ADAPTING THE FLOW OF RESOURCES CONCEPT TO THE BUSINESS ENTERPRISE

By

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The purpose of this study was to develop a resource flow matrix with particular emphasis on the changes in the economic position of the enterprise due to both financial and nonfinancial flows. As such, it serves as the basic link between the balance sheet and the income statement.

The systems approach was the basic approach of the study. The initial step comprised an assessment of the nature and function of the funds statement. This was followed by an examination of the opinions of the American Institute of Certified Public Accountants on funds statements and various funds concepts. The second step of the study included a definition of the aims, constraints, and performance criteria which the resource flow matrix must satisfy. An attempt was then made to explore the meanings

of "system," "information," "accounting," and the role of the accounting information system in the total organization system. A model of the accounting information system was developed in terms of the role of the accounting information system in the total management information system. It was concluded that a decision-making approach to theory verification is consistent with the frame of reference adopted.

The study provided a mathematical basis for relating financial and nonfinancial flows. After an examination of the Leontief input-output model and the general form of the linear programming model, it was demonstrated that the decision models for the allocation of financial and productive resources are the same by relating the linear programming technique to financial planning and, therefore, to financial flows.

The resource flow matrix was found to allow for comprehensive and concise presentation of the account interrelationships, as well as to provide the basis for development of the traditional financial statement. It was concluded that if there are advantages in utilizing the input-output reporting format for depicting productive flows, these same advantages apply to the depiction of total resource flows, financial as well as productive.

CHAPTER I

INTRODUCTION

The income statement traditionally has been the principal statement used by the accountant for reporting the flow of resources of specific business enterprises. However, the income statement is limited only to a disclosure of productive flows. In recognition of the need for a second flow statement, the American Institute of Certified Public Accountants issued *Opinion No. 3* (1963) and *Opinion No. 19* (1971) on the necessity of the "funds" statement and the "funds" concepts which should serve as the basis for disclosure of resource flows.

Even after the issuance of two opinions by the American Institute of Certified Public Accountants, much debate exists among accountants as to the most useful concept and format for disclosure of funds flows. The basic nature and function of the statement, subtitled "Statement of Changes in Financial Position," in *Opinion No. 19,* was to account for the operating and financial activities of an enterprise during the operating period. A statement of this nature is needed to reconcile the financial position of the enterprise at the beginning of the period with that at the end of the period. Many writers are of the opinion that the statements of changes in financial position found in the literature and in finan-

cial reports do not provide a report of the "total" resource flows which have taken place between stock statement dates.

Do accountants presently provide a statement which discloses all resource stock changes due to financial flows? Does a statement prepared on a "working capital" or a "cash" basis, as recommended in *Opinion No. 19,* serve as the basic link between resource stock accounts and nonfinancial flow accounts? These questions suggest the need for an investigation as to the proper concept and statement format for disclosure of the changes in financial position of the business entity.

Statement of Purpose

The purpose of this dissertation was to develop a resource flow matrix which depicts the historical interrelationships between the resources and sources of the resources of the business enterprise. A resource flow matrix so developed then provides a description of the changes in the financial position of the enterprise due to both financial and nonfinancial flows. As such, it serves as the basic link between the resource stock accounts and the nonfinancial flow accounts.

Method of Analysis

The systems approach to problem solution comprised the approach of this study. Recognizing that the use of systems con-

cepts in a research endeavor is not without controversy, considerable discussion is provided in Chapter III on the systems approach.

The chapters are arranged so as to indicate first the relevance of the study, then to provide a theoretical frame of reference for development of the resource flow matrix, next to establish the mathematical basis for development of the resource flow matrix, and, finally, to discuss the relationship of the resource flow matrix to the accounting information system. Several of the funds concepts and formats for funds statements which have been suggested since the construct "funds flows" was first employed are presented in Chapter II. Support is provided in that chapter for further research on funds concepts and formats for the funds statement. A frame of reference for derivation of the resource flow matrix is developed in Chapter III. In that chapter a model of the accounting information system is developed, and the role of the accounting information system in the entity is discussed. In a continuation of the detail of the frame of reference, Chapter III includes, as indicated above, a discussion of the systems approach to theory development. In the last part of Chapter III, the implications of the model and theory adopted for theory development and verification are presented. In Chapter IV the mathematical basis for relating financial and operating flows is deduced. Chapter V demonstrates that the decision models for the allocation of financial and productive flows are identical. It is this proof that is utilized to develop the resource flow matrix. The relationship of the resource flow matrix to the accounting information system is discussed in Chapter

VI. A summary statement and conclusion are provided in the last chapter, Chapter VII.

CHAPTER II

FUNDS CONCEPTS AND FORMATS FOR FUNDS STATEMENTS

In this chapter, several of the funds concepts and formats for funds statements which have been developed since the construct "funds flows" was first employed are considered. The first part of the chapter provides a historical background relevant to the current dissatisfaction with the "limited" funds concepts utilized for financial-reporting purposes. Next, the position of the American Institute of Certified Public Accountants and the broader funds concepts which the Institute's Accounting Principles Board could have utilized at the time of publication of *Opinion No. 19* (1971) are discussed. Support for further research on funds concepts and formats for the funds statement is then provided.

Antecedents to Funds Statement Perplexity

The origin of the statement of changes in financial position is usually credited to William Morse Cole. The 1908 edition of Cole's bookkeeping text, *Accounts, Their Construction and Interpretation for Businessmen and Students of Affairs,* is usually cited as the date of the first funds statement. Funds statements, however, have been dated prior to

1908. Thomas L. Greene presented a "Summary of Changes in the Position of the Company" in his study of railroad financial statements published in 1897 (106 ff.). Liability increases and asset decreases were termed "sources of funds" by Greene. He regarded asset increases and liability decreases as "uses of funds." Rosen and De Coster observed in their "'Funds' Statements: A Historical Perspective" that Cole was illustrating "only one of several types of 'supplementary' statements that were being used in practice at the time. . . . All of these reports are now called 'funds' statements" (1969, p. 125).

With regard to the term "funds," it may be noted that H. A. Finney stated in 1925 that "it is not unlikely that the term 'resources' is preferable" (p. 507). This observation is especially noteworthy, since it is Finney who is credited with the introduction of the term "funds" (1923). Finney led the drive in the late 1910s and 1920s for limiting the concept "funds" to a statement of the causes of changes in working capital (Rosen and De Coster, 1969, p. 128). Kafer and Zimmerman noted that the equating of "funds" to "working capital" is a widely accepted practice that has been attacked by various authors. The final results of the attack, they observed, are still indeterminate due to the recent demands for a widening, as well as a reduction, of the scope of the term (1967, p. 96). It was Finney's position that the purpose of the funds statement was to serve as an extension of the idea of comparative balance sheets. In his view, a funds statement helped to

provide "a clear and comprehensive conception of the change in the financial condition caused by the profits of the period, the dividend payments, and any financing programme which may have taken place" (1923, p. 460).

Although, as noted above, accounting theorists expressed reasonable interest in the funds statement during the period prior to 1925, Rosen and De Coster observed disinterest in the subject on the part of a majority of large public companies of that period. Rosen and De Coster mailed approximately 150 letters to large public companies operating prior to 1925 to ascertain whether or not a funds statement was included in their reports of the time. Sixty companies responded. Four used a type of funds statement. One of the four grouped working-capital items together (1969, p. 129). A lack of interest in the funds statement is also noticed in the textbooks written from 1908 to 1955.

The importance and need for an understandable organization of the funds statement was recognized by A. C. Littleton.

> Management exercises a multiple stewardship, financial as well as operating. . . . A duty exists, therefore, to report on finances as well as on operations. . . . Financial transactions are important, and a report of financial stewardship is very much needed. . . . Unfortunately, however no clear cut and orderly accounting statement for this pur-

> pose has evolved. . . . It is doubtful if an "application of funds statement" . . . fully answer[s] the need [because it] is too complex in organization to be understandable. (1953, p. 80)

At the time of the publication of Littleton's monograph (1953), there was a laxity, as before, in presenting a comprehensive explanation of financial transactions. It was not until after the American Institute of Certified Public Accountants' *Opinion No. 3* (1963) that one could begin to see significant evidence of concern with the funds statement. Note the increase from 25 to 207 companies presenting a funds statement and the corresponding coverage by the auditor's report from 1958 to 1965 (Kafer and Zimmerman, 1967, p. 98).

Statement of Working Capital, Source, and Application of Funds:

	1958	1960	1965
Covered by auditor's report	25	30	207
Not covered by auditor's report	160	178	251
Total	185	208	458

n = 600 companies

It has been recognized for many years that enterprise resources are of two major types--productive and financial. It has also been recognized that information concerning the financ-

ing and investing activities of the business enterprise is essential to financial-statement readers. Based on the above observations, the American Institute of Certified Public Accountants, in *Opinion No. 19,* stated the following:

> When financial statements purporting to present both financial position (balance sheet) and results of operations (statement of income and retained earnings) are issued, a statement summarizing changes in financial position should also be presented as a basic financial statement for each period for which an income statement is presented.
> (1971, paragraph 7)

Many accounting writers have long recognized the need for a funds statement. The diagram presented in Figure 1 was offered by S. C. Yu as exhibiting the two types of flows of resources and the interrelationships which need to be presented in a funds statement (1969, p. 573). In explaining his diagram, Yu stated that "resources" denote a stock point--a state position--from which flows begin and end. The arrows denote continuous interplay between financial and productive activities. It was Yu's observation that "implicitly, the diagram tends to bridge the gap between the balance sheet and the statements of income and retained earnings" (1969, p. 572). Yu was calling for a total-resources funds concept as opposed to the typical working-capital or cash concept.

Considerable evidence is provided by Rosen and De Coster that liquidity has been the primary justification offered

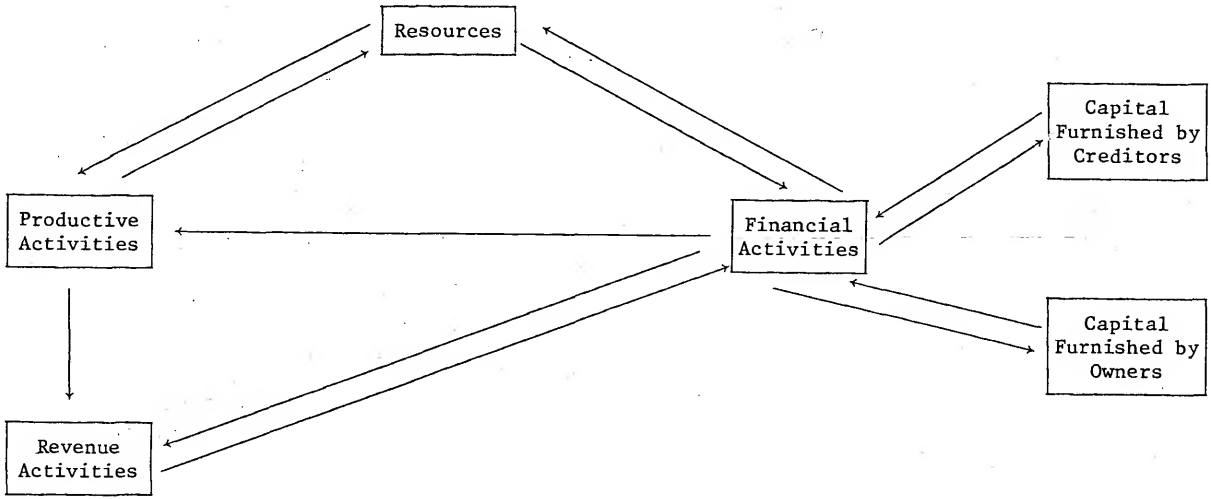


Figure 1. Two Types of Flows of Resources and the Interrelationships Which Need to Be Presented in a Funds Statement.

for the adoption of the working-capital concept of funds. When statements are used primarily as a basis for establishing credit, one cannot question the importance of liquidity. Glenn L. Johnson has presented several formulas for explaining changes in working capital in terms of changes in noncurrent assets and equities (1966). Harold J. Bierman, among other writers, emphasized that the primary information to be obtained from the funds statement is "change in liquidity" (1960, p. 628). Noting confusion on the part of the general public as to an understanding of the term "working capital," the American Institute of Certified Public Accountants, in *Opinion No. 19* (1971), required that an analysis of the changes in the components of working capital accompany statements of changes in financial position prepared on a working-capital basis. It was noted by the Institute that the statement of financial position is no longer a liquidity statement for borrowing purposes, but a basic statement for information communication to many users.

At the extreme of the liquidity spectrum is the "literal-cash" concept of funds. A funds statement prepared on this basis, as compared to the working-capital basis, corresponds to a statement obtained from a set of books prepared on the cash basis. The source-and-use-of-cash statement informs one of where cash came from and how it was used.

The American Institute of Certified Public Accountants

The significance of the statement of changes in financial position is the need for comprehensive information concerning all of the financing and investing activities of the enterprise. The items reported are intimately related to profit, since, to users and to managers, profit is the primary source of continuing-cash and working-capital needs. This statement is essential to fair reporting of the causes of balance-sheet changes from period to period. The purpose of the broad all-resources concept of the statement of changes in financial position expressed in *Opinion No. 19* (American Institute of Certified Public Accountants, 1971), as opposed to the earlier working-capital and cash concepts of funds statements, is to provide the missing link in reporting on all changes in financial position between two consecutive balance sheets. The missing link comes from the fact that the income statement reports changes as a result of operations, and the statement of retained earnings reports only certain changes in owner's equity. Neither statement, separately or jointly, reports all changes in financial position between two consecutive position statements.

In this section we will consider the American Institute of Certified Public Accountants' *Opinion No. 19,* subtitled "Reporting Changes in Financial Position," and the broader funds concepts available to the Institute at the time of *Opinion No. 19.*

Opinion No. 19

The American Institute of Certified Public Accountants was well aware of the varied conception of "funds" in practice in its *Opinion No. 19* (1971). Observing cash or its equivalent and working capital as funds interpretations, the Institute stated,

> . . . a funds statement based on either the cash or the working-capital concept of funds sometimes excludes certain financing and investing activities because they do not directly affect cash or working capital during the period. . . . To meet all of its objectives, a funds statement should disclose separately the financing and investing aspects of all significant transactions that affect financial position during a period. These transactions include acquisition or disposal of property in exchange for debt or equity securities and conversion of long-term debt or preferred stock to common stock.
> (paragraph 6)

In reference to this broadened concept of the funds statement, the Institute recommended that the subtitle of the statement be changed to "Statement of Changes of Financial Position." The statement recommended by the Institute had the following objectives:

1. To report on all of the financing and investing activities of the enterprise.
2. To report on the generation and application of funds (either on a working-capital or cash basis).
3. To complete the reporting of the causes of all of the changes in financial position during the period. (1971)

The Institute specified that the following criteria must be met in presenting a statement of financial position:

1. The statement should be presented as a basic financial statement for each period in which an income statement is prepared.
2. The statement applies to all profit-oriented business entities whether or not there is a classification of assets and liabilities between current and noncurrent.
3. The statement should be based on a broad concept embracing all changes in financial position (not limited to working capital or cash). All important changes in financial position during the period should be disclosed.
4. a. The statement should begin with the income or loss before extraordinary items, if any, and add back (or deduct) items recognized in determining income (or loss) which did not use (or provide) working capital or cash during the period.

   b. Alternatively, so as to not suggest that adjustments to net income, such as depreciation, generate working capital or cash, the statement could begin with revenues that generated working capital or cash during the period and deduct operating expenses that required the outflow of working capital or cash.
5. The items added back (or deducted) in 4a, above, should be clearly presented to avoid the interpretation that they provided funds.
6. The effects of extraordinary items should be reported separately from the effects of normal operating items.
7. The effects of all financing and investing activities, as well as working capital or cash, should be individually disclosed.
8. If the format shows the flow of working capital and two-year comparative balance sheets are presented, the detailed changes in working-capital accounts nevertheless must be presented.
9. Working capital or cash provided (used) should be appropriately described.

10. If the format shows the flow of cash, detailed changes in other working-capital accounts should be disclosed in the body of the statement.

11. Terms referring to cash should not be used unless all noncash items have been appropriately adjusted.

12. There should be flexibility in form, content, and terminology in the statement; flexibility should be used to develop the presentation that is most informative in the circumstances.

13. It is strongly recommended that isolated statistics of working capital and cash, especially per share amounts, not be presented. (1971)

The Institute stipulated the following with regard to concept selection:

> The statement summarizing changes in financial position should be based on a broad concept embracing all changes in financial position, and . . . the title of the statement should reflect this broad concept. The Board [Accounting Principles Board of the American Institute of Certified Public Accountants] therefore recommends that the title be "Statement of Changes in Financial Position" (referred to below as "the Statement"). The Statement of each reporting entity should disclose all important aspects of its financing and investing activities regardless of whether cash or other elements of working capital are directly affected. For example, acquisitions of property and conversions of long-term debt or preferred stock to common stock should be appropriately reflected in the Statement. (1971, paragraph 8)

Opinion No. 19 allows considerable variation in the reporting of the "limited" concepts of funds or "resources" required. It appears that the following recommendations of Perry Masson in *Accounting Research Study No. 2* (1961) could have been more effectively utilized in at least limiting the variation

in the reporting concept and still allow flexibility in the format of the funds-flows statement.

Accounting Research Study No. 2

Perry Masson advocated the all-financial-resources funds concept in *Accounting Research Study No. 2* (1961). He indicated that all-financial resources comprised a different and broad approach to the problem of interpreting the term "funds." He conceived of all-financial resources as including all assets, or financial resources, and not just those which affect or flow through the working-capital accounts.

> This conception of what is meant by "funds" seems to us to be the most useful meaning of the term. The narrower definitions, such as "cash" or "working capital," have often led to the omission from the statement of the effect of transactions which do not directly affect cash or working capital, but which, nevertheless, are important items in the financial administration of the business. Examples are the purchase of property in exchange for shares of stock or bonds, gifts or subsidies, exchanges of property, and the like. The inclusion of such transactions is sometimes justified by assuming intermediate steps, e.g., the issue of bonds for cash and the purchase of property with cash. This introduction of hypothetical transactions could usually be unnecessary under the "all-financial resources" concept since the changes in such items would naturally fall into the scope and purpose of the funds statement. . . .
>
> . . . The narrower concepts also tend to restrict the form in which the statement is prepared and to introduce too high a degree of uniformity in the arrangement of the items. The funds statement should be a flexible device, designed to disclose and emphasize all significant changes and transactions, whether they are

> within or without the current asset and liability groups. Too often a single figure of increase or decrease in working capital is shown, when one of the most significant changes may have been an increase or decrease in inventories, receivables, or some other current item. (1961, p. 54)

Other Concept Suggestions

In addition to the suggestion of Masson (1961), the American Institute of Certified Public Accountants had available to it many other concept suggestions in its preparation of *Opinion No. 19* (1971). In the following pages, some of those concepts will be presented. All of the statements developed will be based on the data of Tables 1 through 3, below. Table 4 indicates the kind of statement used by the Federal Reserve Board prior to 1959. To some extent, Table 5 resembles the format currently used by the Federal Reserve Board for its flow-of-funds accounts. The format of Table 6 is an alternative to that presented in Table 5.

The general structure of Table 5 is as follows:

1. Statements of income and retained earnings--nonfinancial flows.
2. Changes in balance-sheet accounts.
   a. Real accounts--nonfinancial flows.
   b. Financial assets--financial flows.
   c. Liabilities--financial flows.

Note that this statement gives the effect of the nominal accounts (the productive flow accounts in the accounting system) on the real accounts. Also provided are changes within the position

statement accounts. The sum of the two provides total flows. That is, the sum of the two provides an explanation of the changes taking place from one stock position to another.

A format of the type in Table 6 allows concentration in the financial and nonfinancial flows of funds. Information is therefore provided as to how long-term investment was financed. The basic structure of this statement is as follows:

Nonfinancial flows--operating and dividend transactions:	
Sources	$295,480
Uses	275,245
Savings provided from operations	20,235
Financial flows:	
Sources	54,225
Uses	53,850
Net financial sources	375
Total available for capital formation	20,610
Less portion retained in current assets (nonfinancial)	5,310
Capital formation	15,300
Capital formation (various)	15,300

Two of the more limited concepts of funds, in which the emphasis is again on liquidity, are "cash and marketable securities" and "net quick assets." The cash-and-marketable-securities concept is very close to that of "literal cash." It will be considered in the next section of this chapter as we take a look at a sampling of thought subsequent to *Opinion No. 19*. Net quick assets are composed of cash-and-demand deposits, secondary cash reserves (government bonds, notes, etc.), and short-term

receivables less short-term payables. This concept excludes inventories and prepaid items. An adjustment to net income for change in inventories is therefore necessitated. A statement of quick-asset flows based on George Staubus (1966) is presented in Table 7. The statement format is Staubus'. Table 7 was prepared using the data in Tables 1 through 3.

The quick-asset concept utilizing Staubus' format appears very useful as a liquidity measure. A distinction is presented between operating and financing activities. The issue resolution for the funds concept, however, still depends on whether one is interested in cash, quick assets, working capital, and so forth for liquidity or capital formation and net investment. Can all be gained from the same statement or are several statements required? In utilizing the net quick-asset concept, we must distinguish between resource categories in order to prepare the statement. Where is the line drawn between the "pools" of credit and equity used for the various purposes? Does such a distinction really matter? Would a total "source pool" and a total "usage" concept be more descriptive of actual enterprise operations? Does the ability to be liquid in the short term determine long-run success? Or, is the spending power of the enterprise a function of total enterprise resources?

TABLE 1

THE SCFP CORPORATION, COMPARATIVE STATEMENTS OF FINANCIAL POSITION, DECEMBER 31, 1972 AND 1973

	December 31		Net Change	
	1972	1973	Debit	Credit
ASSETS				
Current Assets				
Cash	$ 10,260	$ 18,350	$ 8,090	
Marketable securities		2,000	2,000	
Accounts receivable (net)	31,200	48,700	17,500	
Notes receivable	4,000	6,000	2,000	
Accrued interest receivable	60	100	40	
Inventories	19,000	24,000	5,000	
Prepaid insurance	540	750	210	
Office supplies	300	400	100	
Sundry Assets				
Long-term investments	44,000	48,000	4,000	
Sinking fund	27,000	30,000	3,000	
Fixed Assets				
Land	21,000	33,000	12,000	
Buildings (net)	144,000	138,000		$ 6,000
Furniture and fixtures (net)	11,300	13,500	2,200	
Goodwill	10,000			10,000
Unamortized bond discount	660	600		60
TOTAL ASSETS	$323,320	$363,400		

TABLE 1, continued:

	December 31		Net Change	
	1972	1973	Debit	Credit
LIABILITIES AND STOCKHOLDERS' EQUITY				
Current Liabilities				
Accounts payable	$ 17,400	$ 18,300		$ 900
Accrued wages and salaries	300	400		100
Accrued taxes payable	120	100	$ 20	
Federal income taxes payable	16,200	20,425		4,225
Accrued interest payable	2,400	2,400		
Long-Term Liabilities				
Long-term notes payable	6,000		6,000	
Sink fund bonds payable (4%, due Oct. 31, 1982)	60,000	60,000		
Stockholders' Equity				
Capital stock--no par value; stated value, $10; authorized, 20,000 shares; issued, 15,000 shares of which 300 shares are in the treasury	120,000	150,000		30,000
Capital in Excess of Stated Value				
From stock issuances	15,000	27,000		12,000
From treasury stock transactions	4,000	4,000		
From stock dividends	2,400	2,400		

TABLE 1, continued:

	December 31		Net Change	
	1972	1973	Debit	Credit
LIABILITIES AND STOCKHOLDERS' EQUITY, continued:				
Retained Earnings				
Appropriated				
Reserve for sinking fund	$ 25,000	$ 28,000		$ 3,000
Reserve for contingencies	3,000		$ 3,000	
Unappropriated	51,500	54,575		3,075
Deduct cost of treasury stock		(4,200)	4,200	
TOTAL EQUITIES	$323,320	$363,400		
TOTAL DEBITS AND CREDITS			$69,360	$69,360

TABLE 2

THE SCFP CORPORATION, INCOME STATEMENT, YEAR ENDING DECEMBER 31, 1973

Net sales		$288,000
Cost of goods sold		194,000
Gross profit on sales		94,000
Operating expenses		
Advertising	$ 8,500	
Wages and salaries	30,500	
Insurance	210	
Office supplies	600	
Bad debts	2,500	
Property taxes	400	
Depreciation--buildings	6,000	
Depreciation--furniture and fixtures	1,100	
Miscellaneous	1,200	51,010
Net operating income		$ 42,990
Other income and expenses		
Interest expenses	2,460	
Interest income	320	2,140
Net income after other income and expenses		$ 40,850
Income tax expense		20,425
NET INCOME AFTER INCOME TAX		$ 20,425

TABLE 3

THE SCFP CORPORATION, STATEMENT OF RETAINED EARNINGS, YEAR ENDING DECEMBER 31, 1973

Retained earnings, December 31, 1972		$51,500
Net income for the year		20,425
Release of reserve for contingencies		3,000
TOTAL		$74,925
Increase in reserve for sinking fund	$ 3,000	
Write-off of goodwill	10,000	
Dividends	7,350	20,350
RETAINED EARNINGS, DECEMBER 31, 1973		$54,575

Additional Information

1. The company purchased $2,000 worth of marketable securities during the year.
2. The company wrote off $1,000 accounts receivable as uncollectable and recorded $2,500 estimated bad debts at year end.
3. Insurance premiums paid during the year amounted to $420.
4. Purchases of $700 worth of office supplies were made.
5. The net change in the long-term investments account is the result of two separate transactions--additional purchases, $11,000, and sales with a total cost of $7,000 for $7,000.
6. The net change in the sinking-fund account reflects the annual requirement of deposit for the retirement of sinking-fund bonds at maturity. Sinking-fund expenses and income are ignored for purposes of illustration.
7. Additional land was acquired at a cost of $12,000.
8. Purchases of furniture and fixtures amounted to $3,300.
9. Goodwill was removed from the books by a charge to retained earnings.

TABLE 3, continued:

10. The applicable amount of bond discount amortization for the year is $60.
11. Actual payment of federal income taxes during the year amounted to $16,200, which apparently was the amount of income taxes remaining unpaid at the end of 1972. Income taxes for 1973 amounted to $20,425.
12. Three thousand shares of capital stock were issued, of which 430 shares were issued to retire the long-term notes payable and the remainder sold for $36,000.
13. Reserve for sinking fund was increased by $3,000 and reserve for contingencies was eliminated.
14. The company acquired 300 shares of its own stock at a total cost of $4,200.
15. Dividends declared and paid during the year amounted to $7,350.

TABLE 4

THE SCFP CORPORATION, STATEMENT OF FLOW OF RESOURCES, YEAR ENDING DECEMBER 31, 1973

Sources			
Nonfinancial flows			
Net sales			$288,000
Interest income			320
Depreciation			7,100
Amortization of bond discount			60
TOTAL PROVIDED FROM OPERATIONS			295,480
Financial flows			
Increase in accounts payable		$ 900	
Increase in accrued wages and salaries		100	
Increase in income taxes payable		4,225	
TOTAL PROVIDED FROM CURRENT ACCOUNTS		$5,225	
Sales of long-term securities	$ 7,000		
Issuance of capital stock	42,000		
TOTAL PROVIDED FROM NONCURRENT ACCOUNTS		49,000	54,225
TOTAL SOURCES OF RESOURCES			$394,705
Uses			
Nonfinancial flows			
Cost of goods sold			$194,000
Operating expenses			51,010
Interest expense			2,460

TABLE 4, continued:

Uses, continued:			
Nonfinancial flows, continued:			
Federal income taxes			20,425
Dividends			7,350
TOTAL USED IN OPERATIONS AND DIVIDENDS			$275,245
Increase in inventories		$5,000	
Increase in office supplies		100	
Increase in unexpired insurance		210	
TOTAL USED IN OPERATION AND DIVIDENDS		$5,310	
Acquisition of plant and equipment		15,300	$ 20,610
TOTAL			$295,855
Financial flows			
Increase in cash		$ 8,090	
Increase in marketable securities		2,000	
Increase in accounts receivable (net)		17,500	
Increase in notes receivable		2,000	
Increase in accrued interest receivable		40	
Decrease in property taxes payable		20	
TOTAL USED IN CURRENT ACCOUNTS		$29,650	
Acquisition of long-term securities	$11,000		
Addition to sinking fund	3,000		
Decrease in long-term notes payable	6,000		
Acquisition of treasury stock	4,200		
TOTAL USED IN NONCURRENT ACCOUNTS		24,200	53,850
TOTAL USES OF RESOURCES			$349,705

TABLE 5

THE SCFP CORPORATION, STATEMENT OF FLOW OF RESOURCES, YEAR ENDING DECEMBER 31, 1973

Operating Transactions and Dividends--Nonfinancial Flows		
Sources		
Net sales		$288,000
Interest income		320
Depreciation		7,100
Amortization of bond discount		60
TOTAL SOURCES		$295,480
Uses		
Cost of goods sold	$194,000	
Operating expense	51,010	
Interest expense	2,460	
Federal income taxes	20,425	
Dividends	7,350	
TOTAL USES		275,245
NET SAVING		$ 20,235
Changes in Balance-Sheet Accounts		
Nonfinancial flows--uses		
Increase in inventories		$ 5,000
Increase in office supplies		100
Increase in unexpired insurance		210
Acquisition of plant and equipment		15,300
TOTAL USES		$20,610

TABLE 5, continued:

Changes in Balance-Sheet Accounts, continued:				
Financial flows--sources				
Increase in accounts payable			$ 900	
Increase in accrued wages and salaries			100	
Increase in income taxes payable			4,225	
Total provided from noncurrent accounts			$5,225	
Sales of long-term securities		$ 7,000		
Issuance of capital stock		42,000		
Total provided from noncurrent accounts			49,000	
TOTAL SOURCES			$54,225	
Financial flows--uses				
Increase in cash		8,090		
Increase in marketable securities		2,000		
Increase in accounts receivable (net)		17,500		
Increase in notes receivable		2,000		
Increase in accrued interest receivable		40		
Decrease in property taxes payable		20		
Total used in current accounts		$29,650		
Acquisition of long-term securities	$11,000			
Addition to sinking fund	3,000			
Decrease in long-term notes payable	6,000			
Acquisition of treasury stock	4,200			
Total use in noncurrent accounts		$24,200	53,850	
NET FINANCIAL FLOWS				375[a]
NET INVESTMENT				$20,235

[a]Deduction.

TABLE 6

THE SCFP CORPORATION, STATEMENT OF FLOW OF RESOURCES, YEAR ENDING DECEMBER 31, 1973

Nonfinancial Flows--Operating and Dividend Transactions			
Sources			
Net sales			$288,000
Interest income			320
Depreciation			7,100
Amortization of bond discount			60
TOTAL SOURCES			$295,480
Uses			
Cost of goods sold		$194,000	
Operating expenses		51,010	
Interest expense		2,460	
Federal income taxes		20,425	
Dividends		7,350	275,245
Savings provided from operations			20,235
Financial Flows			
Sources			
Increase in accounts payable		$ 900	
Increase in accrued wages and salaries		100	
Increase in income taxes payable		4,225	
Total provided from current accounts		$5,225	
Sales of long-term securities	$ 7,000		
Issuance of capital stock	42,000		
Total provided from noncurrent accounts		49,000	
TOTAL SOURCES		$54,225	

TABLE 6, continued:

Financial Flows, continued:				
Uses				
Increase in cash		$ 8,090		
Increase in marketable securities		2,000		
Increase in accounts receivable		17,500		
Increase in notes receivable		2,000		
Increase in accrued interest receivable		40		
Decrease in property taxes payable		20		
Total used in current accounts		$29,650		
Acquisition of long-term securities	$11,000			
Addition to sinking fund	3,000			
Decrease in long-term notes payable	6,000			
Acquisition of treasury stock	4,200			
Total used in noncurrent accounts		$24,200	$53,850	
Net financial sources				$ 375
Total available for capital formation				$20,610
Less portion retained in current assets (nonfinancial)				
Increase in inventories			5,000	
Increase in office supplies			100	
Increase in unexpired insurance			210	5,310
Capital formation				$15,300
Purchase of land			$12,000	
Purchase of furniture and fixtures			3,300	

TABLE 7

THE SCFP CORPORATION, QUICK-ASSET FLOW STATEMENT, YEAR ENDING DECEMBER 31, 1973

Routine Operations		
Inflows		
Net sales	$288,000	
Interest income accrued	100	$288,100
Outflows		
Purchases	199,000	
Interest cost accrued	2,400	
Income taxes for the year	20,425	
Routine purchases of supplies and services	44,000	265,825
NET RECURRING QUICK-ASSET FLOW		$22,275
Dividends paid		7,350
NET RECURRING QUICK ASSET FLOW RETAINED		$14,925
Financing Transactions		
Investment by owners and creditors		
Long-term investment by owners (net)	$37,800	
Retirement of long-term debt and sinking-fund deposit	9,000	28,800
Uses		
Net purchases of long-term securities	4,000	
Purchases of plant and equipment and land	15,300	(19,300)
NET CHANGE IN QUICK ASSETS		$24,425
NET QUICK-ASSET BALANCE JANUARY 1, 1973		9,100
NET QUICK-ASSET BALANCE DECEMBER 31, 1973		$33,525

The Issue Still Unresolved

As previously mentioned, Littleton (1953) expressed doubt that an application of funds statement, due to its complex organization, would fully satisfy the need of users for a report on finances as well as operations. Yu (1969) called for further thought toward the development of an understandable funds statement. Now, in 1974, after two opinions by the American Institute of Certified Public Accountants' Accounting Principles Board, the results of the attack in the late 1910s and 1920s on the concept "funds" is still indeterminable. There are authors who today call for a limiting of the funds concept, as well as demanding a widening of the concept employed.

An analysis of the manner in which corporations and the accounting profession are complying with the requirements of *Opinion No. 19* (American Institute of Certified Public Accountants, 1971) indicates that the terminology and format selected does not "fully answer the need" for an understandable funds statement (Giese and Klammer, 1974). In a random sample of 10 percent of the 1971 "Fortune 500," Giese and Klammer found that 42 percent of the fifty firms used the term "funds" provided. As discussed previously, this term has been used to mean everything from literal cash, net quick assets, and working capital to total resources. "Working capital provided" and "working capital used" captions were utilized by 36 percent of the firms. Only 10 percent of the firms used the recommended terminology--

"resources applied" and "resources used." Fifty percent of their sample "did not clearly label items not currently requiring working capital or cash as such" (1974, p. 57).

Giese and Klammer then proceeded to call for the cash approach to the statement of changes in financial position using the flow-through technique. They called for the cash approach because cash was said to represent the only discretionary resource available to management. They stated that the alternative, working capital, was not an available liquid pool of resources and therefore provided less information. The flow-through technique, as set out for working capital in Table 9 and as they recommended for cash in Table 12, with an accompanying schedule in Table 11, was said to segregate the separate but related inflows and outflows from operations.

Giese and Klammer recognized that the presentation format is critical for informative disclosure. They found that all of the fifty firms in their sample used the add-back technique, whether working-capital basis or cash basis, for items not requiring current use of working capital or cash. They observed that although the usual argument for the add-back technique is simplicity, the typical statement in their survey had three or four add-back items. Add-back items included depreciation, depletion, amortization, deferred income taxes, equity in earnings of unconsolidated subsidiaries, installment accounts due after one year, losses on discontinued operations, and minority interest. They presented a statement, Table 8, and asked how the

investor could be expected to understand why undistributed net earnings of unconsolidated subsidiaries are subtracted from operations or why the item "deferred income taxes" is an addition to "from operations" (1974, p. 58).

Of the five firms in the Giese and Klammer survey which indicated they accounted for a change in cash, none computed cash provided by operations as required in *Opinion No. 19* (American Institute of Certified Public Accountants, 1971). The typical presentation used is shown in Table 10. Note that changes in inventories, accounts receivable, and accounts payable are treated as nonoperational. Giese and Klammer indicated that this type of statement "is a throwback to the discredited idea that net income plus depreciation equals cash flow. . . . Operational activities do include changes in current operational assets such as accounts receivable and inventories" (1974, p. 60).

If the data in Tables 1 through 3 were structured in the format suggested by Giese and Klammer, we would have a cash-basis statement as allowed in *Opinion No. 19*. The only difference would be that financing and investing activities not affecting cash would become part of resources applied and resources provided in the Giese and Klammer statement. What can be said of the Giese and Klammer recommendations? Some recommendations for consideration of the clarity of the add-back and flow-through formats are well received. The notion that in the present environment the working-capital basis prepared using the add-back technique creates confusion and errors in interpretation

TABLE 8
WORKING CAPITAL PROVIDED BY OPERATIONS[a]

	1972	1973
Operations		
Net income	$18,990	$11,905
Add (Deduct)		
Items not involving use of working capital:		
Equity in earnings of related companies	(2,255)	(3,803)
Depreciation	10,225	8,921
Deferred income taxes	1,040	2,892
Working Capital		
Provided by operations:	$28,000	$19,915

[a]Illustration of add-back format, working-capital approach.

TABLE 9
WORKING CAPITAL PROVIDED BY OPERATIONS[a]

		1972		1973
Operations				
Revenues		$769,314		$703,560
Less revenues not resulting in increase in working capital				
Equity in earnings of unconsolidated companies (net of dividends)		3,255		3,803
Working-capital inflow from operations		$766,059		$699,757
Expenses	$750,324		$691,655	
Less expenses not requiring current outflow, working capital				
Depreciation	10,225		8,921	
Deferred income taxes	1,040		2,892	
WORKING-CAPITAL OUTFLOW FROM OPERATIONS		739,059		679,842
WORKING CAPITAL PROVIDED BY OPERATIONS		$ 27,000		$ 19,915

[a]Illustration of flow-through format.

SOURCE: Giese and Klammer, 1974, p. 59.

TABLE 10

CONSOLIDATED STATEMENTS OF CHANGES IN FINANCIAL POSITION, YEARS ENDING DECEMBER 31, 1972 AND 1971

	1972	1971
Sources of Funds		
From operations		
Net earnings	$34,806	$25,665
Adjustments for noncash items		
Equity in undistributed net earnings of 50%-owned foreign affiliates	(8,336)	(4,013)
Minority shareholders' equity in net earnings	1,282	1,317
Depreciation	16,859	14,242
Provision for possible losses on receivables	600	600
FUNDS PROVIDED FROM OPERATIONS	45,211	37,811
Borrowings		
Notes payable to banks, due 1982	12,000	
Notes payable to banks, short term	6,368	
Long-term secured	1,171	591
Common stock sold under stock-option plans	1,292	1,072
Reduction in notes and accounts receivable	2,585	17,444
Increase in accounts payable, accrued expenses, and income taxes, etc.	11,560	13,729
TOTAL SOURCES	$80,187	$70,647

TABLE 10, continued:

	1972	1971
Disposition of Funds		
Reduction of debt		
Fifty-three 4% notes payable to banks and insurance companies	$16,555	$14,170
Revolving credit	2,000	20,000
Debentures	4,200	2,188
Other	1,526	3,464
TOTAL REDUCTION OF DEBT	$24,281	$39,822
Purchase of treasury stock	11,627	
Cash dividends paid	3,009	2,251
Additions to plant and equipment, less sales, retirements, etc., of $3,354,000 in 1972 and $7,083,000 in 1971	28,357	23,147
Increase in inventories	15,391	10,657
Increase (decrease) in other assets	(15)	4,190
TOTAL	$82,650	$80,067
Reduction in funds for the year	(2,463)	(9,420)
CASH AND MARKETABLE SECURITIES, BEGINNING OF YEAR	22,505	31,925
CASH AND MARKETABLE SECURITIES, END OF YEAR	$20,042	$22,505

TABLE 11

ILLO COMPANY, ANALYSIS OF CASH FLOW FROM OPERATIONS, YEAR ENDING DECEMBER 31, 1972[a]

Analysis of Revenue Flows		
Revenue as reported on income statement	$4,600,000	
Less increase in accounts and notes receivable that have no effect on cash inflow	54,000	
Net cash inflow from operations		$4,546,000
Analysis of Expense Flows		
Expenses as reported on income statement	4,530,000	
Plus increase in inventory which caused an increase in cash outflow	17,000	
Less changes in items that have no effect on cash outflow		
Amortization of intangibles	10,000	
Depreciation	52,000	
Decrease in prepaid expenses	6,000	
Increase in accounts payable	19,000	
Increase in income tax	2,000	
Increase in accrued liabilities	4,000	
Increase in deferred income taxes	5,000	
Net changes not requiring cash outflow	98,000	
NET CASH OUTFLOW FROM OPERATIONS		4,449,000
NET CASH FLOW FROM OPERATIONS		$ 97,000

[a]Schedule 1.

TABLE 12

ILLO COMPANY, STATEMENT OF CHANGES IN FINANCIAL POSITION, YEAR ENDING DECEMBER 31, 1972

Resources Provided		
Cash from operations (Schedule 1)		$ 97,000
Extraordinary gain from income statement	$2,000	
Book value of plant	6,000	8,000
Sale of investments		38,000
Increase in short-term notes payable		47,000
Increase in current portion of long-term debt		2,000
Increase in long-term debt		16,000
TOTAL RESOURCES PROVIDED		$208,000
Resources Applied		
Short-term investments		$ 30,000
Plant and equipment investment		104,000
Payment of long-term debt		20,000
Treasury stock acquired		5,000
Dividends paid		40,000
Increase in cash		9,000
TOTAL RESOURCES APPLIED		$208,000

which are resolved by the flow-through approach prepared on a cash basis may require some deliberation. Their statement that cash is the only single homogeneous resource completely discretionary to management requires some thought as to its meaning. It is recognized that all resources are discretionary over some period of time. Although it is accepted that changes in current assets and current liabilities are related to operating, financial, and investing activities, a question presents itself. Should current assets and current liabilities be considered operating flows or should they be set apart from operating activities? It appears that some current assets and current liabilities are financial flows--just as it appears that inventory changes are nonfinancial flows and part of the operating cycle. Should all net uses (as determined from an analysis of balance-sheet changes in Table 5) be considered investment? Or, should some of these uses (increases in inventories) be considered operational? One might ask the following question: Is the increase in inventories appropriate (managerially responsible) only as a growth development of the company? If this observation is correct, then an increase in inventories is new investment (hoped to be permanent--that is, in maximization of financial strength, the owners hope the company continues to grow--does not shrink). If the increase in inventories is new investment, then is this increase capital formation? When resources available for capital formation are determined, should the resources retained in current assets (nonfinancial) be

deducted as in Table 6. Is there an inconsistency in the statement in Table 5 and the one in Table 6? What is the difference in net investment and capital formation? Which statement provides the most information to the general user? It appears that Giese and Klammer fail to distinguish between financial and nonfinancial flows. Their statement does not fill the gap between the position statement and the operating statement. When their statement is read, confusion still exists as to the resources provided from operations and the resources provided from financial activities. Financial flows and nonfinancial flows are not segregated in their statement. The investment increase (decrease) and capital formation provided from operations is not distinguished from that provided from financial activities.

In contrast to the more limiting concept of Giese and Klammer, Buzby and Falk presented an expanded funds statement (1974), calling for an integration of the cash and working-capital definition of funds with the concept of changes in financial position. Buzby and Falk's expanded funds statement follows from Figure 2 presented below. Their expansion was said to be based on "expressed needs of users for both a cash flow and a change in working-capital analysis, as well as the disclosure of other significant investing and financing transactions" (1974, p. 57). It should be noted that their concept is no different than those discussed earlier, but a presentation of three statements in one.

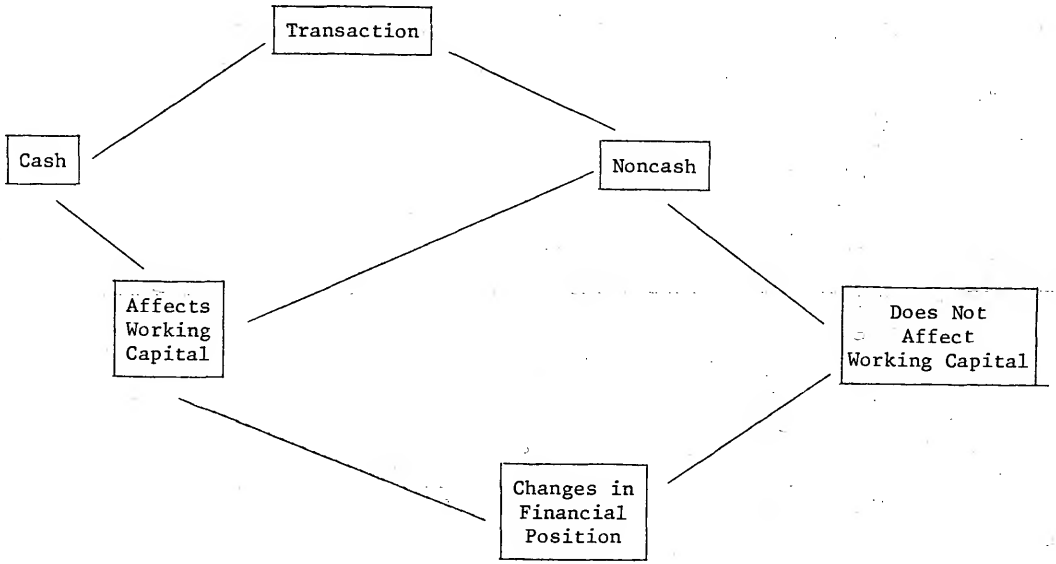


Figure 2. Classifications of Transactions.

Summary

The first part of this chapter was concerned with an acknowledgement of the importance of and the need for an understandable funds statement. This need has been recognized ever since the late 1890s. Debate as to the inappropriateness of the use of the term "funds" dates from the writings of H. A. Finney in 1925. A. C. Littleton (1953) pointed out that an understandable application of funds statement was doubtful due to its complex organization. Until around 1955, a general lack of interest in the funds statement was noted. It was not until after the American Institute of Certified Public Accountants' *Opinion No. 3* (1963) that one could begin to see significant evidence of concern with the funds statement in annual reports of public companies. Increased concern with the term "funds" and increased discussion of the need for a statement to fill the gap between the balance sheet and the income statement culminated with the American Institute of Certified Public Accountants' *Opinion No. 19* issued in 1971.

In that opinion the Institute recommended a broadened concept of the funds statement. Instead of "funds," the term "resources" was indicated as the desirable term. The Institute stated that the objective of the statement is to report on all of the financing and investing activities of the enterprise. The report is to deal with the generation and application of resources on either a working-capital or cash basis. The causes

of all changes in financial position during the period is to be reported. The Institute further recommended that the title of the statement be changed to "Statement of Changes in Financial Position."

The statement of changes in financial position was found to allow much latitude between minimum reporting and maximum reporting, cash or working-capital basis. Several authors felt that there is an overemphasis on liquidity in the development of the statement. Others felt that the resources concepts employed (cash and working capital) are not sufficiently broad to describe fully the changes in financial position during the accounting period. Some authors have even suggested multiple statements. It appears that we do not yet have a statement which answers the call for a statement reporting on total resource flows, financial as well as operating.

CHAPTER III

SYSTEMS AND FINANCIAL ACCOUNTING THEORY, A FRAME OF REFERENCE

The purpose of this chapter is to provide a frame of reference for development of the resource flow matrix. The accounting information system is recognized as the principal communication system producing the basis for decisions concerning the flow of resources to and from the economic enterprise. It is therefore proposed that a study of the meaning of "accounting," "information," and "system," and the role of the accounting information system in the entity, will provide the needed frame of reference. To state that accounting is viewed as an information system appears to indicate that the appropriate methodological framework for the study of accounting may be general systems theory. Therefore, after discussing the accounting information system and its role in the entity, the meaning of "general systems theory" as a methodological approach will be considered. In the last section of the chapter, the relationship of the model and theory adopted to the processes of theory development and verification will be expanded.

The Meaning of System

A well-recognized concept when considering the term "system" is the idea of the whole which is made up of interacting parts. Four of the most noted definitions of the term "system" are the following:

> A system is (1) something consisting of a set (finite or infinite) of entities, (2) among which a set of relations is specified so that (3) deductions are possible from some relations to others or from the relations among the entities to the behavior or the history of the system. (Rapoport, n.d., p. 452)

> A system is a complex of elements or components directly or indirectly related in a causal network such that at least some of the components are related to some others in a more or less stable way at some time. (Buckley, 1968a, p. 493)

> There are two essential characteristics of systems, including (1) a set of elements . . . [and] the relationships between and among the elements and (2) the notion of movement in unison in obedience to some form of control. A system is defined as some ongoing process of a set of elements, each of which are functionally and operationally united in the achievement of an objective. (Optner, 1968)

> A system is an assembly of procedures, processes, methods, routines, or techniques united by some form of regulated interaction to form an organized whole. (United States American Standards Institute)

The above definitions indicate that an information system may be regarded as a related set of events, the aggre-

gate information potential these possess, and the means of acquiring, storing, transforming, transmitting, controlling, or otherwise processing such information. All of these processes are related to, but distinct from, the external environment of the system.

The Meaning of "Information"

It is frequently stated that "information is the negative of uncertainty" (Miller, 1965, p. 194; Pask, 1969, p. 26; Shannon and Weaver, 1949, p. 7). However, this definition is quite unsatisfactory in describing what information is. Consider the following historical antecedent of the general term "information":

> The Latin word *informare,* from which is derived the word "information," signifies to "put in form," to give a form or an aspect, to form, to create, but also to represent, present, create an idea or emotion. It is possible to understand information in general as whatever is put in form or in order. Information signifies the placing of several elements or parties, either material or nonmaterial, into some form, into some classed system that represents classification of something. Under this general form, information is also the classification of symbols and of their relations in a nexus like the "organization of the organs and of the functions of a living being or the organization of any social system or any other community in general." Information expresses the organization of a system which is capable of mathematical description. It does not concern itself with the matter of that system, but with the form which

> can be the same for very different kinds of matter (black marks of characters on paper, neurons in the brain, ants in an ant nest, etc.).
>
> If mass is the measure of the effects of gravitation and of the force inertia and energy the measure of movement, "information is, in the quantitative sense, the measure of the organization of the material object." It is evident that with the characteristics of organization is linked not only the matter but also its characteristics relative to space, time, and movement. Matter, space, time, movement, and organization are in mutual connection. (Zeaman, 1962, p. 20)

It may therefore be said that information is something in "form." The form of something is the essence of its being and its reality. It is the means by which all systems relate to their movement. The above is a point articulated by Wiener after he considered the nature of information from the human body down to the cell.

> One thing at any rate is clear. The physical identity of an individual does not consist in the matter of which it is made. Modern methods of tagging the elements participating in metabolism have shown a much higher turnover than was long thought possible, not only of the body as a whole, but of each and every component part of it. The "biological individuality of an organism seems to lie in a certain continuity of process and in the memory by the organism of the effects of its past development." This appears to hold also for its mental development. In terms of the computing machine, the individuality of the mind lies in the retention of the earlier "taggings" and memories, and in its continued development along lines laid out. . . .
>
> . . . the individuality of the body is that of a flame rather than that of a stone, of a "form" rather than a bit of "substances." (Wiener, 1954, p. 99)

In a more familiar context to accountants, consider the nature of information and information systems in distinguishing between data and information. Gregory and Van Horn define "data" as

> . . . any facts that are a matter of direct observation. As used in business-data processing, "data" means collections of signs or characters generally arranged in some orderly way to make up facts and figures. (1960, p. 335)

Information implies usefulness. Levin distinguishes between "data" and "information" as follows:

> "Data" are facts or statistics, unrelated, uninterpreted, and probably unused.
> "Information" is knowledge derived from the organization and analysis of data. Information is data that are useful in achieving the objectives of the business.
> (1956, p. 122)

An information system therefore has as its function the transformation of data into information. In order to be termed "information," the end product of the transformation process must possess form and purpose.

The Meaning of "Accounting"

The following definition of "accounting" was given by the American Institute of Certified Public Accountants in 1953:

> Accounting is the art of recording, classifying, and summarizing in a significant manner and in terms of money, transactions, and events

> which are, in part at least, of a financial character and interpreting the results thereof. (p. 9)

The function of accounting is stated in *Accounting Research Study No. 1* to be

> . . . (1) to measure the resources held by specific entities, (2) to reflect the claims against and the interest in those entities, (3) to measure the changes in those resources, claims, and interests, (4) to assign the changes to specifiable periods of time, and (5) to express the foregoing in terms of money as a common denominator. (Moonitz, 1961, p. 23)

The American Accounting Association's 1966 Committee to Prepare a Statement of Basic Accounting Theory defined accounting as

> the process of identifying, measuring, and communicating economic information to permit informed judgments and decisions by users of the information. (1966, p. 1).

The Committee stated that the objectives of accounting are to provide information for the following purposes:

1. Making decisions concerning the use of limited resources, including the identification of crucial decision areas and determination of objectives and goals.
2. Effectively directing and controlling an organization's human and material resources.
3. Maintaining and reporting on the custodianship of resources.
4. Facilitating social functions and controls.

In Chapter 3 of *Accounting Principles Board Statement No. 4,* accounting is defined in the following terms:

> Accounting is a service activity. Its function is to provide quantitative information, primarily financial in nature, about economic entities that is intended to be useful in making economic decisions--in making reasoned choices among alternative courses of action. Accounting includes several branches, for example, financial accounting, managerial accounting, and governmental accounting.
>
> Financial accounting for business enterprises is one branch of accounting. It provides, within limitations described below, continued history quantified in money terms of economic resources and obligations of a business enterprise and of economic activities that change those resources and obligations.
>
> (American Institute of Certified Public Accountants, 1970)

Financial accounting was indicated in *Accounting Principles Board Statement No. 4* as being shaped to a significant extent by the environment, especially by:

1. The many uses and users which it serves.
2. The overall organization of economic activity in society.
3. The nature of economic activity in individual business enterprise.
4. The means of measuring economic activity.

(1970, paragraphs 40, 49)

The 1971 Committee on Information Systems of the American Accounting Association described the accounting information system as

> that portion of the formal information system concerned with the measurement and prediction

> of income, wealth, and other economic events of the organization and its subparts or entities. (1971)

The accounting information system therefore has as its function the acquiring, storing, transforming, transmitting, or otherwise processing the data of the economic events of a particular entity. The environment of the accounting information system determines the form and purpose of the transformation processes.

Development of a Model of the Accounting Information System

This section of the chapter provides the development of a model of the accounting information system. It is necessary in providing a frame of reference for development of the resource flow matrix to delineate the general accounting information system. In order to accomplish this objective, we must first consider the role of the total management information system in the organization, so that the role of the accounting information system and its relationship to the management information system and the organization will be more easily understood.

The Management Information System

Karl Patrick believes that a management information system "should come as close to being all things to all men in the business as is economically and politically justifiable"

(1968, p. 10). Bertram A. Colbert (1967) and H. S. Gellman (1968) have presented the following as representative of the thinking of most writers as to the necessary characteristics of a total management information system:

1. The full effect of a decision is considered in advance by supplying complete, accurate, and timely data.
2. Only necessary levels of detail are reported. The problems associated with the use of inconsistent and incomplete data are eliminated from the planning and decision-making processes by providing a means for preparing and presenting information in a uniform manner.
3. Data are presented in a form minimizing the need for further investigation and interpretation. Common data and methods are utilized in the preparations of long-range and short-term plans.
4. Significant past relationships are identified, structured, and quantified, and future relationships are forecasted through the use of advanced mathematical techniques in analyzing data.
5. Financial and production data are merged to help measure performance, control costs, and facilitate planning with minimum processing of data.
6. The needs of all corporate units are recognized so the requirements of each are met with a minimum of duplication while serving the corporation as a whole (the suprasystem).
7. Personnel and data are utilized effectively in order to obtain optimum speed and accuracy at the lowest cost.
8. Flexibility and adaptability are provided.
   (Colbert, 1967, p. 16; Gellman, 1968, p. 20)

As we consider this list of the necessary characteristics of a total management information system, we must ask what the position of accounting is in the information environment of the total management system.

Role of the Accounting Information System in the Total Management System

The information handling process in many firms has undergone a change in the last two decades (American Accounting Association, 1971, p. 293). The following list of developments which have motivated the change was presented by the 1971 Committee on Information Systems of the American Accounting Association:

1. The advent of the general purpose digital computer.
2. The adaptation of the scientific method to the solution of management problems and, accordingly, the establishment of rules for a variety of disciplines, some of which were traditionally found inside and others outside the management area.
3. The development of mathematical methods to the solution of management problems.
4. The formalization of information systems in the operational areas. (1971, p. 293)

The Committee stated that the accountant, due to the new position of accounting in the information environment, is now primarily a user of information. The former data-accumulation activities of the accountant are now said to receive only limited attention. The Committee noted that it is now much more difficult to draw boundaries around accounting due to the involvement of the accounting function and the accounting information system in a rapidly changing environment. In particular,

it is difficult to distinguish the role of the accounting information system in the firm's activities. It was also observed that due to these involvements and evolvements, the systems approach to information systems was implied. The model presented in Figure 3 was suggested by the Committee as a functional example of the information subsystem and its role in the total system (American Accounting Association, 1971, p. 298).

Figure 3 parallels closely the definition of an information system as a related set of events, the aggregate information potential these possess, and the means of acquiring, storing, transforming, transmitting, controlling, or otherwise processing such information. Figure 3 also illustrates that all of these processes are related to, but distinct from, the external environment of the system.

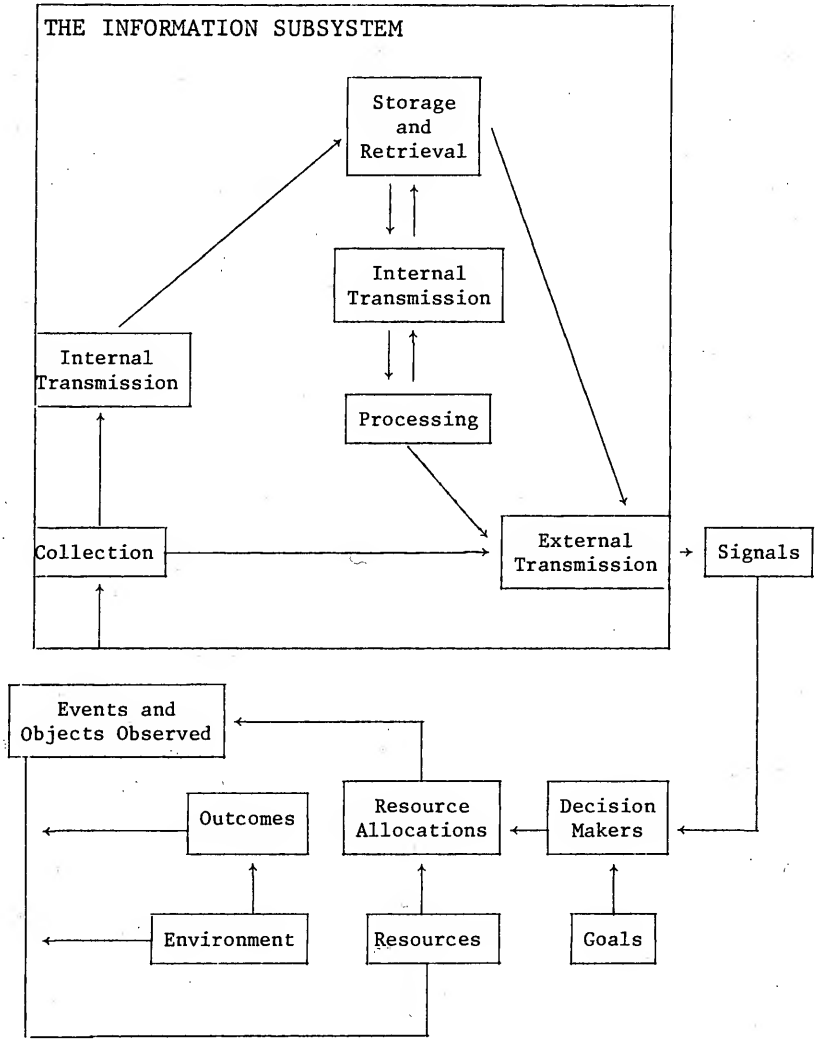
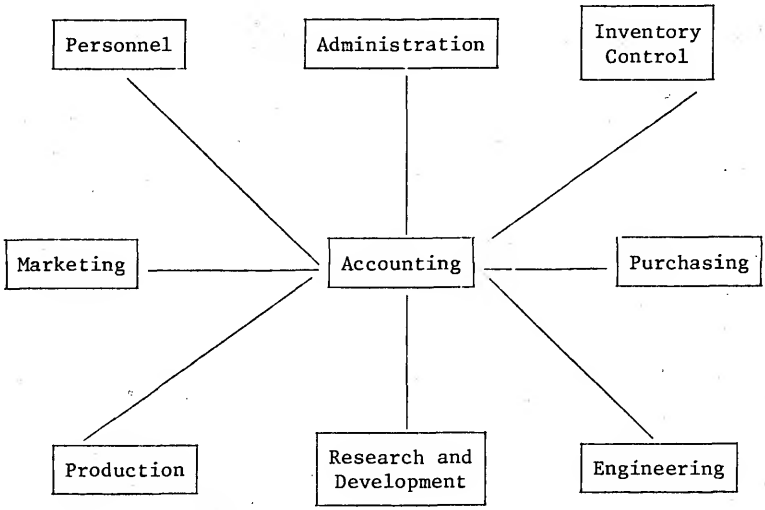


Figure 3. A Function Model of the Information Subsystem and Its Role in the Total System.

John W. Buckley and Kevin N. Lightner present the following diagram of accounting as the "hub of the management information system" (1973, p. 25):



The accounting system is pictured in this diagram as playing a principal role in managing the flow of economic data in and among organizations. The accounting system is charged with tying together the other subsystems in presenting a picture of the total entity to both managers and external users. We must ask, therefore, if there are any differences in accounting information criteria and those of management information systems.

Accounting Information Criteria and Criteria of Management Information Systems

William Thomas Stevens identified purposes, perimeters, and processes as the three dimensions of the management information system in his doctoral dissertation (1970). Stevens surveyed various statements concerning models of management information systems in deriving the following concept which he indicated as approximating the current state of the art:

> A management information system is an organized method of providing each manager with all the evidence and only that evidence which he needs or wants for decisions, when he needs or wants it, and in a form which aids his understanding and stimulates his action. (1970, p. 78)

According to Stevens, the dimension of perimeters constitutes the criterion that distinguishes information from non-information. After establishing the rationale of management in its decision-making operations, Stevens found his concept to be consistent with both the rationale of management accounting and statements on management information systems. The perimeters of accounting were the four basic standards of relevance, verifiability, freedom from bias, and quantifiability as presented in *A Statement of Basic Accounting Theory* (American Accounting Association, 1966). Stevens proposed that the only major differences between accounting information criteria and those of management information systems is the criterion of quantifiability. The quantifiability criterion interpreted "in its

broadest sense" (Stevens, 1970, p. 122) was found to be a necessary attribute of both systems and as being comprehended by his derived concept quoted above. Processes were stated by Stevens to be the series of actions or operations which are directed to an end. The processes identified by him were planning, doing, and reviewing. The review element was taken as being primarily the communication agent linking planning with doing. Stevens concluded that when one takes full account of the three dimensions of the management information system, he has a complete concept.

> A management information system is a means of communication which combines the planning, doing, and reviewing elements of the management process into an integrated and coherent whole. It is designed to provide each manager, whatever his status, with all the relevant, verifiable, quantifiable, and unbiased evidence he will use for making decisions. This information is to be presented to him in such a way as to stimulate behavior that will lead to the attainment of the goals established for the entire management process. (1970, p. 185)

It appears that the boundaries separating the accounting system and the total management information system are increasingly indistinct. However, if the accounting information system has concepts problems, and characteristics which are distinguishable from those of other systems, it is necessary to delineate the boundaries of these two systems.

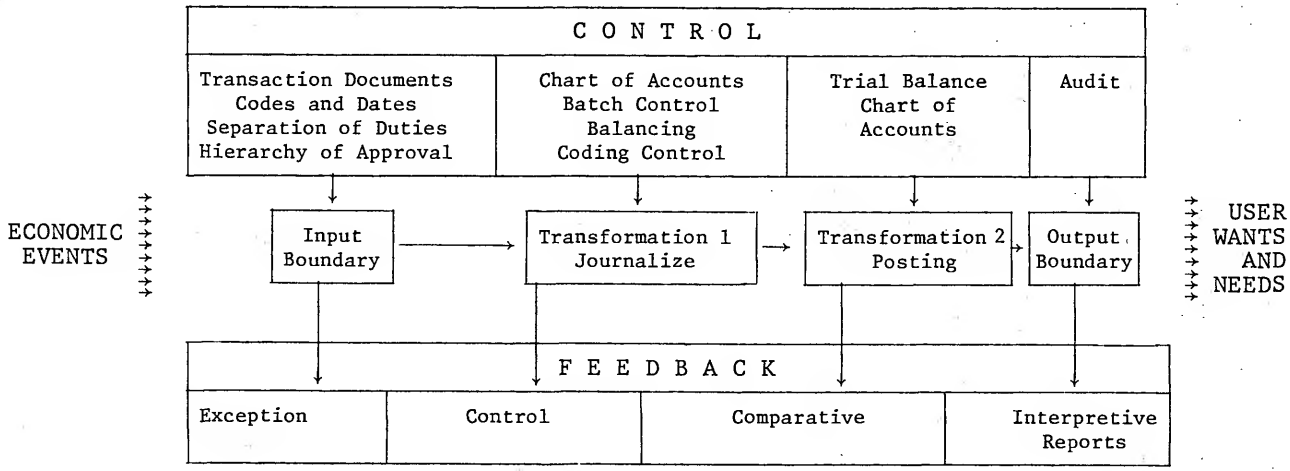
A Model of the Accounting Information System

In Chapter 1 of *Accounting Principles Board Statement No. 4* (American Institute of Certified Public Accountants, 1970), the Board sought to identify and organize concepts that, for the most part, were currently accepted. In setting out the characteristics of the accounting system, we will rely on the proposals in that statement. A systems depiction of the accounting system as described by the Board is presented in Figure 4.

The model presented in Figure 4 satisfies the definition of the accounting information system set out on page 54, above, and the role of the accounting information system in the total management system as discussed previously. Based on this model, it seems that general systems theory is an appropriate methodological framework for development of the resource flow matrix.

The remainder of this chapter is devoted to a discussion of the implications of general systems theory for theory development and verification.

Figure 4. The Accounting System.



Input Boundary--qualitative objectives, i.e., usefulness criterion: relevance, understandability, verifiability, neutrality, timeliness, comparability, completeness. Transformation 1, Journalize--dollars and cents, account titles, debit and credit. Transformation 2, Posting--sorting, aggregation. Output Boundary--accounting entity, going concern, measurement of economic resources and obligations, time periods, measurement in terms of money, accrual, exchange price, approximation, judgment, general-purpose financial statement, fundamentally related financial statement, substance over form, materiality.

GENERAL OBJECTIVES

Goal of system. To present reliable financial information about enterprise resources and obligations, economic progress, and other changes in resources and obligations. To present information helpful in estimating earnings potential and to present other financial information needed by users, particularly owners and creditors.

Motives and Developments Leading to General Systems Theory

In considering the term "system," a query comes to mind as to how this idea came to stimulate the quest for a general systems theory. Ludwig Von Bertalanffy identified several motives which lead to the postulation of a general systems theory (1968, 91 ff.). It was Von Bertalanffy's position that, until recently, the field of science as a nomothetic endeavor was practically identical with theoretical physics. The consequence was the postulate of reductionism. As it turned out, the entities of concern to physics--atoms, elementary particles, and the like--are much more ambiguous than originally thought. Rather than metaphysical building blocks of the universe, Von Bertalanffy points out, the entities of concern to physics are complicated conceptual models which were invented to take account of certain phenomena of observation. Also, due to the maturing of the biological, behavioral, and social sciences, and to new technologies, a generalization of scientific concepts and models which are beyond the traditional system of physics has become necessary. The new conceptual models are described by Von Bertalanffy as transcending the conventional departments of science. These expanded constructs are seen as being applicable to phenomena in various fields.

Von Bertalanffy enumerated the following seven developments intended to meet the needs of a general theory of systems:

1. Cybernetics, based upon the principle of feedback or circular causal trains providing mechanisms for goal-seeking and self-controlling behavior.
2. Information theory, introducing the concept of information as a quantity measurable by an expression isomorphic to negative entropy in physics, and developing the principles of its transmission.
3. Game-theory analyzing, in a novel mathematical framework, rational competition between two or more antagonists for maximum gain and minimum loss.
4. Decision theory, similarly analyzing rational choices, within human organizations, based upon examination of a given situation and its possible outcomes.
5. Topology, or relational mathematics, including nonmetrical fields such as network and graph theory.
6. Factor analysis, i.e., isolation, by way of mathematical analysis, of factors in multivariable phenomena in psychology and other fields.
7. General systems theory in the narrower sense (G.S.T.), trying to derive, from a general definition of "system" as a complex of interacting components, concepts characteristic of organized wholes such as interaction, sum, mechanization, centralization, competition, finality, etc., and to apply them to concrete phenomena.

(1968, p. 90)

The Systems Approach

It was Von Bertalanffy's position that as problems become more complex and as the solutions to these problems involve heterogeneous disciplines, the "systems approach" becomes necessary. C. West Churchman, probably one of the most recognized writers on systems thinking, presents the following five basic considerations which he feels must be remembered in putting systems thinking to use:

1. The total system objectives and, more specifically, the performance measures of the whole system.
2. The system's environment--the fixed constraints.
3. The resources of the system.
4. The components of the system, their activities, goals, and measures of performance.
5. The management of the system.

(Churchman, 1968)

Based on Churchman's considerations and the work of Joseph E. McGrath, Peter G. Nordlie, and W. S. Vaughan, Jr. (Optner, 1973, pp. 73-86), as well as many other writers on the topic of systems research, it may be stated that any systems research problem has at least three aspects.

1. The system itself must be defined as well as its parts.
2. The performance of the system in relation to its purposes or objectives must be assessed.
3. The system's environment--the medium in which it is embedded and in which it operates--must be understood.

The four basic stages of a research problem may be viewed as:

1. Delineation of system performance requirements.
2. Derivation of relevant variables leading to optimal performance.
3. Development and integration of the system.
4. Evaluation of system performance in terms of the requirements.

The collection of information in systems research therefore involves two aspects. First, knowledge must be gathered or generated about the variables relevant to the problem and the

range of variation of those variables. Second, knowledge must be gathered or generated about the covariation of two or more variables and the restrictions which are set on the combinations of values of relevant variables that can actually occur as the system operates.

Churchman's five considerations, in conjunction with the stages of a research problem and the collection of information in systems research enumerated above, lead to the following detail of the systems approach to solution of a given problem.

1. A statement of the problem.
2. An assessment of the relevance of the problem.
3. A defining of the aims, constraints, and performance criteria of the solution to the problem.
4. Determination of the structure of the existing system.
5. Determination of the defective elements in the existing system which hinder the attainment of an assigned objective.
6. Assessment of the relative importance of the outputs of the system as determined by the criteria.
7. Determination of the structure necessary for a choice of alternatives.
8. Determination of the solution-finding process.
9. Selection of alternatives with a view to solution finding.
10. Construction of a model to choose among alternatives.
11. Realization of the solution.
12. Evaluation of the consistency of the solution with original objectives and constraints.
13. Evaluation of the results stemming from the realization of the solution.

The systems approach to problem solution, as enumerated

above, is the approach to be followed in this study. All but Steps 8 through 13 will have been substantially completed by the end of the present chapter. Steps 8, 9, and 10 will have been completed by the end of Chapter IV. The concern of the remainder of the study will be Steps 11 through 13.

The Systems Approach--Not Unchallenged

We must recognize that the use of systems theory in a research endeavor is not without controversy. Systems theory dates from about 1940. In that year Howard Aiken proved that chains of cause and effect, with each effect becoming the next cause, could be extended to an unlimited length. The harnessing of feedback in the 1930s allowed for the controlling and understanding of unlimited regenerative cause-and-effect actions. The subsequent development of information theory provided a technique by which large numbers of causes and effects could be counted. Systems analysis was the subject of heated discussions in the early 1950s. Mixed opinions were expressed, and still are, as to the efficacy of systems analysis in its problem-solving role. The ability to evaluate alternatives in a consistent, unarbitrary manner emerged as a principal objective of systems analysis. Criteria selection received increased emphasis due to writings of the 1950s and early 1960s. In the mid-1950s the use of systems concepts in research became more articulated. At that time, classification, definition, and

other organizational attempts to bring the systems approach into research were well under way (Laszlo, 1972a).

The study of interacting parts may, of course be traced back as far as Newton. Kant pointed out that in organic bodies, the whole, although built up of parts, seems to determine the relations of the parts to one another and to itself. In conscious, purposive activity, Kant observed, the end brought to pass by certain means also determines the means employed to accomplish it. Hegel, in observing cause and effect, asked if any way may be found both of avoiding the difficulties of "infinite regress" and "infinite progress" and of synthesizing efficient and final causation on a concept that would embrace and harmonize them both (Laszlo, 1972a).

Some qualifications as to the newness of the idea of a great synthesis to provide for the unity of science must also be recognized. Commenting on the hierarchy of synthesis, Hegel observed that the "skeleton" of the hierarchy is constructed of a series of superimposed ascending triads in which seemingly antagonistic concepts revealed in experience by the "understanding" are reconciled and combined. These syntheses were said to be derived from one another by logical implication and from a logical hierarchy, culminating in the "all-embracing, all-reconciling absolute idea" (Laszlo, 1972a). The attempt of the logical positivist to provide the means for a unity of all knowledge was not without extensive criticism. Many philosophers, for instance Bertrand Russell, have said that if we go all

the way, we will be dealing with total knowledge. To deal with total knowledge, these writers have said, is humanly impossible.

It is recognized that general systems theory is not the only approach to the building of a sound empirical theory. It was chosen because the accounting information system, as defined in the preceding pages, is a system and therefore should lend itself to systems analysis

Systems Theory Properties

With the above caveats in mind, it is necessary in providing the frame of reference for the remainder of this study to discuss the properties of a general theory of systems.

Ervin Laszlo (1972a) explicity mapped four systems properties which he ascertained as being applicable throughout the range of phenomena of organized complexity. In *Introduction to Systems Philosophy: Toward a New Paradigm of Contemporary Thought* (1972a), he presented the case for a systematic and constructive inquiry into natural phenomena on the assumption of "general order in nature." This assumption, which he clearly labeled as an assumption, was said to follow from the following presuppositions: (1) The world exists and (2) The world is, at least in some respects, intelligibly ordered (open to rational inquiry).

According to Laszlo, if we assume that reality is merely mapped by models and not determined by them, then the models pro-

vide properties of the common underlying core of events. The task of general systems theory is to uncover that core. Since a direct communion cannot be experienced with objective reality, the objectives of general systems theory can only be accomplished through the existing models. However, more than analysis of existing models is required. Analysis requires supplementing by synthesis. Laszlo saw the task as being the evolving of the conceptual categories within which the findings of the special sciences would gain new significance by yielding general laws and principles of organization. He set about the task by conceiving of the units of scientific investigation as systems with certain invariant properties.

The invariant properties Laszlo spoke of were said to serve to define the behavior of the systems in their environments. It was his position that natural systems are characterized by the measurable nonrandom regularity of the coactions of their components. These conceptually discovered invariances are differential equations stating functional relationships between variables. Intrasystematic and intersystematic hierarchies determine the particular transformations of this invariance. Each subsystem, sub-subsystem, and so forth, is indicated by Laszlo's hypothesis to be capable of conceptualization. Such conceptualization yields a system manifesting the postulated invariances. The postulated invariances exist in the coaction of the system's parts as well as in its total system coaction with systems in their surroundings. Mapping invariances by means of "creatively

postulated general systems constructs" overcomes the difficulties entailed by asking "how does it work" or attempting to examine systems from the viewpoint of the primitive parts. He said that analysis to discover which mechanisms "make it tick" is "reductional in intent, if not necessarily in result" (1972a). He cited the prevalent belief in the fallacy of reducing societal phenomena to interactions between biological individuals as one of the instances of frustration of this type of endeavor. Laszlo observed that attempting the explanation of an organized system from the viewpoint of primitive parts leads to simplified laws applying to the whole.

> In the face of much difficulties in interrelating the constraints arising in organized wholes with the degrees of freedom permitted by deterministic laws for the parts, the present approach seeks invariant system properties as a set of constant and universal constraints. Rather than denying that such constraints exist in addition to the known law of physics or looking at them as irreducible emergent laws of organized entities at their own level of organization, we assume that they are formative constants of nature--properties of all "natural systems." These . . . are not observable below a given level of organization, i.e., they are "system properties" or "laws of organization" . . . so the laws defining the constraints at higher levels of organization do not simply emerge when that level has been reached, but should be assumed to be present all along, though not in observable or measurable capacity. (1972a, p. 33)

Laszlo is concerning himself, as a philosopher, with invariant properties of natural systems. He says that these invariant properties are universal constraints which become effect-

ively observable at particular levels of organization. The invariant properties are "thereafter manifest in diverse transformations corresponding to the various levels of the microhierarchy" (1972a). His task, therefore, was to postulate the commonality underlying the manifest behavior of organized entities as a set of invariant properties of natural systems. These invariant properties are seen to be "general laws of natural organization cutting across disciplinary boundaries and applying to organized entities in the microhierarchy at each of its many levels" (1972a).

The theory explored by Laszlo was as follows:

$$R = F(a,\beta,\gamma,\delta),$$

where a, β, γ, and δ are independent variables having the joint function R ("natural system"). The independent variable a was termed the "systematic state property." The variables β and γ represented "System-Cybernetics I and II," respectively. The last of Laszlo's postulated invariances, δ, represented the holon property. We will consider the systematic state property first.

Systematic State Property--$R = F(a)$

This first postulate concerns the calculation of the complexes of elements composing a system. It was stated by Laszlo as follows:

> An "ordered whole" is a nonsummative system in which a number of constant constraints are im-

> proved by fixed forces, yielding a structure with mathematically calculable parameters.
> (1972a)

In further expansion of this property, Laszlo cites Von Bertalanffy's discussion of three ways in which complexes of elements can be calculated.

> 1. Complexes of elements can be calculated according to the number of elements,
> 2. According to the species of the elements,
> 3. And according to the relatives of the elements.
> (Von Bertalanffy, 1968, Chapter 3)

The following illustration was presented by Von Bertalanffy to clarify calculation of complexes of elements. Note that *a* and *b* symbolize various complexes.

```
(1)  a   0 0 0 0      b   0 0 0 0 0
(2)  a   0 0 0 0      b   0 0 0 ●
(3)  a   0-0-0-0      b   0—0
                          |  |
                          0__0
```

In Cases 1 and 2, one may understand the sum of elements considered in isolation. In case 3 one must know both the elements and the relations between them. Cases 1 and 2 exhibit "summative" characteristics. Case 3 exhibits a "constitutive" complex. In a summative complex, characteristics of the elements are the same within and outside the complex. To understand a complex whose characteristics are dependent on the specific relations within the complex, one must know not only the parts,

but also the relations.

As an example of a nonsummative complex of interdependent elements, consider "Pareto's law" of the distribution of income within a nation.

$$Q_1 = bQ_2^{\alpha}$$

where Q_1 = number of individuals gaining a certain income, Q_2 = amount of the income, and b and α are constants. More generally, a nonsummative complex of interdependent elements takes the form

$$\frac{dQ_1}{dF} = F_1(Q_1, Q_2, \ldots Q_n)$$

$$\frac{dQ_2}{dF} = F_2(Q_1, Q_2, \ldots Q_n)$$

$$\frac{dQ_n}{dF} = F_n(Q_1, Q_2, \ldots Q_n) \qquad (1)$$

The above system of simultaneous differential equations specifies that a change in the measure of any Q affects all other Q's. An equation governing a change in any one part is different in form from the equation governing change in the whole. If it is assumed that Equation 1 can be developed into Taylor's series, Equation 2, and if one lets the coefficients of the variables Q_j ($j \neq$ i) become zero, the nonsummative complex degenerates to Equation 3 and is now a summative complex.

$$\frac{dQ_1}{dt} = a_{11}Q_1 + a_{12}Q_2 + \ldots a_{1n}Q_n + a_{111}Q_1^2 + \ldots \qquad (2)$$

$$\frac{dQ_i}{dt} = a_{i1}Q_i + a_{i11}Q_i^2 + a_{i111}Q_i^3 + \ldots \qquad (3)$$

In Equation 3 a change in each element depends only upon the element itself, that is,

$$\frac{dQ_1}{dt} = a_{11}Q_1 + a_{111}Q_1^2 + \ldots$$

$$\frac{dQ_2}{dt} = a_{21}Q_2 + a_{211}Q_2^2 + \ldots$$

$$\frac{dQ_n}{dt} = a_{n1}Q_n + a_{n11}Q_n^2 + \ldots$$

Each element in the system is considered independent of others. The variation in the total complex is the sum of the variations of the elements. The functional behavior of the whole in constitutive complexes is determined by the law-bound regularities exhibited by the interdependent elements. Laszlo emphasized that the construct "ordered wholeness" is not identical with the mystical interpretation of the principle--"a whole more than the sum of its parts"--but is an acceptable and indeed an often-used construct in natural, anthropological, and social scientific literature.

System-Cybernetics I--$R = F(\beta)$

System-Cybernetics I is the second of the independent variables in Laszlo's theory. Laszlo used the term "cybernetics" as the study of processes interrelating systems with inputs and outputs and "this structural, dynamic structure 'system.'" He recognized that the foci of attention in any description interrelating input-output functional analysis with internal-state descriptions become the central processes whereby the input is channeled through the system resulting in the modification of part or all of its existing parameters. System-Cybernetics I refers to the study of self-stabilizing controls operating by error-reducing negative feedback. $R = F(\gamma)$, which will later be discussed as System-Cybernetics II, refers to the importance of error (or "deviation") amplifying control processes which function by means of positive feedback.

System-Cybernetics I concerns the concept of adaptive self-stabilization. Le Chatelier's principle, which has been adopted in many fields, states that every system in chemical equilibrium undergoes, upon variation of one of the factors of the equilibrium, a transformation in such direction that, if it had produced itself, would have led to a variation of opposite sign to the factor under consideration (1888). This principle is the essence of Laszlo's System-Cybernetics I. Compensation for changing conditions in the environment is made through coordinated changes in the system's internal variables. Ordered

wholes of interdependent parts, governed by fixed internal constraints and exposed to externally introduced perturbations, conserve a relative invariance of their total complex compared with a more variant fluctuation of their courting components. Systems with calculable fixed forces (ordered wholes) tend to return to stationary states following perturbations in their environments. Systems of this kind reorganize their flows to eliminate or buffer out the perturbations.

System-Cybernetics II--$R = F(\gamma)$

In his discussion of System-Cybernetics II, Laszlo pointed out that systems with calculable fixed forces (ordered wholes) reorganize their fixed forces and acquire new parameters in their stationary states when subjected to the action of a physical constant in their environment. Laszlo stated that

> We start with the fact that natural systems in general go to ordered steady states. Now most of a natural system's states are relatively unstable. So in going from any state to one of the steady ones, the system is going from a larger number of states to a smaller. In this way, it is performing a selection, in the purely objective sense that it rejects some states by leaving them, retains some other states by sticking to it. Thus, as every determinate natural system goes to its steady state, so does it select. (1972, p. 43)

Therefore, each new steady state is "more resistant" to the original perturbation than the former steady state. The notion is expressed that, given a sufficiently isolated system-environment complex, the system will organize itself as a func-

tion of maximal resistance to the forces acting on it in its environment. Systems will complexify in response to inputs from the environment. As systems evolve from the relatively simple to the relatively more complex, one observes the merging of some characteristics, the differentiating of other characteristics, and the development of partially-autonomous subsystems in a hierarchical sequence.

External Forcing	$\longrightarrow$	Internal Constraints	=	Adaptive Self-Organization

However, Laszlo pointed out that adaptation is not synonymous with structural stability. An adapted system was stated to be resistant to the kind of forcings which elicited the process of self-organization; it was not stated to be more resistant to all factors in its general environment. Laszlo further stated that the opposite is more generally the case, yielding a more improbable and, therefore, unstable system due to the increased complexity of structure. The system's intrinsically unstable structure is balanced by a wider range of self-stabilizatory functions. One may conceptualize the development of systems in an environment in which forces are constantly operative as alternating stabilization around the parameters of existing fixed forces with reorganization of the fixed forces as a function of increasing resistance to perturbation forces in the environment. When it becomes difficult to understand the detached mechanism whereby a change was induced in a particular system considered

in isolation, it may be necessary to consider the next higher suprasystem.

Holon Property--$R = F(\delta)$

The last property presented by Laszlo concerned the vertical ordering of natural phenomena. It was stated in this postulate that from the viewpoint of a system of level n, there is an "intrasystematic hierarchy" of its structure-function constitution. This intrasystematic hierarchy is made up of the hierarchically-ordered series $\big((a \subset b) \subset c\big) \subset n$. The system of level n is also part of an "intersystematic hierarchy." The intersystematic hierarchy consists of the structure-functional wholes constituted by the systems environmental coordinations with other systems such that $\big((n \subset x) \subset y\big) \subset z$.

The four systems properties identified above serve to define the nature of all systems. The consideration at this point is the implication of the adopted concept of the accounting information system and its role in the organization for theory development and verification from a systems point of view.

Implications for Theory Construction and Verification

An acquaintance with decision theory, measurement theory, and communication theory is necessary for information evaluation. The basic objective of the information system is that of providing the necessary input for the user's decision mode. The objective of a decision is to solve a problem--to evaluate alter-

natives in attempting to select the best alternative. Evaluation involves comparison to some standard and comparison among alternatives. Comparison necessitates measurement. The outputs of the information system (expression of measurements) are not information to a decision maker unless he understands their necessity and reliability. Communication is therefore the dominating factor in structuring the information system.

Communication is the connecting and integrating link among the systems network. According to Alfred Kuhn, the purpose of communication is to influence behavior (1963, p. 18). William C. Scott agrees with Kuhn, but further states that the purpose of communication is to prompt actions which lead to the effective accomplishment of goals (1962, p. 173). As stated previously, the accounting information system is the principal communication system furnishing the fuel for decisions regulating the flow of resources to and from business organizations.

It therefore appears that we have the basis for a decision-making approach to theory verification. The outputs of the accounting information system must be verified through the decision models in which they are used (Sterling, 1970). Richard Mattessich has stated that the decision-making problem aims toward the center of the accounting discipline (1964, p. 14). Thomas H. Williams and Charles H. Griffin observed that essentially accounting practice is an analytical mechanism seeking to expose the essence of quantified data. "It is an instrument of decision making" (Williams and Griffin, 1964, p. 47). The

belief that the study of accounting should be related to the nature and objectives of business decisions was expressed by Paul E. Fertig, Donald G. Istvan, and Homer J. Mottice (1965, p. v). Raymond J. Chambers observed that "accounting is concerned with the provision of some of the facts on the basis of which one may act knowledgeably given one's ends or purposes" (1966, p. 15). Another indication of support for the decision-making approach to verification comes from Robert H. Roy and James H. MacNeil's *Horizons for a Profession* (1967, p. 12).

However, in considering the verification process, it must be remembered that a theory of empirical science may be divided into two parts--the formal system which is composed of abstract symbols and syntactical rules for manipulation of those symbols and an interpretation of the formal system which connects certain symbols to observations by semantical rules (American Accounting Association, 1971b, p. 57). The propositions in the formal system are analytic. As we have indicated, these analytical properties must be reenforced by synthesis. The propositions of the interpreted theory are to be empirically tested. As indicated by the American Accounting Association (1971b), the semantical rules connecting the theory plane and the observation plane are themselves connected with two different kinds of observations--inputs and outputs. To complete a theory, the kinds of observations and the measurement rules must be specific. These constitute the empirical input to the formal system. The syntactical rules specify the manipulations of those inputs.

The formal system is said to be verified if the expected occurences (the outputs) are observed in enough cases. Figure 5 illustrates the above (American Accounting Association, 1971b, p. 58).

Accounting terms such as "depreciation expense," "income," "working capital," and so on, are analytic terms. They are calculated from certain inputs and are not subject to separate measurement. The American Accounting Association (1971b) also indicated that it is rather the entire theory plane that is subject to confirmation. Verification of the theory plane brings us back to the decision-making approach to theory development. Decision theory outputs refer to the plane of observation. The choice among competing measurement models for use in a given decision model must be made on the basis of the one yielding the most efficient achievement of the stated goals. The decision model specifies the properties to be measured. The function of accounting is to measure those properties specified by the decision model. The decision model therefore provides us with a definition of relevance.

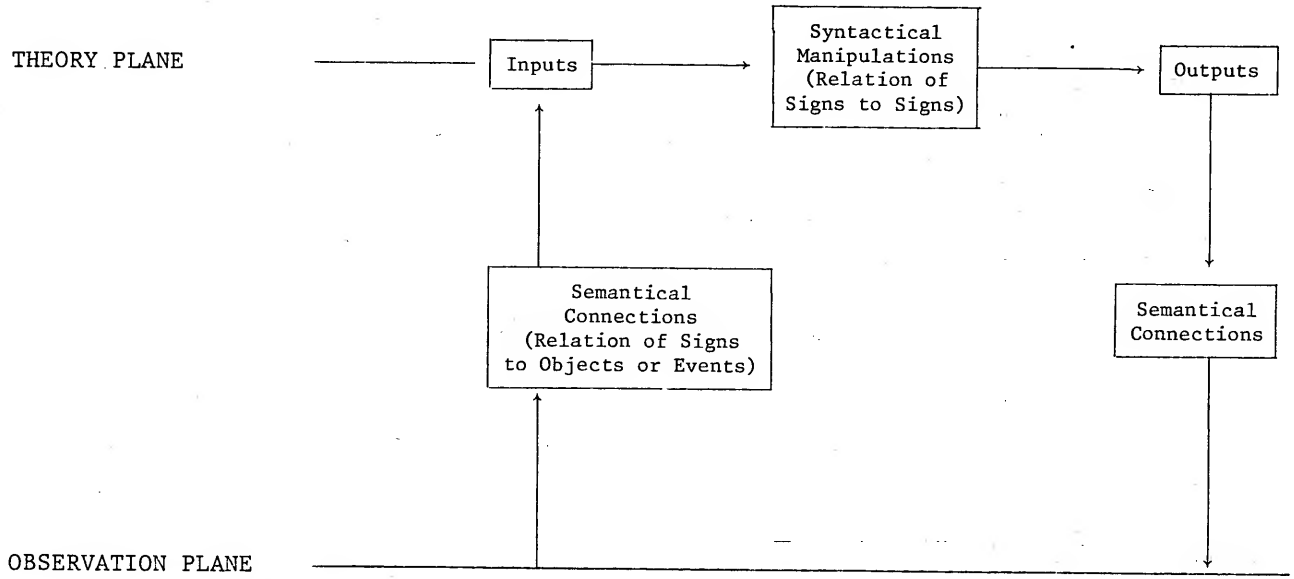


Figure 5. The Verification Process.

Summary

The purpose of this chapter was to provide a frame of reference for consideration of the aims, constraints, criteria, and structure of the dissertation as we move toward development of the resource flow matrix. In the first section of the chapter, the meaning of "system," "information," "accounting," and the role of the accounting information system in the organization was discussed.

The idea of the whole and a whole made up of interacting parts seemed to run through the definitions of system considered. These definitions were found to indicate that an information system is a related set of events, the aggregate information potential these possess, and the means of acquiring, storing, transforming, transmitting, controlling, or otherwise processing such information. All of these processes were found to be related to, but distinct from, the external environment of the system. An information system was therefore determined to have as its function the transformation of data into information. It was determined that in order to be termed "information," the end product of the transformation process must possess form and purpose. The accounting information system was found to have as its function the acquiring, storing, transforming, transmitting, or otherwise processing the data of economic events of a particular entity. The environment of the accounting information system was stated to determine the form and purpose of the transformation processes.

The next section of the chapter provided for the development of a model of the accounting information system. First, the role of the total information system in the organization was considered. Then, the role of the accounting information system in the total management system was discussed. The model presented of the information subsystem and its role in the total system were found to parallel closely the definition of an information system. The accounting system was pictured as playing a principal role in managing the flow of economic data in and among organizations. There were found to be no differences in accounting information criteria and criteria of management information systems. However, it was determined that the accounting information system does have concepts, problems, and characteristics distinguishing it from other systems. A model was developed which satisfies the definition of the accounting information system and the role of the accounting information system in the total management system.

Based on this model, it appeared that general systems theory is the appropriate methodological framework for development of the resource flow matrix. The remainder of the chapter was therefore devoted to a discussion of the implications of general systems theory for theory development and verification. The motives and developments leading to a general systems theory were then presented to place the theory in proper perspective. Systems thinking was interpreted as suggesting the systems approach to complex problems. The detail of systems methodology

led to the development of thirteen facets in the systems approach to problem solution. After observing that the systems approach to theory development is neither new nor noncontroversial, four systems properties were identified as defining the nature of all systems.

The four systems properties were indicated as determining a theory $R = F(a,\beta,\gamma,\delta)$. The independent variable a was termed the "systematic state property." The variables β and γ represented System-Cybernetics I and II, respectively. The holon property was represented by the variable δ. It was determined that an ordered whole is a nonsummative system in which a number of constant constraints are improved by fixed forces yielding a structure with mathematically calculable parameters. System-Cybernetics I refers to the study of self-stabilizing controls which operate by error-reducing negative feedback. System-Cybernetics II refers to the importance of deviation-amplifying control processes which function by means of positive feedback. The holon postulate concerns the vertical ordering of phenomena.

The basis for a decision-making approach to theory verification was then developed. It was stated that a theory of empirical science may be divided into two parts. One part was presented as the formal system which is composed of abstract symbols and syntactical rules for manipulation of those symbols. The other concerns the connection of those symbols to observations. The validity of the theory was stated to depend on its effect on the decisions of the user. If it does not affect the

decisions of the user in the proper manner, then it is not information and, hence, should not be a part of the output of the accounting information system.

CHAPTER IV

THE ESSENCE OF INPUT-OUTPUT

This chapter provides the mathematical basis for relating financial and operating flows. The relationship of simultaneous equations to the accounting information system and systems analysis in general will be provided first. We will then demonstrate that the solution of the Leontief input-output model and the general form of the linear programming model is identical. (This proof will provide the basis for development of the resource flow matrix.) A brief note of the extent of discussion of utilization of input-output accounting at the enterprise level will then be presented.

The Use of Matrices for Allocation

The utilization of simultaneous equations is common to most reciprocal-allocation areas of accounting. Simultaneous equations are involved because of the allocation of interacting effects indicating the presence of a whole other than the simple sum of its parts. An observation of a constellation of interrelated variables is observation of the "systematic state property." Functional behavior of the whole is determined by "law-bound" regularities exhibited by interdependent elements. It is assumed

that the law-bound regularities refer to the interrelations existing at a given state of equilibrium--that is, the variables in the model are simultaneously in a state of rest. A situation therefore exists which necessitates the tools of "static" or "equilibrium" analysis.

In a model of static analysis, variables necessary only to the system level (holon property) for the purpose at hand are selected. Had the model been enlarged to include additional variables (subsystems), a more complex model would be necessary, and the equilibrium state applying to the smaller model would not apply. After the relevant variables have been selected, the state of rest for the system's components detailed follows from the compatability of each component with every other component. If such compatability were not the case, no equilibrium would exist. The defining of an equilibrium exists in referencing Laszlo's System-Cybernetics I and II. The state of rest involved is based on the balancing of the internal forces of the model while the external forces are assumed to be fixed. An environmental change causes a counterbalancing change within the system. Changes cause complexity as the system moves toward a new state of equilibrium. If no changes are experienced in external forces, equilibrium will perpetuate itself.

The solution of a function, such as quantity demanded and quantity supplied considered in an isolated market, is elementary. Solve this equation by finding price where quantity demanded and quantity supplied are a function of price alone.

But consider a model in which several interdependent commodities are simultaneously considered, and the solution becomes somewhat more complex. An adjustment in the quantity of one commodity would call for adjustments in all others. One might picture cost allocation in a company with several interrelated service centers. An adjustment in the amount of service from one department calls for adjustments in all others. Does an adjustment in investment in one activity call for adjustment in other activities? Or does a firm not consider the interacting effects of multiple investments? In seeking the optimal expression of operating activities, should not optimal financial resource usage also be considered? As more variables and more equations enter a model, the system of equations will become larger and more complicated. The use of matrix algebra is a method suitable for handling large systems of simultaneous equations. Through the use of matrix algebra, a way is provided for testing the existence of solutions by evaluation of a determinant.

The Leontief Input-Output Models--Static Version

The question of concern in the static version of Leontief's input-output analysis is the level of output of each of the *n* industries in an economy in order that production will just be sufficient to satisfy the total demand for that product.

The term "input-output analysis" came about because, on the one hand, the output of any industry is needed as an input in several other industries, and even in that industry itself (Leontief, 1951). Therefore, the necessary level of output of any one industry will be a function of the input requirement of all industries. Further, the output of the other industries will affect the input of the industry being considered. Also, the necessary levels of the other products will, in turn, depend partly upon the input requirements of the industry under consideration. Given this interindustry dependence, any set of "correct" output levels of the n industries must be consistent with all the input requirements in the economy. It is therefore necessary to solve simultaneous equations, and this gives rise to the use of matrix algebra.

Due to the complexity of an input-output model, the following simplifying assumptions are usually adopted:

1. Each industry produces only one homogeneous commodity.
2. Each industry uses a fixed input ratio for the production of its output.
3. Production in every industry is subject to constant returns to scale so that a K-fold change in every input will result in a K-fold change in the output. (Chiang, 1967, p. 121)

Although the assumptions are unrealistic, conceptually the multiple commodities or multiple-factor combinations may be treated as separate industries. From these assumptions, one is able to see that to produce one unit of the jth commodity, a

a fixed amount of the ith commodity is required, yielding a_{ij}. That is, production of each unit of the jth commodity requires a_{1j} of the first commodity, a_{2j} of the second commodity, on to a_{nj} of the nth commodity. The i subscripts (first subscripts) refer to input, and the j subscripts (the second subscripts) to output. Assume prices are given and \$1 worth of each commodity as its unit. If $a_{43} = 0.35$, then \$.35 worth of the fourth commodity is required as an input for producing \$1 worth of the third commodity. The symbol a_{ij} is termed an "input coefficient." For an n-industry economy, one may arrange the input coefficients as a matrix $A = (a_{ij})$, where each column specifies the input requirements for the production of one unit of the output of a particular industry. If no industry uses its own output as input, the elements in the principal diagonal matrix will all be 0. The respective matrix forms follow.

$$
\begin{array}{cc}
 & \text{OUTPUT} \\
 & \begin{array}{cccccc} \text{I} & \text{II} & \text{III} & \text{IV} & \cdots & n \end{array} \\
\text{INPUT} \begin{array}{c} \text{I} \\ \text{II} \\ \text{III} \\ \text{IV} \\ \vdots \\ m \end{array} & \begin{pmatrix} a_{11} & a_{12} & a_{13} & a_{14} & \cdots & a_{1n} \\ a_{21} & a_{22} & a_{23} & a_{24} & \cdots & a_{2n} \\ a_{31} & a_{32} & a_{33} & a_{34} & \cdots & a_{3n} \\ a_{41} & a_{42} & a_{43} & a_{44} & \cdots & a_{4n} \\ \vdots & \vdots & \vdots & \vdots & & \vdots \\ a_{m1} & a_{m2} & a_{m3} & a_{m4} & \cdots & a_{mn} \end{pmatrix}
\end{array}
$$

$$
\begin{array}{cc}
 & \text{OUTPUT} \\
 & \begin{array}{cccccc} \text{I} & \text{II} & \text{III} & \text{IV} & \cdots & n \end{array} \\
\text{INPUT} \begin{array}{c} \text{I} \\ \text{II} \\ \text{III} \\ \text{IV} \\ \vdots \\ m \end{array} & \begin{pmatrix} 0 & a_{12} & a_{13} & a_{14} & \cdots & a_{1n} \\ a_{21} & 0 & a_{23} & a_{24} & \cdots & a_{2n} \\ a_{31} & a_{32} & 0 & a_{34} & \cdots & a_{3n} \\ a_{41} & a_{42} & a_{43} & 0 & \cdots & a_{4n} \\ \vdots & \vdots & \vdots & \vdots & & \vdots \\ a_{m1} & a_{m2} & a_{m3} & a_{m4} & \cdots & 0 \end{pmatrix}
\end{array}
$$

For the most part, Leontief input-output models are set up as "open models." That is, besides the n industries, the model contains a sector which exogenously determines a final demand (a noninput demand) for each industry. While determining a noninput demand (household), the "open" sector supplies a primary input (labor hours) not produced by the n industries themselves. If the exogenous sector of the open input-output model is absorbed into the system as just another industry, then the model is a "closed" model. In a closed model final demand and primary input do not appear. Instead of final demand and primary input, the "closed" model includes the input requirements and the output of the newly conceived industry. All goods in the closed-model case are intermediate in nature. Everything that is produced is produced for the sake of satisfying the input requirements of the $(n + 1)$ industries in the model.

Linear Programming and Input-Output Analysis

The methods of linear programming allow for consideration of the problem of maximizing or minimizing a linear objective function subject to a set of linear inequalities which are resource constraints. The generalized n-variable, m-constraint linear program may be stated in three alternative ways--in longhand, in Σ notation, or in matrix notation (Chiang, 1967, p. 585).

Longhand.--Maximize $\pi = c_1x_1 + c_2x_2 + \ldots + c_nx_m$, subject to

$$\begin{array}{l} a_{11}x_1 + a_{12}x_2 + \ldots a_{1n}x_n \leq r_1 \\ a_{21}x_1 + a_{22}x_2 + \ldots a_{2n}x_n \leq r_2 \\ \vdots \qquad \vdots \qquad\qquad \vdots \qquad \vdots \\ a_{m1}x_1 + a_{m2}x_2 + \ldots a_{mn}x_n \leq r_m \end{array} \tag{1}$$

and subject to $x_j \geq 0$ where $j = 1,2, \ldots, n$. Or minimize $C = c_1x_1 + c_2x_2 + \ldots + c_nx_n$, subject to

$$\begin{array}{l} a_{11}x_1 + a_{12}x_2 + \ldots a_{1n}x_n \geq r_1 \\ a_{21}x_1 + a_{22}x_2 + \ldots a_{2n}x_n \geq r_2 \\ \vdots \qquad \vdots \qquad\qquad \vdots \qquad \vdots \\ a_{m1}x_1 + a_{m2}x_2 + \ldots a_{mn}x_n \geq r_m \end{array} \tag{2}$$

and subject to $x_j \geq 0$ where $j = 1,2, \ldots, n$.

Σ notation.--Maximize

$$\pi = \sum_{j=1}^{n} c_j x_j$$

subject to

$$\sum_{j=1}^{n} a_{ij} x_j \leq r_i \tag{3}$$

where $i = 1,2, \ldots, m$ and subject to $x_j \geq 0$ where $j = 1,2, \ldots, n$.

Or minimize

$$C = \sum_{j=1}^{n} c_j x_j$$

subject to

$$\sum_{j=1}^{n} a_{ij} x_j \geq r_i \tag{4}$$

where $i = 1,2, \ldots, m$ and subject to $x_j \geq 0$ where $j = 1,2, \ldots, n$.

<u>Matrix notation</u>.--

$$c \equiv \begin{pmatrix} c_1 \\ c_2 \\ \vdots \\ c_n \end{pmatrix} \tag{5a}$$

$$x \equiv \begin{pmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{pmatrix} \tag{5b}$$

$$r \equiv \begin{pmatrix} r_1 \\ r_2 \\ \vdots \\ r_m \end{pmatrix} \tag{5c}$$

$$A \equiv \begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{pmatrix} \tag{5d}$$

Equations 5a through 5c are columnar vectors--c and x of dimension $n \bullet 1$ and of dimension $m \bullet 1$. Equation 5d is an $m \bullet n$ array. The objective function may be presented by the equation $\pi = c'x$. The vector product $c'x$ is $1 \bullet 1$ and therefore represents a scalar. The advantage of matrix notation is appreciated upon consideration of the m constraints.

The entire set of constraints in Equation 5 can be written as a single inequality, $Ax \leq r$. A point to note with regard to the inequality sign is that it means element-by element inequality. That is, the ith row of matrix Ax is to be less than or equal to the ith row of matrix r for every i. The n nonnegativity

constraints may be expressed by the single inequality $x \geq 0$. Therefore, the linear programming problem may be written concisely as follows: Maximize $\pi = c'x$ subject to $Ax \leq r$ and subject to $x \leq 0$ and minimize $C = c'x$ subject to $Ax \geq r$ and subject to $x \geq 0$ (Equation 6).

If the coefficients in the constraint section of the linear program are read vertically, as column vectors, the program may be viewed within the concept of activity. Consider a firm employing two resources (K and L) to produce two goods (x_1, x_2). If in the model of consideration the available resources are viewed as limited to K_0 and L_0, the firm constraints may be written in a single vector equation as follows:

$$\begin{pmatrix} a_{11} \\ a_{21} \end{pmatrix} x_1 + \begin{pmatrix} a_{12} \\ a_{22} \end{pmatrix} x_2 + \begin{pmatrix} 1 \\ 0 \end{pmatrix} s_1 + \begin{pmatrix} 0 \\ 1 \end{pmatrix} s_2 = \begin{pmatrix} K_0 \\ L_0 \end{pmatrix} \tag{7}$$

As Equation 7 is read vertically (taking every variable with its own coefficient vector by itself), it can be considered as each part representing a distinct activity of the firm. Consider the first activity, consisting of the production of the first product. The problem of determining the solution value x_1 is that of finding the optimal level of the first activity. The slack variables (s_1 and s_2) may even be considered as a separate activity--leaving some resource idle. Note that in pursuing each activity, a definite repercussion will be felt on

the resources of the firm. As indicated in the first vector of Equation 7, each unit of the first activity will exhaust a_{11} units of K and a_{21} units of L. These activity vectors are therefore the indicators of the input requirements for a unit increase in the level of the subject activity. The slack variables are each exclusively associated with one particular resource, and their activity vectors are the unit vectors e_1 and e_2 as follows:

$$e_1 \equiv \begin{pmatrix} 1 \\ 0 \end{pmatrix} \quad \text{and} \quad e_2 \equiv \begin{pmatrix} 0 \\ 1 \end{pmatrix} \tag{8}$$

By denoting the first two activity vectors A_1 and A_2 and the resource vectors as r, the vector equation can be written as follows:

$$A_1x_1 + A_2x_2 + e_1s_1 + e_2s_2 = r \tag{9}$$

The above states that the production activities and the slack activities of the firm must together exactly exhaust the total resources available. Equation 9 is therefore to be the constraint in the production linear program of the firm. It is the intention that nonnegative levels of the four activities be selected, subject to the resource exhaustion constraint, so that a certain objective function will be made optimal (maximized or minimized). An activity vector, however, only presents the input requirements of the activity in question. The output side

must now be included in the vector. Rather than just writing

$$\begin{pmatrix} a_{11} \\ a_{21} \end{pmatrix},$$

we may, by using a plus (+) sign to denote output and a minus (-) sign to denote input, describe the first activity by using

$$\begin{pmatrix} 1 \\ -a_{11} \\ -a_{21} \end{pmatrix}.$$

The top element indicates a unit level of output, and the remaining elements are the input requirements. Chiang (1967) adheres to the input-requirement version of such a vector, and, for the purposes of this paper, such version also appears more convenient.

Two assumptions must be noted regarding the production function, which are implicit in the linear program. One is constant return to scale, and the other is fixed input ratios. If an industry (or firm) is assumed to be characterized by constant returns to scale and by fixed input ratios, the input-output relationships of the industry (firm) can be summarized by a unique activity ray. On such a ray, a point twice as far from the point of origin as another will always mean twice as much output. Constant returns to scale and fixed input ratios are also standard

assumptions in input-output models.

With regard to the macrolevel, the inputs required in the operation of each activity (industry) are of two kinds--primary and intermediate. If one assumes n industries and each producing a distinct commodity, the following three types of vectors become of interest.

$$\begin{pmatrix} -a_{0j} \\ -a_{1j} \\ -a_{2j} \\ \vdots \\ -a_{nj} \end{pmatrix} \tag{10a}$$

$$\begin{pmatrix} a_{0j} \\ a_{1j} \\ a_{2j} \\ \vdots \\ a_{nj} \end{pmatrix} \tag{10b}$$

$$\begin{pmatrix} a_{1j} \\ a_{2j} \\ \vdots \\ a_{nj} \end{pmatrix} \tag{10c}$$

The first element of Equation 10a indicates a one-unit output of the jth commodity. The second element shows the primary input

for it, and the remaining elements show the intermediate inputs for it. A corresponding articulation follows from Equations 10b and 10c.

Considering the vector displayed in Equation 10c, the following $n \cdot n$ matrix is formed for n industries:

$$A = \begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{pmatrix} \tag{11}$$

The task at hand is to find a vector x such that

$$(I - A)x = d \tag{12}$$

where the solution, assuming $(I - A)$ nonsingular is

$$\bar{x} = (I - A)^{-1} \tag{13}$$

Such a task requires, in addition to Equation 11, an output vector and a final-demand vector as follows:

$$x = \begin{pmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{pmatrix} \qquad d = \begin{pmatrix} d_1 \\ d_2 \\ \vdots \\ d_n \end{pmatrix}$$

We still do not have an objective function to be optimized at this point. Even though Equation 12 does stipulate that each industry should produce enough to satisfy demand, no inequalities have been written. But, as observed by Chiang (1967, p. 641), the same input-output problem can be looked at from a different angle. In order to satisfy total demand, it is necessary that industrial output be no less than (not equal to) demand for the industry output. Therefore, Equation 12 may be stated as the following inequality:

$$(I - A)x \geq d \tag{14}$$

In order to guard against excess, a minimization requirement is necessary for the inequality. If labor is assumed to be the only primary input, one can seek to minimize total labor input required for producing the indicated output. Therefore, minimize

$$L = \sum_{j=1}^{n} a_{0j}x_j = \begin{bmatrix} a_{01} & a_{02} & \cdots & a_{0n} \end{bmatrix}$$

$$\begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix} = A_0'x$$

where L = labor required, A_0' = the row vector of labor input coefficients. Also, the nonnegativity restriction $x \geq 0$ may be im-

posed, since the output levels x_j can never be negative. Therefore, the input-output model may now be formulated in the following mathematically equivalent form: Minimize $L = A_0'$ subject to $(I - A)x \geq d$ and subject to $x \geq 0$ (Equation 15). Note that Equation 15 is the standard linear program. The program may be solved by reading the n constraints either horizontally or vertically. When read horizontally, the procedure for solution is standard and yields $\bar{x} = (I - A)^{-1}d$ which is the solution of the regular input-output model. When read vertically, the matrix $(I - A)$ consists of the following n vectors:

$$\begin{pmatrix} 1 - a_{11} \\ -a_{21} \\ \vdots \\ -a_{n1} \end{pmatrix} \quad \begin{pmatrix} -a_{12} \\ 1 - a_{22} \\ \vdots \\ -a_{n2} \end{pmatrix} \quad \cdots \quad \begin{pmatrix} -a_{1n} \\ -a_{2n} \\ \vdots \\ 1 - a_{nn} \end{pmatrix}$$

Each of these activity vectors may be plotted as n-activity rays in an n space as in Chiang (1968, p. 643). In the three-industry model, the constraints take the form

$$\begin{pmatrix} 1 - a_{11} \\ -a_{21} \\ -a_{31} \end{pmatrix} x_1 + \begin{pmatrix} -a_{12} \\ 1 - a_{22} \\ -a_{32} \end{pmatrix} x_2 + \begin{pmatrix} -a_{13} \\ -a_{23} \\ 1 - a_{33} \end{pmatrix} x_3 \geq \begin{pmatrix} d_1 \\ d_2 \\ d_3 \end{pmatrix} \qquad (16)$$

Chiang (1968) explores and interprets the nonnegative

combination of the three vectors on the left of Equation 16 as corresponding to points in a convex polyhedral cone. He further interprets the expression $\geq d$ such that minimization, while meeting the constraint, is at point d. Therefore, Chiang states that Equation 16 optimally must be a strict equality. The above leads one back to Equation 12 and the solution arrived at in Equation 13.

It appears pertinent to consider at this time the extent to which utilization of input-output accounting has been discussed for the enterprise. The scope of such recommendations lies with productive flows. It should be recalled that input-output is set out in the literature of economics as a technique for tracing productive flows and interrelations of a productive nature. It should be further pointed out that the recommendations have been with the planning phase. One of the most developed examples of the use of input-output accounting at the enterprise level is set out in recommendations by George J. Staubus, which are discussed briefly in the section that follows.

Input-Output Accounting--The Enterprise Level

In *Activity Costing and Input-Output Accounting* (1971), Staubus was concerned with emphasizing the relationships among activities and groups of activities, including mutual dependence, in developing an activity input-output costing system. As mentioned earlier, the heart of an input-output accounting system

for the enterprise is the standard costs of activity outputs. The first problem Staubus discussed was the computation of standards for activities where inputs consist of outputs from other activities. He later illustrated the use of input standards for determining optimum output mix and in preparing the operating budget.

After providing data for the standard cost of each service or commodity output that is dependent upon other standard costs, Staubus presented the following equation for the determination of the standard cost of each activity output:

$$P_i = \sum_{j}^{n} = 1p_j q_j, i$$

This equation states that the standard cost of each activity output equals the sum of the products of the price of each input (p) and the standard quantity of input needed per unit of output (q). Note that q is the technical coefficient introduced earlier in this chapter.

As we follow Staubus' presentation, we observe matrix representation as set out previously in this chapter. The final result after solving the interrelationships is a *pro forma* operating plan in the customary form of presentation. The earnings statement developed by Staubus was also the type of statement of profit we customarily see. The matrix format and matrix manipulation were employed as a tool for the solution of the set of simultaneous equations. No intention was expressed for utiliz-

ing the matrix report form. It was used for interrelating the various activities, but after the proper manipulations, the cost of activity utilization was entered on the traditional report. As pointed out by Staubus, complete acceptance of the final product of the activity input-output costing system developed by him requires acceptance of the following ideas:

1. Most operating costs may be assigned to activities with acceptable objectivity, and activity outputs may be assigned to other activities or to expense with acceptable objectivity.

2. Measurement of the cost of performing activities requires measurement of the sacrifices made to perform those activities including the sacrifices made in order to obtain the services of capital funds.

3. Up-to-date standard costs are the best measures of the service potential of the work-in-process inventories in this case, and the standard costs used are up to date.

4. Asset-holding costs are properly included as cost of obtaining future revenues of the assets held and cost in an acceptable basis of asset measurement.

Additional assumptions of importance to the present thesis which were cited by Staubus were:

5. No problem exists with regard to indivisibility of resources.

6. The existing relationships are linear.

7. Input boundaries are assumed independent of their costs. (1971, p. 117)

Summary

The necessity for the use of matrix algebra in the accounting-allocation process was discussed in this chapter. The mathematical properties of input-output analysis were explored in providing the basis for a report which will fill the gap between the balance sheet and the income statement. It was observed that the presence of a whole other than the simple sum of its parts implies the existence of a simultaneous-equation system. The solution of a complex set of simultaneous equations calls for the use of matrix algebra. Input-output analysis was then linked to linear programming techniques in pointing out that this more familiar optimization approach yields the same solution as the input-output technique. An example was then cited of the use of input-output accounting at the enterprise level. It was observed that the only area in which input-output has been discussed for use in accounting has been with regard to the planning phase for productive flows.

CHAPTER V

THE RESOURCE FLOW MATRIX

In the preceding chapter, it was demonstrated that the solution of an input-output model and the general form of the linear programming model are identical. In the first part of this chapter, we will demonstrate that the decision models for the allocation of financial and productive resources are the same by relating linear programming to financial planning and, therefore, to financial flows. By this approach, productive and financial flows will have been related to the input-output technique. In the second part of the chapter, this approach will be utilized to develop the resource matrix.

Linear Programming and Short-Term Financing

The following model, adopted from Alexander A. Robichek, Daniel Teichroew, and J. M. Jones (1965), is presented to illustrate that financial flows are subject to the same type of optimization considerations as were considered in the productive-flow, linear-programming model in the preceding chapter. The symbols defined by Robichek *et al.* were x_i = amount of financing obtained through line of credit at the beginning of period i (i = 1,2, ... 12); y_i = amount of commercial paper sold at the

beginning of period i (i = 1,2, ... 12); z_i = amount of installment financing obtained at the beginning of period 1; z_2 = amount of installment financing obtained at the beginning of period 6; s_j = slack (or surplus) variables associated with the constraint j; C_i = cumulative cash requirement in period i; Q_{ki} = total outstanding debt (excluding accrued interest) in period i from source k, where k = 1 denotes line of credit, k = 2 denotes commercial paper, k = 3 denotes installment financing in January, and k = 4 denotes installment financing in June; I_{ki} = cumulative interest payments from period 1 to period i on money borrowed from source k, where k has the same meaning as above (k = 1,2,3,4); I_{5i} = cumulative interest receipts from period 1 to period i on surplus funds invested in government securities.

The objective of the firm as presented by Robichek *et al.* is to finance short-term requirements so as to minimize its net interest cost during the next twelve months. Since the model is concerned with twelve periods, we will sum the monthly interest over twelve months. With an annual interest rate of 6 percent on bank loans, monthly interest payments on bank loans is measured by

$$.005 \sum_{i=1}^{12} x_i .$$

The quarterly interest on commercial paper is assumed to be .0126, and the semiannual rate on installment financing is assumed to be .0146. These are measured by

$$.0126 \sum_{i=1}^{12} y_6$$

and $.0146(z_1 + z_2)$, respectively. The total interest received from investment of surplus funds (invested in government securities) is given by

$$.0037 \sum_{i=1}^{12} s_{24+i}$$

where .0037 is the assumed monthly interest rate on government securities.

The constraints of the Robichek *et al.* problem consist of constraints on the line of credit, constraints on the amount of commercial paper, a constraint on installment financing, a cash budget constraint, and the nonnegativity conditions. Under an assumed line-of-credit arrangement, the amount borrowed at any one time cannot exceed $140. The company is assumed always to repay its bank loans at the beginning of the month following the loan and then to take out a new loan immediately if funds are still needed. Therefore, the total bank loan outstanding during a given period equals the loan taken out at the beginning of the period. The limit on the total amount of commercial paper outstanding during any given period is assumed by Robichek *et al.* to be $120. The commercial paper issued by this company was assumed to mature in ninety days. Given this length of maturity, the total amount of commercial paper outstanding in period i

($i \geq 3$) is made up of paper issued in periods i-2, i-1, and i. The amount of each installment financing transaction is assumed to be limited to \$100. The cash budget constraint states that during any month the total outstanding borrowing from all sources must be equal to or greater than the cumulative cash requirement plus the cumulative interest payments on all types of borrowing, minus the cumulative interest receipts on surplus funds.

The complete linear programming problem may be written as follows:

1. Minimize $f = .005 \sum_{i=1}^{12} x_i + .0126 \sum_{i=1}^{12} y_i$

$$+ .0146(z_1 + z_2) - .0037 \sum_{i=1}^{12} s_{24+i}$$

subject to Items 2 through 5--

2. Line of credit constraint $x_i + s_i = \$140$

3. Commercial paper constraint $y_i + y_{i-1} + y_{i-2}$

$$+ s_{i+10} = \$120$$

where $i = 3,4, \ldots, 12$.

4. Installment financing constraint $z_1 + s_{23} = \$100$

$$z_2 + s_{24} = \$100$$

5. Cash budget constraint

$$c_1 = x_i + y_1 + z_1 - s_{25}$$

$$c_2 = -0.005x_1 + x_2 + 0.9958y_1 + y_2 + 0.8309z_1$$

$$+ 0.0037s_{25} - s_{26}$$

$$c_3 = -0.005x_1 - 0.005x_2 + x_3 + 0.9916y_1 + 0.9958y_2$$

$$+ y_3 + 0.6618z_1 + 0.0037s_{25} + 0.0037s_{26} - s_{27}$$

For $i = 4,5$,

$$c_i = -0.005x_1 \sum_{j=1}^{i-1} x_j + x_i - \sum_{j=1}^{i-3} (0.0126)y_j$$

$$+ 0.9916y_{i-2} + 0.9958y_{i-1} + y_i$$

$$+ z_1 \left(1 - 0.1691(i-1)\right)$$

$$+ 0.0037 \sum_{j=1}^{i-1} s_{24+j} - s_{24+i}$$

For $i = 6$,

$$c_i = -0.005 \sum_{j=1}^{i-1} x_j + x_i - \sum_{j=1}^{i-3} (0.0126)y_j$$

$$+ 0.9916y_{i-2} + 0.9958y_{i-1} + y_i$$

$$+ z_1\left(1 - 0.15455(i-1)\right) + z_2\left(1 - 0.1691(i-6)\right)$$

$$+ 0.0037 \sum_{j=1}^{i-1} s_{24+j} - s_{24+i}$$

For $i = 7, 8, \ldots, 12$,

$$c_i = -0.005 \sum_{j=1}^{i-1} x_j + x_i - 0.0126 \sum_{j=1}^{i-3} y_j$$

$$+ 0.9916y_{i-2} + 0.9958y_{i-1} + y_i - 0.0146z_1$$

$$+ \left(1 - 0.1691(i - 6)\right) z_2$$

$$+ 0.0037 \sum_{j=1}^{i-1} s_{24+j} - s_{24+i}$$

And x_i, y_i, z_i, $s_i \geq 0$. From the above, we have the following in general form and in sigma notation:

6. Minimize $C = \sum_{j=1}^{n} c_j x_j$

subject to $\sum_{j=1}^{n} a_{ij} x_j \geq r_i$ where $i = 1, 2, \ldots, n$

and subject to $x_j \geq 0$ where $j = 1, 2, \ldots, n$.

7. It will be recalled that Item 6 defines Item 7.

$$c \equiv \begin{pmatrix} c_1 \\ c_2 \\ \vdots \\ c_n \end{pmatrix} \qquad x \equiv \begin{pmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{pmatrix} \qquad r \equiv \begin{pmatrix} r_1 \\ r_2 \\ \vdots \\ r_n \end{pmatrix}$$

$$A \equiv \begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{pmatrix}$$

It should be recalled that the preceding item was written concisely in Chapter IV as follows:

8. Minimize $C = c'x$ subject to $Ax \geq r$ and subject to $x \geq 0$. As developed in Chapter IV, Item 8 was reformulated in the following mathematically equivalent form:

9. Minimize $L = A_0'x$ subject to $(I - A)x \geq d$ and subject to $x \geq 0$. Where L represented the use of a primary input--labor--in the preceding chapter, we use r here to represent net interest cost. The resulting solution is $x = (I - A)^{-1} d$ which is the solution for the Leontief input-output model.

Financial and Operating Flows Reconsidered

Since both the general form of the Robicheck *et al.* model and the general form of the linear programming model discussed in Chapter IV yield identical solutions, it has been clearly demonstrated that financial flows may be considered in the same manner as operating flows. It is recognized that the objective functions of both the financial and the operating examples were simplified in that both dealt with conditions of certainty. Both may be dealt with under unceratin conditions using simulation

techniques. The examples were explored to illustrate that the systems' relationships are the same and that both are subject to mathematically equivalent treatment. Therefore, if there are advantages to utilizing matrix expression and the input-output report form for productive flows, these same advantages should also pertain to financial flows.

It must be recognized that both the productive and the financial models are subsystem models. For the productive models, the objective is the minimizing of costs and maximizing of profits from productive activities. For the financial models, the objective is to minimize the cost of financing. For a total systems representation, either in simulation or in linear programming, the two must be put together in reporting the movement toward the overall objective. It appears pertinent that we recognize that separate disclosure in the enterprise financial reports allows the reader but a glimpse at a part of the system interrelationships. For the user to attain a greater understanding of the total system, he must make additional calculations and inferences of his own. This consideration brings us back to the output boundaries of the accounting information system and user needs.

As discussed in Chapter 3 of *Accounting Principles Board Statement No. 4* (1970), examples of various user groups and user groups in the broader user groups are as follows:

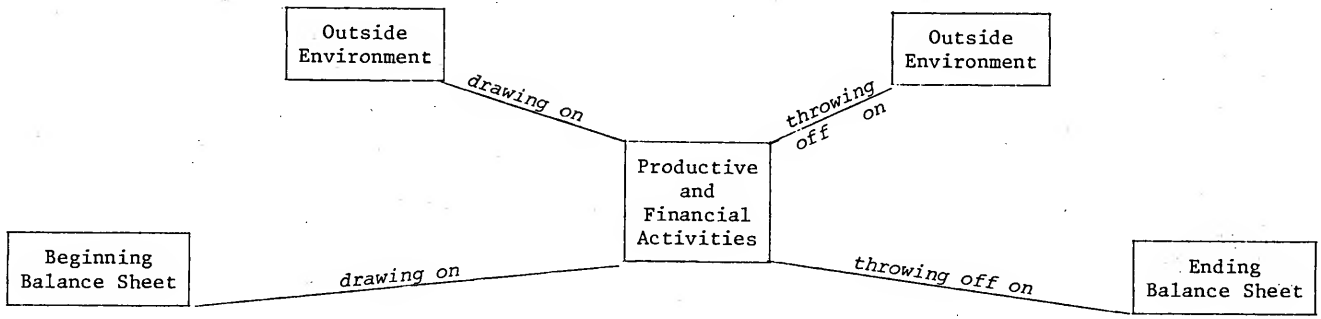
> Owners--Members of this group are faced with decisions as to whether to retain, increase, or decrease their proportionate ownership. They also must evaluate the use and stewardship of resources by management.
>
> Creditors and suppliers--These persons must decide whether to extend credit, determine the terms of credit, decide whether to require security or restrictive covenants, enter suit or force bankruptcy or receivership, increase or decrease reliance on the enterprise as a customer.
>
> Potential owners, creditors, and suppliers--Their decisions concern whether or not to commit resources to the enterprise, the amount of commitment, evaluate the use and stewardship of resources by management.

The statement included discussion of other direct users as well as users with indirect interests and the common and special needs of the various groups. Does the user desire information as to the maximization of enterprise income for the current period or long-run income or enterprise financial strength? We might say that to maximize enterprise income is to maximize enterprise financial strength. But if the user desires information as to enterprise maximization of financial strength, then why not provide a statement depicting how the enterprise came to be in its current financial position as compared to that of the preceding reporting date?

Users wish to consider enterprise financial flows as well as enterprise productive flows. Financial statement users are interested in the financial position of the

firm at some given point in time on a regular basis (period assumption). But these users also desire a periodic report on the results of carrying out the reason for being of the enterprise during that period. In seeking to compare the balance sheet, the user may have in mind a view similar to that presented in Figure 6. To fulfill these purposes, a report depicting the statement relationships presented in Figures 7 and 8 is required.

A statement, such as that depicted in Figures 7 and 8, is consistent with the accounting information system. However, the interpretation given to the term "resources" yields an unsettled state, as was exhibited in the literature cited in Chapter II. The resource flow statements, as seen in financial reports, present an articulation of where cash or working capital came from and where it went. The term "resource" as used in the accounting information system has a much broader meaning than cash or working capital. A statement of changes in enterprise resources from one period to the next should deal with total resources. Such a statement would not only present changes in cash or the changes in working capital, but the changes in all resources. The concept presented should be that of changes in total enterprise resources. In a properly developed statement, which may be termed the "resource flow matrix," the reader should have a total systems picture and not just a glimpse at various



THE USER SEES: Stock_1 /External\ \Internal/ Activities /External\ \Internal/ Stock_2

Figure 6. A User View.

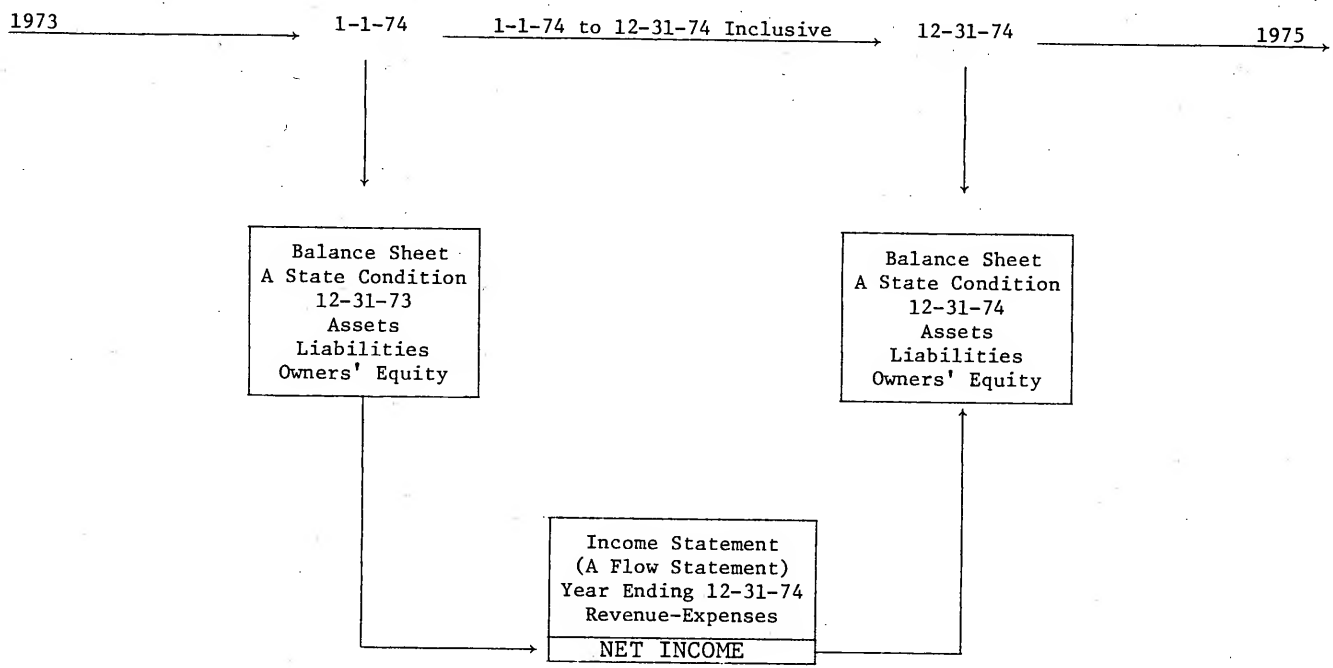


Figure 7. The Relationship of the Income Statement to the Balance Sheet.

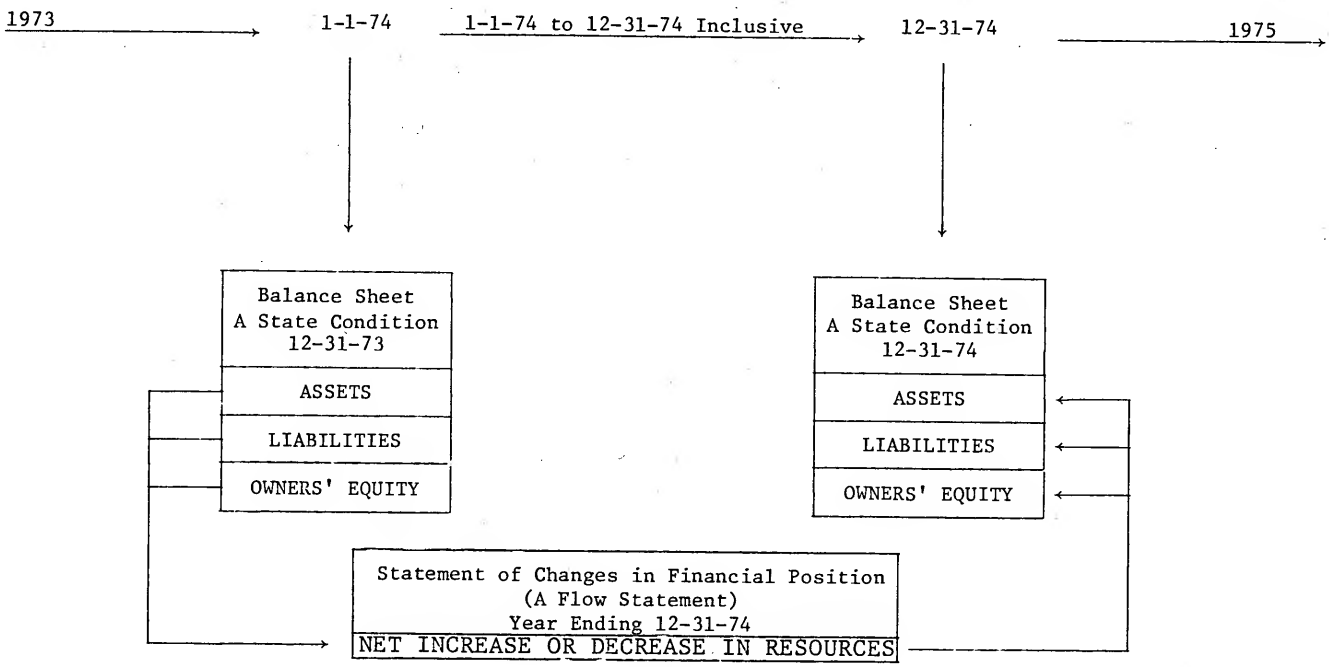


Figure 8. Relationship of the Statement of Changes in Financial Position to the Balance Sheet.

subsystems of the total enterprise complex.

The Resource Flow Matrix

A matrix presentation of the flow of resources, given the account relationships as they exist in the accounting system, is presented in Table 13. An amount appearing at the intersection of a column and a row is simultaneously debited to the account indicated by the row heading and credited to the account indicated by the column heading. The resource flow matrix is a convenient way of depicting how different transactions affect the asset, liability, and equity accounts of a firm's balance sheet. The vertical tabulation of accounts represents a usage of funds. When the double-entry bookkeeping system is considered, it is recalled that a debit may always be thought of as a use of funds. The debit represents a use to increase an asset, decrease a liability, or increase an expense. The horizontal tabulation of accounts represents credits. A credit may be thought of as a source of funds.

The ideas presented in Table 13 may also be expressed in matrix notation. Let a list of n accounts be ordered first along the side of the matrix, representing debits (uses), and then across the top of the matrix, representing credits (uses). Designate the amount appearing at the intersection of row i and column j of the matrix as m_{ij}; m_{ij} signifies that the amount is debited to account i and credited to account j. That is, m_{ij}

TABLE 13
RESOURCE FLOW MATRIX

Sources (Credits) Uses (Debits)	Cash	Invest-ments	Receiv-ables	Inven-tory	Pay-ables	Capital Stock	Sales	Pur-chases	Ex-penses	TOTAL USES (DEBITS)
Cash[a]		1.0	21.5			20.0			0.3	42.8
Investments[b]	5.1									5.1
Receivables[c]							32.4			32.4
Inventory[d]								5.6		5.6
Payables[e]	28.8									28.8
Capital stock										
Sales[f]			0.8							0.8
Purchases[g]					28.7					28.7
Expenses[h]			0.2		6.3					6.5
TOTAL SOURCES (CREDITS)	33.9	1.0	22.5		35.0	20.0	32.4	5.6	0.3	150.7

[a]Sale of investment, collections on account, sale of capital stock, refund of overcharges.

[b]Purchases of investments.

[c]Sales of merchandise.

[d]Purchases unsold.

[e]Payment of liabilities.

[f]Return of sale.

[g]Purchase of merchandise.

[h]Bad debt written off.

represents the funds provided by j and used in i. The total number of accounts is n; therefore, the change in any accounts during a given period can be expressed symbolically as follows:

$$\Delta s = \sum_{j=1}^{n} m_{sj} - \sum_{i=1}^{n} m_{is}$$

where

$$\sum_{j=1}^{n} m_{sj} \text{ and } \sum_{i=1}^{n} m_{is}$$

are, respectively, the total debits and credits to account s and Δs is the net change in the balance of account s. A positive s measures a use of funds, and a negative s measures a source of funds.

Consider the cash account in Table 13 with $n = 9$ and $s = 1$, and we have

$$\Delta_1 = \sum_{j=1}^{9} m_{1j} - \sum_{i=1}^{9} m_{i1}$$

$$= \$42.8 - \$33.9$$

$$= \$8.9$$

The change is positive, indicating an increase in the cash account and, therefore, a use of funds. Consider the capital stock account, $n = 9$ and $s = 6$.

$$\Delta_6 = \sum_{j=1}^{9} m_{6j} - \sum_{i=1}^{9} m_{i6}$$

$$= 0 - \$20$$

$$= -\$20$$

The change in the capital stock was negative (credits greater than debits) thereby indicating a source of funds.

This depiction is the same as saying that through the resource flow matrix, the means is provided for expressing resource flows concisely and, therefore, a convenient way of depicting how different events affect the financial position of the firm. The question which will require further consideration is whether the resource flow matrix provides the basis for the kind of report form which follows from utilization of the information systems approach in the search to increase disclosure in the statement of changes in financial position. This issue will be considered in Chapter VI, together with the relationship of the resource flow matrix to the stock statement and the income statement.

Summary

In the first part of this chapter, linear programming was related to financial flows. Through this avenue, financial flows were related to the input-output technique. The remainder

of the chapter was devoted to developing the resource flow matrix. It was recognized that separate disclosure of financial and productive flows in the enterprise financial reports allows the reader but a glimpse at a part of the system interrelationships. In a properly developed resource flow matrix, the reader has a total systems picture--not just a glimpse at various subsystems of the total enterprise complex. The resource flow matrix allows not only for a concise expression of resource flows, but also a convenient way of depicting how different events affect the financial position of the firm.

CHAPTER VI

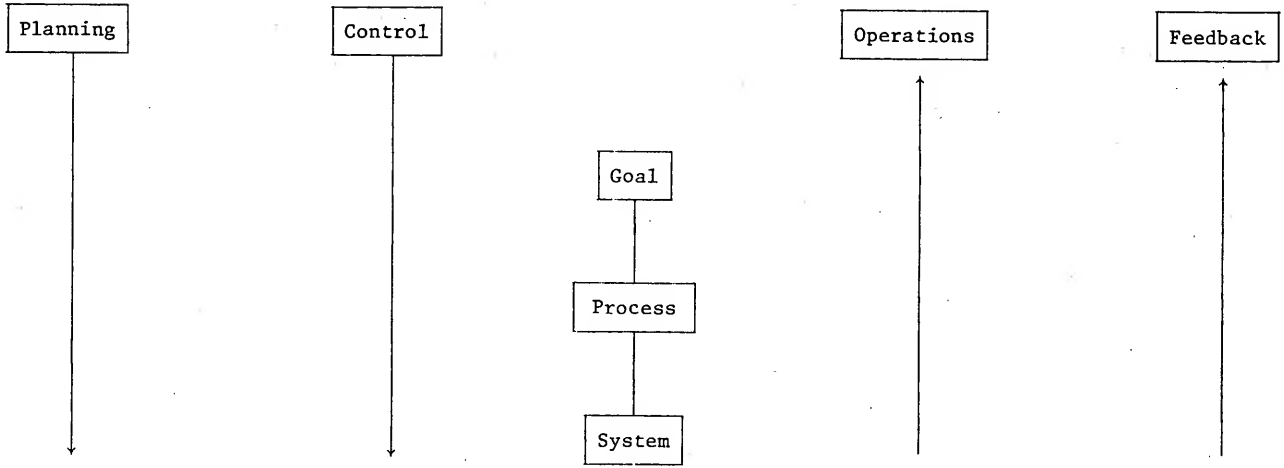
THE RESOURCE FLOW MATRIX AND THE ACCOUNTING INFORMATION SYSTEM

The purpose of this chapter is to consider the relationship of the resource flow matrix to the accounting information system. First we will discuss the consistency of the resource flow matrix with the systems frame of reference. Then the relationship of the resource flow matrix to the stock statement and the income statement will be considered.

The Goal-Process-Systems Complex

In discussing the consistency of the resource flow matrix with the accounting information system, it is necessary to consider the goal-process-systems (GPS) complex of accounting. A GPS complex is presented in Figure 9.

For effective planning, the flow is downward through the GPS complex, that is, from known goals to processes, and to the design of systems. Controls also flow from goals so as to correct deviations from plans. Operations begin at the systems level, generating an activity flow directed toward achievement of goals. Feedback also originates at the systems level in the form of reports on activity and performance.



Objective--the why, the reason for doing something. Activities--the what, the essence of an activity. Resource network--the how, the mechanics enabling the process to occur.

Figure 9. A Goal-Process-Systems Complex.

Goals

It must be recognized that there may be multiple goals, multiple processes, or multiple systems to reckon with. As the number of goals increases, so does the complexity of the system. Goals are assertive and neutral. They must be made explicit and must be compatible with the supporting processes and systems. In addition, goals must be operational so that we may have a basis for monitoring progress and achievement. The assertiveness of a goal is a direct function of the authority of the person stating the goal. Neutrality refers to not categorizing the objective as "good" or "bad." Goals must be made explicit in order to measure progress toward their achievement. If goals are not stated, then they must be deduced by observing the system at work. Subjective or nonoperational goals must be made operational through the use of surrogates.

Progress and Structure

A process is a set of activities undertaken in moving toward a goal. John W. Buckley and Kevin N. Lightner (1973) refer to processes as "transformations." In C. West Churchman's context (1968), transformations encompass the resource-component facets of the system. Processes move things from one state to another. Consider Norbert Weiner's pencil example and the "feedback process." He termed this process "cybernetics." Wiener's pencil example reads:

> Now, suppose I pick up a pencil. To do this, I have to move certain muscles. However, for all of us but a few expert anatomists, we do not know what these muscles are; and even among the anatomists, there are few, if any, who can perform the act by a conscious willing, in succession, of the contraction of each muscle concerned. On the contrary, what we will is to pick the pencil up. Once we have determined on this, our motion proceeds in such a way that we may say roughly that the amount by which the pencil is not yet picked up is decreased at each stage.
> (1961, p. 7)

Wiener is here referring to the fact that in picking up a pencil, one is concerned with comparing a present state (present location of hand) with a desired state (location of pencil--the standard). This comparison is presented in Figure 10.

Based on Wiener's pencil example, the model presented in Figure 11 may be used to depict the role of feedback in controlling movement toward a stated objective. In expansion of this model, it is necessary to consider the system as "closed" or "open." In the following section, the accounting information system is classified as an "open" system.

Open and Closed Systems

A system is defined as closed or open depending on whether or not external intervention is allowed to offset the feedback process. The boundaries of a system are operat-

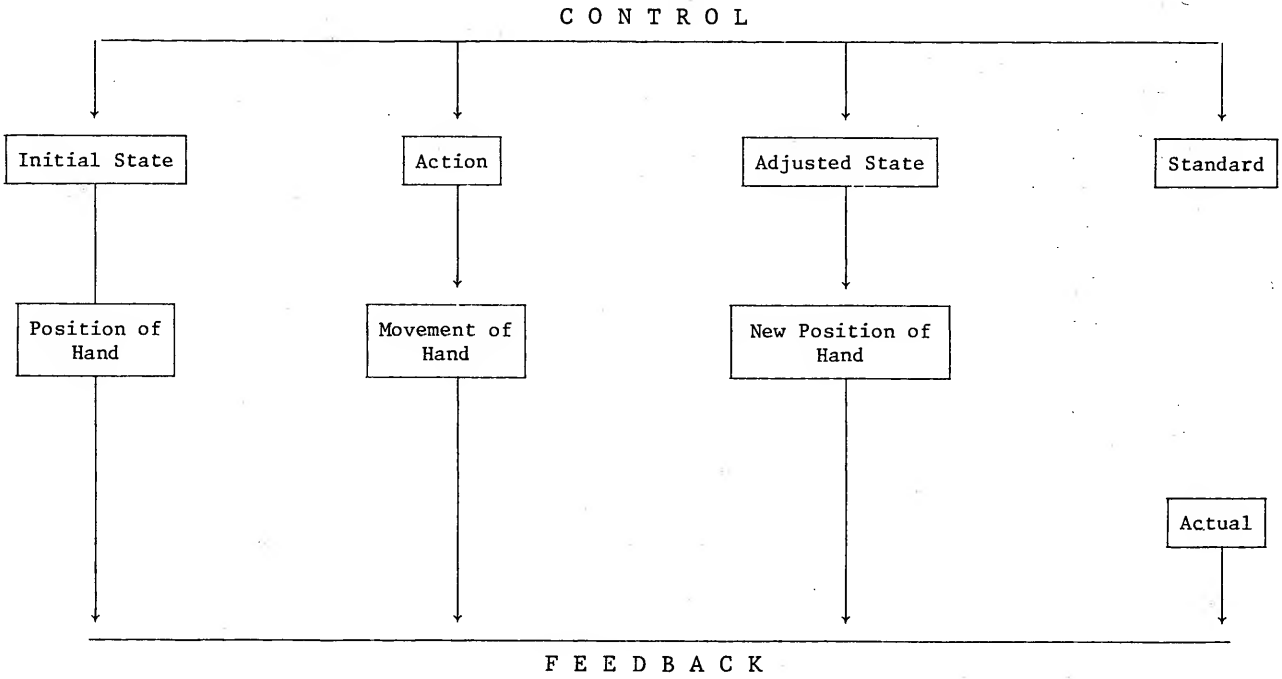


Figure 10. A Comparison of a Present State with a Desired State.

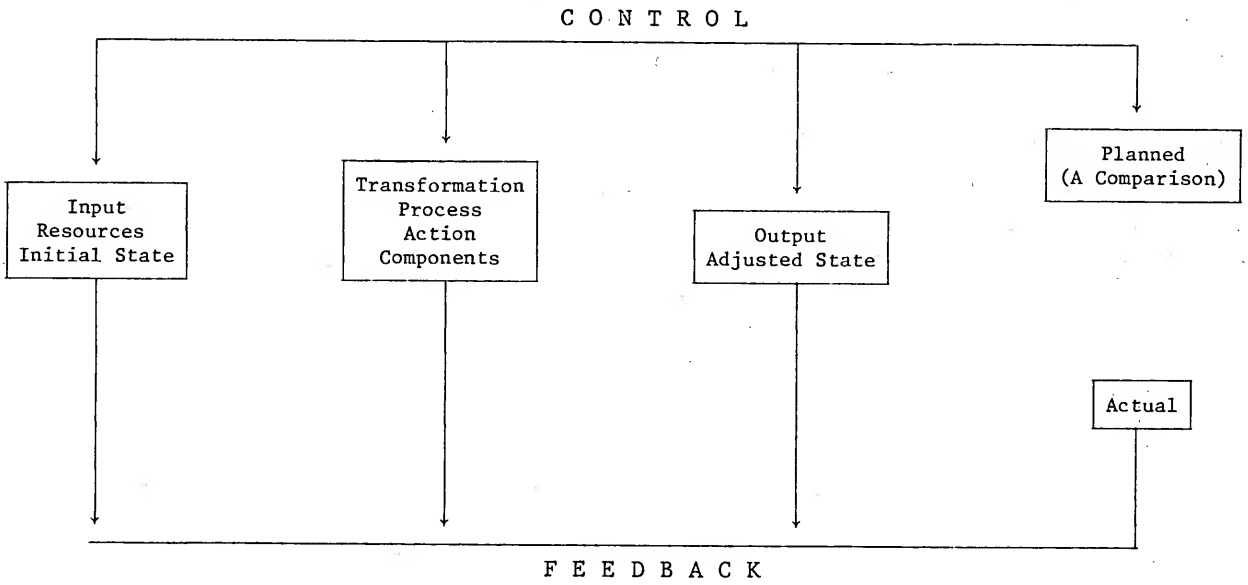


Figure 11. The Role of Feedback in Controlling Movement Toward a Stated Objective.

ing parameters which separate the system from external intervention. In a closed system, feedback does not cross the boundary, but connects directly with control. Figure 12 depicts the relationship of feedback to control in a closed system.

In an open system, feedback is furnished to an external user who may or may not take action to change controls or activities. Figure 13 portrays the user of the information output of the system as he is stimulated from sources outside the system in deciding whether or not to take action. This open system is representative of the action of feedback on control in the accounting system. The input boundaries to the accounting system separate accounting from its environment by determining that only a fraction of the environmental resources are admitted into the process of the system. The output boundary of the accounting system discriminates among user needs in specifying that the system intends to satisfy only a part of user needs.

If the information contained in the resource flow matrix is relevant to the needs of the user and these needs are recognized as being within the purview of the accounting information system, then we have the basis for development of the resource flow matrix. The commonality of resource-allocation decisions for production and financial resources and the advantage of matrix expression have already been discussed. What remains is to relate the resource flow matrix to the GPS complex of accounting.

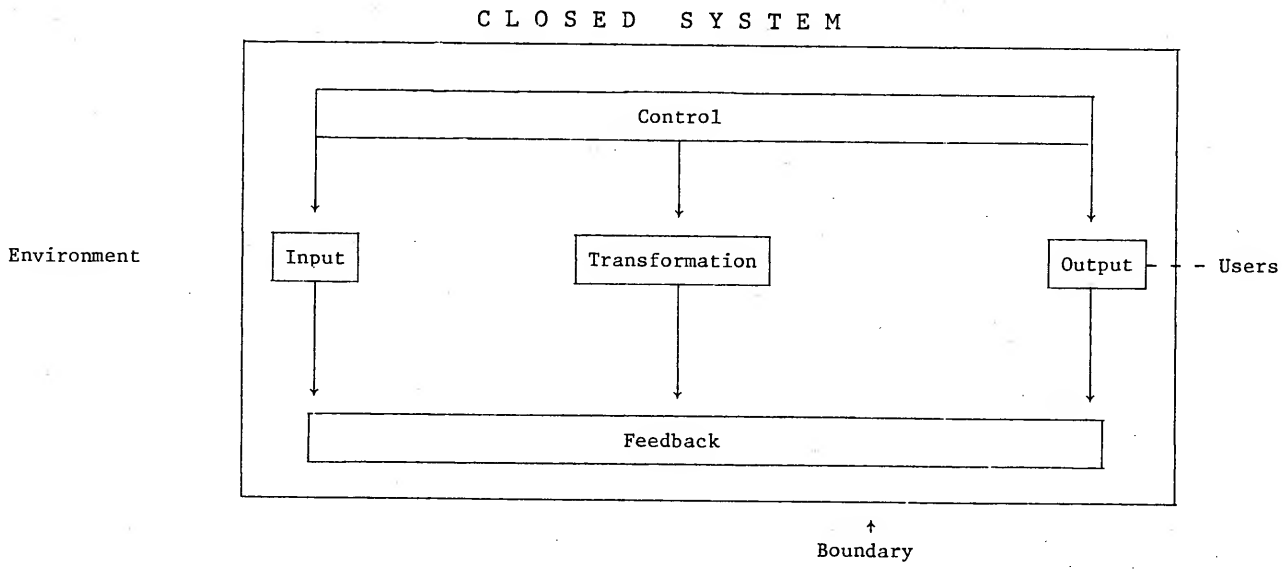


Figure 12. The Relationship of Feedback to Control in a Closed System.

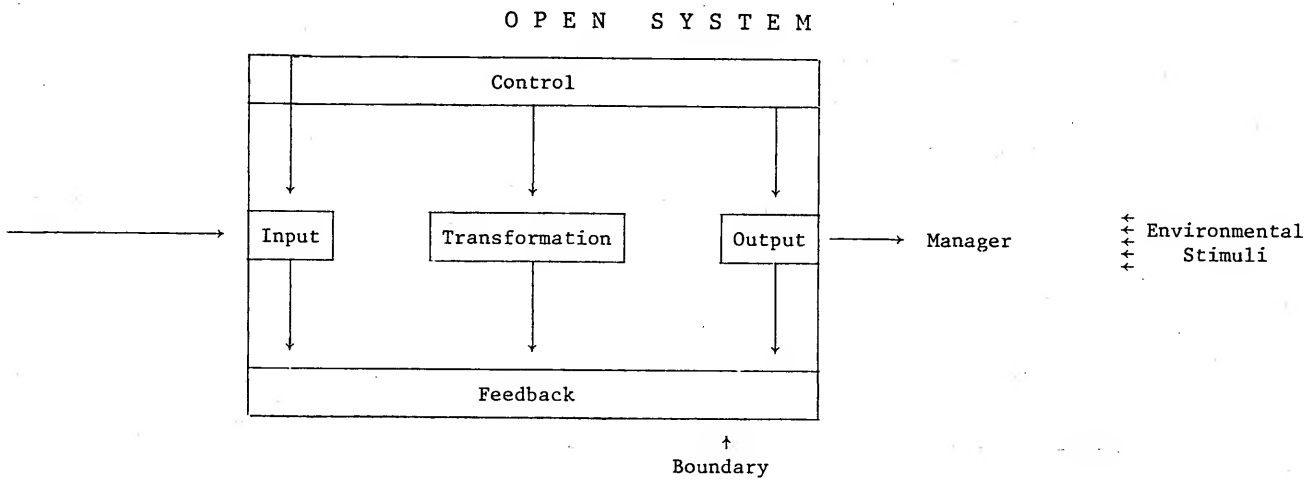


Figure 13. The Relationship of Feedback to Control in an Open System.

The Resource Flow Matrix and the GPS Complex of Accounting

The adopted model of the accounting information system and the implications of general systems theory for theory development and verification were discussed in Chapter III. Based on the theory discussed there, we will explore the theory $R_a = F(a_a, \beta_a, \gamma_a, \delta_a)$ where a_a, β_a, γ_a, and δ_a are independent variables having the joint function R_a (accounting information system). We desire to set forth the invariances of the system such that the capacity will exist for conceptualizing a system which manifests the postulated invariances with regard to not only the coactions of its parts, but, also, the total system's coaction with its environmental systems.

Systematic State Property--$R_a = F(a_a)$

$R_a = F(a_a)$ exhibits the concept of the "ordered whole." Consideration is given here to the system as a nonsummative complex in which a number of constant constraints are improved by fixed forces. This complex is a structure with mathematically calculable parameters. The nonsummative nature of the elements of the accounting system lies in the mutually-constitutive interrelation of the account components. If we were to be satisfied that the measurement problems of the accountant were resolved, a mere summation of the amounts in the various accounts would still offer little aid to the

user in his decision-making role. It may be stated that the accounting information system is a system in the sense expressed by Ervin Laszlo (1972b) and that it meets the requirements of his theory in terms of being a "constitutive" (nonsummative) totality of interdependent components. In further establishment of the systematic state property, we must consider "order."

The essence of the accounting function is to provide order in the presentation of the happenings of the period to the user. In fulfilling this function, accountants provide order in the tabulation, accumulation, and categorizing of the effects of events on the resource components of the entity. To accomplish the goals of the accounting information system, accountants must provide for this accumulation of operational and financial flows. The structure of the ordered whole, that is, the accounting information system follows from the basic units of account of the business enterprise. The units of account of the enterprise are the resources under its control and the sources of these resources. The equality between resources and sources gives use to the basic accounting equation--Assets = Equities.

This equation may be expanded to reveal the interrelated components of the ordered whole as follows:

$$A = L + OE$$

$$A_{t_1} + A_{t_2-t_1} = L_{t_1} + L_{t_2-t_1} + OE_{t_1} + OE_{t_2-t_1}$$

$$A_{t_1} + \Delta A = L_{t_1} + \Delta L + OE_{t_1} + I - D + R - E$$

where A = assets = the resources available to the enterprise; L = liabilities = the claims of creditors against the enterprise resources; OE = owners' equity = the claims of owners against the enterprise resources; t_1 = the beginning of the period; t_2 = the end of the period; I = additional owner investment, therefore giving rise to additional owner claims; D = owner withdrawals = reduction of resources and owner claims in the enterprise; R = revenues = increase in assets due to operating activities; E = expenses = asset outflows associated with operating activities; and Δ = change in.

Accounting System-Cybernetics I--$R_a = F(\beta_a)$

Accounting is considered under the broad heading of cybernetics from two points of view. One point of view concerns the structure of the system. Consideration of the structure of the system implies a concern with the features of the system which can be treated as constants over certain ranges of variation with regard to other significant elements of the theoretical problem. A system may also be analyzed from the point of view of how the internal set of constraints which give the system its structure

are related to sets of external factors, that is, the relation of disturbances (inputs) to responses (outputs). The primary theoretical significance of a functional analysis consists of relating those factors given in the structure to those imposed by the constants of the environment in which the system finds itself. Therefore, in considering the dynamic function of any system, one seeks to describe the relationship of a state description to an input-output description. Such a description constitutes "accounting system cybernetics."

Consideration of the open system is implicit in accounting-system cybernetics. All processes in a closed system are controlled by the system's intrinsic sets of constraints. The open system deals with environmental disturbances. The processes of the open system are determined by its interaction with the relevant factors in its environment. What are those entities in the environment with which accounting systems interact? How might the effects on which they function be regarded? In looking to empirical interpretations of social systems, T. Parsons (1961) is usually cited as having furnished the most explicative systems analysis in social-systems theory. Parsons, in the aforementioned context, states that the environment is systematic in nature. To Parsons, the systematic nature of the environment of social systems includes cultural and personality systems, behavioral systems, and (through the organism) the physical environment. The social environment is taken as never constant.

Personalities and organisms are understood as replacing one another in a succession of traits as cultural norms evolve. Therefore, the social system is contemplated as being in a sea of change, as faced with alternatives of either maintaining itself or suffering possibly irreversible alternations.

But Parsons observes control mechanisms present in social systems due to the observance that they maintain themselves in dynamic environments. Up to a given point, the social system maintains the parameter of the existing structure. Beyond some point, the system is launched on a cumulative process of change. It goes progressively farther away from its institutionalized patterns. The processes referred to are termed by Laszlo as "sociocybernetic processes of negative and positive feedback" (1971b). Parsons terms negative feedback as the process of "equilibration" (pattern maintenance) which in our general systems formulation is the variable β_a. Positive feedback is termed the process of structural change by Parsons and is our variable γ_a.

May we consider the accounting system in the same light? Is it not present in the threshold of the accounting system's control-resources, "negative-feedback mechanisms" which maintain the existing pattern? Also, beyond the threshold of the accounting system's control resources, is it not positive feedback which takes over and evolves the system in new directions? The equilibrium state is the steady state. As long as certain sets of relationships hold (institutionalized patterns), the equilibrium

state is maintained within a given range of disturbances. What are the functional mechanisms which correct for factors of change and, hence, maintain a state of equilibrium for the accounting information system?

Accounting is riddled with institutionalization. Much has been written concerning the institutionalized nature of accounting. Little need is seen for a lengthy discussion to support the contention that the accounting system may be conceived of as a self-regulating, pattern-maintaining cybernetic open system. Control may be thought of as a set of constraints on the parts. The considerations here are of values and goals. A key phenomenon of the accounting system is structural stability. However, capacities for change must also be discussed. Change in the system depends on whether the system's control resources are capable of dealing with environmental changes by buffering them out through internal accommodation or on whether dealing with the disturbances involves a fundamental reorganization of the institutional and goal structure. We must switch from Accounting System-Cybernetics I to System-Cybernetics II in this consideration.

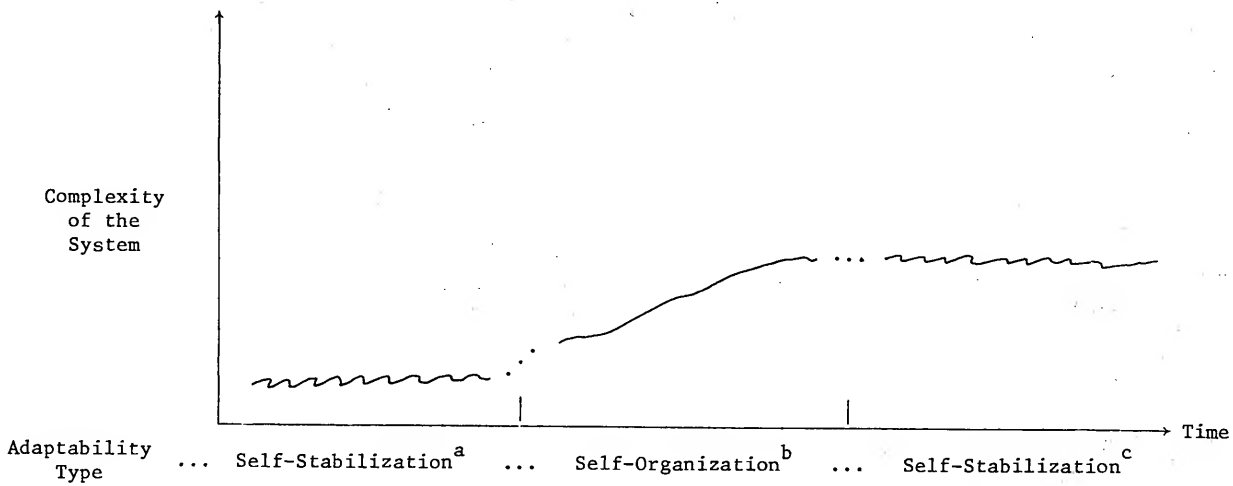
Accounting System-Cybernetics II--$R_a = F(\gamma_a)$

$R_a = F(\gamma_a)$ refers to the tendency for a cumulative process of change to begin which produces states progressively farther from the institutionalized patterns. The accommodation of strains by structural reorganization is but a form of accommoda-

tion of existing systematic components to gain maximum stability. The survival of a system depends on its ability to cope with change in the environment. Coping with change means either offsetting the disturbances which are introduced into the structure by employing regulative controls or reorganizing the basic parameters of the structure. The patterns of development of the accounting system may be viewed in Figure 14.

Holon Property--$R_a = F(\delta_a)$

The components of the accounting system and a conceptualization of the accounting system as a subsystem of the larger information system complex was discussed in Chapter III. The question as to where the accounting system ends and its environment begins must be resolved, however, before one can consider intrasystematic relations. Figure 4 details the input and output boundaries of the system as they currently appear to be. Let us envision the system as having all subsidiary components belonging to its internal constitution rather than its environment. As such, the intrasystematic hierarchy of the accounting system consists of successively lower levels of systems as well as suprasystems. (For example, the accounting information system, the management accounting system, and the cost determination system at the firm, plant, department level, and so forth.) Further, as the decision model of the accounting-information-system output user is perused, an emphasis on both financial and operating flows can be seen. Does this dual emphasis



[a]Pattern maintenance, status quo, e.g., in the preindustrial agricultural era.

[b]Structural change, a cumulative process of change, e.g., transition from agricultural to industrial era.

[c]Pattern maintenance, maintenance of status quo, e.g., in the industrial era.

Figure 14. Patterns of Development in the Accounting System.

imply a financial and an operating subsystem for information gathering? In answer to this question, the system outputs relevant to the needs of the user are considered in the next section.

The Output Goal of the Accounting Information System

Those invariances relating to all systems have been set forth and discussed in relation to the accounting system. The question which presents itself at this point is that if accounting is a system, then what are the implications of identifying it as such with regard to increasing the extent of disclosure in the statement of changes in financial position? More specifically, what are the implications for utilization of the input-output form of report to accomplish such purposes?

To regard accounting as a system means the accounting components are mutually interrelated. Mutual interrelation means representation of the reciprocal effects of the components by sets of simultaneous equations. As expounded in Chapters IV and V, mathematical expression of operating and financial-planning models necessitates the use of matrices. To utilize matrix analysis of a planning model is to utilize input-output analysis of planned operations. In model specification, we must be aware of the entire GPS complex which is under consideration. We must not become unduly intertwined in the mathematical possibilities and relationships in such models. In considering the meaning of the system, the total system objectives and, therefore, the performance measures of the whole system

must be remembered. We must ask again, what are the performance measures of the accounting system?

Given accounting as a service activity, it seems that the performance measure employed is usefulness to the user in making economic decisions. If the output of the system does not satisfy the dimension of the perimeters, it will not stimulate behavior and will not lead to the attainment of the goals of the complex. The outputs of the accounting system are the financial statements. It is by financial statements that the information accumulated and processed in the system is communicated to the user. Further, the accountant has a variety of user models to satisfy. It is through the accounting process that the many diverse events of the enterprise are accumulated, analyzed, quantified, classified, recorded, summarized, and reported. The types of accounting information relevant to the needs of the user are as follows:

1. A statement of financial position--a stock statement at a point in time.
2. A description of changes in financial position--a flow statement concerning a period of time (both operating and financial flows).

The uses and users of financial accounting information are varied. While having some special needs, users also have common needs which are necessitated by the organization of economic activity in society and the economic activity in individual business enterprises. When a user is considering association with a particular enterprise, he wants information concerning

the financial "soundness" of the firm at the present. But, in addition, in his attempt to predict the future financial position of the firm, the user desires information as to past utilization of the firm's resources. He wants to know where those resources came from and how they have been employed.

As the accounting system is related to Accounting System-Cybernetics I and II, does the demand for the input-output form of report necessitate a concern with pattern maintenance or structural change (see page 145, above)? Given that the system's control resources are capable and do deal with some environmental changes by buffering them out through internal accommodation and other disturbances through a fundamental reorganization, do we have cause for concern with either β_a or γ_a in justifying the resource flow matrix? The accounting information system allows for the presentation of the various account relationships in the resource flow matrix. The manner in which such a format depicts operating and financial flows as well as their interrelationships has been discussed. No fundamental reorganization of the system is required for utilization of the input-output form of disclosure for resource flows. But one must consider the output point of view. As the system's output boundary was depicted in Figure 4, is there an aptitude for the input-output report form? It appears that from the systems point of view, the theory $R_a = F(a_a, \beta_a, \gamma_a, \delta_a)$ is

more thoroughly followed through if the account interrelations are totally and concisely displayed in the resource flow matrix. Not only does the resource flow matrix allow for a complete and concise presentation of the account interrelations, but it also can provide the basis for development of the "traditional" balance sheet and income statement, as well as accommodation of any "method" of statement of changes in financial position desired. The integrative qualities of the resource flow matrix are presented in the following section.

The Resource Flow Matrix and Traditional Financial Statements

The data presented in Tables 1 through 3 in Chapter II are used to develop Table 8 to allow the reader to relate the resource flow matrix to the balance sheet, the income statement, and the alternative types of statements of changes in financial position presented in Chapter II. Note that the beginning account balances are indicated on the main diagonal of the matrix (boxed in). Note further that all sales were assumed to be on account for purposes of developing the matrix. All expenses are likewise assumed to be first charged to accounts payable.

In reading the matrix, the beginning balance plus debits to the account less credits to the account equals the ending account balance for an asset as follows:

	(1)		(9)
(1) Cash	.	...	7,000
⋮ ⋮	⋮	⋮	⋮
(9) Long-term investments	11,000	...	$\boxed{44,000}$

The credits (sources) are in vertical tabulation (that is, a credit to any account is indicated by a vertical entry under the column heading for that account), and the debits (uses) are in horizontal tabulation. Therefore, the ending balance for the long-term-investment account is

$$\$44,000 + \$11,000 - \$7,000 = \$48,000.$$

The same process leads to the ending balance of the federal-income-taxes-payable account.

	(1)		(20) Federal Income Taxes Payable
(1) Cash	.	...	.
⋮ ⋮	⋮	⋮	⋮
(20) .	16,200	...	$\boxed{16,200}$
⋮ ⋮	⋮	⋮	
(32) Operating expenses	.	...	20,425

The $20,425 ending balance in federal income taxes payable is computed as follows:

$$\$16,200 + \$20,425 - \$16,200 = \$20,425$$

In the resource flow matrix, an entry is always a debit

to the account listed as the row heading and a credit to the account listed as the column heading. Further, account titles for accounts normally having a debit or credit balance, as the case may be for rows or columns, are written out. Otherwise, only a row or column number is provided. The ending stock statement balances for the equity accounts are provided under the respective column headings. Likewise, for the asset accounts, the ending stock balances are to the far right on the same row as the asset row headings.

In reading the statement, it is noted that cash was a net user of resources to the extent of $2,000. Buildings appear to be a net source of resources due to a $6,000 decrease in the account. However, it is realized that the full decrease in the buildings account was due to depreciation. Depreciation is neither a source nor a use of resources, but must be added back to the total operating sources, since it was subtracted from net income as if a use. A footnote must be used to clarify the point that the source comes from revenues generated, not the depreciation of the buildings. The resource flow matrix provides much more information than changes in account balances. The interrelationships giving rise to changes are provided. This information places the statement user in a much better position to gauge trends (in comparison from year to year) and to assess the "how" of the company's financial position changes from year to year.

Accounting statements in their traditional format may

be developed from the matrix by computing the ending account balances as indicated alone. If a more limited disclosure of resource flows is desired, any of the statements of changes in financial position presented in Chapter II may be prepared from the information provided in the resource flow matrix.

TABLE 14

RESOURCE FLOW MATRIX FOR THE SCFP CORPORATION FOR THE YEAR ENDING DECEMBER 31, 1973

Sources (Credit)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Uses (Debits)										
(1) Cash	10,260		266,000						7,000	
(2) Marketable securities	2,000	--0--								
(3) Accounts receivable (net)			31,200							
(4) Notes receivable			2,000	4,000						
(5) Accrued interest receivable					60					
(6) Inventories						19,000				
(7) Prepaid insurance	420						540			
(8) Office supplies	700							300		
(9) Long-term investments	11,000								44,000	
(10) Sinking fund	3,000									27,000
(11) Land	12,000									
(12) Buildings (net)										
(13) Furniture and fixtures (net)	3,300									
(14) Goodwill										
(15) Unamortized bond discount										
(16) Cost of treasury stock	4,200									
(17)	238,600									
(18)										
(19)	20									
(20)	16,200									
(21)										
(22)										
(23)										
(24)										
(25)										
(26)										
(27)										
(28)										
(29)										
(30)	7,350									
(31)										
(32) Operating expenses			2,500				210	600		
(33)										
(34) Interest expense	2,400									
(35) TOTAL SOURCES	301,190	--0--	270,500	--0--	--0--	--0--	210	600	7,000	--0--
(36)										
(37) Add operating revenue										
(38) Add interest income										
(39) Subtract operating expense										
(40) Subtract interest expense										
END OF PERIOD BALANCES (CREDIT)										

[a]The source arises not from the depreciation on the assets, but from revenue generated.

TABLE 14, continued:

Sources (Credit) / Uses (Debits)	(11)	(12)	(13)	(14)	(15)	(16)	(17) Accounts Payable	(18) Accrued Wages and Salaries Payable	(19) Accrued Taxes Payable	(20) Federal Income Taxes Payable
(1) Cash										
(2) Marketable securities										
(3) Accounts receivable (net)										
(4) Notes receivable										
(5) Accrued interest receivable										
(6) Inventories							5,000			
(7) Prepaid insurance										
(8) Office supplies										
(9) Long-term investments										
(10) Sinking fund										
(11) Land	21,000									
(12) Buildings (net)		144,000								
(13) Furniture and fixtures (net)			11,300							
(14) Goodwill				10,000						
(15) Unamortized bond discount					660					
(16) Cost of treasury atock						--0--				
(17)							17,400			
(18)								300		
(19)									120	
(20)										16,200
(21)										
(22)										
(23)										
(24)										
(25)										
(26)										
(27)										
(28)										
(29)										
(30)				10,000						
(31)										
(32) Operating expenses		6,000[a]	1,100[a]				234,500	100		20,425
(33)										
(34) Interest expense					60					
(35) TOTAL SOURCES	--0--	6,000[a]	1,100[a]	10,000	60	--0--	239,500	100	--0--	20,425
(36)										
(37) Add operating revenue										
(38) Add interest income										
(39) Subtract operating expense										
(40) Subtract interest expense										
END OF PERIOD BALANCES (CREDIT)							18,300	400	100	20,425

TABLE 14, continued:

Sources (Credit) / Uses (Debits)	(21) Accrued Interest Payable	(22) Long-Term Notes Payable	(23) Sinking Fund Bonds Payable	(24) Capital Stock	(25) Excess Over Stated Value from Stock Issuances	(26) Excess Over Stated Value from Treasury Stock Transactions	(27) Excess Over Stated Value from Stock Dividends	(28) Retained Earnings Appropriated for Sinking Fund
(1) Cash				25,700	10,300			
(2) Marketable securities								
(3) Accounts receivable (net)								
(4) Notes receivable								
(5) Accrued interest receivable								
(6) Inventories								
(7) Prepaid insurance								
(8) Office supplies								
(9) Long-term investments								
(10) Sinking fund								
(11) Land								
(12) Buildings (net)								
(13) Furniture and fixtures (net)								
(14) Goodwill								
(15) Unamortized bond discount								
(16) Cost of treasury stock								
(17)								
(18)								
(19)								
(20)								
(21)	2,400							
(22)		6,000		4,300	1,700			
(23)			60,000					
(24)				120,000				
(25)					15,000			
(26)						4,000		
(27)							2,400	
(28)								25,000
(29)								
(30)								3,000
(31)								
(32) Operating expenses								
(33)								
(34) Interest expense								
(35) TOTAL SOURCES	--0--	--0--	--0--	30,000	12,000	--0--	--0--	3,000
(36)								
(37) Add operating revenue								
(38) Add interest income								
(39) Subtract operating expense								
(40) Subtract interest expense								
END OF PERIOD BALANCES (CREDIT)	2,400	--0--	60,000	150,000	27,000	4,000	2,400	28,000

TABLE 14, continued:

Sources (Credit) / Uses (Debits)	(29) Retained Earnings Appropriated for Contingencies	(30) Unappropriated Retained Earnings	(31) Operating Revenue	(32)	(33) Interest Income	(34)	TOTAL USES	END OF PERIOD BALANCES (DEBIT)
(1) Cash					280		309,280	18,350
(2) Marketable securities							2,000	2,000
(3) Accounts receivable (net)			288,000				288,000	48,700
(4) Notes receivable							2,000	6,000
(5) Accrued interest receivable					40		40	100
(6) Inventories							5,000	24,000
(7) Prepaid insurance							420	750
(8) Office supplies							700	400
(9) Long-term investments							11,000	48,000
(10) Sinking fund							3,000	30,000
(11) Land							12,000	33,000
(12) Buildings (net)								138,000
(13) Furniture and fixtures (net)							3,300	13,500
(14) Goodwill								
(15) Unamortized bond discount								600
(16) Cost of treasury stock								4,200
(17)							283,600	
(18)								
(19)							20	
(20)							16,200	
(21)								
(22)							6,000	
(23)								
(24)								
(25)								
(26)							4,200	
(27)								
(28)								
(29)	3,000	3,000					3,000	
(30)		51,500					20,350	
(31)								
(32) Operating expenses							265,435	
(33)								
(34) Interest expense							2,460	
(35) TOTAL SOURCES	--0--	3,000	288,000	--0--	320	--0--	1,193,005	
(36)								
(37) Add operating revenue		288,000						
(38) Add interest income		320						
(39) Subtract operating expense		265,435						
(40) Subtract interest expense		2,460						
END OF PERIOD BALANCES (CREDIT)	--0--	54,575						367,600

Summary

The purpose of this chapter was to consider the implications of the resource flow matrix for the accounting information system. The first topic considered was consistency of the resource flow matrix with the systems frame of reference. It was determined that the goal-process-system (GPS) complex of accounting does allow for utilization of the resource flow matrix to depict total resource flows during the period. It appears that from the systems point of view, the theory $R_a = F(a_a, \beta_a, \gamma_a, \delta_a)$ is more thoroughly followed through if the account relationships are completely and concisely displayed. The resource flow matrix was found to allow for a complete and concise presentation of the account interrelationships as well as to provide the basis for development of the traditional balance sheet and income statement, plus any other statement changes in financial position desired.

CHAPTER VII

SUMMARY AND CONCLUSIONS

The accounting information system is the principal communication system disclosing the flow of resources to and from the business enterprise. Accountants conventionally have chosen to perform this function by providing two basic statements--the statement of financial position and the income statement. The statement of financial position provides the user (the decision maker) with a statement depicting the stock of resources and claims to the resources of the business enterprise at a point in time. The income statement provides a statement of operating flows for the period. A survey of the literature on accounting indicates that since the beginning of the twentieth century, some writers have indicated that a statement of financial flows is also needed. This statement, frequently referred to as the "funds-flow statement," describes the financial and nonfinancial flows during a period, their interrelations, and their effect on a statement of financial position. Recognizing the need for a funds-flow statement in *Opinion No. 3* (1963), the American Institute of Certified Public Accountants encouraged the inclusion of the funds statement in annual reports. Eight years later, in *Opinion No. 19* (1971), the Institute required that the

funds statement be included in annual reports and that it be titled "Statement of Changes in Financial Position," However, the Institute recommended in *Opinion No. 19* that the statement be based on a cash or working-capital definition of funds.

Even though the Institute has expressed two opinions on the subject of funds flows, many writers are of the opinion that the statements of changes in financial position usually seen in the accounting literature and in financial reports do not provide a report of the total resource flows which have taken place between position statement dates. The purpose of this dissertation was to utilize the input-output form of report to develop a resource flow matrix which would depict the historical interrelationships between resources and sources of resources of the business enterprise, as well as the increases and decreases in these resources and their sources.

The first step of the study was to convey the relevance of the point in question by indicating the variability in funds concepts and funds-statement format suggestions. The need and importance of an understandable funds statement was discussed in the first part of Chapter II. It was indicated that debate as to the inappropriateness of the use of the term "funds" for a statement of the nature of the source and application of funds statement dates from the writings of H. A. Finney in 1925. Finney indicated "resources" as "probably" a better term in 1925, although he was the writer who first used "funds" in this context. Although a general lack of interest in the funds statement

existed until 1955, A. C. Littleton expressed doubt in 1953 that an understandable "application of the funds statement" could be developed due to its "complex" organization. Significant evidence of concern with the funds statement was not noted until after the issuance of the American Institute of Certified Public Accountants' *Opinion No. 3*. Increased concern with the term "funds" and increased discussion of the need to fill the gap between the balance sheet and the income statement culminated with the Institute's *Opinion No. 19*. In recommending a broad concept to serve as the basis for the funds statement, the Institute indicated that instead of "funds," the term "resources" is more descriptive.

Opinion No. 19 was found to allow much latitude in statement format. In addition, numerous authors have expressed the opinion that there is an overemphasis on liquidity in the development of the statement recommended by the Institute. Also, several writers have stated that the resource concepts employed (cash or working capital) are not sufficiently broad to describe fully the changes in financial position during the accounting period. Some writers have even suggested a presentation of multiple statements. It was apparent that the missing link between the end-of-period balance sheet, the income statement, and the beginning-of-period balance sheet was still lacking.

The next step in the research endeavor was to develop a frame of reference for the study. The meanings of "system," "information," "accounting," and the role of the accounting informa-

tion system in the organization were discussed. An analysis of several definitions of system, information, and accounting led to a description of the accounting information system as a system having as its function the acquiring, storing, transforming, transmitting, or otherwise processing the data of economic events of a particular entity. The environment of the accounting information system was stated as determining the form and purpose of the transformation process. It was then determined that no differences exist in accounting information criteria and criteria of the management information system. However, it was determined that the accounting information system does have concepts, problems, and characteristics which distinguish it from other systems. Therefore, it appeared useful to construct a model for the accounting information system in order to depict more clearly its nature and function. The model developed was consistent with both the derived definition of the accounting information system and the role of the accounting information system in the total management system.

Consideration of the accounting-information-system model indicated that general systems theory was the appropriate methodological framework for development of the resource flow matrix. Therefore, the implications of general systems theory and the accounting information system for theory development and verification were considered. In order to place the theory in proper perspective, the motives and developments leading to a general systems theory were first considered. Next the systems approach

to complex problems was discussed. The detail of systems methodology led to the development of thirteen facets in the systems approach to problem solution. Four systems properties were then identified as determining the nature of all systems. It was postulated that a system is a nonsummative complex in which a number of constant constraints are improved by fixed forces yielding a structure with mathematically calculable parameters (systematic state property). The discussion revealed that all systems exhibit control qualities (System-Cybernetics I and II) which either compensate internally for changing conditions in the environment, so as to maintain a relative invariance of its total complex, or reorganize fixed forces and acquire new parameters in establishing new equilibrium relations with the environment. All subsystems occupy a position within a hierarchy of systems (holon property), so that the configuration exhibits a vertical ordering of phenomena.

The basis of a decision-making approach to theory verification was then developed. It was stated that a theory of empirical science may be divided into two parts. One part was presented as the formal system which is composed of abstract symbols and syntactical rules for manipulation of these symbols. The other part concerned the connection of these symbols to observations. The validity of the theory was stated to depend on its effect on the decisions of the user. If the decisions of the user are not affected in the proper manner, then the output of the system is not information and, hence, should not be a part

of the output of the accounting information system.

The necessity for the use of matrix algebra in the accounting allocation process was discussed. The mathematical properties of input-output analysis were explored in providing the basis for a report to fill the gap between the balance sheet and the income statement. It was observed that the presence of a whole other than the simple sum of its parts implies the existence of a simultaneous-equation system. The solution of a complex set of simultaneous equations calls for the use of matrix algebra. It was demonstrated that the solution of the Leontief input-output model (the matrix of productive flows) (1951) and the solution of the general form of the linear programming model are identical. It was this proof that provided the basis for linking productive flows and financial flows.

The decision models for the allocation of financial and productive resources were found to lend themselves to linear programming techniques. Therefore, since the solution of the linear programming model and the input-output model are identical, both productive and financial decisions lend themselves to the input-output technique. Based on this observation, the resource flow matrix (an input-output report) was developed.

The goal-process-system (GPS) complex of accounting was then analyzed in determining that the accounting information system requires no alterations in the resource flow matrix to depict total resource flows during the time period. The invariant properties of the accounting information system were found to be

followed through more completely if the account relationships are displayed completely and concisely. The resource flow matrix was found to allow for a complete and concise presentation of the account interrelationships, as well as to provide the basis for development of the balance sheet, the income statement, and the statement of changes in financial position.

It was demonstrated that financial flows may be considered in the same manner as productive flows. Therefore, if there are advantages to utilizing the input-output format for depicting productive flows, these same advantages should apply to using the input-output report form for financial flows. Both the productive-flow model and the financial-flow model are subsystem models. Separate disclosure of productive and financial flows provides the report user only a partial view of the system interrelationships. For the user to attain a greater understanding of the total system, he must make additional calculations. For a total system representation, the two models must be integrated in order to assess the growth of the enterprise toward its overall objective.

It was concluded that the resource flow matrix depicts this total system representation. While the cash and working-capital concepts of funds are provided in the resource flow matrix, the much broader concept of total resource flows is utilized for an exhibition of change in enterprise financial strength. The resource flow matrix offers the user a picture of total enterprise resource flows, not just a glimpse at various subsystems of the total complex.

The input-output form of report displays a clearer gestalt for consideration of the existent operating relationships of the period. Additionally, this form makes a presentation of accounts in a more concise form than that convetionally utilized. Debate as to the advantages of aggregation versus full detail are still pertinent. The model awaits empirical testing and an application of future innovations in the areas of measurement and communication theory.

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BIOGRAPHICAL SKETCH

Danny Ray Hines was born October 4, 1947, at Rocky Mount, North Carolina. In 1953, he and his family moved to Gifton, North Carolina, where he was graduated from Gifton High School in June, 1965. In June of 1969 he received the degree of Bachelor of Science in Business Administration with a major in accounting from East Carolina University. He received the North Carolina Association of Certified Public Accountants' Outstanding Student in Accounting Award as a graduating senior from East Carolina University. In September of 1969 he enrolled in the graduate-studies program at the University of Florida. He worked as a Graduate Assistant in the Department of Accounting until June, 1970, and as a Teaching Assistant until August, 1973. He received the Master of Arts in Accounting, with minors in economics and finance, in June of 1971. In March, 1975, he received the Doctor of Philosophy in Business Administration, with majors in accounting and economics and a minor in operations analysis, from the University of Florida.

Danny Ray Hines successfully completed the North Carolina C.P.A. Examination in May of 1969. He was employed by the New Bern Office of the public-accounting firm of A. M. Pullen &

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Danny Ray Hines is married to the former Earle Carole Tucker. They have one child, daughter Amanda Alicia. He was a member of Phi Sigma Pi while at East Carolina University. He is currently a member of the University of Florida chapter of Beta Alpha Psi and a past president of the University of Florida chapter of Beta Gamma Sigma. He is a member of the American Accounting Association and the Coastal Plains Chapter of the North Carolina Association of Certified Public Accountants.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Shih C. Yu, Chairperson
Professor of Accounting

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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