Integration of Computers Into the Financial and Cost Accounting Curriculum.

Anthony George Petrie Jr
Louisiana State University and Agricultural & Mechanical College

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AND COST ACCOUNTING CURRICULUM

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Accounting

by

Anthony George Petrie, Jr.
B.S., Louisiana State University, 1962
M.S., Louisiana State University, 1964
August, 1970
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ABSTRACT

The areas of accounting and scientific computer analysis have developed, for the most part, independently over the past decade. The science applications of computer techniques and processing have excelled with each generation. The mathematical techniques in some business applications such as production control (e.g., Markovian Processes, Monte Carlo Analysis, Bayesian Decision Theory, and PERT.) seem to serve the industrial technology manager, but accountants are continually searching for different mathematical tools and adaptations for cost analysis and financial information. Programs need to be developed employing capital budgeting, financial accounting and, more importantly, cost behavior systems of the job order and/or process cost nature.

With the scientific emphasis in the past, the languages and capabilities of the EDP equipment have focused on the scientific needs of the community. As a result, many business applications remain in an embryonic stage. Demands by students, industry and professional leaders have provided impetus to stimulate the growth of these fertile areas. The increased competition in the data processing industry has
aided this development in the business field. At present, the business firm has available a business oriented language called COBOL for general business applications and FORTRAN IV for computational operations in financial accounting and cost analysis.

The educational opportunities for future development of computerized accounting techniques has excited the academic community. By integrating the fields of scientific computer analysis and accounting, both could benefit. For the most part, the areas of managerial and cost accounting appear to offer the greatest promise for computerized adaptations.

The primary aim of this dissertation is to integrate the fields of scientific analysis and accounting with the hope that the areas will complement each other in the future. Applications developed in this study will introduce the college student to computerized techniques tailored to his needs and background. Topics of the utmost interest to most accountants will be afforded primary emphasis. Programs will be written for cost behavior analysis and managerial decision making. Practical models for a matrix based accounting system, capital budgeting decisions, process cost accounting and related matrix accounting adaptations will provide valuable tools for the integration of computers into existing college curriculums.
The material in this study will be organized in such a fashion that it can be blended into existing courses within an established curriculum. In this manner, all professors will be given the opportunity to implement data processing into their course material by the selection of pertinent programs.

Many universities are now instituting a program to integrate the computer into their curriculum and are searching for proven material to build their programs. The information and materials developed in this dissertation should provide good cornerstones on which to build these programs. Of course, auditing, income tax accounting and numerous other accounting areas offer excellent opportunities for blending the computer into the accounting curriculum. The integration of computerized problem solving into the cost and financial accounting area should establish avenues permitting universities to further implement computerized techniques into other related business areas.

As a result of this study, computer applications will be provided to further the student's progress toward the implementation of computers in decision making. Periodic appraisals of computer adaptations will be needed to determine a student's progress in the utilization of the computer. It is recognized that this phase will need periodic updating.
because techniques along with coverage will require evaluation and testing to achieve the desired goal of the universities.
CHAPTER I

INTRODUCTION

Developments in the business community along with technological advancements in industrial operations have had a major impact on the academic environment of universities and colleges. The demand for qualified personnel that are well prepared for our dynamic economy far exceeds the available supply.\(^1\) With the advent of computer-based management information systems in recent years, progressive companies have installed extensive study programs in the areas of cost control, production scheduling and financial analysis. Major studies are presently being made in production control, financial analysis and cost control with the advent of computer-based management information systems. The core of this system is the electronic data processing equipment that is capable of emitting immediate and relevant information on

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the many facets of operations with a firm. The search continues for talented individuals with the ability to organize and generate the flow of information needed by management to effectively guide the fortunes of their company.

Universities are recognizing this need for qualified systems and procedure analyst with management potential by expanding curriculum coverage in the computer and data processing area. A research study by Dr. J. Daniel Couger\(^2\) verified the increased attention being placed on computer courses in both the graduate and undergraduate programs. Many of these universities, mostly members of the American Association of Collegiate Schools of Business, are facing a major problem in implementing these curriculum changes necessary for the integration of electronic data processing into their programs. The main problems center on the method of blending computer applications into the curriculum and the level of detail for particular courses. Dr. Couger points out that "more than 90 percent of the respondents agreed that the minimal goal should be a level of detail to permit the student to recognize the applicability of computers to

These objectives can be accomplished by integrating computers into established college programs.

Recommendations of the American Accounting Association concur with Dr. Couger's findings and help to shed some light on the subject. The undergraduate curriculum proposed in a 1964 study concluded that, students should have the knowledge of at least one or more programming language (i.e., Fortran or Cobol) and be required to study electronic data processing systems in a business information systems course. Therefore, preparations of the accountant on the undergraduate level should establish a foundation for understanding programming logic and management information system concepts.

Horizons for a Profession published by the A.I.C.P.A. in 1967 reinforces the accountants need for computer education with the following recommendations:

1. That beginning CPA's be required to have basic knowledge of at least one computer system.

2. That they have knowledge of at least one computer language (e.g., Cobol).

---

3 Couger, Computers and the Schools of Business, p. 2.

3. That they possess the ability to chart or diagram an information system of modest complexity.

4. That they have the ability to design an information system, prepare a program for it and carry their work through the stages of debugging and testing.

The academic development of accounting students should aim at these common objectives and establish the needed background for future graduate study and employment training.

**Approach to Accounting Curriculum Design**

There have been a number of approaches to accounting curriculum development ranging from separate courses on computer utilization to complete integration of electronic data processing into an established program. A separation approach would allow greater concentration in the study of computer configurations, but this could lead to an alienation of the subject matter and overspecialization in computer operations. This is not to say that separate computer courses are not beneficial, for much can be gained in elective courses in accounting. A complete integration approach, on the other hand, blends the capabilities of electronic data processing equipment with accounting subjects and affords a greater

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understanding of the computer's applicability to specific areas in accounting. Full integration must be tempered, however, by courses designed to introduce the student to computer components and a programming language like Fortran or Cobol. Certain electives can be offered in the later stages of the program to offer students the opportunity for greater specialization in computer operations.

An excellent approach for the integration of computers into an existing curriculum is outlined by Dr. Couger in his survey of eleven prominent schools of business. These institutions suggested a program consisting of four phases:

1. Coverage of computer fundamentals, systems analysis, design and programming required of all students early in their academic program.

2. Coverage of the applications of computers through incorporation of the material into the functional area courses.

3. Coverage of computer capabilities for abetting decision making in a dynamic business environment through computer-oriented business games.

4. Coverage of integration and optimization of computer applications through a course on design and implementation of a sophisticated, computer-based management information system.\(^6\)

These phases represent a comprehensive plan for the complete integration of computer technology into the business

curriculum. The introductory phase is being implemented in most universities by offering an introductory course in computer fundamentals and FORTRAN Programming.\footnote{Couger, \textit{Computers and the Schools of Business}, p. 4.}

Initially the student is provided a foundation that serves as a frame of reference for future course study and understanding of computer capabilities and adaptations. Thus, a separate approach in the introductory stage is advantageous for the student and beneficial to the development of the curriculum.

The second phase in this program represents the principal area of concentration in this dissertation. Instructional material, in the form of programs and computer adaptations, will be developed for incorporation into cost and financial accounting courses in the junior and senior years of a student's program. These applications will enable the professor to integrate data processing into accounting courses and suggest avenues for additional computer usage in their course coverage. Through the professor's leadership, students can further their understanding of computer capabilities in the accounting environment along with the vast computational powers
of this equipment. During this period, the student is preparing for the launching of the third and fourth phases of the program.

In the third phase, computerized practice sets\(^8\) can be covered in accounting courses concurrently with the second phase of the program.

Computer-oriented business games\(^9\) can also be blended into related business subjects within the accounting curriculum. These games and practice sets challenge the participants analytical and decision-making ability while producing computerized print-outs reflecting the results of their decisions. In most of these exercises the student is exposed

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\(^8\) Examples of computerized practice sets include the following:


\(^9\) Available business games include:


to a simulated business environment that provides insight into human behavior, business negotiations and economic principles as they relate to a firm's operations.

The final phase of the program would cover a computer-based management information system. At this stage, the student is prepared to integrate his knowledge of electronic data processing into an over-all package. The course would be designed to cover the following objectives:

1. To summarize and report all data pertinent to the firm's operations.

2. To process the information in the most efficient manner, requiring the use of techniques in management sciences.

3. To produce concise and timely information, as required by each level of management for optimum execution of its functional objectives.¹⁰

With this scope of coverage, a student can begin to appreciate the network of information so vital to management in the decision-making process.

Many universities are blending these four phases into their business curriculums thereby establishing programs on the intermediate level of computer sophistication. In the accounting curriculum, several avenues of integration are

available in the managerial and cost accounting courses. In addition, auditing, income tax accounting and financial accounting have provided excellent opportunities for incorporating the computer into the accounting program. Primary emphasis, however, will be placed on managerial and cost accounting because they offer the greatest promise for computerized adaptations. These subjects also represent the backbone of a management information system in addition to the strategic part they play in the accounting curriculum.

**Scope of Dissertation**

The growing interrelationships of accounting and computer technology have expanded the opportunities for accounting graduates. The business community welcomes the student who possesses a well-rounded accounting background complemented by training in computer techniques and applications. Universities are now offering the accounting student an opportunity to study computer technology within accounting programs through the introduction of computers and the integration of electronic data processing into the curriculum. To assist in this effort, computer applications need to be developed for professors to implement in their course coverage.

Chapter II introduces the student to a matrix based accounting system that can generate a voucher register, matrix
ledger and trial balance as transactions are processed during the period. Controls are established through batch processing, a transaction log and related control totals. In Chapter III an examination is made of capital budgeting analysis in financial planning. A system is developed for the selection of capital projects through comparisons of payback, accounting rate of return and time-adjusted rates of return. Process cost accounting on a historical cost basis is covered in Chapter IV. As an alternative, Chapter V develops a process cost system on a standard cost basis with variance analysis included in the over-all system. Certain other computerized matrix applications highlight the material in Chapter VI. Techniques of matrix inversion and multiplication are adapted to such accounting problems as sum-of-years-digits depreciation, consolidations, bonus and tax computations, and least squares analysis. The writer's conclusions and recommendations are outlined in Chapter VII.

The primary aim of this research is the integration of computer applications into established accounting curriculums with particular emphasis on the areas of managerial and cost accounting. Related financial applications of the computer complement the cost and managerial coverage by broadening the student's exposure in computerized accounting adaptations. Program applications will be in Fortran IV programming language.
for the following reasons: 11

1. It is an easy language to master.
2. It has powerful computational abilities.
3. It emphasizes logical thought processes.
4. It has universal acceptance.
5. It allows for programming without having to become a programmer.

Therefore, most universities favor FORTRAN in the introductory phase of their programs.

11 Couger, Computers and the Schools of Business, p. 4.
CHAPTER II

MATRIX ACCOUNTING SYSTEM

The development of the double-entry accounting system is considered a hallmark in the evolution of accounting thought and accounting concepts. Origination of the double-entry system by Italian merchants in the fourteenth century, first published by Luca Paciolo in *Summa de Arithmetica, Geometria, Proportioni et Proportionalita*, established a starting point for the formulation of a theory of accounting.¹ Could a single-entry method contribute to the double-entry system and make advancements in the field of accounting? Certain refinements in single-entry accounting, through the use of matrices, can complement the double-entry system and provide a valuable tool in computerized accounting systems. Innovations with matrices in accounting can provide more up-to-date information without sacrificing needed internal controls or audit requirements in the system.

Many students and professors are cognizant of the wealth of information written on mathematical approaches to accounting along with the sophisticated applications of mathematical techniques to accounting practices and procedures. Will these practices improve accounting functionally or can accounting consider these areas within its domain? Possibly some of these applications will prove fruitful while others will become ineffective and too abstract in nature. Matrix algebra is one of the areas that shows a great deal of promise for adaptation to accounting operations. The accounting process of recording transactions and the preparation of financial statements can benefit from the implementation of matrices to the accounting cycle. Improved techniques of recording transactions, analyzing accounts and determining account balances are available through matrix analysis coupled with the capabilities of the computer. A voucher system can be designed to provide the financial information and controls for the matrix ledger and a trial balance can be readily generated for statement preparation and analysis purposes. An audit program could also be designed to analyze accounts selected by the auditor. Transactions processed during the period could be screened by identifying selected account numbers thereby providing a summary of the activity for these accounts.
Working with this system will offer the student an opportunity to explore a different approach to a financial information system within a computerized environment.

The Voucher and Control System

The flow of information through the matrix based system would originate with the preparation of a transaction voucher shown in Exhibit 2-1.

**EXHIBIT 2-1**

<table>
<thead>
<tr>
<th>DATE X/XX/XX</th>
<th>VOUCHER NO. XXXXXX</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACCOUNT DEBITED</td>
<td>XXXXX</td>
</tr>
<tr>
<td>ACCOUNT CREDITED</td>
<td>XXXXX</td>
</tr>
</tbody>
</table>

**EXPLANATION:**

ENTRY BY ___________________________ APPROVAL ____________

Information on the voucher would include the date of the transaction, the voucher number, the accounts debited and credited, transaction amounts and an explanation of the transaction. The voucher number could start with a letter for each month (i.e., A for January) thereby expanding the field usage.
and providing a monthly identification of transactions. The overall format is streamlined and designed in the order of the input record to facilitate keypunching of the information. In addition, source documents could be utilized to provide the details of the transactions by entering a cross reference of the voucher date and voucher number on these documents.

Greater refinement of the system could be achieved by utilizing special journals for such categories as cash receipts, sales and purchases. These special journal transactions would be recorded on separately marked or colored vouchers with a description voucher code of CRXXXX, SJXXXX, and PJXXXX. The voucher format would be altered to record only one total for the individual subsidiary accounts posted at the end of the period. Allowances could also be made for sales returns and allowances or purchases discount in the special journal processing. In the program developed for this chapter, it is assumed that these transactions will be vouched in the normal manner since their volume would not warrant special treatment in the system.

Transactions will be grouped in batches of 10 items and a batch control card can be completed for each group as shown in Exhibit 2-2. Of course, batch grouping is optional and can be enlarged by the student to accommodate larger volumes of transactions while still maintaining the control principle of batch processing.
The batch control card contains a batch number, control totals and identifications for assigning responsibilities for batch totals as well as entering the transactions batch in the batch log. This information provides the necessary controls for routing the transactions through the system and establishes a trail for identifying transactions errors or processing problems encountered during the period.

Each batch to be processed would be recorded on a batch log for future comparison with the computer generated voucher register. An example of the batch log is shown in Exhibit 2-3. Entry on the batch log signals that the vouchers are ready to be keypunched and processed through the system. It also establishes the date recorded and control references for batch number, voucher numbers and control totals.
EXHIBIT 2-3

BATCH LOG

<table>
<thead>
<tr>
<th>ENTERED DATE</th>
<th>BATCH NUMBER</th>
<th>VOUCHER NUMBERS</th>
<th>PAGE TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>DEBITS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CREDITS</td>
</tr>
</tbody>
</table>

Computerized Matrix System

Conversion of these batch documents is optional with the student and the facilities available to the university. For example, vouchers could be converted to magnetic tape or discs for high speed processing in the event there were a large number of transactions. On the other hand, a standard 80 column punched card will usually serve the student's needs and is assumed to be the basic input for the matrix system. The format for the input records is exemplified in Exhibit 2-4. These data elements represent the fundamental activity base for recording transactions during the period. Fields in the record are aligned with the format of the voucher to facilitate keypunching or coding of the essential transaction data. At this point, the student is ready to process his data utilizing the program developed in Exhibit 2-7 to prepare a
<table>
<thead>
<tr>
<th>FIELD</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Voucher Number</td>
</tr>
<tr>
<td>B</td>
<td>Name of Account Debited</td>
</tr>
<tr>
<td>C</td>
<td>General Ledger Account Number</td>
</tr>
<tr>
<td>D</td>
<td>General Ledger Matrix Location</td>
</tr>
<tr>
<td>E</td>
<td>Subsidiary Ledger Account Number</td>
</tr>
<tr>
<td>F</td>
<td>Amount Debited</td>
</tr>
<tr>
<td>G</td>
<td>Name of Account Credited</td>
</tr>
<tr>
<td>H</td>
<td>General Ledger Account Number</td>
</tr>
<tr>
<td>I</td>
<td>General Ledger Matrix Location</td>
</tr>
<tr>
<td>J</td>
<td>Subsidiary Ledger Account Number</td>
</tr>
<tr>
<td>K</td>
<td>Amount Credited</td>
</tr>
<tr>
<td>L</td>
<td></td>
</tr>
</tbody>
</table>
voucher register, a matrix ledger and a trial balance for statement preparation.

Each transaction processed in the batch transactions program (Exhibit 2-7) will be based on a unit relationship where only one account is debited and one account credited with each voucher card submitted in the program. Should a transaction involve more than two accounts, like a note paid with accrued interest, then the transaction can be broken down into two components: (1) one debiting interest expense and crediting cash, (2) another debiting notes payable and crediting cash. Thus, in order to up-date the matrix ledger and record each transaction on the voucher register, the unit principle will be followed for each transaction.

One of the more important output components of the computerized system is the voucher register. Each transaction will be represented by a voucher that is processed through the computerized program and recorded in voucher number order on the register. Upon the completion of a batch, the total debit and credit amounts are printed along with the batch number. The batch sizes can be tailored to a voucher register page in the program output and control is established by comparing the batch totals with processed totals when each batch is completed. The design of the voucher register is shown in Exhibit 2-5.
EXHIBIT 2-5

VOUCHER REGISTER

<table>
<thead>
<tr>
<th>Voucher No.</th>
<th>Account No.</th>
<th>Account Debited</th>
<th>XXXXXX</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Account No.</td>
<td>Account Credited</td>
<td>XXXXXX</td>
</tr>
<tr>
<td>Batch No.</td>
<td></td>
<td>XXXXXX</td>
<td>XXXXXX</td>
</tr>
</tbody>
</table>

The general ledger matrix in Exhibit 2-6 and the related subsidiary arrays represent the core of the matrix accounting system. Every transaction recorded by the student is vouched and processed under batch control with the ultimate effect being reflected in a row and column in the general ledger matrix. At the same time, the subsidiary ledgers are balanced with the control accounts by a sub-routine in the computer program.

Each row in the general ledger matrix represents a debit account and related valuation accounts (e.g., allowance for uncollectible accounts) developed in the same order as a traditional general ledger except for Operating and Other Expenses. The related credit accounts are recorded in the matrix columns in the same traditional fashion. This order will facilitate statement preparation from the trial balance and the Operating and Other Expenses control will be shown at the end of the accounts along with a detailed listing of the related
expense and other subsidiary ledgers. The balances in the respective debit and credit accounts are the totals of the rows and columns which they represent in the matrix. For example, the total of row one (1) is the balance in the Cash account and the total of column eleven (11) is the Common Stock account balance. A sale of common stock for cash would be entered in the general ledger matrix by increasing row one, (1), column eleven (11) in the matrix or GLMTX (1,11) by $100,000, the amount of common stock sold. This entry is illustrated by Voucher No. A0001 in Batch No. 10000. Balances in these two accounts, assuming no other transactions, would be the total of row one (1) or $100,000 for Cash and the Common Stock account would be the total of column eleven (11) or $100,000. Five batches, numbered from 10000 to 10004, are processed through the system in Exhibit 2-7. After all the transactions have been recorded in the matrix, the general ledger account balances are the corresponding row or column totals of the matrix. In the month of January, the Common Stock account had a $100,000 balance (see Exhibit 2-7) since no other activity was recorded in the account.

The computerized program used in matrix accounting is shown in Exhibit 2-7. The components of the program are tailored to the illustrations and matrix chart of accounts developed in this chapter. However, the program can be adopted to the
## GENERAL LEDGER MATRIX

<table>
<thead>
<tr>
<th>Row Accounts</th>
<th>Column Accounts (Cont.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10101-Cash</td>
<td>50707-Bonds Payable</td>
</tr>
<tr>
<td>10202-Temporary Investments</td>
<td>50808-Mortgage Payable</td>
</tr>
<tr>
<td>10303-Notes Receivable</td>
<td>60909-Preferred Stock</td>
</tr>
<tr>
<td>10404-Accounts Receivable</td>
<td>61010-Premium or (Discount) on Preferred Stk.</td>
</tr>
<tr>
<td>10505-Allowance for Uncollectible</td>
<td>61111-Common Stock</td>
</tr>
<tr>
<td>10606-Accrued Interest Receivable</td>
<td>61212-Premium or (Discount) on Common Stk.</td>
</tr>
<tr>
<td>10707-Inventory</td>
<td>61313-Treasury Stock</td>
</tr>
<tr>
<td>10808-Purchases</td>
<td>61414-Retained Earnings</td>
</tr>
<tr>
<td>10909-Other Prepaid Expenses</td>
<td>71515-Sales</td>
</tr>
<tr>
<td>21010-Land</td>
<td>71616-Sales Returns &amp; Allowances</td>
</tr>
<tr>
<td>21111-Building</td>
<td>81717-Other Income</td>
</tr>
<tr>
<td>21212-Accumulated Depreciation-Bldg.</td>
<td></td>
</tr>
<tr>
<td>21313-Machinery and Equipment</td>
<td></td>
</tr>
<tr>
<td>21414-Accumulated Depreciation-(M.&amp;E.)</td>
<td></td>
</tr>
<tr>
<td>31515-Other Assets</td>
<td></td>
</tr>
<tr>
<td>91616-Operating and Other Expenses</td>
<td></td>
</tr>
</tbody>
</table>

### CHART OF ACCOUNTS

<table>
<thead>
<tr>
<th>Column Accounts</th>
</tr>
</thead>
<tbody>
<tr>
<td>40101-Accounts Payable</td>
</tr>
<tr>
<td>40202-Bonds &amp; Mtg. Payable-Current</td>
</tr>
<tr>
<td>40303-Accrued Salaries</td>
</tr>
<tr>
<td>40404-Interest Payable</td>
</tr>
<tr>
<td>40505-Accrued Taxes</td>
</tr>
<tr>
<td>40606-Other Accrued Expenses</td>
</tr>
</tbody>
</table>
Exhibit 2-6 (Continued)

SUBSIDIARY LEDGERS

10404 ACCOUNTS RECEIVABLE
1. R. L. Carpenter
2. B. V. Holt
3. D. B. Jones
4. C. D. Marwick
5. A. C. Wiley

21313 MACHINERY AND EQUIPMENT
1. Warehouse Equipment
2. Warehouse Furniture
3. Office Furniture
4. Office Equipment
5. Delivery Equipment

40101 ACCOUNTS PAYABLE
1. Davis Co.
2. Evans, Inc.
3. Holden, Inc.
4. Tidewater Co.
5. Watson Co.

91616 OPERATING AND OTHER EXPENSES
1. Advertising
2. Bad Debt Expense
3. Commissions
4. Delivery Expense
5. Depreciation-Bldg.
7. Insurance
8. Interest
9. Office Expense
10. Office Salaries
11. Payroll Taxes
12. Repairs & Maintenance
13. Taxes-Other
14. Utilities
15. Miscellaneous
students individual problems by changing a few control cards and operational commands. The matrix can be expanded to include other general ledger accounts and the parameters increased for the variable GLMTX. Any account renumbering or additional subsidiary ledgers could be incorporated into the program by changing the logical IF commands or increasing the number of commands for added subsidiary ledgers. Of course, the new variables in the expanded matrix would require adjustments in such commands as the DIMENSION statement and programming assistance would be helpful for these revisions. The logic and techniques in the matrix based accounting system are flexible enough, however, to allow the professor sufficient latitude in utilizing the system within his course coverage.

The program contains several built-in checks on transaction data for the elimination of processing invalid transactions. Any entry that is improperly coded for debits and credits will be rejected from the voucher register and a note displayed of the voucher number that contains the error. An example of an improper transaction is shown in Batch No. 10002, voucher A00026. Notice the voucher is highlighted in the voucher register and the batch totals also indicate an error in the batch with only the correct transactions processed for this particular batch. To correct the Commissions and
Cash accounts, an adjustment is made with Voucher No. A00050 and the trial balance is adjusted to the end of January.

Other adjusting entries in Batch No. 10004 update the trial balance and provide the student with an adjusted trial balance for the preparation of a Income Statement and Balance Sheet. The adjustments and reclassifications are fairly standard in the illustration. Certain assumptions made in the adjustment process are as follows:

1. The $2700 note from B. V. Holt had one-half month interest due at 8 percent per annum.

2. Insurance of $360.00 would be for a three (3) year policy and is recorded as an other asset.

3. Depreciation on the building cost of $75,000 is based on a twenty-five (25) year life. Depreciation on machinery and equipment with a cost of $25,800 has an average life of five (5) years. The straight-line method is assumed in these adjustments.

4. Bonds payable are due in installments of $1,000 a year for twenty (20) years. Interest accrues for the year and is paid with the currently due portion of the bonds at year end. Mortgage payable is a level monthly payment of principal and interest commencing in February.

5. Bad debt expense is estimated at $200 a month based on projected credit sales for the year.

6. The cost of goods sold can be derived by the standard process of adding net purchases to beginning inventory and then subtracting ending inventory. Purchases, returns and allowances are credited directly to the purchase account as illustrated by Voucher No. A00034.
Most of the remaining information in the program and output documents will be familiar to the student with a background in accounting. The primary aim of the matrix system is the exposure to a computerized accounting operation that can record transactions in a voucher register format, simultaneously post the data to the general ledger and subsidiary ledgers, and provide an adjusted trial balance for statement preparation. This represents a total package of the accounting cycle along with valuable insights into computer operations and capabilities at the disposal of the professor and students for additional accounting adaptations.
C PROGRAM FOR PROCESSING BATCH TRANSACTIONS IN THE MATRIX ACCOUNTING SYSTEM

C A G PERRY DISSERTATION

1 DIMENSION ACCTNM(33,11),GLMTX(16,17),ARNAM(5,5),ARSUB(5),
   * EMSUB(5),APNAM(5,5),APSUB(5),EXPNAM(15,5),EXPSUB(15),EMNAM(5,5)

3 FORMAT(7)
4 FORMAT(//)
5 FORMAT(58X, 'VOUCHER REGISTER FOR JANUARY')
6 FORMAT(11A4)
7 FORMAT(5A4)
8 FORMAT(412)
9 FORMAT(216,5A4,13,212,F10.2)
10 FORMAT(12A3)
11 FORMAT(13X,5A4,65X,F10.2)
12 FORMAT(17X,13,2X,5A4,75X,F10.2)
13 FORMAT(1X, 'ERROR IN TRANSACTION RECORD', 2X, 2A3)
14 FORMAT(1X, 'BATCH NO', 17X,F12.2, 3X,F12.2)
15 FORMAT(1X, 'BATCH NO', 17X,F12.2, 3X,F12.2)
16 FORMAT(IX, 'ERROR IN TRANSACTION RECORD', 30X,F12.2, 3X,F12.2)
17 FORMAT(IX, 'TRIAL BALANCE FOR JANUARY')
18 FORMAT(IX, 'SUBSIDIARY LEDGERS')
19 FORMAT(IX, 'PRODUCT AND OTHER EXPENSES')
20 FORMAT(IX, 'ACCOUNTS RECEIVABLE')
21 FORMAT(IX, 'ACCOUNTS PAYABLE')
22 FORMAT(IX, 'GENERAL LEDGER MATRIX')
23 FORMAT(IX, 'GENERAL LEDGER MATRIX')
24 FORMAT(IX, 'TOTAL', 21X,F12.2)
25 FORMAT(IX, 'ACCOUNTS PAYABLE')
26 FORMAT(IX, 'TOTAL', 21X,F12.2)
27 FORMAT(IX, 'ACCOUNTS PAYABLE')
28 FORMAT(IX, 'TOTAL', 21X,F12.2)
29 FORMAT(IX, 'ACCOUNTS PAYABLE')
30 FORMAT(IX, 'TOTAL', 21X,F12.2)
31 FORMAT(IX, 'TOTAL', 21X,F12.2)
32 FORMAT(IX, 'TOTAL', 21X,F12.2)
33 FORMAT(IX, 'TOTAL', 21X,F12.2)
34 FORMAT(IX, 'TOTAL', 21X,F12.2)
35 FORMAT(IX, 'TOTAL', 21X,F12.2)
36 FORMAT(IX, 'TOTAL', 21X,F12.2)
37 FORMAT(IX, 'TOTAL', 21X,F12.2)
38 FORMAT(IX, 'TOTAL', 21X,F12.2)
39 FORMAT(IX, 'TOTAL', 21X,F12.2)
40 FORMAT(IX, 'TOTAL', 21X,F12.2)
41 FORMAT(IX, 'TOTAL', 21X,F12.2)
42 FORMAT(IX, 'TOTAL', 21X,F12.2)
43 FORMAT(IX, 'TOTAL', 21X,F12.2)
44 FORMAT(IX, 'TOTAL', 21X,F12.2)
45 FORMAT(IX, 'TOTAL', 21X,F12.2)
46 FORMAT(IX, 'TOTAL', 21X,F12.2)
47 FORMAT(IX, 'TOTAL', 21X,F12.2)
48 FORMAT(IX, 'TOTAL', 21X,F12.2)
49 FORMAT(IX, 'TOTAL', 21X,F12.2)
50 FORMAT(IX, 'TOTAL', 21X,F12.2)
51 FORMAT(IX, 'TOTAL', 21X,F12.2)
52 FORMAT(IX, 'TOTAL', 21X,F12.2)
53 FORMAT(IX, 'TOTAL', 21X,F12.2)

CRIT = 0
DRTOT = 0
TDRM0 = 0
TCRM0 = 0
HRITE16.35)
WRITE(6,35)
WRITE(6,10)
WRITE(6,8)
READ(5,11)(ACCTNM(I,J),J=1,11),I=1,33
READ(5,12)(ARNAM(I,J),J=1,5),I=1,5
READ(5,12)(EMNAM(I,J),J=1,5),I=1,5
READ(5,12)(APNAM(I,J),J=1,5),I=1,5
READ(5,12)(EXPNAM(I,J),J=1,5),I=1,5
READ(5,13)N,H,K,L
DO2211=1,N
DO2212=1,K
GLMTX(1,J)=0
D02211=1,K
ARSUB(I)=0
EMSUB(I)=0
APSUB(I)=0
EXSUB(I)=0
READS = 14ND3TH,8TDR,8TCR
IF(NOTH.EQ.99999)GOTO101
56 TDR=0
57 TCR=0
58 READ(5,15)VR1,N11,AD1,AD2,AD3,AD4,AD5,NDR,MND,LSUB,AMTDN,
* AC1,AC2,AC3,AC4,AC5,NCR,MCN,NSUB,AMTCR
59 IF(MTCR,NE.,AMTCR)GOTO102
60 WRITE(6,16)VR1,N11,NDR,AD1,AD2,AD3,AD4,AD5,NMND,AMTDN
61 WRITE(6,17)NCR,MCN,AC1,AC2,AC3,AC4,AC5,AMTCR
62 TDR=TMP+AMTDN
63 TCR=TCM+AMTCR
64 IF(NXR.LT.401.OR.NDR.EQ.916).AND.(NCR.LT.416).AND.(NDR.GT.315).AND.(NDR.LT.916)
* GOTO72
65 IF(NDR.GT.315).AND.(NDR.LT.916)GOTO72
66 GLMTX(MN0,MNC)=GLMTX(MN0,MNC)+AMTDN
67 GOTO100
68 70 GLMTX(MN0,1)=GLMTX(MN0,1)+AMTDN
69 GLMTX(MN1,1)=GLMTX(MN1,1)-AMTCR
70 GOTO100
71 GLMTX(MN1,1)=GLMTX(MN1,1)+AMTCR
72 GLMTX(MN1,1)=GLMTX(MN1,1)-AMTDN
73 GOTO100
74 GOTO224
75 80 IF(NDR.EQ.104)ARSUB(LSUB)=ARSUB(LSUB)+AMTDN
76 IF(NCR.EQ.104)ARSUB(NSUB)=ARSUB(NSUB)+AMTCR
77 IF(NDR.EQ.213)EMSUB(LSUB)=EMSUB(LSUB)+AMTDN
78 IF(NCR.EQ.213)EMSUB(NSUB)=EMSUB(NSUB)-AMTCR
79 IF(NDR.EQ.916)EXPUB(LSUB)=EXPUB(LSUB)+AMTDN
80 IF(NCR.EQ.916)EXPUB(NSUB)=EXPUB(NSUB)-AMTCR
81 IF(NDR.EQ.401)APSUB(NSUB)=APSUB(NSUB)+AMTCR
82 IF(NDR.EQ.401)APSUB(LSUB)=APSUB(LSUB)-AMTDN
83 GOTO224
84 WRITE(6,A)
85 WRITE(6,10)VR1,N01
86 WRITE(6,B)
87 224 CONTINUE
88 IF(PTDR,NE.,TDR.OR.,BTCR,NE.,TCR)GOTO81
89 WRITE(6,19)NORTH,TDR,TCR
90 WRITE(6,A)
91 GOTO102
92 WRITE(6,20)NORTH,TDR,TCR
93 WRITE(6,A)
94 82 TDR=TMP+TDR+TDR
95 TCM=TCM+TCM
96 GOTH100
97 101 WRITE(6,9)
98 WRITE(6,21)TDM0,TCM0
99 WRITE(6,35)
100 WRITE(6,33)
101 WRITE(6,31)
102 WRITE(6,31)1(1 GLMTX(I,J),J=1,M),I=1,N)
C TRIAL BALANCE FOR THE MONTH
103 WRITE(6,35)
104 WRITE(6,22)
105 DD3001=1,N
106 DD3002=1,N
00302 J=1,N
00303 R(I)=R(I)+GLMTX(I,J)
00304 CONTINUE
00305 N=N+1
00306 EXP=EXP+EXPSUB(I)
00307 ART=ART+ARTSUB(I)
00308 EMT=EMT+EMSUB(I)
00309 APT=APT+APSUB(I)
169 WRITE(6,8)
170 WRITE(6,32) APT
171 STOP
172 END

ENTRY
### VOUCHER REGISTER FOR JANUARY

<table>
<thead>
<tr>
<th>Voucher</th>
<th>Account</th>
<th>Description</th>
<th>Amount 1</th>
<th>Amount 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A00001</td>
<td>101 CASH</td>
<td>COMMON STOCK</td>
<td>100000.00</td>
<td>100000.00</td>
</tr>
<tr>
<td>A00002</td>
<td>101 CASH</td>
<td>BONDS PAYABLE</td>
<td>20000.00</td>
<td>20000.00</td>
</tr>
<tr>
<td>A00003</td>
<td>101 CASH</td>
<td>PREFERRED STOCK</td>
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<td>40000.00</td>
</tr>
<tr>
<td>A00004</td>
<td>101 CASH</td>
<td>PREMIUM ON PREF STK</td>
<td>2000.00</td>
<td>2000.00</td>
</tr>
<tr>
<td>A00005</td>
<td>210 LAND</td>
<td>MORTGAGE PAYABLE</td>
<td>20000.00</td>
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</tr>
<tr>
<td>A00006</td>
<td>211 BUILDING</td>
<td>MORTGAGE PAYABLE</td>
<td>75000.00</td>
<td>75000.00</td>
</tr>
<tr>
<td>A00007</td>
<td>213 MACH-EQUIP-WHSE EOP</td>
<td>401 ACCOUNTS PAY-DAVISCO</td>
<td>12000.00</td>
<td>12000.00</td>
</tr>
<tr>
<td>A00008</td>
<td>213 MACH-EQUIP-WHSE FUR</td>
<td>401 ACCOUNTS PAY-EVANS</td>
<td>3000.00</td>
<td>3000.00</td>
</tr>
<tr>
<td>A00009</td>
<td>213 MACH-EQUIP-UPF FUR</td>
<td>401 ACCOUNTS PAY-EVANS</td>
<td>3300.00</td>
<td>3300.00</td>
</tr>
<tr>
<td>A00010</td>
<td>213 MACH-EQUIP-DELIVERY</td>
<td>401 ACCOUNTS PAY-TIDEWAT</td>
<td>6500.00</td>
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</table>

**BATCH NO 10000**

<table>
<thead>
<tr>
<th>Voucher</th>
<th>Account</th>
<th>Description</th>
<th>Amount 1</th>
<th>Amount 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A00011</td>
<td>213 MACH-EQUIP-CFF EOP</td>
<td>401 ACCOUNTS PAY-DAVISCO</td>
<td>1000.00</td>
<td>1000.00</td>
</tr>
<tr>
<td>A00012</td>
<td>108 PURCHASES</td>
<td>401 ACCOUNTS PAY-HOLDEN</td>
<td>20000.00</td>
<td>20000.00</td>
</tr>
<tr>
<td>A00013</td>
<td>401 ACCT PAY-EVANS INC</td>
<td>101 CASH</td>
<td>6300.00</td>
<td>6300.00</td>
</tr>
<tr>
<td>A00014</td>
<td>104 ACCT REC-B V HOLT</td>
<td>715 SALES</td>
<td>2700.00</td>
<td>2700.00</td>
</tr>
<tr>
<td>A00015</td>
<td>315 OTHER ASST-ORG COSTS</td>
<td>101 CASH</td>
<td>2000.00</td>
<td>2000.00</td>
</tr>
<tr>
<td>A00016</td>
<td>102 TEMP INVESTMENTS</td>
<td>101 CASH</td>
<td>30000.00</td>
<td>30000.00</td>
</tr>
<tr>
<td>A00017</td>
<td>104 ACCT REC-RL CARPENTR</td>
<td>715 SALES</td>
<td>15400.00</td>
<td>15400.00</td>
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<tr>
<td>A00018</td>
<td>916 OP EXP-ADVERTISING</td>
<td>101 CASH</td>
<td>250.00</td>
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<tr>
<td>A00019</td>
<td>315 OTHER ASST-INSURCE</td>
<td>101 CASH</td>
<td>360.00</td>
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<tr>
<td>A00020</td>
<td>104 ACCT REC-CD MARWICK</td>
<td>715 SALES</td>
<td>1900.00</td>
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</table>

**BATCH NO 10001**

<table>
<thead>
<tr>
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<th>Account</th>
<th>Description</th>
<th>Amount 1</th>
<th>Amount 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A00021</td>
<td>916 OP EXP-UTILITIES</td>
<td>101 CASH</td>
<td>45.00</td>
<td>45.00</td>
</tr>
<tr>
<td>A00022</td>
<td>104 ACCT REC-AC WILEY</td>
<td>715 SALES</td>
<td>600.00</td>
<td>600.00</td>
</tr>
<tr>
<td>A00023</td>
<td>108 PURCHASES</td>
<td>401 ACCTS PAY-WATSON CO</td>
<td>12000.00</td>
<td>12000.00</td>
</tr>
<tr>
<td>A00024</td>
<td>613 TREASURY STK-COMMON</td>
<td>101 CASH</td>
<td>5000.00</td>
<td>5000.00</td>
</tr>
<tr>
<td>A00025</td>
<td>103 NOTES REC-BV HOLT</td>
<td>104 ACCTS REC-BV HOLT</td>
<td>2700.00</td>
<td>2700.00</td>
</tr>
</tbody>
</table>
ERROR IN TRANSACTION RECORD A00026

A00027  916  OP EXP-OFFICE EXP
        101 CASH          340.00
A00028  916  OP EXP-TAKES-OTHER
        401 ACCTS PAY-WATSON CO 175.00
A00029  104  ACCTS REC-AC WILEY
        715 SALES          1200.00
A00030  104  ACCTS REC-DB JONES
        715 SALES          14000.00
BATCH NO 10002  ERROR IN BATCH-ONLY CORRECT TRANSACTIONS RECORDED
            36050.00

A00031  916  OP EXP-MISC
        101 CASH          27.00
A00032  916  OP EXP-DELIVERY
        101 CASH          35.00
A00033  104  ACCTS REC-AC MARWICK
        715 SALES          950.00
A00034  401  ACCTS PAY-HOLDEN INC
        108 PURCHASES      1000.00
A00035  108  PURCHASES
        401 ACCTS PAY-WATSON CO 3000.00
A00036  401  ACCTS PAY-DAVIS CO
        101 CASH          12000.00
A00037  101  CASH            15400.00
A00038  101  CASH            15400.00
A00039  104  ACCTS REC-RL CARPENT
        104 ACCTS REC-DB JONES
        401 ACCTS PAY-HOLDEN INC
        101 CASH          7000.00
A00040  916  OP EXP-COMMISSIONS
        101 CASH          460.00
BATCH NO 10003
            47872.00

A00041  106  ACCRUED INT REC
        817 OTHER INC-INTEREST  9.00
A00042  916  OP EXP-INSURANCE
        315 OTHER ASST-INSURANCE 10.00
A00043  916  DEPRECIATION-RLDG
        212 ACCUM DEPR-RLDG    250.00
A00044  916  DEPRECIATION-MOF
        214 ACCUM DEPR-MOF      430.00
A00045  916  OP EXP-OFFICE SAL
        403 ACCRUED SALARIES   165.00
A00046  916  OP EXP-INTEREST-HIND
        404 INTEREST PAYABLE   100.00
A00047  507  BONDS PAYABLE
        402 MORTGAGE PAYABLE   1000.00
A00048  508  MORTGAGE PAYABLE
        402 BOND/MORTG PAY-CURRENT 3000.00
A00049  916  OP EXP-PAD DEBT EXP
        105 ALLOW FOR UNCOL ACCT 200.00
A00050  916  OP EXP-COWN-CORRECT
        101 CASH (INV NO A00026) 280.00
BATCH NO 10004
            5464.00
END OF JANUARY TRANSACTIONS—TOTALS

451106.00  451106.00
<table>
<thead>
<tr>
<th>Account</th>
<th>Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>CASH</td>
<td>121,303.00</td>
</tr>
<tr>
<td>TEMPORARY INVESTMENTS</td>
<td>30,000.00</td>
</tr>
<tr>
<td>NOTES RECEIVABLE</td>
<td>2,700.00</td>
</tr>
<tr>
<td>ACCOUNTS RECEIVABLE</td>
<td>10,650.00</td>
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<tr>
<td>ALLOWANCE FOR UNCOLLECTIBLE ACCOUNTS</td>
<td></td>
</tr>
<tr>
<td>ACCOUNTS RECEIVABLE</td>
<td></td>
</tr>
<tr>
<td>ALLOWANCE FOR UNCOLLECTIBLE ACCOUNTS</td>
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</tr>
<tr>
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**TOTAL** 25800.00

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**TOTAL** 34675.00

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**WATFIV - Version 1 Level 1 January 1970 Date**

- 70/162
CHAPTER III

CAPITAL BUDGETING ANALYSIS

Introduction to Capital Budgeting

Management faces one of the most critical decision areas of financial resource allocation when planning for capital outlays. Capital budgeting involves long-run commitments for equipment, plant and other long-lived facilities that have a direct bearing on the future flexibility and revenues of an enterprise. Alternatives must be carefully evaluated and as many factors as possible should be identified in projecting future developments in the economy.

Due to this uncertainty, management needs methods and procedures for evaluating future projections in order to make intelligent decisions on alternative proposals.

The criteria for evaluating future investments and their related cash flows are well defined by Gordon Shillinglaw as follows:¹

1. The amount and timing of initial investment outlays.

2. The amount and timing of subsequent investment outlays.

3. The amount and timing of operating cash inflows and outflows.

4. Economic life of investment

5. End-of-life residual values.

The first four components are directly associated with the familiar cash flow stream in capital budgeting and the residual value represents a recovery of the initial investment at the end of the project's life. Each segment presents its unique problems and suggested methods of handling these categories will be discussed in this chapter. Attention will be focused on the different inflows and outflows over a time period since capital budgeting analysis relates these flows to a timetable rather than by classification alone.

The matrix accounting system, developed in Chapter II, can generate current financial information for investment analysis. Management has the responsibility to utilize this up-to-date information in channeling the firm's financial resources so that it can maintain a competitive position in the economy through growth in assets and profits.
To aid management in this perplexing area, financial analysts have developed meaningful measurement techniques designed to determine project profitability and allow for comparisons among alternative proposals. These general yardsticks are payback on investment, accounting rate of return, and time-adjusted rates of return. In order for analysis to be effective, however, management must project reasonable cash flows for each alternative and ascertain acceptable rates of return for selecting capital-budgeting proposals.

Cash Flows in Capital Budgeting

Future projections of cash flows necessitates an analysis of the interrelationships of cash inflows and cash outflows. The primary cash outflows include the initial investment along with subsequent outlays required during the life of the project for major overhauls as restorations. Regular cash outflows that relate to operations and maintenance, such as labor and materials, can effectively be handled in the annual cash flows projected for the life of the investment. The cash inflows are generally characterized

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by increments in revenues or reductions in operating costs which are directly attributable to the capital improvement or investment. Comparisons of capital proposals are based on the incremental relationships of the various cash inflows and outflows during the investment period along with the measures for payback, accounting rate of return and time adjusted rates-of-return. The complex nature of these cash flows, however, requires careful preparation of the data for analysis purposes.

The initial investment would include the original costs, installation or construction costs, training and testing prior to utilizing the equipment or facilities in the firm's operations. In addition, currently owned equipment may be traded or retired and the value of these items should be taken into consideration in determining the net investments. Retirements of equipment or facilities would reduce the investment by its resale value and/or possible tax savings. Allowing for all related costs, including the above items, is strategic and demand individual appraisals for each capital expenditure.

Income tax considerations play an important role in evaluating investment alternatives. Gains and losses on
assets, investment credits and related tax deductible expenses should be considered in capital budgeting. Cash flows are affected by income tax provisions along with the initial investment outlays and retirements. Cash inflows and outflows should be net of income tax considerations so that management can arrive at a realistic picture for capital budgeting decisions. Extensive coverage of income tax accounting, however, cannot be adequately covered in this material, but its importance cannot be overlooked. Students should become familiar with income tax provisions as well as seek counsel of professor who specialize in the income tax area.

Management must generate the net investment and projected cash flows for capital investments since these items involve judgement decisions and detail analysis for each proposal. Statistical techniques can assist with probability analysis and some systems could be adopted in this area. Generally, a system can be developed after the net investment and cash flows are determined because this segment of the capital budgeting evaluation is more structured for the design of a computer system. A computer can provide valuable assistance to the student in calculating after-tax
cash flows and depreciation for capital investments.

A flowchart for a cash flow system is presented in Figure 3-1. This segment of the over-all capital budgeting system starts with the net investment and other asset statistics so that the after-tax cash flows can be determined. These cash flows will provide the essential data for calculating the payback period, accounting rate of return and time-adjusted rates of return.

Payback on Investment

The payback period is one method of screening capital investment proposals that provides a measure of liquidity for each project. A lack of sophistication has caused criticism of the payback measurement, but this guide is widely used in capital budgeting analysis and provides useful information on planning cash requirements for a company. Payback is very helpful in appraising risky proposals, for example, when an extended cash and credit position faces a firm.

The payback period is a measure of the length of time it will take to recoup, through projected cash flows, the initial investment in a capital project. Comparisons can be made of alternative proposals on a payback period.
FIGURE 3-1
CAPITAL BUDGETING SYSTEM FLOWCHART

Read
1 Net Capital Investment
2 Salvage Value
3 Asset Life

Read
1 Cash Inflows Array
2 Operating Expenses Array

Calculate
Net Cash Flows = Cash Inflows - Operating Expenses

Select Depreciation Method For Book and/or Tax
- Straight Line Method
- Declining Balance Method
- Soyd Method
- Declining Balance Method

Calculate
Depreciation And Accumulated Depreciation

Calculate
Taxable Income = Net Cash Flows - Depreciation

Calculate
Income Tax = Taxable Income X Tax Rate

Calculate
After Tax Cash Flows = Net Cash Flows - Income Tax

Write-Year, Depreciation After Tax Cash Flows

Stop
basis and certain minimum standards established for acceptability of investments. Of course, payback is only a basic measure of profitability because it does not take into consideration the different life spans of investments or the true value of money. Students can, however, use the payback period to calculate a payback reciprocal, a discounted payback period and a bail-out payback for more complete analysis.³

Varying cash flows present a problem in calculating the payback period of an investment. The standard formula is as follows:

\[
\text{INITIAL INVESTMENT} \quad \text{ANNUAL NET CASH INFLOWS}
\]

This payback formula is designed for even cash flows and will not give a realistic picture for uneven cash flows. This problem can be solved, however, with the use of computer. Each yearly cash flow can be subtracted from the initial investment until the balance is recovered and a payback period calculated. The number of years and/or fractions of years can be ascertained in the computer program for both even and uneven cash flow proposals. Figure 3-2 illustrates the system for calculating the payback period.

³See Horngren, Cost Accounting, pp. 454-458.
FIGURE 3-2

PAYBACK PERIOD SYSTEM FLOWCHART

Read
1 Net Investment
2 Array of Net Cash Inflows
3 Life of Investment

Calculate
Computed Net Investment = Net Investment

Do 100 I=1, Life

Calculate
Investment Remainder = Computed Net Investment-Yearly Net Cash Inflows

Calculate
Computed Net Investment = Investment Remainder

Calculate
Investment Remainder = Computed Net Investment-Yearly Net Cash Inflows

If
Investment Remainder = Zero

Calculate
Payback = I

If
I Equals Life

Calculate
Payback Reciprocal = 1/Payback

Write
1 Net Investment
2 Payback
3 Payback Reciprocal

Stop
An additional alternative that should be investigated is the discounted payback period. A profitability factor relating to the time value of money would enhance the value of a payback index and possibly make this measurement a more meaningful tool for decision making in capital budgeting.

Accounting Rate of Return on Investment

Basically, the accounting rate of return is an averaging technique that is closely aligned with the conventional accounting methods of determining income and investment. The income component is calculated by subtracting annual expenses, including depreciation, from the annual incremental cash flows from operations. Average investment, beginning investment plus ending investment divided by two (2), is the most commonly used denominator based on the assumption that the asset does not require a permanent investment since it is gradually recovered as earnings are realized. Straight-line depreciation is most frequently used because most assets are considered to decline in a linear fashion for book purposes. Some authors present alternative methods of calculating the accounting rate of

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return, but the consensus of opinion generally agrees with the above assumptions.

The accounting rate of return equation, as developed above, is as follows:

\[
\text{AVERAGE ANNUAL INCREMENTAL CASH FLOWS - DEPRECIATION} \\
\text{AVERAGE INVESTMENT}
\]

As a supplement to this calculation, the rate can also be calculated on the total net investment since this is one of the recognized alternatives to this measurement.

**Net Present Value of Investment**

Net present value analysis is one of the discounted cash flow methods that overcomes some of the shortcomings of the payback method and the accounting rate of return measurements. Net present value incorporates the time value of money within its calculations by discounting the incremental cash flows by a desired rate of return. Selection of the discount rate can be made from a variety of alternatives, including the following: a minimum cut-off rate, cost of debt equity, marginal cost of capital and average cost of capital. Once this rate is selected, an investment can be appraised by comparing the discounted cash flows with the capital outlays to arrive at a profitability index for each proposal. Desirable alternatives will have an excess of
discounted cash flows over the investment amount resulting in a profitability index greater than 100 percent. Other alternatives will be rejected because of a negative result and a profitability index less than 100 percent. Students can screen various alternatives first for acceptance as rejection and then select the most profitable proposals within the budget constraints of the company.

Figure 3-3 illustrates a system flowchart for net present value of investments. The minimum desired rate of return is selected by management and is introduced into the system along with an array of net cash inflows and the net investment. The system shows a discounting of cash flows which can be on an annuity basis for even flows or on individual years for uneven cash flows. A profitability index is determined for each alternative in order for the student to be able to utilize this criteria in evaluating and ranking investment proposals.

Dr. C. T. Horngren points out some of the pitfalls of project selection under budgeted constraints. He points out some difficulties of using an excess present value index.

---

FIGURE 3-3

NET PRESENT VALUE ON INVESTMENT SYSTEM FLOWCHART

Read
1 Net Investment
2 Net Cash Inflows
3 Cut-Off Rate of Return

Calculate
Present Value of Net Cash Flows=Net Cash Inflows
X Present Value Factors of Cut-Off Rate of Return

Calculate
Profitability Index=
Present Value of Net Cash Inflows/Net Investment

Write
1 Net Investment
2 Present Value of Net Cash Inflows
3 Profitability Index

Stop
and advocates the net present value of investments as the important guide in screening alternative proposals. His main point is that the profitability index does not take into consideration the dollar amount of incremental cash flows discounted to the current period. A more complete discussion of this and other difficult areas of capital budgeting will be covered after the time-adjusted rate of return section.

**Time-Adjusted Rate of Return on Investment**

Contrasted with the net present value method, the time-adjusted rate of return is a trail and even method that equates the net investment with the present value of the cash inflows to arrive at an actual rate of return on investment. The rate calculated using the time-adjusted method provides a maximum interest rate for borrowing capital. The minimum rate of return as cost of capital could be used as a cut-off point for the acceptance of rejection of alternatives. When the cost of capital as of borrowing funds is less than the time-adjusted rate, the company can earn a profit on the investment. Should the rate for securing capital as employing capital exceed time-adjusted rate, then the proposal should be rejected because the company would incur a loss.
Figure 3-4 presents the time-adjusted rate of return system flowchart. In this system the net investment, cash inflows and interest rates are introduced into the system by the company or student. A time-adjusted rate is calculated for each proposal under consideration and the output shows the investment amount along with the time-adjusted rate for the investment. The initial rate for this system will be six percent (6%) with increments of one percent (1%) until the investment is equal to or greater than the present value of the net cash inflows. Some adjusting may be desired if the rate is not an even percentage. The student can then use interpolation to arrive at a true rate of return.

Some of the problems encountered in working and selecting proposals by their profitability and liquidity are unequal lines of projects and the reinvestment of funds from shorter-lived investments. The time-adjusted rate of return has a built-in assumption in favor of short-lived projects that have a rate of return in excess of the cut-off rate because it assumes the reinvestment rate is equal to the rate of return for the shorter-lived project. On the other hand, the net present value method has a built-in minimum rate of return for reinvestment of cash flows which
FIGURE 3-4

TIME-ADJUSTED RATE OF RETURN ON INVESTMENT SYSTEM FLOWCHART

Read
1 Net Investment
2 Net Cash Inflows
3 Interest Rate (6%)

Calculate
Present Value of Net Cash Inflows = Net Cash Inflows \times Interest Rate

\[ \text{Interest Rate} = 0.01 \]

Calculate
Interest Rate = Interest Rate = 0.01

If
Net Investment - Present Value of Net Cash Inflows

Zero
Plus

Write
1 Net Investment
2 Present Value of Cash Inflows
3 Interest Rate

Stop
favors the longer-lived projects. Reconciling these differences is not a simple chore, but certain assumptions can assist in this conflict.

Ezra Solomon\(^7\) attempted to reconcile these differences by making common assumptions for both approaches to ranking investment proposals. He assumes the reinvestment rate is at least equal to the rate of the longer-lived project and the proposals should be evaluated at a common terminal date. He suggests the terminal date of the longer-lived project because this is a measure of the total wealth that the investor can expect from each alternative under consideration. Under these assumptions, the approaches rank projects identically and eliminate the conflict caused by different assumptions employed by each of the methods concerning the future.

Harold Bierman and Seymour Smidt\(^8\) contest these conclusions by Ezra Solomon because a company does not have to consider reinvestment unless the proposals are mutually


exclusive and certain future cash flows can be invested at different rates other than the original reinvestment rates assumed by Ezra Solomon. Mr. Bierman and Mr. Smidt illustrate conflicts for same lived proposals and show where a change in reinvestment rates can cause projects of Mr. Solomon to be in conflict from the net present value method and the time-adjusted rate of return measurements. They contend the opposite of Mr. Solomon in their conclusion summarizing their arguments sited in this paragraph.

Mr. Solomon's assumptions, however, do assist in reconciling the differences of net prevent value and time-adjusted rate of return. Should common assumptions, like common terminal dates or reinvestment at a reasonable rate of return, be made on alternative proposals, then most of the conflicts can be eliminated. This seems to be a better approach than not attempting to project future plans because of the uncertainty involved in planning.

Complete Investment Analysis System

A comprehensive system flowchart of the four measures in capital budgeting is presented in Figure 3-5. The system starts with a reading in of the variables: net investment, salvage value, asset life, operating expenses, cash inflows,
cut-off rate of return and a minimum interest rate for the
time-adjusted rate of return. Each of the systems in this
chapter are consolidated into Figure 3-5 in order to present an
over-all view of the capital budgeting process.
FIGURE 3-5

CAPITAL BUDGETING COMPREHENSIVE

SYSTEM FLOWCHART

Read
1 Net Investment
2 Salvage Value
3 Asset Life
4 Operating Expenses
5 Cash Inflows
6 Cut-Off Rate of Return
7 Minimum Interest Rate

Calculate
Net Cash Inflows=
Cash Inflows-
Operating Expenses

Select
Depreciation
Method For
Book and/or Tax

Soysd
Method

Declining
Balance

Straight
Line
Method

Calculate
Depreciation and
Accumulated Depreciation

Calculate
Taxable Income=
Net Cash Inflows-
Depreciation

Calculate
Income Tax=
Taxable Income
X Tax Rate

Calculate
After Tax Cash
Flows=Net Cash Flows
-Income Tax
FIGURE 3-5 (continued)

A

Calculate
Computed Net Investment=
Net Investment

If
100 I=1,
Life

Calculate
Investment Remainder=Computed
Net Investment-Yearly
After Tax Cash Flows

Calculate
Computed Net Investment=Investment Remainder

If
Investment Remainder=Zero

Zero

Calculate
Payback=I

If
I equals Life

Yes

Write 'Payback Less Than One
Re-evaluate Proposal'

No

Calculate
Payback Reciprocal
=1/Payback

Calculate
Accounting Rate of Return=
After Tax Cash Flows-
Depreciation/Average Investment
FIGURE 3-5 (continued)

Calculate Present Value of After Tax Cash Flows = After Tax Cash Flows × Present Value Factors of Cut-Off Rate of Return

Calculate Profitability Index = Present Value of After Tax Cash Flows / Net Investment

Calculate Time-Adjusted Present Value of After Tax Cash Flows = After Tax Cash Flows × Minimum Interest Rate

Calculate Minimum Interest Rate = Minimum Interest Rate + .01

If Net Investment - Time-Adjusted Present Value of After Tax Cash Flows

Write
1. Net Investment
2. Year and Depreciation
3. After Tax Cash Flows
4. Payback
5. Payback Reciprocal
6. Accounting Rate of Return
7. Present Value of After Tax Cash Flows
8. Profitability Index
10. Minimum Interest Rate (Time-Adjusted Interest Rate)

Stop
CHAPTER IV

PROCESS COST SYSTEM ON AN HISTORICAL COST BASIS

The process costing method is usually contrasted with job order costing in accounting literature pertaining to production costing operations. The nature of the production process establishes the primary criteria for selecting between a job order and process cost system. Job order costing is designed for the company that produces commodities of a unique nature with assignable costs for specific job lots or batches. Process costing, on the other hand, is applicable to inventory costing for continuous processing of either a single produce or a complete line of products over a relatively longer period of time. Usually process costing techniques involve numerous computations and separate identifications within the production analysis. To relieve the student of this computational burden, a computerized program could be utilized for process costing problems that would enable him to focus his attention on the flow of specific operational costs through the various departments within the system. He would benefit from interaction with the computer and gain greater insights
into process costing methods and procedures.

** Characteristics of a Historical Process Cost System **

The process cost method is basically an averaging process. Unit cost calculations for inventory valuations are the result of accumulating costs for particular departments and dividing these costs by a measure of production. The process costing system will usually involve homogeneous units that pass in a continuous fashion through a series of production operations or processes.¹

The historical process cost system may be developed in a number of different structures depending on a particular author's approach and cost method. The flow and calculations are essentially the same for comparable cost techniques so that a fundamentally sound approach can serve as a foundation for designing a basic computerized process cost system. Dr. C. T. Horngren has suggested a systematic method that furnishes a uniform approach to process cost accounting problems. His suggestions are divided into a five step program as follows:²

²Horngren, *Cost Accounting*, p. 630.
Step 1. **Physical Flow.** Trace the physical flow of production. In other words, (A) What are the units to be accounted for? and (B) How are they accounted for? A flowchart can be helpful in this preliminary step.

Step 2. **Equivalent Units.** Convert the physical flow, as accounted for in Step 1, into equivalent units of production. Thus, if 6,000 physical units are two-thirds complete as to materials and one-half complete as to conversion costs, this means that 4,000 doses of material and 3,000 doses of conversion costs have been applied.

Step 3. **Total Costs to be Accounted For.** Summarize, using materials, labor, overhead and so forth, the total costs to be accounted for in the operations.

Step 4. **Cost Per Equivalent Whole Unit.** Divide the data in Step 3 by the equivalent units calculated in Step 2. The result will be cost per equivalent whole unit.

Step 5. **Build the Total Cost of Production and Inventories.** Apply the unit costs obtained in Step 4 to inventories and to goods transferred out.
Make certain that the total of these figures agree with the grand total obtained in Step 3.

These steps afford the student an organized guide for solving process cost problems while providing internal calculation checks on the cost and unit amounts. This approach establishes the basic framework for the computerized program written in this chapter.

Development of a Historical Process Cost System Based on Weighted Average Costs

One of the most universal approaches to teaching process costing is based on the weighted average cost concept. Most authors utilize the weighted average or moving average method because it does not tax the student with additional cost calculations for maintaining identity of layers of costs for labor, materials and related overhead costs. With this method, the student can concentrate on the basic concepts in the process cost system and gain a greater appreciation of operational steps involved in a process cost network.


The basis difference in average costs, fifo and lifo methods is the technique of handling different losses of costs, beginning inventories and ending inventories as they relate to current production costs. Fifo and lifo unit cost figures usually require extensive cost details that may, in some cases, lead to complicated and inaccurate schemes. Any added precision to unit cost is a debatable advantage, since the manufacturing process is continuous and production uniform in most process cost systems. Therefore, the average cost method usually yields satisfactory cost measures since material fluctuations would not normally be experienced in calculating unit costs of operations.

Of course, many students will desire greater sophistication in cost analysis after mastering the weighted average method of process costing. This objective can be achieved with certain modifications in the cost input variables and computations in the computerized program in Exhibit 4-3.

The program developed in this chapter will employ weighted average costs in a process cost system characterized by two departments. Input data for the program is supplied through the use of a hypothetical chemical producer called NUCOST Chemical Company. NUCOST produces a general industrial cleaning chemical called NUCHEM that requires processing
in a blending department and a refining department. Raw materials, labor and overhead costs are included in the processing operations of each department. Materials are added at the beginning of the blending department and at the end of the refining department. Labor and overhead costs are combined into a conversion cost category, as suggested by several authors, since these costs are applied uniformly in both departments. These amounts form the basis for determining equivalent unit costs when matched with the equivalent units produced for the period.

The basis assumptions in the computerized process cost system, illustrated with the NUCOST Chemical Company in Exhibit 4-3, are as follows:

1. Each department has a beginning and ending inventory for the period. Should a process cost problem not have a beginning or ending inventory for a department, the student could then assign a zero value to the unit and cost variables for the appropriate inventory item.

2. Materials are added at the beginning of the blending department (first operation) and at the end of the refining department (second operation). The percentage completion pertains to conversion costs only.
3. Conversion costs are incurred uniformly throughout the production process.

4. Production costs are based on an output concept with normal spoilage, shrinkage and waste absorbed in the cost of operations.

A production and inventory schedule of the NUCOST Chemical Company is illustrated in Exhibit 4-1.

These production figures will serve as the input data for the computerized process cost system in Exhibit 4-3. Equivalent unit costs are calculated for the refining department after the transferred-in costs are determined in the blending department. These transferred-in costs become available with the calculation of unit costs in the blending department which can then be applied to the units transferred to the refining department. Appropriate built-in checks on total costs and units of production are established in the program as suggested in the five step approach outlined above. The program output is a summary of all production costs, by departments, in the form of a monthly production report. Accompanying the production report will be the necessary journal entries for recording the production activity of the NUCOST Chemical Company.
## EXHIBIT 4-1

### NUCOST CHEMICAL COMPANY

### Production Report

#### Blending Department

<table>
<thead>
<tr>
<th>Quantities</th>
<th>Physical Flow</th>
<th>Conversion Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work-in-Process, beginning</td>
<td>5,000</td>
<td>(1/2)(^A)</td>
</tr>
<tr>
<td>Units started</td>
<td>30,000</td>
<td></td>
</tr>
<tr>
<td>Units to be accounted for</td>
<td>35,000</td>
<td></td>
</tr>
<tr>
<td>Units completed</td>
<td>33,000</td>
<td></td>
</tr>
<tr>
<td>Work-in-process, end</td>
<td>2,000</td>
<td>(3/4)(^A)</td>
</tr>
<tr>
<td>Total units accounted for</td>
<td>35,000</td>
<td></td>
</tr>
</tbody>
</table>

#### Costs

<table>
<thead>
<tr>
<th>Costs</th>
<th>Totals</th>
<th>Materials</th>
<th>Conversion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work-in-Process, beginning</td>
<td>$10,000</td>
<td>$5,000</td>
<td>$5,000</td>
</tr>
<tr>
<td>Current costs</td>
<td>90,000</td>
<td>30,000</td>
<td>60,000</td>
</tr>
<tr>
<td>Total costs to be accounted for</td>
<td>100,000</td>
<td>35,000</td>
<td>65,000</td>
</tr>
</tbody>
</table>

#### Refining Department

<table>
<thead>
<tr>
<th>Quantities</th>
<th>Physical Flow</th>
<th>Transferred-in Costs</th>
<th>Conversion Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work-in-process, beginning</td>
<td>4,000(1/4)(^A)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transferred-in</td>
<td>33,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Units to be accounted for</td>
<td>37,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^A\) Pertains to degree of completion on conversion costs only.
EXHIBIT 4-1 (CONTINUED)

<table>
<thead>
<tr>
<th>Quantities</th>
<th>Physical Flow</th>
<th>Transferred-in Costs</th>
<th>Materials Costs</th>
<th>Conversion Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units completed</td>
<td>35,000</td>
<td>35,000</td>
<td>35,000</td>
<td>35,000</td>
</tr>
<tr>
<td>Work-in-process, end</td>
<td>2,000(2/5)^A</td>
<td>2,000</td>
<td>----</td>
<td>800</td>
</tr>
<tr>
<td>Total units accounted for</td>
<td>37,000</td>
<td>37,000</td>
<td>35,000</td>
<td>35,800</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Costs</th>
<th>Transferred-in Costs</th>
<th>Materials Costs</th>
<th>Conversion Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work-in-process, beginning</td>
<td>$6,000</td>
<td>$4,000</td>
<td>----</td>
</tr>
<tr>
<td>Current Costs (B)</td>
<td>(B)</td>
<td>$17,500</td>
<td>105,000</td>
</tr>
<tr>
<td>Total costs to be accounted for</td>
<td>$ (B)</td>
<td>$ (B)</td>
<td>$17,500</td>
</tr>
</tbody>
</table>

^A^Pertains to degree of completion on conversion costs only.
^B^To be calculated in program from production data of the blending department.

Computerized Historical Process Cost System

Using Weighted Average Costs

The complete program for the computerized process cost system is illustrated in Exhibit 4-3. This system is based on historical costs and employs the weighted average method for production unit costs. Input and output information for the program represents the production activity of the NUCOST
Chemical Company. The input variables for each department are shown in Exhibit 4-2. The output from the program is the monthly production report and journal entries which are included in the program printout in Exhibit 4-3.

This computerized process cost system enables the student to solve a basic process cost problem in the form of a production cost report along with supporting journal entries. Interaction with the computer expands his understanding of data processing capabilities and helps to reduce the numerous calculations involved in process cost accounting.

The more involved process cost problems can be solved by expanding the basic program in Exhibit 4-3. One possibility is additional departments in the process cost system. The second segment of the computerized program can be utilized for subsequent departments since the structure of the refining department includes the basic cost elements required for transferred-in costs, materials and conversion costs as well as the unit categories for each of these elements. With the appropriate input data, a transfer of control statement (i.e., G0 T0) and certain alterations in the FORMAT statements, the program could be adapted to expanded process cost problems.

Other program modifications are also available to the student. Fifo and lifo costing can be introduced by increasing the cost variable identifications for the segmentation of
<table>
<thead>
<tr>
<th>Description</th>
<th>Variable</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Blending Department</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Quantities</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work-in-process, beginning</td>
<td>WIPB</td>
<td>5,000</td>
</tr>
<tr>
<td>Units started</td>
<td>UTS</td>
<td>30,000</td>
</tr>
<tr>
<td>Units completed</td>
<td>UTC</td>
<td>33,000</td>
</tr>
<tr>
<td>Work-in-process, end</td>
<td>WIPE</td>
<td>2,000</td>
</tr>
<tr>
<td>Work-in-process, percentage completion, beginning</td>
<td>PCBI</td>
<td>50%</td>
</tr>
<tr>
<td>Work-in-process, percentage completion, end</td>
<td>PCEI</td>
<td>75%</td>
</tr>
<tr>
<td><strong>Costs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work-in-process, beginning-materials</td>
<td>CMBI</td>
<td>$ 5,000</td>
</tr>
<tr>
<td>Work-in-process, beginning-conversion costs</td>
<td>CONBI</td>
<td>5,000</td>
</tr>
<tr>
<td>Current costs-materials</td>
<td>CMCC</td>
<td>30,000</td>
</tr>
<tr>
<td>Current costs-conversion costs</td>
<td>CONCC</td>
<td>60,000</td>
</tr>
<tr>
<td><strong>Refining Department</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Quantities</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work-in-process, beginning</td>
<td>RWPB</td>
<td>4,000</td>
</tr>
<tr>
<td>Transferred-in</td>
<td>RUTI</td>
<td>33,000</td>
</tr>
<tr>
<td>Units completed</td>
<td>RUTC</td>
<td>35,000</td>
</tr>
<tr>
<td>Work-in-process, end</td>
<td>RWPE</td>
<td>2,000</td>
</tr>
<tr>
<td>Work-in-process, percentage completion, beginning</td>
<td>PRBI</td>
<td>25%</td>
</tr>
<tr>
<td>Work-in-process, percentage completion, end</td>
<td>PREI</td>
<td>40%</td>
</tr>
<tr>
<td><strong>Costs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work-in-process, beginning-transferred-in</td>
<td>TICB</td>
<td>$ 4,000</td>
</tr>
<tr>
<td>Work-in-process, beginning-conversion costs</td>
<td>RCONB</td>
<td>2,000</td>
</tr>
<tr>
<td>Current costs-materials</td>
<td>RCCM</td>
<td>17,500</td>
</tr>
<tr>
<td>Current costs-conversion costs</td>
<td>RCONCC</td>
<td>105,000</td>
</tr>
</tbody>
</table>
cost layers which are traceable as first-in, first-out costs and last-in, first-out costs for unit of production figures. In addition, variable costing could be employed in the program through the use of variable input costs for materials, labor and overhead. The variables could be divided into these three categories or the later two combined into a conversion cost element as shown in Exhibit 4-1. The production report and journal entries would reflect the variable costs of production and the period costs would be expensed in the period incurred.

These suggestions point out a few of the possibilities available for coverage in a cost accounting course. Professors and students can use their imaginations to further expand these computer adaptations to process cost accounting solutions.
PROGRAM FOR PROCESS COST SYSTEM-HISTORICAL

AG PEREIRE DISSERTATION

1 10 FORMAT(F4.0,F5.0,F4.0,F3.2)
11 10 FORMAT(2F4.0,F5.0)
12 10 FORMAT(1X,F8.0)
13 10 FORMAT(1X,2F15.0)
14 10 FORMAT(1X,2F15.0)
15 10 FORMAT(1X,5X,THE MONTH ENDING JUNE 30,1969)
16 10 FORMAT(S4X,HEIGHTED-AVERAGE METHOD)
17 10 FORMAT(SX,BLENDING DEPARTMENT)
18 10 FORMAT(SX,EQUIVALENT UNITS)
19 10 FORMAT(I9X,QUANITIES,26X,PHYSICAL FLOW,5X,_MATERIALS,5X)
20 10 FORMAT(/)*CONVERSION COSTS* )
21 20 FORMAT(I9X,WORK-IN-PROCESS, BEGINNING,12X,F7.0)
22 20 FORMAT(I9X,UNITS STARTED,25X,F7.0)
23 20 FORMAT(1X,UNITS COMPLETED,23X,F7.0,11X,F7.0,11X,F7.0)
24 20 FORMAT(1X,WORK-IN-PROCESS,  END, 11X,F7.0)
25 20 FORMAT(1X,TOTALS,31X,F8.0,10X,F8.0,10X,F8.0)
26 20 FORMAT(I9X,COST BREAKDOWN)
27 20 FORMAT(I9X,COSTS,35X,TOTALS,8X, MATERIALS,5X,CONVERSION )
28 20 FORMAT(I9X,9X,CONVERSION COSTS )
29 20 FORMAT(I9X,10X,7X,F7.0)
30 20 FORMAT(I9X,10X,7X,F7.0)
31 20 FORMAT(I9X,10X,7X,F7.0)
32 20 FORMAT(I9X,10X,7X,F7.0)
33 20 FORMAT(I9X,10X,7X,F7.0)
34 20 FORMAT(I9X,10X,7X,F7.0)
35 20 FORMAT(I9X,10X,7X,F7.0)
36 20 FORMAT(I9X,10X,7X,F7.0)
37 20 FORMAT(I9X,10X,7X,F7.0)
38 20 FORMAT(I9X,10X,7X,F7.0)
39 20 FORMAT(I9X,10X,7X,F7.0)
40 20 FORMAT(I9X,10X,7X,F7.0)
41 20 FORMAT(I9X,10X,7X,F7.0)
42 20 FORMAT(I9X,10X,7X,F7.0)
43 20 FORMAT(I9X,10X,7X,F7.0)
44 20 FORMAT(I9X,10X,7X,F7.0)
45 20 FORMAT(I9X,10X,7X,F7.0)
46 20 FORMAT(I9X,10X,7X,F7.0)
47 20 FORMAT(I9X,10X,7X,F7.0)
48 20 FORMAT(I9X,10X,7X,F7.0)
49 20 FORMAT(I9X,10X,7X,F7.0)
50 20 FORMAT(I9X,10X,7X,F7.0)
51 20 FORMAT(I9X,10X,7X,F7.0)
52 20 FORMAT(I9X,10X,7X,F7.0)
53 20 FORMAT(I9X,10X,7X,F7.0)
54 20 FORMAT(I9X,10X,7X,F7.0)
55 20 FORMAT(I9X,10X,7X,F7.0)
FORMAT IX,'COST PER E.U.P.',14X,'$7.4',F7.4
57  FORMAT IX,'TOTAL COST PER E.U.P.',17X,'$7.4
58  FORMAT IX,'SUMMARY OF COSTS' /
59  FORMAT IX,'COST OF UNITS COMPLETED',16X,'$7.0
60  FORMAT IX,'WORK-IN-PROCESS',16X,'$7.0
61  FORMAT IX,'TOTAL COST OF WORK IN PROCESS',16X,'$7.0
62  FORMAT IX,'TOTAL COSTS TO BE ACCOUNTED FOR', 7X,'$7.0 
63  FORMAT IX,'EQUIVALENT UNITS'
64  FORMAT IX,'JOURNAL ENTRIES' /
65  FORMAT IX,'BLENDING DEPT-FORK-IN-PROCESS',4 IX,','$7.0
66  FORMAT IX,'MATERIALS',4 IX,','$7.0
67  FORMAT IX,'ENDING DEPT-WORK-IN-PROCESS',4 IX,','$7.0
68  FORMAT IX,'LABOR AND OVERHEAD-CONVERSION COSTS',4 IX,','$7.0
69  FORMAT IX,'REFINING DEPT-WORK-IN-PROCESS',4 IX,','$7.0
70  FORMAT IX,'PACKAGING DEPT-MATERIALS',4 IX,','$7.0
71  FORMAT IX,'REFINING DEPT-WORK-IN-PROCESS',4 IX,','$7.0
72  FORMAT IX,'MATERIALS',4 IX,','$7.0
73  FORMAT IX,'REFINING DEPT-WORK-IN-PROCESS',4 IX,','$7.0
74  FORMAT IX,'LABOR AND OVERHEAD-CONVERSION COSTS',4 IX,','$7.0
75  FORMAT IX,'FINISHED GOODS',57X,'$7.0
76  FORMAT IX,'REFINING DEPT-WORK-IN-PROCESS',4 IX,','$7.0
77  FORMAT IX,'INITIAL DEPARTMENT - BLENDING
78  READ 5,10P8,UTS,UTC,WIP,PC1,PC2
79  READ 5,11 P9,CMH,CONBI,CMCC,CONCC
80  UNACCT=IP8+UTS
81  ZUNACT=UTC+WIP
82  IF (UNACCT .NE. ZUNACT) WRITE 16,12) UNACCT, ZUNACT
83  EUHM=UTC+WIP
84  PECUCC=UTC+PC1,PC2
85  EUCC=UTC+PCC
86  TCW=CMH+CONBI
87  TCW1=CMCC+CONCC
88  TCF=TCW+TCW1
89  TOTCF=CMH+CMCC
90  TOTC=CONBI+CONCC
91  TOTC=TOTC*TOTCF
92  IF (TOTCF .NE. TOTC) WRITE 16,13) TOTCF, TCF
93  EUHM=TOTCF/EUHM
94  EUCC=TOTCC/EUCC
95  TEC=PECUCC+EUCC
96  SUMMARY OF COSTS
97  WRITE 16,42) UNTC=UTC+TEC
98  CWP=IPF*EUHM
99  CWP=CMH+CMCC
100  TCF=CMH*CMCC
101  TCF=CMH*CMCC
102  TCF=CMH*CMCC
103  TCF=CMH*CMCC
104  WRITE 16,23) UTC, UTC, UTC
C SECOND DEPARTMENT—REFINING
READ(5,10)K,WPB,KRT,RCM,RPB,PRBI,PRP
READ(5,41)TIC,TCONB,RCCM,RCONC
TIC=UNTC
RUAF=K*WPB*UTI
ZRUAF=RUTC*WPPE
IF(ZRUAF,NE,0)WRITE(6,12)RUAF,ZRUAF
RFTP=RUTC*WPPE
REP=RUTC
RPWP=WPPE*PREI
RCCM=RUTC*PXPE
TOBI=TICC+RCONB
TOCC=TICC+RCCM+RCONC
RTOCAF=TOBI+TOCC
TOTIC=TICB+RCONB
TOTCC=PCUNB*RCONC
ZTUCF=TOTIC+TOTCC+TORCC
IF(ZTUCF,NE,0)WRITE(6,13)ZTUCF

SUMMARY OF COSTS
RCOM=RUTC*REUCC
RTC=ROC+REUCC
RCM=RPWP*REUCC
RTPF=ATICS+RCONCS
STCAF=STCAF+RTPF
IF(STCAF,NE,0)WRITE(6,13)STCAF

WRITE(6,42)
WRITE(6,43)
WRITE(6,44)
WRITE(6,45)
WRITE(6,46)
WRITE(6,47)
WRITE(6,48)
WRITE(6,49)
WRITE(6,50)
WRITE(6,51)
WRITE(6,52)
WRITE(6,53)TOCC,TOC,ACCH,HCCH
164 WRITE(6,54)RTDCAF,TOTC,TOMC,TOMC
165 WRITE(6,55)REP,TMA,REPC
166 WRITE(6,56)REUC,RUCM,REUC
167 WRITE(6,57)RTUG
168 WRITE(6,58)
169 WRITE(6,59)RUCOM
170 WRITE(6,60)
171 WRITE(6,61)PTCS
172 WRITE(6,62)HCONCC
173 WRITE(6,63)RTWPE
174 WRITE(6,64)STCAF
175 C JOURNAL ENTRIES FOR MONTHLY PRODUCTION
176 WRITE(6,65)
177 WRITE(6,66)CCH
178 WRITE(6,67)HCONCC
179 WRITE(6,68)HCONCC
180 WRITE(6,69)HCONCC
181 WRITE(6,70)HCONCC
182 WRITE(6,71)HCONCC
183 WRITE(6,72)HCONCC
184 WRITE(6,73)HCONCC
185 WRITE(6,74)HCONCC
186 WRITE(6,75)HCONCC
187 WRITE(6,76)HCONCC
188 WRITE(6,77)HCONCC
189 STOP
190 END

ENTRY
100000.
100000.
**PRODUCTION COST REPORT**

**FOR THE MONTH ENDING JUNE 30, 1969**

**WEIGHTED-AVERAGE METHOD**

**BLENDING DEPARTMENT**

<table>
<thead>
<tr>
<th>QUANTITIES</th>
<th>PHYSICAL FLOW</th>
<th>MATERIALS</th>
<th>CONVERSION COSTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>WORK-IN-PROCESS, BEGINNING</td>
<td>5000.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UNITS STARTED</td>
<td>30000.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UNITS TO BE ACCOUNTED FOR</td>
<td>35000.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UNITS COMPLETED</td>
<td>33000.</td>
<td>33000.</td>
<td>33000.</td>
</tr>
<tr>
<td>TOTALS</td>
<td>35000.</td>
<td>35000.</td>
<td>34500.</td>
</tr>
</tbody>
</table>

**COST BREAKDOWNS**

<table>
<thead>
<tr>
<th>COSTS</th>
<th>TOTALS</th>
<th>MATERIALS</th>
<th>CONVERSION COSTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>WORK-IN-PROCESS, BEGINNING</td>
<td>$10000.</td>
<td>$5000.</td>
<td>$5000.</td>
</tr>
<tr>
<td>CURRENT COSTS</td>
<td>90000.</td>
<td>30000.</td>
<td>60000.</td>
</tr>
<tr>
<td>TOTAL COSTS TO BE ACCOUNTED FOR</td>
<td>$100000</td>
<td>$35000.</td>
<td>$65000.</td>
</tr>
<tr>
<td>DIVIDED BY E.U.P.</td>
<td>35000.</td>
<td>34500.</td>
<td>1500.</td>
</tr>
<tr>
<td>TOTAL COST PER E.U.P.</td>
<td>$2.8841</td>
<td>$1.0000</td>
<td>$1.8841</td>
</tr>
</tbody>
</table>

**SUMMARY OF COSTS**

| COST OF UNITS COMPLETED      | $95174. |
| WORK-IN-PROCESS, END |        |
| MATERIALS                  | 2000.   |
| CONVERSION COSTS           | 2826.   |
| TOTAL COST OF WORK-IN-PROCESS | $4826. |
| TOTAL COSTS TO BE ACCOUNTED FOR | $100000. | 223674. | 223674. |
## Refining Department

### Quantities

<table>
<thead>
<tr>
<th>Physical Flow</th>
<th>Transferred-In Costs</th>
<th>Materials</th>
<th>Conversion Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units Transferred-In</td>
<td>$33000.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Units to Be Accounted For</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Units Completed</td>
<td>$35000.</td>
<td>$7000.</td>
<td>$35000.</td>
</tr>
<tr>
<td>Work-In-Process, End</td>
<td>$2000.</td>
<td></td>
<td>$800.</td>
</tr>
<tr>
<td>Totals</td>
<td>$37000.</td>
<td>$37000.</td>
<td>$35800.</td>
</tr>
</tbody>
</table>

### Cost Breakdowns

<table>
<thead>
<tr>
<th>Costs</th>
<th>Totals</th>
<th>Transferred-In Costs</th>
<th>Materials</th>
<th>Conversion Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Costs</td>
<td>$217674.</td>
<td>$95174.</td>
<td>$17500.</td>
<td></td>
</tr>
<tr>
<td>Total Costs to Be Accounted For</td>
<td>$223674.</td>
<td>$37000.</td>
<td>$17500.</td>
<td>$107000.</td>
</tr>
<tr>
<td>Divided by E.U.P.</td>
<td></td>
<td></td>
<td></td>
<td>$35800.</td>
</tr>
<tr>
<td>Cost Per E.U.P.</td>
<td>$6.1692</td>
<td>$2.6804</td>
<td>$0.5000</td>
<td>$2.9888</td>
</tr>
</tbody>
</table>

### Summary of Costs

<table>
<thead>
<tr>
<th>Costs</th>
<th>Totals</th>
<th>Transferred-In Costs</th>
<th>Conversion Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work-In-Process, End</td>
<td>$215922.</td>
<td>$5361.</td>
<td>$2391.</td>
</tr>
<tr>
<td>Total Cost of Work in Process</td>
<td>$7752.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Costs to Be Accounted For</td>
<td>$223674.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### JOURNAL ENTRIES

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLENDING DEPT-WORK-IN-PROCESS</td>
<td>$ 30000</td>
<td>LABOR AND OVERHEAD-CONVERSION COSTS</td>
<td>$ 30000</td>
</tr>
<tr>
<td>BLENDING DEPT-WORK-IN-PROCESS</td>
<td>$ 60000</td>
<td>BLENDING DEPT-WORK-IN-PROCESS</td>
<td>$ 60000</td>
</tr>
<tr>
<td>REFINING DEPT-WORK-IN-PROCESS</td>
<td>$ 95174</td>
<td>BLENDING DEPT-WORK-IN-PROCESS</td>
<td>$ 95174</td>
</tr>
<tr>
<td>REFINING DEPT-WORK-IN-PROCESS</td>
<td>$ 17500</td>
<td>MATERIALS</td>
<td>$ 17500</td>
</tr>
<tr>
<td>REFINING DEPT-WORK-IN-PROCESS</td>
<td>$ 105000</td>
<td>LABOR AND OVERHEAD-CONVERSION COSTS</td>
<td>$ 105000</td>
</tr>
<tr>
<td>FINISHED GOODS</td>
<td>$ 215922</td>
<td>REFINING DEPT-WORK-IN-PROCESS</td>
<td>$ 215922</td>
</tr>
</tbody>
</table>

**CORE USAGE**
- OBJECT CODE = 9496 Bytes
- ARRAY AREA = 0 Bytes
- TOTAL AREA AVAILABLE = 116640 Bytes

**COMPILE TIME**
- 0.66 SEC

**EXECUTION TIME**
- 0.18 SEC

**WATFIV - VERSION 1 LEVEL 1 JANUARY 1970 DATE = 70/162**
CHAPTER V

PROCESS COST SYSTEM WITH STANDARD COSTS
AND VARIANCE ANALYSIS

Standard Cost in a Process Cost System

A study in the development and utilization of standard costing enables a student to better appreciate planning and control in financial management. Standard costing fosters an understanding of budgeting techniques, measurements of performance and related control practices available to the financial manager. Establishing standards becomes an educational process that affords insights into production, cost behavior and fiscal planning. Equipped with a background in standard costing techniques and procedures, a student will be in a better position to schedule and control the productive operation and financial affairs of a company.

Process costing blends well with standard costs because of the mass production characteristics in the system. Meaningful standards, physical and costs, can more easily be established for a process which is of a continuous and repetitive nature because these activities form a pattern of behavior that facilitate physical and cost measurements.
Cost trends and physical consumption statistics enable the accountants and engineers to design guidelines for production control that allows for normal shrinkage, waste and spoilage within the production processes.

Standard costs not only afford better planning and control information, they also eliminate recomputation of average unit costs after cash purchase or period of time as in weighted average costing or separate costing for successive lots of merchandise under the fifo and lifo cost methods. Economics also accrue from reduced clinical costs through the use of standard costs. A company can maintain inventory records on a physical quantity basis and issue materials at standard costs. Thus, standard costing can promote more effective planning and control practices while offering opportunities for streamlining an accounting system.

**Development of a Process Cost System**

**Based on Standard Costs**

The Scott Aluminum Company, a hypothetical aluminum producer, will be utilized to structure the standard cost process system and provide the cost process system and provide the input data for the computerized program. The Scott Company operates a processing operation that requires two departments - a processing department and a finishing department.
Standards for each department are segmented into materials, labor, variable overhead and fixed overhead. In addition, a flexible overhead budget is formulated for each department with an identification for normal capacity and a range of production levels below and above this normal operating level. These flexible overhead budgets for the company are depicted in Exhibit 5-1.

EXHIBIT 5-1

<table>
<thead>
<tr>
<th>SCOTT ALUMINUM COMPANY</th>
<th>Flexible Overhead Budget</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PROCESSING DEPARTMENT</strong></td>
<td>Normal Capacity</td>
</tr>
<tr>
<td>UNITS PRODUCED</td>
<td>2,000</td>
</tr>
<tr>
<td>Standard direct labor hours</td>
<td>8,000</td>
</tr>
<tr>
<td>Variable factory overhead</td>
<td>$16,000</td>
</tr>
<tr>
<td>Fixed factory overhead</td>
<td>30,000</td>
</tr>
<tr>
<td>Total factory overhead</td>
<td>$46,000</td>
</tr>
</tbody>
</table>

| **FINISHING DEPARTMENT** | Normal Capacity |
| UNITS PRODUCED          | 2,000 | 2,500 | 3,000 | 3,500 |
| Standard direct labor hours | 4,000 | 5,000 | 6,000 | 7,000 |
| Variable factory overhead  | 12,000 | 15,000 | 18,000 | 21,000 |
| Fixed factory overhead    | 21,000 | 21,000 | 21,000 | 21,000 |
| Total factory overhead    | $33,000 | $36,000 | $39,000 | $42,000 |
The standard overhead rates for each budget are based on direct labor hours at normal operating capacity. For the processing department, the standard cost for the variable overhead rate is $2.00 per direct hour ($24,000/12,000 hrs.) at an output level of 3,000 units of production. The finishing department has a variable overhead rate of $3.00 per direct labor hour ($18,000/6,000 hrs.) at an output level of 3,000 units of production and a fixed overhead rate of $3.50 per direct labor hour ($21,000/6,000 hrs.) at 3,000 units of production. The material and labor unit costs along with these overhead rates are illustrated in Exhibit 5-2. These costs standards represent the planning and control tools used in analyzing the production costs and operations of Scott Aluminum Company.

Production activity for the month of June, 19XX is detailed in Exhibit 5-3 for the processing department and in Exhibit 5-4 for the finishing department. These production reports provide the basic information on the monthly physical output along with the actual costs incurred during the month. Given this information, a production report can be developed for each department that reflects standard costs of production as well as variances from these standards. This complete production report, including physical flow, standard costs and variance analysis for each department, is the end product of the process cost program in Exhibit 5-6.
### SCOTT ALUMINUM COMPANY

#### Standard Unit Costs

#### PROCESSING DEPARTMENT

<table>
<thead>
<tr>
<th>ITEM</th>
<th>PER UNIT</th>
<th>COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATERIALS</td>
<td>$1.50A</td>
<td>$4.50</td>
</tr>
<tr>
<td>DIRECT LABOR</td>
<td>3.50B</td>
<td>14.00</td>
</tr>
<tr>
<td>FIXED OVERHEAD</td>
<td>2.50C</td>
<td>10.00</td>
</tr>
<tr>
<td>VARIABLE OVERHEAD</td>
<td>2.00C</td>
<td>8.00</td>
</tr>
<tr>
<td><strong>TOTAL UNIT COSTS</strong></td>
<td></td>
<td><strong>$36.50</strong></td>
</tr>
</tbody>
</table>

#### FINISHING DEPARTMENT

<table>
<thead>
<tr>
<th>ITEM</th>
<th>PER UNIT</th>
<th>COST</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATERIALS</td>
<td>$1.00D</td>
<td>$2.00</td>
</tr>
<tr>
<td>DIRECT LABOR</td>
<td>4.00E</td>
<td>8.00</td>
</tr>
<tr>
<td>FIXED OVERHEAD</td>
<td>3.50F</td>
<td>7.00</td>
</tr>
<tr>
<td>VARIABLE OVERHEAD</td>
<td>3.00F</td>
<td>6.00</td>
</tr>
<tr>
<td><strong>TOTAL COSTS ADDED IN FINISHING DEPARTMENT</strong></td>
<td></td>
<td><strong>23.00</strong></td>
</tr>
<tr>
<td><strong>TRANSFERRED-IN COSTS FROM PROCESSING DEPARTMENT</strong></td>
<td></td>
<td><strong>36.50</strong></td>
</tr>
<tr>
<td><strong>TOTAL UNIT COSTS - FINISHING DEPARTMENT</strong></td>
<td></td>
<td><strong>59.50</strong></td>
</tr>
</tbody>
</table>

#### STANDARDS ESTABLISHED PER UNIT PRODUCED:

- **A** Three units of raw material per unit produced.
- **B** Four direct labor hours per unit produced.
- **C** Based on direct labor hours (12,000 hours for 3,000 units) with four direct labor hours employed for each unit produced.
- **D** Two units of raw material per unit produced.
- **E** Two direct labor hours per unit produced.
- **F** Based on direct labor hours (6,000 hours for 3,000 units) with two direct labor hours employed for each unit produced.
## EXHIBIT 5-3

SCOTT ALUMINUM COMPANY  
PROCESSING DEPARTMENT  
Production Report  
For the Month Ended May 31, 197X

### PRODUCTION QUANTITIES

<table>
<thead>
<tr>
<th></th>
<th>PHYSICAL FLOW</th>
<th>EQUIVALENT UNITS</th>
<th>OVERHEAD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MATERIALS</td>
<td>LABOR</td>
<td>FIXED</td>
</tr>
<tr>
<td>Work-in-process, beginning</td>
<td>800 (3/4)A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Units started</td>
<td>2900</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Units to be accounted for</td>
<td>3700</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Units completed:
- From beginning inventory 800 200 200 200 200 200 |
- From current production 2300 2300 2300 2300 2300 |

Work-in-process, end 600 (1/2)A 300 300 300 300 300 |
| Units accounted for 3700 2800 2800 2800 2800 2800 |

### ACTUAL COSTS AND QUANTITIES

<table>
<thead>
<tr>
<th></th>
<th>TOTAL</th>
<th>MATERIAL</th>
<th>LABOR</th>
<th>OVERHEAD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>FIXED</td>
<td>VARIABLE</td>
<td></td>
</tr>
<tr>
<td>TOTAL ACTUAL COSTS</td>
<td>$13,120</td>
<td>$36,300</td>
<td>$29,000</td>
<td>$21,840</td>
</tr>
<tr>
<td>ACTUAL ITEM COSTS PER EQUIVALENT UNIT</td>
<td>1.60</td>
<td>3.30</td>
<td>10.36</td>
<td>7.80</td>
</tr>
<tr>
<td>ACTUAL QUANTITY USED IN PRODUCTION</td>
<td>8,200</td>
<td>11,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A Percentage completion applies to all cost elements: materials, labor, fixed overhead, and variable overhead.
<table>
<thead>
<tr>
<th>PRODUCTION QUANTITIES</th>
<th>PHYSICAL FLOW</th>
<th>EQUIVALENT UNITS</th>
<th>OVERHEAD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>TRANSFERRED-IN</td>
<td>MATERIAL</td>
</tr>
<tr>
<td>Work-in-process,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>beginning</td>
<td>1,200 (3/4)A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Units transferred-in</td>
<td>3,100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Units to be</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>accounted for</td>
<td>4,300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Units completed:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>From beginning inventory</td>
<td>1,200</td>
<td>1,200</td>
<td>300</td>
</tr>
<tr>
<td>From current production</td>
<td>2,100</td>
<td>2,100</td>
<td>2,100</td>
</tr>
<tr>
<td>Work-in-process ends</td>
<td>1,000 (1/2)A</td>
<td>1,000</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td>4,300</td>
<td>4,300</td>
<td>2,900</td>
</tr>
</tbody>
</table>

A Percentage completion applies to all cost elements: materials, labor, fixed overhead and variable overhead.
<table>
<thead>
<tr>
<th>ACTUAL COSTS AND QUANTITIES</th>
<th>TOTAL</th>
<th>TRANSFERRED-IN COSTS</th>
<th>MATERIAL</th>
<th>LABOR</th>
<th>OVERHEAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL ACTUAL COSTS</td>
<td>$156,950</td>
<td>$6,160</td>
<td>$23,985</td>
<td>$23,000</td>
<td>$18,850</td>
</tr>
<tr>
<td>ACTUAL ITEM COSTS PER EQUIVALENT UNIT</td>
<td>36.50</td>
<td>1.10</td>
<td>4.10</td>
<td>7.93</td>
<td>6.50</td>
</tr>
<tr>
<td>ACTUAL QUANTITY USED IN PRODUCTION</td>
<td>5,600</td>
<td>5,850</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Computerized Process Cost System With Standard Costs and Variances

The process cost system employing standard cost measurements is developed for the computer program illustrated in Exhibit 5-6. This program accepts inputs of standard costs and actual costs for expenditure categories of the two departments: transferred-in; materials; labor; fixed overhead and variable overhead. In addition, it identifies the physical flow for each department along with the specific time period covered by the production report. Variance calculations are performed during the program processing with the monetary variances and percentage variances included in the final report. Therefore, the design of this process cost system provides a comprehensive analysis of the production operations of the Scott Aluminum Company.

Exhibit 5-5 gives a complete listing of the input variables along with the corresponding production data and cost values for the Scott Aluminum Company. The student must supply identifications for these variables in determining his solution of a specific process cost problem. Most process cost problems based on standard costs can be prepared for acceptance into this computerized process cost system and a production report developed like the one provided for the Scott Aluminum Company.
<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>VARIABLE</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PROCESSING DEPARTMENT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ACTUAL-QUANTITIES AND PERCENTAGES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work-in-process, beginning:</td>
<td>WPB</td>
<td>800</td>
</tr>
<tr>
<td>Units Started</td>
<td>USTD</td>
<td>2,900</td>
</tr>
<tr>
<td>Units completed - beginning inventory</td>
<td>UCBI</td>
<td>800</td>
</tr>
<tr>
<td>Units completed - current production</td>
<td>UCCP</td>
<td>2,300</td>
</tr>
<tr>
<td>Work-in-process, end</td>
<td>WPE</td>
<td>600</td>
</tr>
<tr>
<td>Work-in-process, percentage completion, begin</td>
<td>PWPB</td>
<td>75%</td>
</tr>
<tr>
<td>Work-in-process, percentage completion, end</td>
<td>PWPE</td>
<td>50%</td>
</tr>
<tr>
<td>Units of material - ACTUAL</td>
<td>UMAT</td>
<td>8,200</td>
</tr>
<tr>
<td>Labor hours - ACTUAL</td>
<td>HCAB</td>
<td>11,000</td>
</tr>
</tbody>
</table>

| **STANDARDS--COSTS AND QUANTITIES**             |          |        |
| Unit cost of materials                          | UÇMT     | $1.50  |
| Equivalent unit cost of materials               | EUMT     | 4.50   |
| Unit cost of direct labor                       | UDL      | 3.50   |
| Equivalent unit cost of direct labor            | EUDL     | 14.00  |
| Unit cost of fixed overhead                     | UFO      | 2.50   |
| Equivalent unit cost of fixed overhead          | EUFO     | 10.00  |
| Unit cost of variable overhead                  | UVO      | 2.00   |
| Equivalent unit cost of variable overhead       | EUVO     | 8.00   |
| Standard cost per equivalent unit               | SCUE     | 36.50  |
| Budgeted fixed cost at standard                 | BFCS     | 30,000 |
| Standard units of raw material per unit          | SMUT     | 3      |
| Standard hours of direct labor per unit          | SDLUT    | 4      |

<p>| <strong>ACTUAL COSTS</strong>                                 |          |        |
| Total cost of materials                          | PAMC     | $13,120|
| Unit cost of materials                           | PUCM     | 1.60   |
| Total cost of direct labor                       | PALC     | 36,300 |
| Unit cost of direct labor                        | PUCL     | 3.30   |
| Total cost of fixed overhead                     | PAFO     | 29,000 |
| Unit cost of fixed overhead                      | PUFO     | 10.36  |</p>
<table>
<thead>
<tr>
<th>ACTUAL COSTS</th>
<th>VARIABLE</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total cost of variable overhead</td>
<td>FAVO</td>
<td>21,840</td>
</tr>
<tr>
<td>Unit cost of variable overhead</td>
<td>PUVO</td>
<td>7.80</td>
</tr>
<tr>
<td>Budgeted fixed cost based on actual</td>
<td>BFCA</td>
<td>30,000</td>
</tr>
</tbody>
</table>

FINISHING DEPARTMENT

ACTUAL-QUANTITIES AND PERCENTAGES

<table>
<thead>
<tr>
<th>Work-in-process, beginning</th>
<th>FWPB</th>
<th>1,200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units transferred-in</td>
<td>UTI</td>
<td>3,100</td>
</tr>
<tr>
<td>Units completed - beginning inventory</td>
<td>BIUC</td>
<td>1,200</td>
</tr>
<tr>
<td>Units completed - current production</td>
<td>CPUC</td>
<td>2,100</td>
</tr>
<tr>
<td>Work-in-process, end</td>
<td>FWPE</td>
<td>1,000</td>
</tr>
<tr>
<td>Work-in-process, percentage completion, beginning</td>
<td>FPWB</td>
<td>75%</td>
</tr>
<tr>
<td>Work-in-process, percentage completion, end</td>
<td>FPWE</td>
<td>50%</td>
</tr>
<tr>
<td>Units of material - ACTUAL</td>
<td>FUTM</td>
<td>5,600</td>
</tr>
<tr>
<td>Labor hours - ACTUAL</td>
<td>FLH</td>
<td>5,850</td>
</tr>
</tbody>
</table>

STANDARD—COSTS AND QUANTITIES

<table>
<thead>
<tr>
<th>Unit cost of materials</th>
<th>FCM</th>
<th>$1.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equivalent unit cost of materials</td>
<td>EFCM</td>
<td>2.00</td>
</tr>
<tr>
<td>Unit cost of direct labor</td>
<td>FDLC</td>
<td>4.00</td>
</tr>
<tr>
<td>Equivalent unit cost of direct labor</td>
<td>EFDLC</td>
<td>8.00</td>
</tr>
<tr>
<td>Unit cost of fixed overhead</td>
<td>FUFO</td>
<td>3.50</td>
</tr>
<tr>
<td>Equivalent unit cost of fixed overhead</td>
<td>EFFO</td>
<td>7.00</td>
</tr>
<tr>
<td>Unit cost of variable overhead</td>
<td>FUVO</td>
<td>3.00</td>
</tr>
<tr>
<td>Equivalent unit cost of variable overhead</td>
<td>FEVO</td>
<td>6.00</td>
</tr>
<tr>
<td>Standard cost per equivalent unit</td>
<td>FSEU</td>
<td>59.50</td>
</tr>
<tr>
<td>Budgeted fixed cost</td>
<td>FBFC</td>
<td>21,000</td>
</tr>
<tr>
<td>Standard units of raw material per unit</td>
<td>FSMUT</td>
<td>2</td>
</tr>
<tr>
<td>Standard hours of direct labor per unit</td>
<td>FSDLU</td>
<td>2</td>
</tr>
</tbody>
</table>

ACTUAL COSTS

<table>
<thead>
<tr>
<th>Total costs transferred-in</th>
<th>FATI</th>
<th>$156,950</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit cost of transferred-in units</td>
<td>FUTI</td>
<td>36.50</td>
</tr>
<tr>
<td>Total cost of materials</td>
<td>FAMC</td>
<td>6,160</td>
</tr>
<tr>
<td>Unit cost of materials</td>
<td>FUMC</td>
<td>1.10</td>
</tr>
<tr>
<td>Total cost of direct labor</td>
<td>FALC</td>
<td>23,985</td>
</tr>
<tr>
<td>Unit cost of direct labor</td>
<td>FULC</td>
<td>4.10</td>
</tr>
<tr>
<td>Total cost of fixed overhead</td>
<td>FAFO</td>
<td>23,000</td>
</tr>
<tr>
<td>Unit cost of fixed overhead</td>
<td>FAUF</td>
<td>7.93</td>
</tr>
<tr>
<td>Total cost of variable overhead</td>
<td>FAVO</td>
<td>18,850</td>
</tr>
<tr>
<td>Unit cost of variable overhead</td>
<td>FAUV</td>
<td>6.50</td>
</tr>
<tr>
<td>Budgeted fixed cost based on actual</td>
<td>FBFCA</td>
<td>21,000</td>
</tr>
</tbody>
</table>
The program output encompasses a production report based on standard costs with physical unit flows and a variance analysis of production costs. Combined journal entries, that record the costs incurred and variances from standard costs in a single entry, are given for each cost category by departments. This provides the vehicle for entering the production activity into the accounting system. The report and variance analysis represent the basic information for the student to use in evaluating the production operations and efficiency of Scott Aluminum Company.

Several alternatives are available in these areas of cost accounting, for example, direct costing, price-level adjustment, seasonal variations and spoilage or waste production considerations. Some of the possible variations are discussed in Chapter IV related to the process cost system based on historical costs. Standard costing opens additional avenues for statistical analysis (i.e., "t" test, chi-Square, Runs test) of monetary and percentage variances which can provide a more sophisticated review of production management.

\[\text{Paul G. Hoel. Introduction to Mathematical Statistics} \]
efficiency and utilization of materials, manpower, and facilities. As in the prior chapters, the possibilities are limited only by the imagination and ingenuity of the students and the professors.
EXHIBIT 5-6
SCOTT ALUMINUM COMPANY

PROGRAM FOR PROCESS COST SYSTEM WITH STANDARD COSTS
A G PETRIE DISSERTATION

0001  FORMAT(5F4.0,2F3.2,F5.0)
0002  FORMAT(4F4.2,F5.0,2F2.0)
0003  FORMAT(4(F5.0,F4.2),F5.0)
0004  FORMAT(1X,2F15.0,4D9.2,2*DIFFERENCE IN UNIT COSTS*)
0005  FORMAT(1X,2F10.2,2*UNITS ACCOUNTED FOR UNEQUAL*)
0006  FORMAT(1X,2F10.0)
0007  FORMAT(1X,2F12.2)
0008  FORMAT(5(F6.0,F4.2),F5.0)
0009  FORMAT(5X)
0010  FORMAT(4X,'SCOTT ALUMINUM COMPANY* //>
0011  FORMAT(4X,*PROCESSING DEPARTMENT*)
0012  FORMAT(37X,*PRODUCTION REPORT AT STANDARD COSTS*)
0013  FORMAT(34X,*FOR THE MONTH ENDED MAY 31, 19XX* //)
0014  FORMAT(35X,*STANDARD COST PER EQUIVALENT UNITS*
0015  FORMAT(97X,*OVERHEAD*)
0016  FORMAT(1X,*QUANTITIES*32X,*PHYSICAL FLOW*,7X,*MATERIALS*,7X,
1  *LAUG*,7X,*FIXED*,7X,*VARIABLE*]
0017  FORMAT(5X,*WIP IN PROCESS*, BEGINNING*,12X,F8.0)
0018  FORMAT(5X,*UNITS STARTED*,7X,F5.0,10X,F5.0)
0019  FORMAT(5X,*UNITS TO BE ACCOUNTED FOR*,13X,F8.0,10X,F5.0)
0020  FORMAT(5X,*UNITS COMPLETED*)
0021  FORMAT(5X,*FROM BEGINNING INVENTORY*,14X,F8.0,12X,F6.0,10X,F5.0)
1  7X,F5.0,4X,F5.0)
0022  FORMAT(5X,*CURRENT STANDARD COSTS",18X,F8.0,10X,F5.0,7X,
1  7X,F5.0,4X,F5.0)
0023  FORMAT(5X,*TOTAL COSTS ACCOUNTED FOR*,17X,F9.0,7X,F5.0,7X,
1  7X,F5.0,4X,F5.0)
0024  FORMAT(5X,*STANDARD COST PER EQUIVALENT UNIT",10X,F7.2,7X,
1  *F7.2,7X,F5.0,7X,F5.0,7X)
0025  FORMAT(5X,* Beginnings INVENTORY",20X,F8.0,10X,F5.0,7X,F5.0,7X,
1  7X,F5.0,4X,F5.0)
0026  FORMAT(5X,*TOTAL COSTS",27X,F8.0,9X,F7.2,11X,
1  *F7.2,7X,F5.0,7X,F5.0,7X)
0027  FORMAT(5X,*SUMMARY (IF COSTS")
0028  FORMAT(5X,*UNITS COMPLETED",15X,F8.0,12X,F6.0,10X,F5.0)
1  7X,F5.0,4X,F5.0)
0029  FORMAT(5X,*TOTAL COSTS ACCOUNTED FOR",17X,F7.2,11X,
1  *F7.2,7X,F5.0,7X,F5.0,7X)
0030  FORMAT(5X,*VARIANCE ANALYSIS FOR CURRENT PRODUCTION")
0031  FORMAT(5X,*VARIANCES")
0032  FORMAT(30X,*PRICE CR",22X,*BUDGET")
0033  FORMAT(32X,*RATIO",7X,F7.2,11X,
1  *F7.2,7X,F5.0,7X,F5.0,7X)
0034  FORMAT(5X,*EFFICIENCY",4X,F7.2,11X,
1  *F7.2,7X,F5.0,7X,F5.0,7X)
0035  FORMAT(5X,*SPENDING",4X,F7.2,11X,
1  *F7.2,7X,F5.0,7X,F5.0,7X)
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I  4X,'EFFICIENCY %', 5X,'CAPACITY %', 6X,'NET %')
1 4X,'PRIME COSTS', 5X,'MATERIALS', 6X,'LABOR', 7X,'OVERHEAD')
1 9X,'STANDARD COST PER EQUIVALENT UNIT', 10X,'NET VARIANCES')
1 FUNCTION PRODUCTION REPORT AT STANDARD COSTS')
1 FUNCTION FOR THE MONTH ENDED MAY 31, 19XX')
1 FUNCTION EQUIVALENT UNITS')
1 FUNCTION TRANSFERRED-IN')
1 FUNCTION QUANTITY IN WORK-IN-PROCESS')
1 FUNCTION END OF WORK-IN-PROCESS')
1 FUNCTION TRANSFERRED-IN COSTS')
1 FUNCTION COSTS PAID')
1 FUNCTION ACTUAL COST PER EQUIVALENT UNIT')
1 FUNCTION STANDARD COST PER EQUIVALENT UNIT')
1 FUNCTION EQUIVALENT UNITS')
1 FUNCTION BEGINNING INVENTORY')
1 FUNCTION CURRENT STANDARD COSTS')
1 FUNCTION SUMMARY OF COSTS')
1 FUNCTION UNITS COMPLETED')
1 FUNCTION UNITS ACCOUNTED FOR')
1 FUNCTION COST BREAKDOWN')
1 FUNCTION PRODUCTION REPORT')
1 FUNCTION BEGINNING INVENTORY')
1 FUNCTION CUMULATIVE PRODUCTION')
1 FUNCTION CURRENT STANDARD COSTS')
1 FUNCTION STANDARD COST PER EQUIVALENT UNIT')
1 FUNCTION SUMMARIZED COSTS')
1 FUNCTION UNITS COMPLETED')
1 FUNCTION ACTUAL COSTS')
1 FUNCTION EQUIVALENT UNITS')
1 FUNCTION COSTS PAID')
1 FUNCTION ACTUAL COST PER EQUIVALENT UNIT')
1 FUNCTION STANDARD COST PER EQUIVALENT UNIT')
1 FUNCTION SUMMARY OF COSTS')
1 FUNCTION UNITS ACCOUNTED FOR')
1 FUNCTION BEGINNING INVENTORY')
1 FUNCTION CUMULATIVE PRODUCTION')
1 FUNCTION CURRENT STANDARD COSTS')
1 FUNCTION STANDARD COST PER EQUIVALENT UNIT')
1 FUNCTION SUMMARIZED COSTS')
FORTRAN IV G LEVEL 1, MOD 4

MAIN

DATE = 70162
18/38/47
PAGE 0003

0087  127  FORMAT(5X,'MATERIALS',12X,F8.0)
0088  128  FORMAT(5X,'LABOR',15X,F8.0)
0089  129  FORMAT(5X,'FIXED OVERHEAD',21X,F8.0)
0090  130  FORMAT(5X,'VARIABLE OVERHEAD',18X,F8.0)
0091  131  FORMAT(5X,'TOTAL COST OF WORK-IN-PROCESS',5X,F8.0)
0092  132  FORMAT(1X,'TOTAL COSTS ACCOUNTED FOR',12X,F8.0)
0093  133  FORMAT(1X,'VARIANCE ANALYSIS FOR CURRENT PRODUCTION',1X)
0094  134  FORMAT(6X,'VARIANCE')
0095  135  FORMAT(5X,'PRIME COSTS',5X,F6.0,F6.2,5X,F6.0,F6.2,5X,F6.0,F6.2)
0096  136  FORMAT(5X,'LABOR',19X,F7.0,F6.2,9X,F6.0,F6.2,5X,F7.0,F6.2)
0097  137  FORMAT(1X,'PRIME COSTS')
0099  139  FORMAT(5X,'LABOR',19X,F7.0,F6.2,9X,F6.0,F6.2,5X,F7.0,F6.2)
0100  140  FORMAT(5X,'TOTAL PRIME COSTS',6X,F7.0,12X,F8.0,6X,F7.0)
0101  141  FORMAT(1X,'VARIANCE ANALYSIS FOR CURRENT PRODUCTION',1X)
0102  142  FORMAT(5X,'FIXED OVERHEAD',5X,F7.0,6X,F7.0,5X,F7.0,6X,F7.0)
0103  143  FORMAT(5X,'VARIABLE OVERHEAD',55X,F6.0,F6.2,6X,F6.0,F6.2,5X,F6.0,F6.2)
0104  144  FORMAT(5X,'TOTAL OVERHEAD VARIANCES',3X,F7.0,11X,F7.0)
0105  145  FORMAT(1X,'VARIANCE PER UNIT',4X,F10.6)
0106  146  FORMAT(1X,'CHECK OF TOTAL NET VARIANCES',1X)
0107  147  FORMAT(5X,'TOTAL NET VARIANCES',97X,F10.6)
0108  148  FORMAT(1X,'STANDARD COST PER EQUIVALENT UNIT',1X,F10.6)
0109  149  FORMAT(1X,'ACTUAL COST OF EQUIVALENT UNIT',14X,F10.6)
0110  150  FORMAT(5X,'TOTAL NET VARIANCES',97X,F10.6)
0111  151  FORMAT(5X,'TOTAL NET VARIANCES',97X,F10.6)
0112  200  FORMAT(1H1)
0113  201  FORMAT(27X,'JOURNAL ENTRIES',1X)
0114  202  FORMAT(5X,'MATERIAL PRICES',29X,F10.0)
0115  203  FORMAT(5X,'MATERIAL QUANTITY',31X,F10.0)
0116  204  FORMAT(1X,'MATERIAL PRICES',31X,F10.0)
0117  205  FORMAT(1X,'MATERIAL QUANTITY',31X,F10.0)
0118  206  FORMAT(5X,'DIRECT LABOR',29X,F10.0)
0119  207  FORMAT(5X,'DIRECT LABOR RATE',29X,F10.0)
0120  208  FORMAT(5X,'DIRECT LABOR EFFICIENCY',29X,F10.0)
0121  209  FORMAT(5X,'ACC遂ED PAYROLL',29X,F10.0)
0122  210  FORMAT(5X,'WORK-IN-PROCESS',29X,F10.0)
0123  211  FORMAT(5X,'MATERIAL PRICES',29X,F10.0)
0124  212  FORMAT(5X,'MATERIAL QUANTITY',29X,F10.0)
0125  213  FORMAT(5X,'ACC遂ED PAYROLL',29X,F10.0)
0126  214  FORMAT(5X,'Direct Labor',29X,F10.0)
0127  215  FORMAT(5X,'Direct Labor Efficiency',29X,F10.0)
0128  216  FORMAT(5X,'ACC遂ED PAYROLL',29X,F10.0)
0129  217  FORMAT(5X,'Material Price',29X,F10.0)
0130  218  FORMAT(5X,'Material Quantity',29X,F10.0)
0131  219  FORMAT(5X,'ACC遂ED PAYROLL',29X,F10.0)
0132  220  FORMAT(5X,'Material Price',29X,F10.0)
0133  221  FORMAT(5X,'Material Quantity',29X,F10.0)
0134  222  FORMAT(5X,'Material Price',29X,F10.0)
0135  223  FORMAT(5X,'Material Quantity',29X,F10.0)
0136  224  FORMAT(5X,'ACC遂ED PAYROLL',32X,F10.0)
0137  225  FORMAT(5X,'Work-in-Process',30X,F10.0)
0138  226  FORMAT(5X,'Direct Labor',30X,F10.0)
0139 227 FORMAT(5X,9H MFG. EXPENSES - EFFICIENCY VARIANCE - FINISHING), (12X,F10.0)
0140 228 FORMAT(5X,9H MFG. EXPENSES - CAPACITY VARIANCE - FINISHING), (14X,F10.0)
0141 229 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (36X,F10.0)
0142 230 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (41X,F10.0)
0143 231 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (56X,F10.0)
0144 232 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (71X,F10.0)
0145 233 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (86X,F10.0)
0146 234 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (101X,F10.0)
0147 235 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (116X,F10.0)
0148 236 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (131X,F10.0)
0149 237 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (146X,F10.0)
0150 238 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (161X,F10.0)
0151 239 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (176X,F10.0)
0152 240 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (191X,F10.0)
0153 241 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (206X,F10.0)
0154 242 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (221X,F10.0)
0155 243 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (236X,F10.0)
0156 244 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (251X,F10.0)
0157 245 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (266X,F10.0)
0158 246 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (281X,F10.0)
0159 247 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (296X,F10.0)
0160 248 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (311X,F10.0)
0161 249 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (326X,F10.0)
0162 250 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (341X,F10.0)
0163 251 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (356X,F10.0)
0164 252 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (371X,F10.0)
0165 253 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (386X,F10.0)
0166 254 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (401X,F10.0)
0167 255 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (416X,F10.0)
0168 256 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (431X,F10.0)
0169 257 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (446X,F10.0)
0170 258 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (461X,F10.0)
0171 259 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (476X,F10.0)
0172 260 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (491X,F10.0)
0173 261 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (506X,F10.0)
0174 262 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (521X,F10.0)
0175 263 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (536X,F10.0)
0176 264 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (551X,F10.0)
0177 265 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (566X,F10.0)
0178 266 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (581X,F10.0)
0179 267 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (596X,F10.0)
0180 268 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (611X,F10.0)
0181 269 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (626X,F10.0)
0182 270 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (641X,F10.0)
0183 271 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (656X,F10.0)
0184 272 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (671X,F10.0)
0185 273 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (686X,F10.0)
0186 274 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (701X,F10.0)
0187 275 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (716X,F10.0)
0188 276 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (731X,F10.0)
0189 277 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (746X,F10.0)
0190 278 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (761X,F10.0)
0191 279 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (776X,F10.0)
0192 280 FORMAT(5X,9H MFG. EXPENSES - CONTROL), (791X,F10.0)
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<tr>
<td>0193</td>
<td>IF (XMNET.NE.SMN) WRITE (6,15) XMNET, SMN</td>
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<tr>
<td>0194</td>
<td>CALC=ILAD*PUCL</td>
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<td>0195</td>
<td>IF (PACL.NE.CALC) WRITE (6,15) PALC, CALC</td>
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<td>0196</td>
<td>SLC=ILAD*UDL</td>
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<tr>
<td>0197</td>
<td>S1DC=(EUPL*SOLUT)*UDL</td>
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<tr>
<td>0198</td>
<td>XLPV=PALC-SLC</td>
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<tr>
<td>0199</td>
<td>XLPV=PALC/SLC</td>
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<td>0200</td>
<td>XLEV=SLC*ST1DC</td>
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<tr>
<td>0201</td>
<td>PLEV=SLC/ST1DC</td>
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<tr>
<td>0202</td>
<td>XLNET=CALC-ST1DC</td>
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<tr>
<td>0203</td>
<td>PLNET=CALC/ST1DC</td>
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<tr>
<td>0204</td>
<td>SLNET=XLV*XLLEV</td>
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<td>0205</td>
<td>IF (XLN'T.NE.SLN) WRITE (6,15) XLNET, SLN</td>
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<td>0206</td>
<td>TPR=XM9V*XLEV</td>
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<td>0207</td>
<td>TDE=XMOV*XLEV</td>
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<td>0208</td>
<td>TNET=XM9V*XLNET</td>
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<tr>
<td>0209</td>
<td>STFO=(EFPV+SOLUT)*UVO</td>
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<tr>
<td>0210</td>
<td>SVFO=PAFO-SFC</td>
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<tr>
<td>0211</td>
<td>PSVFO=PAFO/RFCA</td>
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<tr>
<td>0212</td>
<td>EVF=BFCA-FCS</td>
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<tr>
<td>0213</td>
<td>EVF=BFCA/SFC</td>
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<tr>
<td>0214</td>
<td>CVFO=BFCS-STFO</td>
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<tr>
<td>0215</td>
<td>PINCN=BFCS/STFO</td>
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<tr>
<td>0216</td>
<td>SNVFO=SVFO+EVFO-CVFO</td>
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<tr>
<td>0217</td>
<td>TVFO=PAFO-STFO</td>
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<tr>
<td>0218</td>
<td>PTVFO=PAFO/STFO</td>
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<td>0219</td>
<td>IF (SNVFO.NE.TNVFO) WRITE (6,15) SNVFO, TVFO</td>
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<tr>
<td>0220</td>
<td>BSTVO=(EFPV+SOLUT)*UVO</td>
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<tr>
<td>0221</td>
<td>SSTVO=(EFPV+SOLUT)*UVO</td>
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<tr>
<td>0222</td>
<td>BAFO=ILAB*UVO</td>
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<tr>
<td>0223</td>
<td>SVFO=PAFO-AVFO</td>
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<tr>
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<td>PPSVFO=PAFO/AVFO</td>
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<td>0225</td>
<td>EVF=PAFO-ASTVO</td>
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<tr>
<td>0226</td>
<td>PVE=BAFO/ASTVO</td>
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<tr>
<td>0227</td>
<td>CVFO=BFCS-Stvo</td>
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<tr>
<td>0228</td>
<td>PINCN=BFCS/STFO</td>
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<tr>
<td>0229</td>
<td>TVVO=PAVO-STVO</td>
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<tr>
<td>0230</td>
<td>PTVVO=PAVO/STVO</td>
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<tr>
<td>0231</td>
<td>SNVVO=SVVO+FVVO+CVVO</td>
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<td>IF (SVVO, NL.TNVVO) WRITE (6,15) SNVVO, TVVO</td>
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<td>0233</td>
<td>TA=PAFO*PAVO</td>
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<tr>
<td>0234</td>
<td>TS=SIFO+STVO</td>
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<tr>
<td>0235</td>
<td>TS=RFCS*STVO</td>
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<td>0236</td>
<td>TDA=RFCS+PAVO</td>
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<tr>
<td>0237</td>
<td>TSV=SVVO+SVVO</td>
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<tr>
<td>0238</td>
<td>TTV=EVFO+EVVO</td>
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<tr>
<td>0239</td>
<td>TCV=CVVO+CVVO</td>
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<tr>
<td>0240</td>
<td>TNETV=TVVO+TNETV</td>
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<tr>
<td>0241</td>
<td>XTNETV=TVVO+TEV+TCV</td>
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<td>0242</td>
<td>IF (TNETV,NF.XTNETV) WRITE (6,15) TNETV, XTNETV</td>
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<tr>
<td>0243</td>
<td>GNETV=TNETV+TNETV</td>
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<tr>
<td>0244</td>
<td>RKAU=UMAT*UPM</td>
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<tr>
<td>0245</td>
<td>ACM=RHAUP*PUCH</td>
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<tr>
<td>0246</td>
<td>RHAU=ILAB*EFPL</td>
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<tr>
<td>0247</td>
<td>AYO=RHAUP*PUCL</td>
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<tr>
<td>0248</td>
<td>ACTUT=ACM+AYO*PUFO+PUVO</td>
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<tr>
<td>0249</td>
<td>CVPU=ACTUT-SCEU</td>
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<tr>
<td>0250</td>
<td>CNVAR=CVPU*EUTS</td>
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<td>Item</td>
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**FINISHING DEPARTMENT**

**PRINTED ON EUTS, CANADA**

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**INTERNET**

**10% NET**

**WATER**

**MICROFICHE**

**REPRINT**

**PAPER**

**FINISHING DEPARTMENT**
FORTRAN IV \G LEVEL 1, MOD 4

0363 FRLV=FALC=FSLC
0364 PFLRV=FALC=FSLC
0365 FLEV=FSLC=FSLD
0366 PLEV=FSLC/FSLD
0367 FLNTV=FALC=FSULC
0368 PFLNT=FALC/FSULC
0369 SFNLV=FLNV+FLEV
0370 IF(IFLNTV.NE.FSFDLV)WRITE(6,15)FLNTV,FSFDLV
0371 FTPR=FPRV+FLRV
0372 FTJE=FTJVF+CLEV
0373 FTPET=FTNET+FLNTV
0374 FSTF0=(FSPF0+FSUFD)*FUSH
0375 FSPG=FAP0=FAPC
0376 FSP0=FAP0+FAPC
0377 FEO=FEOCA-FBC
0378 PFE0=FEOCA-FBFC
0379 PFC0=FEOCA-FSTF0
0380 PFC0=FEOCA/FSTF0
0381 FTPQ=FSF1+FEOF*FEOU
0382 FTPQ=FAS0+FSTF0
0383 PFTP0=ASP0/FSF0
0384 IF(IFSP0V.NE,FSFP0)WRITE(6,15)FSF0V,FTNP0
0385 FHSVP=(IFSVP+FSFDV)*FUSH
0386 FSFDV=(IFSVP+FSFDV)*FUSH
0387 FBADV=FLHV*FUVU
0388 FSVD=FAVO-FBADV
0389 PFSX=FADV/FRADO
0390 FREV=FREVU-BSVO
0391 PFF=FADVU-BSVD
0392 FCVD=FRSO-FSSV
0393 PFC=FSVDV-FSSV
0394 FSVDV=FSVD+FFVVD+FCVVD
0395 FTNVD=FAVO-FSSV
0396 PPNVO=FAVO-FSSV
0397 IF(IFSVNV.NE,FTNV0)WRITE(6,15)FSVNV,FTNV0
0398 TAF=FAVO+FADV
0399 FSF=FSFD0+FSSV
0400 BSF=FBCB+FRSO
0401 THAF=FBCB+FHAVD
0402 FTSV=FSFD0+FSSV
0403 FTFD=FPOD+FEVVO
0404 FTGV=FCTV+FCVVD
0405 FTP=FTNV0+HTNV0
0406 CFTNV=FTSV+FLCV+FTCV
0407 IF(ITNV.NE.FCTNV)WRITE(6,15)FTNV,CFTNV
0408 FNUT=FTNET+FTNV
0409 FMTU=FMTU+FCPM
0410 FACM=FAU+FUCM
0411 FLAV=FLHV+FCPL
0412 FACL=FLAV+FULC
0413 FATC=FUTI+FAK+FAACL+FAU+FAU
0414 FCVPU=FATC-FSCU
0415 FCFD=FCVPU+FCUT
0416 IF(IFGNET.NE.FCVAR)WRITE(6,16)FNET,FCVAR
0417 WRITE(6,100)
0418 WRITE(6,100)
0419 WRITE(6,100)
0420 WRITE(6,100)
<table>
<thead>
<tr>
<th>Line</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FORTRAN IV LEVEL I. MOD</td>
</tr>
</tbody>
</table>
FORTRAN IV G LEVEL 1, MUD 4

0479   WRITE(6,209)PALC
0480   WRITE(6,210)TS
0481   WRITE(6,211)TCV
0482   WRITE(6,212)TEV
0483   WRITE(6,213)TSV
0484   WRITE(6,214)TA
0485   WRITE(6,215)CUTC
0486   WRITE(6,216)CUTC
0487   WRITE(6,217)FSM
0488   WRITE(6,218)FMPC
0489   WRITE(6,219)FQV
0490   WRITE(6,220)FAMC
0491   WRITE(6,221)FSMVC
0492   WRITE(6,222)FLPV
0493   WRITE(6,223)FLCV
0494   WRITE(6,224)FALC
0495   WRITE(6,225)TSF
0496   WRITE(6,226)FTSV
0497   WRITE(6,227)FTSV
0498   WRITE(6,228)FTCV
0499   WRITE(6,229)TAF
0500   WRITE(6,230)FCUC
0501   WRITE(6,231)FCUC
0502   STOP
0503   END
<table>
<thead>
<tr>
<th>13120.</th>
<th>13120.</th>
</tr>
</thead>
<tbody>
<tr>
<td>520.</td>
<td>520.</td>
</tr>
<tr>
<td>36:00.</td>
<td>36300.</td>
</tr>
<tr>
<td>-2900.</td>
<td>-2900.</td>
</tr>
<tr>
<td>-1940.02</td>
<td>-1932.14</td>
</tr>
</tbody>
</table>
SCOTT ALUMINUM COMPANY

PROCESSING DEPARTMENT
PRODUCTION REPORT AT STANDARD COSTS
FOR THE MONTH ENDED MAY 31, 19XX

<table>
<thead>
<tr>
<th>QUANTITIES</th>
<th>PHYSICAL FLOW</th>
<th>MATERIALS</th>
<th>EQUIVALENT UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>WORK-IN-PROCESS, BEGINNING UNITS STARTED</td>
<td>800.</td>
<td>2000.</td>
<td>2900.</td>
</tr>
<tr>
<td>UNITS TO BE ACCOUNTED FOR</td>
<td>3700.</td>
<td>2800.</td>
<td>3700.</td>
</tr>
<tr>
<td>UNITS COMPLETED FROM BEGINNING INVENTORY</td>
<td>800.</td>
<td>2000.</td>
<td>2300.</td>
</tr>
<tr>
<td>FROM CURRENT PRODUCTION</td>
<td>2300.</td>
<td>300.</td>
<td>2800.</td>
</tr>
<tr>
<td>WORK-IN-PROCESS, END</td>
<td>600.</td>
<td>300.</td>
<td>2800.</td>
</tr>
<tr>
<td>UNITS ACCOUNTED FOR</td>
<td>3700.</td>
<td>2800.</td>
<td>3700.</td>
</tr>
</tbody>
</table>

COST BREAKDOWNS

<table>
<thead>
<tr>
<th>COSTS</th>
<th>TOTALS</th>
<th>MATERIALS</th>
<th>LABOR</th>
<th>FIXED</th>
<th>VARIABLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEGINNING INVENTORY</td>
<td>$ 21900.</td>
<td>$ 2700.</td>
<td>$ 8400.</td>
<td>$ 6000.</td>
<td>$ 4000.</td>
</tr>
<tr>
<td>CURRENT STANDARD COSTS</td>
<td>$ 102200.</td>
<td>$ 12600.</td>
<td>$ 39200.</td>
<td>$ 28000.</td>
<td>$ 22400.</td>
</tr>
<tr>
<td>TOTAL COSTS</td>
<td>$ 124100.</td>
<td>$ 15300.</td>
<td>$ 47600.</td>
<td>$ 34000.</td>
<td>$ 27200.</td>
</tr>
<tr>
<td>STANDARD COST PER EQUIVALENT UNIT</td>
<td>$ 36.50</td>
<td>$ 4.50</td>
<td>$ 14.00</td>
<td>$ 10.00</td>
<td>$ 8.00</td>
</tr>
</tbody>
</table>

SUMMARY OF COSTS

| UNITS COMPLETED-3100. | $ 113150. |
| WORK-IN-PROCESS, END- 600. | $ 10950. |
| MATERIALS | $ 1350. |
| LABOR | $ 4200. |
| FIXED OVERHEAD | $ 3000. |
| VARIABLE OVERHEAD | $ 2400. |
| TOTAL COST OF WORK-IN-PROCESS | $ 10950. |
| TOTAL COSTS ACCOUNTED FOR | $ 124100. |
### Variance Analysis for Current Production

#### Variance Analysis

<table>
<thead>
<tr>
<th></th>
<th>Variance Analysis</th>
<th>Variance Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Price or Rate 0/0</td>
<td>Quantity or Efficiency 0/0</td>
</tr>
<tr>
<td><strong>Prime Costs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Materials</td>
<td>$ 820. 1.07</td>
<td>$-300. 0.98</td>
</tr>
<tr>
<td>Labor</td>
<td>-2200. 0.94</td>
<td>-700. 0.98</td>
</tr>
<tr>
<td><strong>Total Prime Costs</strong></td>
<td>$ -1380.</td>
<td>$ -1000.</td>
</tr>
<tr>
<td><strong>Overhead</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed</td>
<td>-1000. 0.97</td>
<td>0. 1.00</td>
</tr>
<tr>
<td>Variable</td>
<td>-160. 0.99</td>
<td>-400. 0.98</td>
</tr>
<tr>
<td><strong>Total Net Variances</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Check of Total Net Variance

- **Actual Cost per Equivalent Unit**: $35.809952
- **Standard Cost per Equivalent Unit**: $36.500000
- **Variance per Unit**: -0.690048

#### Unit Variance Calculation

\[
\text{Unit Variance} \times \text{Units Produced} = \text{Net Variance}
\]

\[
-0.690048 \times 2900 = -1932
\]

<table>
<thead>
<tr>
<th>Unit Variance</th>
<th>Units Produced</th>
<th>Net Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.690048</td>
<td>2900</td>
<td>-1932</td>
</tr>
</tbody>
</table>

$-1932$
### Equivalent Units

<table>
<thead>
<tr>
<th>Quantities</th>
<th>Physical Flow</th>
<th>Transferred-In Costs</th>
<th>Materials</th>
<th>Labor</th>
<th>Fixed</th>
<th>Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work-in-process, beginning</td>
<td>1200</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transferred-in</td>
<td>3100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Units to be accounted for</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4300</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Units completed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>From beginning inventory</td>
<td>1200</td>
<td></td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>From current production</td>
<td>2100</td>
<td></td>
<td>2100</td>
<td>2100</td>
<td>2100</td>
<td>2100</td>
</tr>
<tr>
<td>Work-in-process, end</td>
<td>1000</td>
<td></td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>Units accounted for</td>
<td></td>
<td></td>
<td>2900</td>
<td>2900</td>
<td>2900</td>
<td>2900</td>
</tr>
</tbody>
</table>

### Cost Breakdowns

<table>
<thead>
<tr>
<th>Costs</th>
<th>Totals</th>
<th>Transferred-In Costs</th>
<th>Materials</th>
<th>Labor</th>
<th>Fixed</th>
<th>Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning inventory</td>
<td>$ 64500.</td>
<td>$ 43000.</td>
<td>$ 1900.</td>
<td>$ 7200.</td>
<td>$ 6300.</td>
<td>$ 5400.</td>
</tr>
<tr>
<td>Current standard costs</td>
<td>179850.</td>
<td>113150.</td>
<td>5800.</td>
<td>23200.</td>
<td>20300.</td>
<td>17400.</td>
</tr>
<tr>
<td>Total costs</td>
<td>$ 244350.</td>
<td>$ 156950.</td>
<td>$ 7600.</td>
<td>$ 30400.</td>
<td>$ 26600.</td>
<td>$ 22800.</td>
</tr>
<tr>
<td>Standard cost per equivalent unit</td>
<td>$ 59.50</td>
<td>$ 36.50</td>
<td>$ 2.00</td>
<td>$ 8.00</td>
<td>$ 7.00</td>
<td>$ 6.00</td>
</tr>
</tbody>
</table>

### Summary of Costs

<table>
<thead>
<tr>
<th>Units completed</th>
<th>$ 196350.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work-in-process, end</td>
<td>$ 36500.</td>
</tr>
<tr>
<td>Transferred-in costs</td>
<td>$ 36500.</td>
</tr>
<tr>
<td>Materials</td>
<td>1000.</td>
</tr>
<tr>
<td>Labor</td>
<td>4000.</td>
</tr>
<tr>
<td>Fixed overhead</td>
<td>3500.</td>
</tr>
<tr>
<td>Variable overhead</td>
<td>3000.</td>
</tr>
<tr>
<td>Total cost of work-in-process</td>
<td>$ 48000.</td>
</tr>
<tr>
<td>Total costs accounted for</td>
<td>$ 244350.</td>
</tr>
</tbody>
</table>
### Variance Analysis for Current Production

#### Prime Costs

<table>
<thead>
<tr>
<th></th>
<th>Price or Rate 0/o</th>
<th>Quantity or Efficiency 0/o</th>
<th>Spending 0/o</th>
<th>Budget Efficiency 0/o</th>
<th>Capacity 0/o</th>
<th>Net 0/o</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials</td>
<td>$560. 1.10</td>
<td>$-200. 0.97</td>
<td>585. 1.02</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labor</td>
<td></td>
<td></td>
<td>200. 1.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Prime Costs</strong></td>
<td><strong>$1145.</strong></td>
<td><strong>$0.</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>$1145.</strong></td>
</tr>
</tbody>
</table>

#### Overhead

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed</td>
<td>$2000. 1.10</td>
<td>$0. 1.00</td>
<td>$700. 1.03</td>
<td>$2700. 1.13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variable</td>
<td>$1300. 1.07</td>
<td>$150. 1.01</td>
<td>$0. 1.00</td>
<td>$1450. 1.08</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Overhead Variance</strong></td>
<td><strong>$3300.</strong></td>
<td><strong>$150.</strong></td>
<td><strong>$700.</strong></td>
<td><strong>$4150.</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Total Net Variance

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$5295.</td>
</tr>
</tbody>
</table>

### Check of Total Net Variance

- **Actual Cost per Equivalent Unit**: $61.324799
- **Standard Cost per Equivalent Unit**: $59.500000
- **Variance per Unit**: $1.824799

#### Unit Variance

- **Unit Variance**: $1.824799
- **Units Produced**: 2900
- **Net Variance**: $5292
## JOURNAL ENTRIES

### WORK-IN-PROCESS-PROCESSING

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material Price Variance</td>
<td>$12,600</td>
</tr>
<tr>
<td>Material Quantity Variance</td>
<td>$820.</td>
</tr>
<tr>
<td>Raw Materials</td>
<td>$13,120</td>
</tr>
<tr>
<td>Direct Labor Rate Variance</td>
<td>$39,200</td>
</tr>
<tr>
<td>Direct Labor Efficiency Variance</td>
<td>$-2,200</td>
</tr>
<tr>
<td>Accrued Payroll</td>
<td>$-700.</td>
</tr>
<tr>
<td>MFG. Expenses Capacity Variance</td>
<td>$50,400</td>
</tr>
<tr>
<td>MFG. Expenses Efficiency Variance</td>
<td>$-400.</td>
</tr>
<tr>
<td>MFG. Expenses Spending Variance</td>
<td>$-1,160</td>
</tr>
<tr>
<td>MFG. Expenses Control</td>
<td>$50,840</td>
</tr>
</tbody>
</table>

### WORK-IN-PROCESS-FINISHING

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material Price Variance</td>
<td>$5,800.</td>
</tr>
<tr>
<td>Material Quantity Variance</td>
<td>$560.</td>
</tr>
<tr>
<td>Raw Materials</td>
<td>$6,160.</td>
</tr>
<tr>
<td>Direct Labor Rate Variance</td>
<td>$23,200</td>
</tr>
<tr>
<td>Direct Labor Efficiency Variance</td>
<td>$505.</td>
</tr>
<tr>
<td>Accrued Payroll</td>
<td>$2,398.5</td>
</tr>
<tr>
<td>MFG. Expenses Spending Variance</td>
<td>$37,700</td>
</tr>
<tr>
<td>MFG. Expenses Efficiency Variance</td>
<td>$3,300.</td>
</tr>
<tr>
<td>MFG. Expenses Capacity Variance</td>
<td>$150.</td>
</tr>
<tr>
<td>MFG. Expenses Spending Capacity Variance</td>
<td>$700.</td>
</tr>
<tr>
<td>MFG. Expenses Control</td>
<td>$4,185.</td>
</tr>
</tbody>
</table>

### FINISHED GOODS

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work-in-Process-Finishing</td>
<td>$19,635</td>
</tr>
</tbody>
</table>

**Subtotal:** $19,635.00
CHAPTER VI

COMPUTERIZED MATRIX ADAPTATIONS TO ACCOUNTING PROBLEMS

The sections of Chapter VI are designed in case form with a statement of the problem accompanied by an approach to the solution of each case. After the approach is organized, a computerized program is provided for the solution and analysis of the problem. Financial accounting is given more attention in this chapter in order to achieve a better balance between the cost applications and financial applications available to the professor. There is a high correlation between financial and cost accounting techniques and procedures that can be cultivated through the utilization of electronic data processing.

Each problem, of course, deals with a mathematical application in accounting which lends itself to computerization. The subjects covered are blended with matrix algebra to enhance the efficiency of solving these problems. Numerous avenues are opened in this chapter for increasing the implementation of computers in financial and cost analysis. The expansion is limited mainly by the depth of the students' accounting background and the ingenuity of both the student and the professor.
Several other areas of cost accounting and financial accounting can be integrated with electronic data processing to take advantage of the computer's capabilities. Systems flowcharting and documentation would be a satisfactory foundation for adapting computerized programming to financial and cost problems. Of course, computer programming would be a valuable complement to systems design and flowcharting, but programming assistance can be utilized and implemented through adequately designed and flowcharted financial and cost accounting systems. An understanding of programming functions such as FORTRAN or COBOL, even without a technical knowledge of languages or programming, can be an important supporting factor in systems design and implementation.

**Matrix Solution to Sum-of-Years-Digits Method of Depreciation**

**Case Problem**

The Erscott Company operates three lathes in their machine shops. Each lathe is being depreciated by the sum-of-years-digits method of depreciation. A schedule of the lathe costs, salvage values and useful lives are as follows:
<table>
<thead>
<tr>
<th>MACHINE</th>
<th>COST</th>
<th>SALVAGE VALUE</th>
<th>USEFUL LIFE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$150,000</td>
<td>$30,000</td>
<td>10 years</td>
</tr>
<tr>
<td>2</td>
<td>$200,000</td>
<td>$50,000</td>
<td>10 years</td>
</tr>
<tr>
<td>3</td>
<td>$300,000</td>
<td>$30,000</td>
<td>10 years</td>
</tr>
</tbody>
</table>

The controller of the company needs a depreciation schedule for these three assets along with the total depreciation for each year. A summary of total depreciated cost for each machine will complete the information for the company and provide a check on the depreciation computations.

**Approach**

A computer program can be employed to solve this and similar problems through the use of matrix algebra. The cost of each machine can be arrayed in a vector called COST with three elements. XMAT (3 x 3) will serve as a complement to the COST vector and enable the financial analyst to ascertain the depreciable cost for each component of machinery through depreciable cost percentages. The depreciable cost vector will be called DCOST. DCOST multiplied by an array of sum-of-years-digits factors, named SOYD, gives the depreciation array SUMAT which is printed out in EXHIBIT 6-1 using a three by ten matrix format. The yearly depreciation is depicted below the depreciation schedule.
along with a summary of the total depreciated cost over the ten years for each lathe.¹

A complete program for solving this depreciation project is given in EXHIBIT 6-1. The vector and matrix variables identified above are used in the program to arrive at solutions for the program printout.

Matrix Adaptation to Equity
in Consolidations

Case Problem

One of the many problems posed by mergers or consolidations is the solution of simultaneous equations for the determination of equities of the consolidating companies as well as the number of shares to be received by each firm. This situation becomes more complex when the merging companies own corresponding stock in each of the other merging firms. With three or more companies involved, the equations present a complex network of ownership that is difficult to solve. However, the application of mathematical techniques to the solution of accounting problems has greatly assisted the accounting profession in these areas.

JOB WATFOR  

EXHIBIT 6-1  
SUM-OF-YEARS-DIGITS METHOD  

SOYD DEPRECIATION SCHEDULE AG PETRIE  

DIMENSION XMAT(3,3),COST(3),SOYD(10),OCOST(3),SUMAT(3,10),SOCST(3)  

FD1 7 FORMAT(/)  
FD1 8 FORMAT(1H1)  
FD1 9 FORMAT(F2.0)  
FD1 10 FORMAT(6.0)  
FD1 11 FORMAT(F2.2)  
FD1 12 FORMAT(1X,10F12.2)  
FD1 13 FORMAT(53X,13,9X,F12.2)  
FD1 14 FORMAT(10X,*TOTAL DEPRECIATED COST MACHINE*,12,5X,F10.2)  
FD1 15 FORMAT(55X,*DEPRECIATION SCHEDULE*)  
FD1 16 FORMAT(55X,*YEAR*,10X,*DEPRECIATION*)  
FD1 17 READ(5,9)YR  
FD1 18 SYD = YR*{(YR+1.0)/2.0}  
FD1 19 DD20H=1,3  
FD1 20 DCOST(1)=0.0  
FD1 21 DD21=1,3  
FD1 22 PEAN(5,10)COST(1)  
FD1 23 DD22=1,3  
FD1 24 KFADI5,10)XNAT(J,K)  
FD1 25 DD23L=1,3  
FD1 26 N024V=1,3  
FD1 27 DCOST(1)=XMAT(L,M)*COST(L)+OCST(L)  
FD1 28 DD25K=1,10  
FD1 29 DD26J=1,10  
FD1 30 SUMAT(I,J)=OCOST(I)*SOYD(J)  
FD1 31 DD27=1,3  
FD1 32 SDCST(I)=SUMAT(I,J)+SOCST(I)  
FD1 33 DD28=1,3  
FD1 34 WRITE(6,8)  
FD1 35 WRITE(6,15)  
FD1 36 WRITE(6,7)  
FD1 37 WRITE(6,12)((SUMAT(I,J),J=1,10),I=1,3)  
FD1 38 WRITE(6,7)  
FD1 39 WRITE(6,16)  
FD1 40 DD29=1,10  
FD1 41 DD30=1,0  
FD1 42 SDEPR=SUMAT(L,K)+SDEPR  
FD1 43 DD31=1,3  
FD1 44 WRITE(6,7)  
FD1 45 WRITE(6,14)I,SOCST(I)  
FD1 46 STOP  
FD1 47 END
<table>
<thead>
<tr>
<th>YEAR</th>
<th>DEPRECIATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>98191.75</td>
</tr>
<tr>
<td>2</td>
<td>88363.56</td>
</tr>
<tr>
<td>3</td>
<td>78545.30</td>
</tr>
<tr>
<td>4</td>
<td>68727.25</td>
</tr>
<tr>
<td>5</td>
<td>58909.05</td>
</tr>
<tr>
<td>6</td>
<td>49090.89</td>
</tr>
<tr>
<td>7</td>
<td>39272.71</td>
</tr>
<tr>
<td>8</td>
<td>29454.54</td>
</tr>
<tr>
<td>9</td>
<td>19636.35</td>
</tr>
<tr>
<td>10</td>
<td>9818.18</td>
</tr>
</tbody>
</table>

TOTAL DEPRECIATED COST MACHINE 1 119999.80

TOTAL DEPRECIATED COST MACHINE 2 149999.70

TOTAL DEPRECIATED COST MACHINE 3 269999.60

CORE USAGE OBJECT CODE: 2088 BYTES ARRAY AREA: 232 BYTES TOTAL AREA AVAILABLE: 116640 BYTES

COMPILE TIME: 0.18 SEC EXECUTION TIME: 0.06 SEC WATFIV - VERSION 1 LEVEL 1 JANUARY 1970 DATE: 70/162
A client of AGP & Co., Regal, Inc., has entered into an agreement with Savoy, Inc. and Dixie, Inc., for the merger of the three companies. Under the terms of the agreement, the stockholders of each constituent company are to receive a pro-rata share of the capital stock of Nire Industries, Inc. The new corporation, Nire Industries, Inc., has authorized in its charter 1,000,000 shares of $5 par value common stock which will be distributed among the three merging corporations based on the assets of each constituent company as of December 31 of the previous year.

AGP & Co., has been retained to appraise the three companies to establish the reasonableness of the assets and related equities in the year-end financial statements of the respective corporations.

A review of Regal, Savoy and Dixie reveals that each corporation owns part of the common stock of the other two corporations. Management explains that these mutual ownerships were a result of the close relationships that have been developed between the corporations over the past five years. The investments of the corporations are as follows:²

Dollar Ownership Value Per Percentage Books

Regal, Inc.
Investment in Savoy 15% $20,000
Investment in Dixie 15% 600,000

Savoy, Inc.
Investment in Regal 15% $300,000
Investment in Dixie 10% 350,000

Dixie, Inc.
Investment in Regal 5% $100,000
Investment in Savoy 5% 120,000

The audits and appraisals of the corporations have indicated that all three parties have unqualified opinions on their financial statements and the merger agreement can be based on the following condensed balance sheets as of December 31, 19xx.

<table>
<thead>
<tr>
<th></th>
<th>Regal, Inc.</th>
<th>Savoy, Inc.</th>
<th>Dixie, Inc.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Assets</strong></td>
<td>$3,000,000</td>
<td>$4,000,000</td>
<td>$7,000,000</td>
</tr>
<tr>
<td><strong>Total Liabilities</strong></td>
<td>$5,000,000</td>
<td>$1,500,000</td>
<td>$2,200,000</td>
</tr>
<tr>
<td><strong>Common Stock, $100 par</strong></td>
<td>2,000,000</td>
<td>1,500,000</td>
<td>4,000,000</td>
</tr>
<tr>
<td><strong>Retained Earnings</strong></td>
<td>500,000</td>
<td>1,000,000</td>
<td>800,000</td>
</tr>
<tr>
<td><strong>Total Liabilities and Capital</strong></td>
<td>$3,000,000</td>
<td>$4,000,000</td>
<td>$7,000,000</td>
</tr>
</tbody>
</table>

Regal, Inc. has engaged AGP & Co. to perform the preliminary work and to determine the distribution of the stock of Nire Industries, Inc. The mathematical method best suited for solution of this case is the formulation of simultaneous linear equations which can be solved using matrix algebra. This case has all the necessary prerequisites of a "pooling of interests" and should be handled on that basis.
Approach

A basic computer program can be used to invert the matrix developed from the equations based on ownership of the three corporations. The net assets for each firm must be ascertained and a set of equations determined from these computations along with the percentages of ownership shown in the schedule above. This step is illustrated in the following schedule:

Assets and Investments:

<table>
<thead>
<tr>
<th></th>
<th>Regal, Inc.</th>
<th>Savoy, Inc.</th>
<th>Dixie, Inc.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Assets</td>
<td>$3,000,000</td>
<td>$4,000,000</td>
<td>$7,000,000</td>
<td>$14,000,000</td>
</tr>
<tr>
<td>Less:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liabilities</td>
<td>500,000</td>
<td>1,500,000</td>
<td>2,200,000</td>
<td>4,200,000</td>
</tr>
<tr>
<td>Net Assets Including Investments</td>
<td>$2,500,000</td>
<td>$2,500,000</td>
<td>$4,800,000</td>
<td>$9,800,000</td>
</tr>
<tr>
<td>Less:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Investments</td>
<td>800,000</td>
<td>650,000</td>
<td>220,000</td>
<td>1,670,000</td>
</tr>
<tr>
<td>Net Assets Excluding Investments</td>
<td>$1,700,000</td>
<td>$1,850,000</td>
<td>$4,580,000</td>
<td>$8,130,000</td>
</tr>
</tbody>
</table>

Equations:

\[ R = \text{net assets of Regal plus its equity in Savoy and Dixie} \]
\[ S = \text{net assets of Savoy plus its equity in Regal and Dixie} \]
\[ D = \text{net assets of Dixie plus its equity in Regal and Savoy} \]

\[ R = 1,700,000 + .15S + .15D \]
\[ S = 1,850,000 + .15R + .10D \]
\[ D = 4,580,000 + .05R - .05S \]
\[ R - .15S = .15D = 1,700,000 \]
\[ -.15R + S - .10D = 1,850,000 \]
\[ -.05R - .05S + D = 4,580,000 \]

Set Up for Matrix Solution:

\[ \begin{bmatrix}
  1 & -.15 & -.15 & R \\
  -.15 & 1 & .10 & S \\
  -.05 & -.05 & 1 & D \\
\end{bmatrix} \begin{bmatrix} R \\ S \\ D \end{bmatrix} = \begin{bmatrix} 1,700,000 \\ 1,850,000 \\ 4,580,000 \end{bmatrix} \]

The entry to record the merger is as follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assets</td>
<td>$14,000,000</td>
</tr>
<tr>
<td>Liabilities</td>
<td>$4,200,000</td>
</tr>
<tr>
<td>Capital Stock</td>
<td>5,000,000</td>
</tr>
<tr>
<td>Paid-in Capital</td>
<td>2,500,000</td>
</tr>
<tr>
<td>Retained Earnings</td>
<td>2,300,000</td>
</tr>
</tbody>
</table>

To record the merger of Regal, Inc., Savoy, Inc., and Dixie, Inc., into Nire Industries, Inc. as per agreement dated January xx, 19xx.

This would complete the engagement for merger of the three firms. The experience gained from this solution should enhance the student's understanding of matrix algebra and its applications to accounting problems.

**Bonus and Tax Matrix Solution**

**Case Problem**

Each year the auditors of the ECP Corporation are confronted with the problem of determining the accuracy of the liability for the bonus due the president as well as the liability for state and Federal income taxes. This year a review of the minutes of the Board of Directors reveals that on April 1, 19xx the board voted to pay the president a bonus of ten percent (10%) of the corporate net income after deducting both state and Federal income taxes.

The state income tax provisions provide that the net income of the ECP Corporation be taxed on the net profit in
SJOB

C

C NICE INDUSTRIES INC. MERGER - POOLING OF INTEREST

C A G PEPPLE DISSERTATION

1 DIMENSION D(3,3),E(3,3),CONAM(3,3)

2 DIMENSION SUM(3),CO(3),STKP(3),COPEC(3),COSH(3)

3 90 FORMAT(1H1)

4 95 FORMAT(//)

5 100 FORMAT(2)

6 101 FORMAT(3A4)

7 102 FORMAT(F4.2)

8 103 FORMAT(5X,*INVERTED MATRIX* //)

9 104 FORMAT(40X,3F10.9)

10 105 FORMAT(3F9.2)

11 106 FORMAT(F7.0)

12 107 FORMAT(10X,3A4,10X,*F10.0)

13 108 FORMAT(10X,3A4,10X,6F15.0,2X,*SHARES*1)

14 109 FORMAT(10X,3A4,6X,F15.0,2X,SHAPES*I)

15 16 READ5, 100INS

17 18 READ5,101INS(CONAM(1,N),N=1,3),I=1,3

18 19 READ5,102INS(D(N),N=1,NS),M=1,NS)

19 20 IFAD5,105INS(COPEC(I),I=1,NS)

21 21 READ5,106INS(CO(1),I=1,NS)

22 22 REAL5,10GINS(1,3A4,10X,*SHARE*1)

23 23 DOII=1,NS

24 24 DO1J=1,NS

25 25 DO1J=1,NS

26 3 E(I,J)=0

27 3 DO3H=1,NS

28 2 SUM(I)=0.0

29 20 DO4MP=1,NS

30 30 NIV=MP

31 31 T=EMP,NIV

32 32 DO5H=1,NS

33 33 EMP,N=E(MP,N)/T

34 34 DO5MP=1,NS

35 34 EMP,N=O(MP,N)/T.

36 21 CONTINUE

37 37 IFIM,LE,NSGO TO 20

38 38 CM=CM,MP,NIV)

39 39 DO6N=1,NS

40 40 TM=OMP,N)CM

41 41 T=EMP,N)CM

42 42 EMP,N=EM(N,N)TA

43 43 DO6N=CON(N)TM

44 44 H=H+1

45 20 DO6J=1,NS

46 21 IFI,LE,NSGO TO 21

47 4 CONTINUE

48 4 WRITE(6,901)

49 4 WRITE(6,103)

50 4 WRITE5,104INS(E(I,N),N=1,NS),H=1,NS)

51 50 DO7N=1,NS

52 51 DO7=1,NS

53 7 SUM(N)=EM(N,1)+CO(1)+SUM(N)

54 53 WRITE(6,95)

55 54 DO7=1,3

56 55 WRITE(6,107) (CONAM(J,K),K=1,3),SUM(J)

EXHIBIT 6-2

MATRIX SOLUTION TO CONSOLIDATION INTEREST
DO K = 1, NS
   SUM(K) = SUM(K) + COPEC(K)
   ESUM = (SUM(K) + ESUM)
   DO J = 1, NS
      STK(J) = (SUM(J) / ESUM) * 100.0
      WRITE(6,95)
      DO 12 L = 1, 3
      WRITE(6,108) (CONAM(L,M), M = 1, 3), STKP(L)
      DO 14 N = 1, NS
      STKP(N) = STKP(N) / 100.0
      WRITE(6,95)
      DO 11 L = 1, 3
      WRITE(6,109) (CONAM(L,M), M = 1, 3), COSH(L)
   STOP
END

$ENTRY
INVERTED MATRIX

<table>
<thead>
<tr>
<th></th>
<th>1.033095000</th>
<th>0.163529900</th>
<th>0.171317000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.160943000</td>
<td>1.030498000</td>
<td>0.127190000</td>
</tr>
<tr>
<td></td>
<td>0.059701480</td>
<td>0.059701430</td>
<td>1.014925000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Company</th>
<th>Shares</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>REGAL, INC.</td>
<td>279,796</td>
<td>27.98%</td>
</tr>
<tr>
<td>SAVOY, INC.</td>
<td>271,837</td>
<td>27.18%</td>
</tr>
<tr>
<td>DIXIE, INC.</td>
<td>448,367</td>
<td>44.84%</td>
</tr>
</tbody>
</table>

CORE USAGE: 3496 BYTES, ARRAY AREA: 168 BYTES, TOTAL AREA AVAILABLE: 116640 BYTES

COMPILE TIME: 0.31 SEC, EXECUTION TIME: 0.08 SEC, WATFIV - VERSION 1 LEVEL 1 JANUARY 1970 DATE: 70/162
excess of three thousand dollars ($3,000) at a rate of four percent (4%) after allowing a deduction for Federal income taxes due and payable for the year. The Federal income tax rate is twenty-two percent (22%) on the first $25,000 of net income and twenty-six (26%) on net income above $25,000. In addition, a tax surcharge of ten percent (10%) of the Federal income tax liability is assessed for the year.

Net income of the ECP Corporation for the year is $27,770. The auditing firm wants to set up a matrix solution for the calculation of the president's bonus and related tax liabilities. A computer program should be employed to provide the solution for the following:

1. The bonus due the president of ECP Corporation
2. The state income tax liability
3. The Federal income tax liability before the ten percent (10%) tax surcharge
4. The Federal tax surcharge
5. The corporate net income before bonus or taxes
6. The corporate net income after bonus and taxes

Approach

The first step in the solution of this bonus and tax problem is the formulation of a matrix solution for the linear equations in this case. A computer program for the
inversion of a matrix and multiplication of this inverted matrix times a vector of dollar amounts will provide a solution for the six areas listed above. EXHIBIT 6-3 incorporates an inversion of a matrix and multiplication times a vector to arrive at a solution to the ECP Corporation case.  

The variables for ECP Corporation, the linear equations for each variable and the corresponding matrix formulas are developed in the following schedule:

Variables:

- B = Bonus due the president
- S = State income tax liability
- F = Federal income tax liability excluding surcharge
- E = Federal tax surcharge
- I = Net income before bonus or taxes
- P = Net income after bonus and taxes

Formulas:


5The net income level of $27,770 is the cutoff point for the above matrix solution. Whenever the net income is below $27,770, the Federal tax surtax of 26% would not be applicable to a corporation's net income. The effective tax rate would be only the normal tax or at a rate of 22% on the first $25,000 bracket of net income. In the case where net income is below $27,770, the following equations and corresponding matrix from these equations should be utilized:

- B = .10 (I - S - F - E)
- S = .04 (I - B - E - F - $3,000)
- F = .22 (I - B - S)
- E = .10 (.22 (I - B - S))
- I = Below $27,770
- P = I - B - S - F - E
\[ B = 0.10 \ (I - S - F - E) \]
\[ S = 0.04 \ (I - B - E - F - 3,000) \]
\[ F = 0.48 \ (I - B - S) - 6,500 \]
\[ E = 0.10 \ (0.48 \ (I - B - S) - 6,500) \]
\[ I = 27,770 \]
\[ P = I - B - S - F - E \]

\[ B = 0.10I - 0.10S - 0.10F - 0.10E \]
\[ S = 0.04I - 0.04B - 0.04E - 0.04F - 120 \]
\[ F = 0.48I - 0.48B - 0.48S - 6,500 \]
\[ E = 0.048I - 0.048B - 0.048S - 650 \]
\[ I = 27,770 \]
\[ P = I - B - S - F - E \]

Matrix and Vector:

\[
\begin{bmatrix}
1 & 0.10 & 0.10 & 0.10 & -0.10 & 0 \\
0.04 & 1 & 0.04 & 0.04 & -0.04 & 0 \\
0.48 & 0.48 & 1 & 0 & -0.48 & 0 \\
0.048 & 0.048 & 0 & 1 & -0.048 & 0 \\
1 & 0 & 0 & 0 & 1 & 1 \\
1 & 1 & 1 & 1 & -1 & 1 \\
\end{bmatrix}
\begin{bmatrix}
B \\
S \\
F \\
E \\
I \\
P \\
\end{bmatrix} = \begin{bmatrix}
0 \\
-120 \\
-6,500 \\
-650 \\
27,770 \\
0 \\
\end{bmatrix}
\]

The solution to the \( X \) vector of variables is obtained by inverting the \( A \) matrix and multiplying by the \( C \) vector.

This can be illustrated in the following formulas:

\[ AX = C \]
\[ X = CA^{-1} \]
ECF CORPORATION PROGRAM FOR BONUS AND TAX

A G PETRIE DISSERTATION

DIMENSION A(6,6),E(6,6),C(6), SUM(6)

FORMAT(11)
FORMAT(58X,'INVERTED MATRIX* ')
FORMAT(6.0)
FORMAT(6.1)
FORMAT(/)
FORMAT(15X,6F17.9)
FORMAT(20X,'SCHEDULE OF SOLUTION*')
FORMAT(10X,'BONUS',25X,16.0)
FORMAT(10X,'STATE TAX*',21X,F10.0)
FORMAT(10X,'FEDERAL TAX*',19X,F10.0)
FORMAT(10X,'FEDERAL SURCHARGE*',13X,F10.0)
FORMAT(10X,'INCOME BEFORE BONUS AND TAXES*',11X,F10.0)
FORMAT(10X,'INCOME AFTER BONUS AND TAXES*',2X,F10.0)
READ(5,NO)
READ(5,31)((A(J,K),J=1,NO),K=1,NO)
DO 21 N=1,NO
DO 22 L=1,NO
E(L,1)=0.0
DO 23 N=1,NO
E(N,1)=1.0
DO 24 N=1,NO
INV=I
T=INV
DO 25 N=1,NO
INV=N
TA=E(INV,N)*T
A(INV,N)=A(INV,N)/T
M=N+1
IF (INV.EQ.M) GOTO 18
CONTINUE
IF (INV.EQ.NO) GOTO 18
CONTINUE
WRITE(6,29)
WRITE(6,29)
WRITE(6,33)
WRITE(6,34)
DO 9 N=1,NO
SUM(N)=E(N,1)+SUM(N)
WRITE(6,35)
WRITE(6,36)SUM(1)
WRITE(6,37)SUM(2)
WRITE(6,38)SUM(3)
INVERTED MATRIX

1.056757000  -0.050955180  -0.103637500  -0.103637500  0.048916990  0.000000000
-0.020382000  1.022557000  -0.034864110  -0.034864110  0.019343840  0.000000000
-0.497460900  -0.466369300  1.068400000  0.068400076  0.447714600  0.000000000
-0.049746080  -0.046636940  0.006840076  1.006839000  0.044771470  0.000000000
0.000000000  0.000000000  0.000000000  0.000000000  1.000000000  0.000000000
-0.469169800  -0.458966700  -0.412738600  -0.432738600  0.440252900  1.000000000

SCHEDULE OF SOLUTION

BONUS  2106.
STATE TAX  665.
FEDERAL TAX  550.
FEDERAL SUPCHARGE  550.
INCOME BEFORE BONUS AND TAXES  27770.
INCOME AFTER BONUS AND TAXES  18950.

CORE USAGE  OBJECT CODE=  2768 BYTES, ARRAY AREA=  336 BYTES, TOTAL AREA AVAILABLE=  116640 BYTES

COMPILE TIME=  0.23 SEC, EXECUTION TIME=  0.18 SEC, WATFIV - VERSION 1 LEVEL 1 JANUARY 1970 DATE= 70/162
This case is an additional extension of the use of matrix algebra in solving fairly complex accounting problems involving simultaneous equations. The number of equations could be enlarged or contracted to fit other accounting situations. State laws also differ and allowances could be made in the appropriate equations for different state rates and tax brackets. As in the other program adaptations, several alternatives are available to the student as well as the professor for solving accounting case problems.

**Least-Squares Regression Analysis**

One of the most common techniques for the study of cost behavior is a graphic analysis of the relationship between cost and volume accompanied by a least-squares regression line. This statistical tool enables a student to ascertain the variable and fixed, elements of past cost behavior as they relate to a total mixed cost at a particular volume. The approach employs both a graphic analysis and a statistical component that fits a least square regression line to the graphic plot of past cost data. This graph depicts total costs on the vertical axis and volume for total

---

costs each period on the horizontal axis. The valuable rate is measured by the slope of the least-squares regression line. Actual total mixed costs are plotted on the graph with a least-squares regression line fitted to this data representing the estimated total cost at various volume levels. The regression line is not plotted visually by the student. Instead, the fit of this line is determined through two simultaneous linear equations:

\[ EY = na + bEX \quad \text{and} \quad EXY = aE x + bEX^2 \]

The variables in each equation will be identified in the case approach developed below in this section.

Case Problem

The Tracy Corporation has not utilized a formal means of projecting and controlling maintenance costs for its machine shop operations. The financial vice-president request you to analyze these costs and develop a yearly budget for the machine shop.

Data on maintenance costs are available from last year and these figures are considered to be realistic for the current year. Machine hours appear to be the best available volume factor for predicting maintenance cost although other variables (e.g., direct labor hours) should be considered in
your final analysis. A schedule of these volumes and costs is as follows:

<table>
<thead>
<tr>
<th>MONTH</th>
<th>MACHINE HOURS (X)</th>
<th>MAINTENANCE COSTS (Y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>72,000</td>
<td>$44,000</td>
</tr>
<tr>
<td>February</td>
<td>71,300</td>
<td>43,600</td>
</tr>
<tr>
<td>March</td>
<td>68,400</td>
<td>42,180</td>
</tr>
<tr>
<td>April</td>
<td>64,200</td>
<td>39,900</td>
</tr>
<tr>
<td>May</td>
<td>61,000</td>
<td>38,500</td>
</tr>
<tr>
<td>June</td>
<td>59,500</td>
<td>38,000</td>
</tr>
<tr>
<td>July</td>
<td>58,000</td>
<td>37,240</td>
</tr>
<tr>
<td>August</td>
<td>60,100</td>
<td>38,270</td>
</tr>
<tr>
<td>September</td>
<td>64,500</td>
<td>40,300</td>
</tr>
<tr>
<td>October</td>
<td>69,000</td>
<td>42,630</td>
</tr>
<tr>
<td>November</td>
<td>73,800</td>
<td>44,980</td>
</tr>
<tr>
<td>December</td>
<td>75,000</td>
<td>45,400</td>
</tr>
</tbody>
</table>

Approach

A least-square regression analysis will provide the vehicle for determining the fixed and variable components of maintenance costs. The historical data should be prepared so that the following two equations can be solved.

\[
EY = na + bEX
\]

\[
EXY = aEX + bEX^2
\]

Variables Defined as Follows:

\[ Y = \text{Total costs at each volume} \]
\[ X = \text{Volume variable at each cost level} \]
\[ N = \text{Number of observations} \]
\[ A = \text{Fixed cost per period at Zero Volume} \]
\[ B = \text{Average variable cost per unit of volume} \]

In order to facilitate the solving of this problem, a computer program (Exhibit VI - 4) has been developed to test the relationship of machine hours and maintenance cost along with the fixed and variable cost components for maintenance. To complete this analysis, other variables should also be tested and the most correlated volume factor selected for budgeting maintenance costs for the machine shop.

The least-square regression analysis can be expanded into multiple correlation\(^8\) by increasing the variable relationships. Actual costs may be highly correlated to two or more volume variables and this fact can improve the cost projections used in financial budgeting.

PROGRAM FOR LEAST-SQUARES REGRESSION ANALYSIS

A G PEWIE DISSERTATION

DIMENSION X(12), Y(12), XY(12), X2(12)

READ(*,10)H
READ(*,11)X(I), I=1,N
READ(*,12)Y(J), J=1,N

 SX=X(J)+SX
 SY=Y(J)+SY
 XY=XY(J)+Y(J)
 SX=XY+SY
 X2=XY+Y(J)

 A=XM*L*XQK
 B=XM2*XQ2K

 WRITE(*,13)
 WRITE(*,14)
 WRITE(*,15)
 WRITE(*,16)
 WRITE(*,17)
 WRITE(*,18)
 WRITE(*,19)

STOP
END
<table>
<thead>
<tr>
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**FIXED COST ELEMENT-A**  8902.00

**VARIABLE COST ELEMENT-B**  0.4872

**CORE USAGE**  OBJECT CODE= 2200 BYTES, ARRAY AREA= 192 BYTES, TOTAL AREA AVAILABLE= 116640 BYTES

**COMPILE TIME=**  0.18 SEC, EXECUTION TIME= 0.06 SEC, WATFIV - VERSION 1 LEVEL 1 JANUARY 1970 DATE= 70/162
CHAPTER VII

SUMMARY AND CONCLUSIONS

The programs developed in this dissertation are designed to serve as a foundation for the integration of electronic data processing systems into the accounting curriculum. Variables within the programs have been developed mnemonically to assist the student in the identification and understanding of computations along with the logic of solving accounting problems. This technique should facilitate the transition from manual solutions to computerized solutions and encourage improvisations in program adaptations. This flexibility will also enable the student and professor to expand or alter these programs so that they can best serve their needs for solving problems in the cost or financial accounting areas.

Chapter I serves as an introduction to the integration of computer technology into the financial and accounting field. The demand for competent financial managers with a background in electronic data processing has increased sharply in recent years according to publications in leading
periodicals and major university studies. This development has activated interests in the academic community for the expansion of electronic data processing systems coverage in both the graduate and undergraduate programs.

A matrix accounting system is developed in Chapter II to provide the student with an introduction to the use of matrices in accounting. A two-dimensional matrix serves as the general ledger for an accounting system that records entries through a batched voucher system and updates the general ledger for each transaction. The output of the computerized system gives the student a voucher register with batch totals, a general ledger matrix, a trial balance and subsidiary ledgers. The material in this chapter can broaden a student’s background in accounting techniques and procedures that will blend with computer capabilities and enhance the flow of financial information within a company.

In Chapter III a capital budgeting system is developed to generate information on cash flows, a payback period, an accounting rate of return and time-adjusted rates of return. Flowcharts for each facet of the analysis are designed in a general system form and summarized at the end of the chapter. Some questions concerning unequal lives, reinvestment and uneven cash flows are discussed in the material with suggestions
and recommendations for handling these problems. The student will need to make certain assumptions in capital budgeting analysis because the selection process should be founded on criteria that is consistent from period to period. The uncertainties in evaluating capital investments require judgment forecasts and assumptions that demand sophistication and experience in the business environment. This is what the student should begin to develop during his college career.

Process cost accounting is covered in Chapters IV and V. A process cost system based on historical costs is developed in Chapter IV. This material includes a discussion of the process cost system, a weighted average cost system and a complete program for the process cost operations of a two department firm. The output of the program presents production reports on physical flow as well as dollar costs for each category in inventory. In Chapter V a process cost system based on standard costs along with variance analysis illustrates some of the refinements available for process cost operations. Two departments are also included in this system with transferred-in costs and variance analysis for each of the two operations. These two programs offer a broad coverage of process cost accounting that can be beneficial for saving time in calculations along with affording more time for
analysis and review for the process cost system flows and outputs.

Chapter VI contains the balance of the programs developed in this dissertation. Selected topics covering the areas of depreciation, consolidations, bonus and tax solutions, and least squares regression were adapted to matrix operations which were solved through the use of computer programs. Each of the four sections present a case problem for the student to analyze and a suggested approach to the solution of each case. A computer program performs the calculations and provides the logic for each case solution with a printout of the requested information. The solutions to these cases included multiplication of a vector times a matrix, matrix multiplication and matrix inversion. These exercises give the student valuable inroads into the use of matrix algebra in accounting as well as increase his understanding of matrix calculations in the solution of complex problems. The speed and capabilities of the computer for matrix and other calculations can be better appreciated and understood through the solution of these and similar cases.

The computerized systems designed in this research can assist in the use of data processing in accounting and financial planning. Certain extensions can be implemented
in these systems that will improve their application to particular accounting courses or possibly related business courses. For example, a random number generator could be incorporated into the matrix accounting system and be used to select accounts receivable for confirmation or to test inventory items in stock. Sales analysis could be made by product lines and statistics developed for product sales in relation to total sales volume, average prices of product sales and contribution margins of product lines. The inventory area also offers the potential for expanded analysis for such functions as inventory test counts, valuations of inventory items, inventory turnover and inventory control. Additional opportunities are open for statistical probability analysis in sales forecasting, inventory levels and re-order points, and capital budgeting forecasts.

These concepts for integration of data processing into the accounting curriculum provide the student with a functional frame of reference for solving accounting problems with computers. The student and professor should become familiar with these applications in the financial and cost accounting areas and use this foundation to venture into additional applications that interest and excite them. The boundaries are limited only by the educational background of
the individuals along with the depth of their imagination. The more knowledgeable a person becomes with accounting techniques, matrix algebra and computers, the more he will feel comfortable to explore avenues of advancement in accounting procedures and practices. Implementation of computerized problem solving into the cost and financial accounting areas can establish inroads into the business curriculum for further utilization of computerized techniques for teaching and problem solving.

Curriculum development can be enhanced through the establishment of a system for sharing computer applications among the various schools and universities. Development of computer programs independently would become too costly and a duplication of effort could result with this approach. Sharing programs can be accomplished through a system of documentation and an agency in the educational system to distribute computer programs to interested universities. The cost saving will also assist in maintaining access to computer facilities which even schools with limited budgets have been able to afford in the past. Some additional equipment may be added with the savings of system design work efforts through the program sharing agency.

Computer programs developed in this dissertation, which range from a matrix ledger along with matrix solutions
for accounting problems to process cost accounting, serve as a foundation for blending together accounting, matrix algebra and electronic data processing systems. The student will be able to utilize knowledge gained during his studies to solve problems in accounting courses, management and marketing courses, and related business electives. Certainly this will provide a broader and more complete education as the student learns the interconnections of the various fields of study in business. As areas are related, a student can gain appreciation for the functions of accounting, marketing, financial planning and management as well as learn how each function can contribute to other areas along with the accomplishment of a firm's overall goals and objectives.

The field of accounting has expanded in recent years with the introduction of computers into business operations. A management information system has evolved to provide all levels of the organization with statistical, financial, production and qualitative information for planning and control of operations. A financial executive needs to expand his scope of operations if he intends to assume this new position of responsibility. The proper foundation for launching a career in the management information system field is a inter-disciplined education that encompasses accounting, statistics,
management, marketing, finance and electronic data processing systems. These areas need to be molded during a student's education through the application of the various fields to related areas in other fields of study. This research and dissertation work has been aimed in that direction.
BIBLIOGRAPHY
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VITA

Anthony George Petrie, Jr., the son of Anthony George Petrie and the late Alma Dimm Petrie, was born in New Orleans, Louisiana on June 1, 1940. He received his elementary and secondary education in the public and private schools of New Orleans, Louisiana, graduating from De La Salle High School in May, 1957.

In the following September, he entered Louisiana State University in Baton Rouge, Louisiana and received the degree of Bachelor of Science with a major in Accounting in May, 1962.

In June, 1962, he enrolled in the Graduate School of Louisiana State University. On August 25, 1962, he was married to the former Judith Ann Bourgeois of Baton Rouge, Louisiana. In November, 1962, he successfully passed the Uniform Certified Public Accountant Examination and is a Certified Public Accountant in Louisiana. In May, 1963, he was awarded a Graduate Assistantship from the Department of Accounting at Louisiana State University and received the degree of Master of Science in January, 1964.
From December, 1964 through September, 1965, he was on the staff of Haskins & Sells.

In September, 1965, he accepted a position as Instructor in Accounting at Louisiana State University in New Orleans and re-enrolled in the Graduate School of Louisiana State University in June, 1966. During his time at that institution, he worked as a Graduate Teaching Assistant in the Department of Accounting and from May, 1969 through May, 1970, he worked as a Senior Consultant with Peat, Marwick, Mitchell & Co. He was awarded a Graduate Summer Fellowship at Louisiana State University, Haskins & Sells Instructor Fellowship Award and selected to Phi Kappa Phi, Beta Gamma Sigma and Beta Alpha Phi.

He is currently a candidate for the degree of Doctor of Philosophy in Accounting.
Candidate: Anthony George Petrie, Jr.

Major Field: Accounting

Title of Thesis: "Integration of Computers into the Financial and Cost Accounting Curriculum"

Approved:

[Signatures]

Major Professor and Chairman

Dean of the Graduate School

EXAMINING COMMITTEE:

[Signatures]

Date of Examination: July 9, 1970