--------|--------|--------|--------|

$0 $250 $500 $750 $1,000 $1,250 $1,500 $1,750 $2,000 $2,250 $2,500

7. At the beginning of the first month, by what amount did you expect overhead costs would change for each one-unit change in **Production Runs**?

|-------|--------|--------|--------|---------|---------|--------|--------|--------|--------|

$0 $250 $500 $750 $1,000 $1,250 $1,500 $1,750 $2,000 $2,250 $2,500

8. The cost system provided cost rate(s) as estimates of the impact of the activity(s) on total overhead costs. I was told that these cost rate(s):

|------|-------|-------|-------|-------|-------|-------|-------|-------|--------|

0 10 20 30 40 50 60 70 80 90 100

would definitely be accurate ... might not be accurate

APPENDIX E (cont'd)

9. When engaging in the experiment and making predictions of total overhead costs for January, 1999, how did you view your role as the plant manager? (please check ONE)

____ I viewed my role as a manager trying to *verify* that the beliefs of activity-total overhead cost relationships provided to me at the beginning of the experiment were correct. Thus, I used the cost reports to verify these beliefs.

____ I viewed my role as a manager trying to *disprove* the beliefs of activity-total overhead cost relationships that were provided to me at the beginning of the experiment. Thus, I used the cost reports to disprove the beliefs that were provided to me.

____ I did not view my role as a manager in either of the two ways described above.

10. After seeing each month of data individually, you were given a year-end cost report and asked to make cost predictions assuming that MH, Parts, and Production Runs each increased by one unit from December (1998) to January (1999). When making these cost predictions, to what extent did you TRY to remember the *previous twelve months' of data* concerning the month-to-month changes in *the number of Parts and the number of Production Runs*?

|------|--------|--------|--------|--------|--------|--------|--------|--------|---------|

0	10	20	30	40	50	60	70	80	90	100
Did not try to remember at all					Tried somewhat to remember					Very much tried to remember

Please answer the following questions by circling the extent to which you agree or disagree with each statement. Circling 0 means you strongly disagree with the statement; 50 means that you neither agree nor disagree with the statement; 100 means you strongly agree with the statement.

11. My Year-end Cost Report contained the actual number of MHs for each month.

|------|--------|--------|--------|--------|--------|--------|--------|--------|---------|

0	10	20	30	40	50	60	70	80	90	100
Strongly Disagree					Neutral					Strongly Agree

12. My Year-end Cost Report contained the actual number of Parts for each month.

|------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
0 10 20 30 40 50 60 70 80 90 100
Strongly Disagree — Neutral — Strongly Agree

13. My Year-end Cost Report contained the actual number of Production Runs for each month.

|------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
0 10 20 30 40 50 60 70 80 90 100
Strongly Disagree — Neutral — Strongly Agree

14. My Monthly Cost Reports contained a budgeted Costing Rate for MHs.

|------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
0 10 20 30 40 50 60 70 80 90 100
Strongly Disagree — Neutral — Strongly Agree

15. My Monthly Cost Reports contained a budgeted Costing Rate for Parts.

|------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
0 10 20 30 40 50 60 70 80 90 100
Strongly Disagree — Neutral — Strongly Agree

16. My Monthly Cost Reports contained a budgeted Costing Rate for Production Runs.

|------|-------|-------|-------|-------|-------|-------|-------|-------|--------|
0 10 20 30 40 50 60 70 80 90 100
Strongly Disagree — Neutral — Strongly Agree

17. The monthly changes in the levels of the three activities (MH, Parts, and Production Runs) given on the production reports and cost reports were accurate.

|------|-------|-------|-------|-------|-------|-------|-------|-------|--------|

0 10 20 30 40 50 60 70 80 90 100

Strongly Disagree — Neutral — Strongly Agree

18. The random influence of various factors (e.g., cost of electricity) can cause the cost of MH, Parts, or Production Runs, and thus the actual change in total overhead costs, to be greater or less than predicted for particular month(s).

|------|-------|-------|-------|-------|-------|-------|-------|-------|--------|

0 10 20 30 40 50 60 70 80 90 100

Strongly Disagree — Neutral — Strongly Agree

19. How complex was the task of predicting the increases in total overhead costs from December (1998) to January (1999) given the increase in MH, Parts, and Production Runs from December (1998) to January (1999)?

|------|-------|-------|-------|-------|-------|-------|-------|-------|--------|

0 10 20 30 40 50 60 70 80 90 100

Low Complexity — High Complexity

20. At the beginning of the <u>first</u> month, how strongly did you believe that each one-unit change in **Machine Hours** incurred during the month would lead to about a $125 change in total overhead costs?

|------|-------|-------|-------|-------|-------|-------|-------|-------|--------|

0 10 20 30 40 50 60 70 80 90 100

Did not believe it at all — Somewhat believed it — Very much believed it

APPENDIX E (cont'd)

21. At the beginning of the first month, how strongly did you believe that each one-unit change in **Parts** used in production during the month would lead to about a $500 change in total overhead costs?

|-------|--------|--------|--------|--------|--------|--------|--------|--------|---------|

0	10	20	30	40	50	60	70	80	90	100
Did not believe it at all					Somewhat believed it					Very much believed it

22. At the beginning of the first month, how strongly did you believe that each one-unit change in **Production Runs** incurred during the month would lead to about a $2,500 change in total overhead costs?

|-------|--------|--------|--------|--------|--------|--------|--------|--------|---------|

0	10	20	30	40	50	60	70	80	90	100
Did not believe it at all					Somewhat believed it					Very much believed it

23. Do you have any professional experience using Activity-Based Costing Information?
Please circle one: Yes No
If YES, how many years of such experience? ____
If YES, please explain your experience briefly:____

APPENDIX F

Task Procedures and Script

Make sure each form received by a given participant has the same unique participant #. Bring Experimental Materials Checklist to experiment.

1. Hand out Informed Consent form, pencil, and calculator to each participant as they enter room. Have participants fill out form.

"Toward the bottom of the Consent form there is a dotted line. Please tear off the bottom portion of the form along the dotted line and keep the bottom portion with the number. Thank you."

Collect top portion of Consent forms.

2. "Welcome to the exercise and thank you for your participation. I appreciate your time and hopefully you will find the experience somewhat profitable".

3. Introduction and practice periods. Read the following description to participants of the kind of predictions they will be making. This explains to them the reason for making their subsequent cost predictions and how they should be made. Calculations, such as the predicted change in total overhead costs will be performed on an overhead projector.

"We are going to be looking at several factors that drive firms' overhead costs. Some people refer to these factors as cost drivers, others refer to them as activities. In either case they are the factors that cause a firm to incur overhead costs. Let's assume that within our particular production plant there are three such activities, or cost drivers, that account for the majority of our plant's overhead costs. If as managers we possess a belief or expectation about the impact of each of the three activities on total overhead costs, then we can observe how each activity changes from one period to the next and come up with a prediction of how overhead costs should change from one period to the next. Predicting how overhead costs should change from one period to the next is a very important task for many managers. For example, suppose as managers we possess the belief from our own experiences or from conversations with other managers that each one-unit change in activity X_1 will lead to a \$20 change in total overhead costs, each one-unit change in activity X_2 will lead to a \$10 change in total overhead costs, and each one-unit change in activity X_3 will lead to a \$5 change in total overhead costs. If from period 1 to period 2 we observe that the level of activity X_1 increases from 4 to 6, which is an increase of 2 units of X_1, then 2 multiplied by our \$20 believed impact on costs of each unit of X_1 leads to a predicted increase in costs from period 1 to period 2 of \$40, given what happened to X_1 from period 1 to period 2. Similarly, if from period 1 to period 2 we observe that the level of activity X_2 decreases from 10 to 7, which is a decrease of 3 units of X_2, then 3 multiplied by our $10 believed impact on costs of each unit of X_2 leads to a predicted or expected decrease in costs from period 1 to period 2 of $30, given what happened to X_2 from period 1 to period 2. Finally, if from period 1 to period 2 we observe that the level of activity X_3 increases from 3 to 7, which is an increase of 4 units of X_3, then 4 multiplied by our $5 believed impact on costs of each unit of X_3 leads to a predicted increase in costs from period 1 to period 2 of $20, given what happened to X_3 from period 1 to period 2. Given that we know that these three activities account for the majority of our plant's overhead costs, we can net the three predictions against each other and come up with our prediction for how total overhead costs should change from period 1 to period 2. Netting out the three (an increase of $40, a decrease of $30, and an increase of $20) against each other we come up with a predicted increase in total overhead costs of $30."

"We then can turn to the cost report for the same time period to see the actual change in total overhead costs from period 1 to period 2. Thus, we can compare the **predicted** change in costs to the **actual** change in total overhead costs, which will give us an indication of how accurate our beliefs (the $20, $10, and $5) are about each activity's impact on overhead costs. As managers trying to predict costs we want our predictions to be as close to the actual change in costs as possible. The cost report also provides a costing rate for each activity's impact on costs [for participants in the single cost pool system the discussion explains that the cost report provides a costing rate for only one of the three activities, but that actual total overhead costs still represents the costs of all three activities]. The costing rates represent the cost system's estimate of each activity's impact on total overhead costs (i.e., the amount by which total overhead costs will increase or decrease as a result of increases or decreases in activity levels). The costing rates are based on various assumptions and budgeted numbered estimated at the beginning of the year and can therefore be of varying accuracy. More information concerning the costing rates will be provided later."

"I will now pass out a practice production report and a practice cost report. Using the beliefs of $20, $10, and $5 for activity X_1, X_2, and X_3, respectively, that we used on the overhead a minute ago, calculate on the production report the predicted change in costs and then look at the cost report to compare the predicted change in costs to the actual change in costs to see how far off the predicted is to the actual change in costs. We'll then talk about the reports."

Pass out practice period 2 production report and practice period 2 cost report. Give participants the same type of cost report that they will receive during the actual experiment- either SINGLE, MULTIPLE, or, MRSYA. After several minutes go over practice period 2 reports on overhead.

"Looking at the production report we calculate the predicted change in costs to be an increase of $30. So we think that costs should increase by about $30. Did they actually go up by $30? We refer to the practice cost report for the same time period. The cost report indicates that the actual change in costs is $20 [circle the column title 'Actual change in total overhead costs' and the '$20' change in actual costs]. We thought costs would increase by $30 and they actually increased by $20, so we were off by $10. The cost report also contains costing rates as we discussed before [circle the 'Activity' column title and the 'Costing Rate' column]. Are there any questions at this point? I'm going to pass out one more practice production report and practice cost report. Using the same beliefs as before ($20, $10, and $5) calculate on the production report the predicted change in costs and then compare the prediction to the actual change in costs on the cost report. We'll then discuss the reports in a little more detail."

Pass out practice period 3 production report and practice period 3 cost report. After several minutes go over practice period 3 reports on overhead.

"On period 3's production report we see that X_1 decreases by 1 multiplied by our $20 believed impact on costs leads to a predicted decrease in costs of $20 from period 2 to period 3 given the change in X_1 from period 2 to period 3. The level of X_2 did not change from period 2 to period 3 so there should not be any change in total costs associated with X_2 from period 2 to period 3. Finally, X_3 increased by 2 multiplied by our $5 believed impact on costs of each unit of activity X_3 leads to a predicted increase of $10. So the predicted change in total overhead costs from period 2 to period 3 is a decrease of $10. Did actual costs decrease by $10? Let's turn to the cost report. The actual change in total overhead costs is a decrease of $15 [circle the column title 'Actual change in total overhead costs' and the '$20' change in actual costs]. Again, the cost report provides the same estimated or budgeted costing rates [circle the 'Activity' column title and the 'Costing Rate' column]. Thus, we thought costs would decrease by $10 and they actually decreased by 15, so we were off by $5. The other period we thought costs would increase by $30 and they actually increased by $20, so we were off by $10. What does that mean? We want to see how close the predicted change in costs, based upon our beliefs about each activity's impact on costs, is to the actual change in costs and whether these beliefs appear to generate the prediction that is as close as possible to the actual change in costs. It is rare that the actual change in costs is exactly equal to the predicted change in costs, because actual costs are rather complex. So why specifically might there be differences between the predicted change in costs and the actual change in costs? Differences could result for several reasons. It could be that there are some random variation in actual costs. For example, we believe that X_1 has on average about a $20 impact on total overhead costs. But it might be that at the end of one period out some of the plant's employees go on vacation and it has to hire some replacement workers at the last minute, which costs a little more than usual. Thus, for that period each unit of X_1 (direct labor hours) costs $22. Several periods later just the opposite might happen and each unit of X_1 (direct labor hours) costs $18. But on average our belief of $20 per unit of X_1 (direct labor hours) is pretty accurate, there is just some random variation around the

$20 in some periods. So random variation is one reason why the predicted and actual cost changes might be different certain periods. Or it might be that one or more of our beliefs ($20, $10, and $5) concerning the impact of each activity on costs is incorrect. This would cause the predicted change in costs to be different from the actual change in costs. Or it might be a combination of the two - random variation in actual costs and one or more of our beliefs being wrong - that causes there to be differences between predicted and actual changes in costs. Thus, it could be that our beliefs are accurate and random influences on actual costs cause the actual change in costs to be different from the predicted change in costs, or it could be that our beliefs about one or more of each activity's impact on costs is wrong. Or it could be a combination of the two. It is hard to determine from any one period why there is a difference between the predicted and actual cost change. Several periods of data and additional information about the production environment and costs system would need to be examined to determine why there is any difference between predicted and actual cost changes."

"Are there any questions? Forget about the $20, $10, and $5. These production reports and cost reports were just practice to get us used to calculating the predicted change in costs and using the production and cost reports. Take the practice reports and turn them over, we're not going to be using them anymore."

Collect practice round materials.

4. "I'm going to handout a page of information to you. You'll have this Information Sheet available to you throughout the exercise and will be able to refer to it whenever you want. Please read it carefully and raise your hand if you have any questions. Keep the information page in case you want to refer to it later. Look up when you are finished and ready to move on."

Hand out appropriate Appendix A (Information Sheet) to participants. There are four versions of Appendix A: COR SINGLE, INC SINGLE, COR MULTIPLE, and INC MULTIPLE. MRSYA participants receive the same Appendix A as MULTIPLE participants. Let participants keep Appendix A until Appendix E Exit Questionnaire is handed out.

5. "You will now look at several months' production reports and cost reports and follow the same procedure as the practice rounds, but using the information on the information sheet. Pay attention to the reports. Later on you will be asked several questions about them. Each month, calculate the predicted change in total overhead costs, given the information about Machine Hours, Parts, and Production Runs provided on the Information Sheet. Then, compare the predicted change in costs to the actual change in costs contained on the monthly cost report. You can then see how close the predicted change in costs was to the actual change in costs. Once you are finished examining the production and cost reports, raise your hand and I'll give you the next month's production report and cost report."

6. Hand out the Production Report and appropriate Cost Report (SINGLE, MULTIPLE or MRSYA) for February to each participant.

7. When participant is finished with February's reports, collect them. Then, hand out the Production Report and Cost Report for March. Continue with this process until December's Production Report and Cost Report are collected.

8. Administer brief distractor task (Appendix B) containing demographic information to all each participant. Collect when finished.

* Steps 9 and 10 are counterbalanced such that half of participants receive Appendix C's cost differences/activity data recall tasks first and the other half of participants receive Appendix D's activity cost estimation task first.

9. Administer Appendix C (two versions - COR and INC) to participant for activity data recall test. Collect when finished.

"These are some questions about the data you saw. Please provide your best estimate from memory. Let me know if you have any questions."

10. Handout the Year-end Cost Report for the appropriate cost system condition as well as Appendix D for activity cost estimation task.

"Here is the year-end cost report from the cost system. The numbers on the year-end report are exactly the same numbers that appeared on each monthly cost report. The cost system just condenses the monthly reports at year-end by putting the data onto one page in order to make them easier to use. If you wish, you may use the year-end cost report when you read these paragraphs and respond to the three items below [point to Appendix D]. Let me know if you have any questions. Before you begin, please record the time on top of the first page (above Question 1). When you are finished, please record the time on the second page (after Question 6). Take as much time as you want. Time will not affect your earnings. When you are finished, raise your hand to let me know."

Collect Appendix D and Year-end Cost Report when finished.

11. Collect Appendix A.

12. ONLY for participants who performed the amount estimation task before performing the cost estimation task. Hand out Appendix K.

"These are some questions about the same data you saw during the year. Again, please provide your best estimate from memory. Let me know if you have any questions."

13. Hand out appropriate Appendix E (two versions - COR and INC) to participant for exit questionnaire.

APPENDIX F (cont'd)

"Please respond carefully to these exit questions. Let me know if you have any questions."

Collect Appendix E when finished.

14. When participant is finished with Appendix E inform them of the time and location of the earnings payment session.

"Please bring the little piece of paper that you tore off from the page you read and signed at the beginning of the exercise to the earnings payment session. At that time there will be a two page written explanation of the task, what was being examined, and why I asked you to do what I did. Also, if you have any questions about anything that we did I will be more than happy to answer them. Please do not discuss the exercise with other people until all others have had the opportunity to participate. Again, thank you very much for your participation."

Appendix G

Monthly Cost Reports from the Single Cost Pool System

Cost Report
February 1998

Activity	Applied Manufacturing OH Costs		Actual Change in Total OH Costs	Activity Level		Change in Activity Levels	Budgeted Costing Rate
	Jan98	Feb98		Jan98	Feb98		
Machine Hours	$217,502	$163,127		480	360	-120	$453
variance from budget =	-$54,502	-$10,127					
Actual Total OH Costs =	$163,000	$153,000	-$10,000				

Cost Report
March 1998

Activity	Applied Manufacturing OH Costs		Actual Change in Total OH Costs	Activity Level		Change in Activity Levels	Budgeted Costing Rate
	Feb98	Mar98		Feb98	Mar98		
Machine Hours	$163,127	$135,939		360	300	-60	$453
variance from budget =	-$10,127	$29,561					
Actual Total OH Costs =	$153,000	$165,500	$12,500				

Cost Report
April 1998

Activity	Applied Manufacturing OH Costs		Actual Change in Total OH Costs	Activity Level		Change in Activity Levels	Budgeted Costing Rate
	Mar98	Apr98		Mar98	Apr98		
Machine Hours	$135,939	$217,502		300	480	180	$453
variance from budget =	$29,561	-$54,502					
Actual Total OH Costs =	$165,500	$163,000	-$2,500				

Cost Report
May 1998

Activity	Applied Manufacturing OH Costs		Actual Change in Total OH Costs	Activity Level		Change in Activity Levels	Budgeted Costing Rate
	Apr98	May98		Apr98	May98		
Machine Hours	$217,502	$135,939		480	300	-180	$453
variance from budget =	-$54,502	$59,561					
Actual Total OH Costs =	$163,000	$195,500	$32,500				

Cost Report
June 1998

Activity	Applied Manufacturing OH Costs		Actual Change in Total OH Costs	Activity Level		Change in Activity Levels	Budgeted Costing Rate
	May98	Jun98		May98	Jun98		
Machine Hours	$135,939	$163,127		300	360	60	$453
variance from budget =	$59,561	-$10,127					
Actual Total OH Costs =	$195,500	$153,000	-$42,500				

Cost Report
July 1998

Activity	Applied Manufacturing OH Costs		Actual Change in Total OH Costs	Activity Level		Change in Activity Levels	Budgeted Costing Rate
	Jun98	Jul98		Jun98	Jul98		
Machine Hours	$163,127	$135,939		360	300	-60	$453
variance from budget =	-$10,127	-$17,439					
Actual Total OH Costs =	$153,000	$118,500	-$34,500				

Cost Report
August 1998

Activity	Applied Manufacturing OH Costs		Actual Change in Total OH Costs	Activity Level		Change in Activity Levels	Budgeted Costing Rate
	Jul98	Aug98		Jul98	Aug98		
Machine Hours	$135,939	$135,939		300	300	0	$453
variance from budget =	-$17,439	-$31,439					
Actual Total OH Costs =	$118,500	$104,500	-$14,000				

Cost Report
September 1998

Activity	Applied Manufacturing OH Costs		Actual Change in Total OH Costs	Activity Level		Change in Activity Levels	Budgeted Costing Rate
	Aug98	Sep98		Aug98	Sep98		
Machine Hours	$135,939	$135,939		300	300	0	$453
variance from budget =	-$31,439	$11,561					
Actual Total OH Costs =	$104,500	$147,500	$43,000				

Cost Report
October 1998

Activity	Applied Manufacturing OH Costs		Actual Change in Total OH Costs	Activity Level		Change in Activity Levels	Budgeted Costing Rate
	Sep98	Oct98		Sep98	Oct98		
Machine Hours	$135,939	$108,751		300	240	-60	$453
variance from budget =	$11,561	$23,249					
Actual Total OH Costs =	$147,500	$132,000	-$15,500				

Cost Report
November 1998

Activity	Applied Manufacturing OH Costs		Actual Change in Total OH Costs	Activity Level		Change in Activity Levels	Budgeted Costing Rate
	Oct98	Nov98		Oct98	Nov98		
Machine Hours	$108,751	$135,939		240	300	60	$453
variance from budget =	$23,249	-$10,439					
Actual Total OH Costs =	$132,000	$125,500	-$6,500				

Cost Report
December 1998

Activity	Applied Manufacturing OH Costs		Actual Change in Total OH Costs	Activity Level		Change in Activity Levels	Budgeted Costing Rate
	Nov98	Dec98		Nov98	Dec98		
Machine Hours	$135,939	$54,376		300	120	-180	$453
variance from budget =	-$10,439	$64,624					
Actual Total OH Costs =	$125,500	$119,000	-$6,500				

Appendix H

Monthly Cost Reports from the Multiple Cost Pool System and the Multiple Rates with Single Year-end Activity System

Cost Report
February 1998

Activity Center	Activity	Applied Manufacturing OH Costs		Actual Change in Total OH Costs	Activity Level		Change in Activity Level	Budgeted Costing Rate
		Jan98	Feb98		Jan98	Feb98		
Machine Maintenance	# of MHs	$77,971	$58,478		480	360	-120	$162
Material handling	# of Parts	$45,014	$45,014		30	30	0	$1,500
Production scheduling	# of Prod. runs	$48,004	$48,004		30	30	0	$1,600
	variance from budget =	-$7,989	$1,504					
	Actual Total OH Costs =	$163,000	$153,000	-$10,000				

Cost Report
March 1998

Activity Center	Activity	Applied Manufacturing OH Costs		Actual Change in Total OH Costs	Activity Level		Change in Activity Level	Budgeted Costing Rate
		Feb98	Mar98		Feb98	Mar98		
Machine Maintenance	# of MHs	$58,478	$48,732		360	300	-60	$162
Material handling	# of Parts	$45,014	$63,020		30	42	12	$1,500
Production scheduling	# of Prod. runs	$48,004	$19,202		30	12	-18	$1,600
	variance from budget =	$1,504	$34,547					
	Actual Total OH Costs =	$153,000	$165,500	$12,500				

Cost Report
April 1998

Activity Center	Activity	Applied Manufacturing OH Costs		Actual Change in Total OH Costs	Activity Level		Change in Activity Level	Budgeted Costing Rate
		Mar98	Apr98		Mar98	Apr98		
Machine Maintenance	# of MHs	$48,732	$77,971		300	480	180	$162
Material handling	# of Parts	$63,020	$45,014		42	30	-12	$1,500
Production scheduling	# of Prod. runs	$19,202	$48,004		12	30	18	$1,600
	variance from budget =	$34,547	-$7,989					
	Actual Total OH Costs =	$165,500	$163,000	-$2,500				

Cost Report
May 1998

Activity Center	Activity	Applied Manufacturing OH Costs		Actual Change in Total OH Costs	Activity Level		Change in Activity Level	Budgeted Costing Rate
		Apr98	May98		Apr98	May98		
Machine Maintenance	# of MHs	$77,971	$48,732		480	300	-180	$162
Material handling	# of Parts	$45,014	$72,022		30	48	18	$1,500
Production scheduling	# of Prod. runs	$48,004	$76,806		30	48	18	$1,600
	variance from budget =	-$7,989	-$2,061					
	Actual Total OH Costs =	$163,000	$195,500	$32,500				

Cost Report
June 1998

Activity Center	Activity	Applied Manufacturing OH Costs		Actual Change in Total OH Costs	Activity Level		Change in Activity Level	Budgeted Costing Rate
		May98	Jun98		May98	Jun98		
Machine Maintenance	# of MHs	$48,732	$58,478		300	360	60	$162
Material handling	# of Parts	$72,022	$45,014		48	30	-18	$1,500
Production scheduling	# of Prod. runs	$76,806	$48,004		48	30	-18	$1,600
	variance from budget =	-$2,061	$1,504					
	Actual Total OH Costs =	$195,500	$153,000	-$42,500				

Cost Report
July 1998

Activity Center	Activity	Applied Manufacturing OH Costs		Actual Change in Total OH Costs	Activity Level		Change in Activity Level	Budgeted Costing Rate
		Jun98	Jul98		Jun98	Jul98		
Machine Maintenance	# of MHs	$58,478	$48,732		360	300	-60	$162
Material handling	# of Parts	$45,014	$36,011		30	24	-6	$1,500
Production scheduling	# of Prod. runs	$48,004	$28,802		30	18	-12	$1,600
	variance from budget =	$1,504	$4,954					
	Actual Total OH Costs =	$153,000	$118,500	-$34,500				

Cost Report
August 1998

Activity Center	Activity	Applied Manufacturing OH Costs		Actual Change in Total OH Costs	Activity Level		Change in Activity Level	Budgeted Costing Rate
		Jul98	Aug98		Jul98	Aug98		
Machine Maintenance	# of MHs	$48,732	$48,732		300	300	0	$162
Material handling	# of Parts	$36,011	$18,006		24	12	-12	$1,500
Production scheduling	# of Prod. runs	$28,802	$67,206		18	42	24	$1,600
	variance from budget =	$4,954	-$29,443					
	Actual Total OH Costs =	$118,500	$104,500	-$14,000				

Cost Report
September 1998

Activity Center	Activity	Applied Manufacturing OH Costs		Actual Change in Total OH Costs	Activity Level		Change in Activity Level	Budgeted Costing Rate
		Aug98	Sep98		Aug98	Sep98		
Machine Maintenance	# of MHs	$48,732	$48,732		300	300	0	$162
Material handling	# of Parts	$18,006	$45,014		12	30	18	$1,500
Production scheduling	# of Prod. runs	$67,206	$57,605		42	36	-6	$1,600
	variance from budget =	-$29,443	-$3,851					
	Actual Total OH Costs =	$104,500	$147,500	$43,000				

Cost Report
October 1998

Activity Center	Activity	Applied Manufacturing OH Costs		Actual Change in Total OH Costs	Activity Level		Change in Activity Level	Budgeted Costing Rate
		Sep98	Oct98		Sep98	Oct98		
Machine Maintenance	# of MHs	$48,732	$38,986		300	240	-60	$162
Material handling	# of Parts	$45,014	$45,014		30	30	0	$1,500
Production scheduling	# of Prod. runs	$57,605	$48,004		36	30	-6	$1,600
	variance from budget =	-$3,851	-$4					
	Actual Total OH Costs =	$147,500	$132,000	-$15,500				

Cost Report
November 1998

Activity Center	Activity	Applied Manufacturing OH Costs		Actual Change in Total OH Costs	Activity Level		Change in Activity Level	Budgeted Costing Rate
		Oct98	Nov98		Oct98	Nov98		
Machine Maintenance	# of MHs	$38,986	$48,732		240	300	60	$162
Material handling	# of Parts	$45,014	$36,011		30	24	-6	$1,500
Production scheduling	# of Prod. runs	$48,004	$38,403		30	24	-6	$1,600
	variance from budget =	-$4	$2,354					
	Actual Total OH Costs =	$132,000	$125,500	-$6,500				

Cost Report
December 1998

Activity Center	Activity	Applied Manufacturing OH Costs		Actual Change in Total OH Costs	Activity Level		Change in Activity Level	Budgeted Costing Rate
		Nov98	Dec98		Nov98	Dec98		
Machine Maintenance	# of MHs	$48,732	$19,493		300	120	-180	$162
Material handling	# of Parts	$36,011	$45,014		24	30	6	$1,500
Production scheduling	# of Prod. runs	$38,403	$48,004		24	30	6	$1,600
	variance from budget =	$2,354	$6,489					
	Actual Total OH Costs =	$125,500	$119,000	-$6,500				

Appendix I

The Practice Rounds' Reports: Production Department Reports and Periodic Cost Reports

Production Department Report
Period 2

Activity	Totals		Changes in Activity Levels
	Per1	Per2	
X1	4	6	2
X2	10	7	-3
X3	3	7	4

Given the change in the level of each of the three activities and the beliefs provided on the Information Sheet about each of the activities' impact on total overhead costs, what should be the predicted change in total overhead costs? $__________

Production Department Report
Period 3

Activity	Totals		Changes in Activity Levels
	Per2	Per3	
X1	6	5	-1
X2	7	7	0
X3	7	9	2

Given the change in the level of each of the three activities and the beliefs provided on the Information Sheet about each of the activities' impact on total overhead costs, what should be the predicted change in total overhead costs? $__________

Cost Report
Period 2

Activity	Applied Manufacturing OH Costs		Actual Change in Total OH Costs	Activity Level		Change in Activity Level	Budgeted Costing Rate
	Per1	Per2		Per1	Per2		
X1	$60	$90		4	6	2	$15
X2	$120	$84		10	7	-3	$12
X3	$24	$56		3	7	4	$8
variance from budget =	-$4	-$10					
Actual Total OH Costs =	$200	$220	$20				

Cost Report
Period 3

Activity	Applied Manufacturing OH Costs		Actual Change in Total OH Costs	Activity Level		Change in Activity Level	Budgeted Costing Rate
	Per2	Per3		Per2	Per3		
X1	$90	$75		6	5	-1	$15
X2	$84	$84		7	7	0	$12
X3	$56	$72		7	9	2	$8
variance from budget =	-$10	-$26					
Actual Total OH Costs =	$220	$205	-$15				

Cost Report
Period 2

Activity	Applied Manufacturing OH Costs		Actual Change in Total OH Costs	Activity Level		Change in Activity Levels	Budgeted Costing Rate
	Per1	Per2		Per1	Per2		
X1	$168	$252		4	6	2	$42
variance from budget =	$32	-$32					
Actual Total OH Costs =	$200	$220	$20				

Cost Report
Period 3

Activity	Applied Manufacturing OH Costs		Actual Change in Total OH Costs	Activity Level		Change in Activity Levels	Budgeted Costing Rate
	Per2	Per3		Per2	Per3		
X1	$252	$210		6	5	-1	$42
variance from budget =	-$32	-$5					
Actual Total OH Costs =	$220	$205	-$15				

Appendix J

Monthly Production Department Reports

Production Department Report
February 1998

Activity	Totals Jan98	Totals Feb98	Changes in Activity Levels
Number of machine hours	480	360	-120
Number of parts in production	30	30	0
Number of production runs	30	30	0

Given the change in the level of each of the three activities and the beliefs provided on the Information Sheet about each of the activities' impact on total overhead costs, what should be the predicted change in total overhead costs? $__________

Production Department Report
March 1998

Activity	Totals Feb98	Totals Mar98	Changes in Activity Levels
Number of machine hours	360	300	-60
Number of parts in production	30	42	12
Number of production runs	30	12	-18

Given the change in the level of each of the three activities and the beliefs provided on the Information Sheet about each of the activities' impact on total overhead costs, what should be the predicted change in total overhead costs? $__________

Production Department Report
April 1998

Activity	Totals		Changes in Activity Levels
	Mar98	Apr98	
Number of machine hours	300	480	180
Number of parts in production	42	30	-12
Number of production runs	12	30	18

Given the change in the level of each of the three activities and the beliefs provided on the Information Sheet about each of the activities' impact on total overhead costs, what should be the predicted change in total overhead costs? $__________

Production Department Report
May 1998

Activity	Totals Apr98	Totals May98	Changes in Activity Levels
Number of machine hours	480	300	-180
Number of parts in production	30	48	18
Number of production runs	30	48	18

Given the change in the level of each of the three activities and the beliefs provided on the Information Sheet about each of the activities' impact on total overhead costs, what should be the predicted change in total overhead costs? $__________

Production Department Report
June 1998

Activity	Totals May98	Totals Jun98	Changes in Activity Levels
Number of machine hours	300	360	60
Number of parts in production	48	30	-18
Number of production runs	48	30	-18

Given the change in the level of each of the three activities and the beliefs provided on the Information Sheet about each of the activities' impact on total overhead costs, what should be the predicted change in total overhead costs? $____________

Production Department Report
July 1998

Activity	Totals		Changes in Activity Levels
	Jun98	Jul98	
Number of machine hours	360	300	-60
Number of parts in production	30	24	-6
Number of production runs	30	18	-12

Given the change in the level of each of the three activities and the beliefs provided on the Information Sheet about each of the activities' impact on total overhead costs, what should be the predicted change in total overhead costs? $____________

Production Department Report
August 1998

Activity	Totals Jul98	Totals Aug98	Changes in Activity Levels
Number of machine hours	300	300	0
Number of parts in production	24	12	-12
Number of production runs	18	42	24

Given the change in the level of each of the three activities and the beliefs provided on the Information Sheet about each of the activities' impact on total overhead costs, what should be the predicted change in total overhead costs? $__________

Production Department Report
September 1998

Activity	Totals Aug98	Totals Sep98	Changes in Activity Levels
Number of machine hours	300	300	0
Number of parts in production	12	30	18
Number of production runs	42	36	-6

Given the change in the level of each of the three activities and the beliefs provided on the Information Sheet about each of the activities' impact on total overhead costs, what should be the predicted change in total overhead costs? $____________

Production Department Report
October 1998

Activity	Totals Sep98	Totals Oct98	Changes in Activity Levels
Number of machine hours	300	240	-60
Number of parts in production	30	30	0
Number of production runs	36	30	-6

Given the change in the level of each of the three activities and the beliefs provided on the Information Sheet about each of the activities' impact on total overhead costs, what should be the predicted change in total overhead costs? $___________

Production Department Report
November 1998

Activity	Totals Oct98	Totals Nov98	Changes in Activity Levels
Number of machine hours	240	300	60
Number of parts in production	30	24	-6
Number of production runs	30	24	-6

Given the change in the level of each of the three activities and the beliefs provided on the Information Sheet about each of the activities' impact on total overhead costs, what should be the predicted change in total overhead costs? $__________

Production Department Report
December 1998

Activity	Totals Nov98	Totals Dec98	Changes in Activity Levels
Number of machine hours	300	120	-180
Number of parts in production	24	30	6
Number of production runs	24	30	6

Given the change in the level of each of the three activities and the beliefs provided on the Information Sheet about each of the activities' impact on total overhead costs, what should be the predicted change in total overhead costs? $____________

APPENDIX K

Second Cost Differences Estimation Task (same as first in Appendix C)

For each of the previous months, you calculated the predicted (given the information sheet) monthly change in total overhead costs. The actual monthly change in total overhead costs was provided on each associated monthly cost report. Consider the *difference* each month between the predicted monthly change in total overhead costs and the associated actual monthly change in total overhead costs (there were eleven monthly changes).

7. What was the **average** *difference* between the predicted change in total overhead costs and the actual change in total overhead costs across all eleven monthly changes? Disregard the sign of the difference - i.e., consider the absolute value of the difference each month.

Average *difference* = $________

8. What was the **greatest** *difference* between the predicted change in total overhead costs and the actual change in total overhead costs across all eleven monthly changes? Disregard the sign of the difference - i.e., consider the absolute value of the difference each month.

Greatest *difference* = $________

APPENDIX K (cont'd)

Again, consider the *difference* each month between the predicted monthly change in total overhead costs and the associated actual monthly change in total overhead costs (there were eleven monthly changes).

9. In how many months was the actual change in total overhead costs **approximately equal (within $0 - $10,000)** to the predicted change in total overhead costs? That is, approximately equal to a $125 change in total costs per Machine Hour, a $500 change in total costs per Part, and a $2,500 change in total costs per Production Run? (there were eleven monthly changes in total)

Number of such months = ________

10. In how many months was the actual change in total overhead costs **different (more than $10,000)** from the predicted change in total overhead costs? That is, different by more than $10,000 from a $125 change in total costs per Machine Hour, a $500 change in total costs per Part, and a $2,500 change in total costs per Production Run? (there were eleven monthly changes in total)

Number of such months = ________

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