Methodological Preconditions and Problems of A General Theory of Accounting

Richard Mattessich

The last fifteen years of accounting history seem to be part of a transition period replacing the loose traditional approach by more rigorous methods. Although spanning over considerable time this transition continues, most likely transgressing into the eighties, and promises to cause a major break in the evolution of our discipline. A change of spirit, much more than computerized techniques, is the main force behind this trend. The distinction between what I call the modern, rigorous or generalized approach, on one side, and the loose traditional or particularized approach, on the other, is summarized by the following five points:

1. Formulation and utilization of well defined terms and empirically meaningful concepts versus employment of vaguely described expressions and nonoperational concepts.

2. Adaptation of general scientific tools and methods from mathematics, philosophy, economics and the behavioral sciences to accounting theory versus particularization and utilization of a narrowly specialized conceptual framework.

3. Orientation toward specific accounting and management information models for specific objectives versus dogmatic acceptance of a unique, overall or undefined purpose.

4. Systematic testing procedures through which alternative accounting models and hypotheses (for one and the same objective) can be tested as to their relevance, reliability, accuracy, efficiency, timeliness or perhaps overall profitability versus mere testing of stewardship and fulfillment of conventions.

5. Integration of specific accounting areas to a coherent entity versus collecting loosely connected conventions, dogmas,

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rules and isolated particularized models.

From time to time the need arises to look at past research activity from the bird's perspective with the aim of an overall survey. Such is the intent of the following investigation which tries to fit recent research efforts into this live-point pattern, and which examines major methodological and related problems still to be solved before this phase of transition is completed. Prior to such an investigation it may be opportune to avoid some misunderstandings.

It is neither my intention to deride traditional accounting which I recognize as the basis of further endeavors, nor do I plead for eliminating value judgements from our discipline. However, the persistence of value judgements raises the serious question whether modern accounting will be as dogmatic as traditional accounting is. A normative approach which explicated its value judgements and reduced them to more basic levels, which furthermore applies systematic testing procedures to reject inadequate systems, could well be regarded as a nondogmatic approach.

It would be extravagant to regard accounting as a pure or cognitive science. But neither medicine nor meteorology nor engineering are pure sciences; they are not concerned with finding scientific laws but with serving specific practical purposes in a pragmatic fashion. These disciplines are generally recognized as applied sciences because they operate with such scientific concepts as hypotheses, diagnoses, models, theories and systems, and endeavor to subject these hypotheses, diagnoses, models, theories and systems to systematic testing procedures with the serious intention to eliminate those theories which the accepted criteria indicate as inadequate for their practical objectives. Since progressive accountants and management information systems experts also operate with models, theories, systems, and the like and since they too aspire toward more rigorous testing procedures, the gap between accounting and other applied sciences may not be as great as some of our colleagues suggest.

The ultimate purpose of accounting is to provide managerial information systems satisfactory or even optimal for specific needs. That this should be done through systematic testing and by means of an instrumental theory commensurate to needs as well as scientific means at our disposal, hardly appears to be an unreasonable quest.

I Terminological and Conceptual Difficulties

Defined Versus Undefined Terms

Traditional accounting, as most other academic disciplines, partly borrows concepts from neighboring disciplines and partly creates its own conceptual apparatus. Yet, accounting theoreticians rarely make an effort to indicate clearly which of their terms are primitive (hence borrowed from outside) and which are derived from these primitives by means of nominal definitions within the accounting theory proper. This vagueness is one reason why the boundaries of traditional accounting theory and its subareas are blurred and

3 A strict distinction between a "specific model" mentioned under (3) and an "isolated particularized model" mentioned under (5) ought to be made. Whereas the former is embedded in a theoretical framework and thus has common bonds with other specific models, the particularized model lacks this connection and is theoretically isolated.

4 "As we shall see in some detail, applied research has the advantage of being able to formulate criteria of its own efficiency in terms of the objectives for which the problem is being investigated. Because of its lack of specific objectives, pure research cannot formulate such criteria as explicitly," Russell L. Ackoff, Scientific Method—Optimizing Applied Research Decisions (John Wiley & Sons, Inc., 1962), p. 24. Also "In science, whether pure or applied, a theory is both the culmination of a research cycle and a guide to further research. In applied science theories are, in addition, the basis of systems of rules prescribing the course of optimal practical action," Mario Bunge, Scientific Research II—The Search for Truth (Springer Verlag Co., 1967), p. 121.
why accounting itself is usually described instead of defined. For example the well known “definition” of accounting offered by the Committee on Terminology of the American Institute of Certified Public Accountants4 is neither a nominal, nor an analytical, nor an operational definition; it does not set sharp boundaries to the term “accounting” nor does it prescribe operational rules by means of which one can test whether something is an accounting system or not. Indeed, the “definition” would fit other areas of business administration equally well.

Although the failure to distinguish between primitive (undefined) and defined terms leads to confusion, it might be a lesser evil than the failure to discern between interpreted and uninterpreted concepts and calculi.

Interpreted versus Uninterpreted Concepts

Whereas a definition is a relationship between terms or between a term and its constituents, an interpretation is a relationship between a phenomenon (fact or idea) and the term (symbol) representing it. General concepts require specific and, in many cases, empirical interpretations. In accounting, unfortunately, the distinction between interpreted and uninterpreted concepts is even more neglected than that between defined and undefined terms. Concepts like income, wealth, value and measure are treated as though they were well interpreted concepts, but at best an interpretation is merely implied, and in the case of scholarly controversies the two opponents often imply different interpretations, usually without realizing it.

In this regard the example of the probability concept offers a valid analog from which accountants can learn much. For considerable time hot controversies were fought over the question whether probability is an objective-empirical, an objective-formal, or a subjective-empirical concept. This controversy was resolved after Kolmogoroff created the general and thus uninterpreted probability concept stipulated by his axioms of the probability calculus. Then different rules of interpretations were devised in such a way that under one set of rules the relative frequency concept (an objective-empirical one) emerges, under another set the degree of confirmation (an objective-formal concept), and under a third the Bayesian probability concept (a subjective-empirical one). Later even more interpretations were devised. Would it not be possible, in a similar fashion, to devise certain conditions or common traits for the concepts of income, wealth, value and other accounting concepts in order to create first general uninterpreted concepts and then rules of interpretations for specific needs? In this way, much clarity could be brought into our discipline and many a futile controversy could be avoided.

Endeavors Toward Better Conceptualization

Systematic attempts to create a series of clearly defined uninterpreted concepts of the major accounting notions and alternative interpretations (for specific or standardized needs) of each concept have not been made in our discipline. But in an informal, vague and incomplete manner such interpretations have been customary in traditional accounting for a long time. One could well argue that the acquisition cost basis, the market value basis and the present value basis are nothing but “interpretations” of a general uninterpreted value concept. But the essence of the methodological achievement of distinguishing between uninterpreted and interpreted concepts and theories (calculi) lies

in the specification of the conditions characterizing every uninterpreted concept. These rules of interpretation are rarely, if ever, spelled out in accounting. Thus the practice of distinguishing various species of one and the same super-concept as encountered in our discipline, is merely a first step in the direction of fulfilling this important methodological prerequisite.

However, credit has to be given to several academic accountants for having concerned themselves with this or the closely related problem of operationalism. Bedford, recommends the utilization of an operational income concept:

The fact is that there is a need for one overall general concept of income in our society. The formulation of the set of operations to be used in developing such a general concept of income is by far the most difficult aspect of such a process of theory formation.

Yet, he (apart from distinguishing between business income and "income as a generalized means to gratify a variety of human needs") which he deems beyond the concern of accounting) seems to regard the generalized (business) income concept as an interpreted instead of uninterpreted concept, and thus does not aim towards further interpretations. For him the operational rules are what we called the conditions of the general concept, while in modern methodology the operational rules would be equivalent to the rules of interpretation of the specific concepts.

Devine, too, recommends in his essay "Principles, Theories, Systems—Again" that "principles be operationally defined and treated as guidelines." Explicit mentioning of "semantical rules" (i.e., rules of interpretation) in the recent accounting literature is made by Sterling in his paper "On Theory Construction and Verification" and in the "Report of the Committee on Accounting Theory Construction and Verification." Yet, the actual significance of the rules of interpretations for creating subconcepts and subtheories from the general concept or theory respectively, is not emphasized in these writings.

To attain better conceptualization in accounting and management information systems, comprehensive and systematic taxonomic research is indispensable. Such research will have to formulate both the conditions of each of the uninterpreted accounting concepts as well as the rules of interpretations of all the specific and standardized subconcepts. Such classificational research is tedious and by far not as glamorous as model building, and it might take some time before the Linneas of accounting emerges. However, if biology was in a position to classify over one-and-a-half million species of plants and animals within a complex taxonomic system of kingdoms, phyla, classes (with subclasses, orders (with suborders and sections), families, genera and species, then it should not be impossible for accounting to produce a classificational structure of a few dozens or hundreds of concepts and sub-concepts.

2. ADAPTATION OF SCIENTIFIC METHODS

Mathematical and Economic Contributions

The greatest progress of the transition period, made thus far, lies in adapting economic ideas and mathematical methods or technique of these known, and summing up the following investmen studies of network research and statistics informat...
techniques to accounting. Since the details of these achievements are sufficiently well known, I can restrict myself to classifying and summarizing these achievements from a methodological point of view. Accordingly we might distinguish between the following categories: (1) Present value and investment calculations, (2) structural studies by means of matrices, vectors and networks, (3) linear programming, simulation and computer applications, and (4) statistical applications and valuation of information.

Present value and investment calculations are no novelty in accounting. Their applications have to be credited to traditional accounting but were ultimately derived from economics. It is Irving Fisher's merit to have interpreted capital theory by means of accounting concepts. The fundamental significance of this Fisharian interpretation lies in a new and much broader vision of our discipline; in other words it was the first and perhaps most important step toward a more general theory of accounting. But it was such a radical innovation that some accountants still refuse to grasp several of its consequences. Nevertheless, strides were made by Canning, later by Moonitz and Stachling, and in more recent times by Albach, Bierman, Hansen, Honko, Jordan, Moonitz, Sprouse and others to elaborate the consequences of the present value approach within the confines of accounting. The justification to include here this kind of development is best supported by two articles that appeared almost a decade ago. Both Corbin and Phillips spoke of a "revolution" in our discipline; indeed they concentrated chiefly on the economic valuation facet just mentioned, without entering into other revolutionary aspects then visible on the horizon.

The insight that the matrix notion is a general and convenient means for depicting the structure of the basic accounting models had far-reaching consequences for business accounting, as well as beyond it. Above all, a rectangular matrix reveals the double classificational structure of accounting in a more generally understandable fashion than does the language of traditional bookkeeping; and second, matrix algebra lends itself to the solution of many allocation problems and related issues of micro- and macro-accounting. Some experts regard this matrix mode a new "paradigm" by means of which accountants and economists nowadays visualize the basic structure of economic flows. This claim may be reinforced by the "official" adoption of the matrix mode in national income accounting. The United Nations, for example, based their recent publication A System of National Accounts entirely on the matrix mode of accounting.

A further advantage of this mode grows out of its mathematical generality. Due to the latter the matrix mode can easily be converted into the vector mode, or network mode, or any other equivalent (yet, occasionally more convenient) way of looking at an input-output structure. Since most accounting and management information systems possess such an input-output structure this new paradigm may...
become an indispensable element in the design of a general theory of accounting, even where no actual double classification is practiced.

Apart from these methodological aspects which have been treated extensively elsewhere, the more algebraic aspects of this new paradigm have inspired a series of exciting accounting contributions on microeconomic input-output models, their theory and further generalization. Starting from the interindustry model and the insight that Leontief’s basic idea of interdependent commodity transfers between production areas need not be restricted to the macro-economy, several authors made significant contributions by applying matrix algebra to traditional cost accounting, budgeting and other areas.

Linear programming, simulation and computer applications in several respects are related to the research area indicated in footnote 19. They, too, constitute a comprehensive body of mathematical studies that greatly contributed to more rigorous analytical thinking in accounting. Both linear programming and the matrix calculus are part of linear algebra, and although the matrix application of accounting is strongly oriented toward allocation procedures, it too may be geared to planning and budgeting, like linear programming and systems simulation. Thus a peculiar feature of our “transition period” is the much stronger orientation of accounting toward projections of future economic events. Traditional accounting did not lack this element (already fifty years ago did McKinsey lay the foundations to a systematic and comprehensive business budgeting), but during these five decades budgeting has never been more than a side issue of minor importance. Even today some experts wish to exclude budgeting from accounting proper. But it is this neglect of budgeting which has deprived traditional accounting of its most important task, namely to answer the question “How well could management have performed if they would have allocated resources in the best feasible way?” Numerous recent developments of linear programming and system simulation, however, indicate that the control function as well as the exploration of alternative factor combinations, by means of budgeting and management information systems, is becoming a dominant issue of modern accounting.

[Richard Mattessich, Accounting and Analytical Methods (Richard D. Irwin, Inc., 1964) and Die wissenschaftlichen Grundlagen des Rechnungswesens (Bertelsmann University Press, 1970) are recommended reading on this subject.]

21 On the other hand many linear programming applications in accounting are related to allocation problems via the broad issue of transfer pricing. Beyond that, there exists an interesting attempt to apply linear programming to overhead allocations: see Robert S. Kaplan and Gerald L. Thomson, “Overhead Allocation via Mathematical Programming Models,” The Accounting Review (April 1971), pp. 334-34.


20 Richard Mattessich, Accounting and Analytical Methods (Richard D. Irwin, Inc., 1964) and Die wissenschaftlichen Grundlagen des Rechnungswesens (Bertelsmann University Press, 1970) are recommended reading on this subject.
How needed if in the demand that appraisals, by an indomitable budget-getting, the scientist (Herbert Landsberg) allocates one-third of the research in both management and accountancy to statistical applications and valuation of information. These are the fourth area greatly enhancing rigor and quality of accounting research. This group spans a broad spectrum of which several subareas may be distinguished: First, the application of statistical sampling and hypothesis testing (especially in auditing and control charting); second, the econometric study of cost behaviour; third, decision and information theory and the evaluation of information; and finally, all other statistical accounting applications difficult to classify otherwise.

Statistical sampling and control charting are subareas of most immediate practical usefulness, while the econometric determination of cost curves and the like seems to be the most neglected one within accounting. The third subarea, however, the evaluation of accounting information touches the very core of our discipline and appears to have the greatest future potential (for further details see a later subsection "The Value of Information").

Measurement Theory

Finally, the application of basic concepts of modern measurement theory to accounting may contribute substantially to conceptual clarification of several accounting issues. Accounting describes past and occasionally future events, and thus is a special kind of measurement activity, at least for those who identify measurement with quantitative description. The conceptualization of measurement theory goes back to M. von Helmholtz and Norman Campbell, but assumes special significance in the social sciences with the contributions of Stevens and other social scientists or mathematicians.

reserve considerable space for the discussion of "The Budget as a Comprehensive Planning Device," pp. 57-58. The "Report of the Committee on Accounting and Information Systems," The Accounting Review Supplement to Vol. 46, 1971, explicitly points out with regard to traditional accounting (in contrast to modern accounting) that "the information was not designed for planning purposes nor necessarily for measuring performance against organizational objectives," p. 291.


The essence of these instrumental hypothesis is discussed in detail in Richard Mattessich, Instrumental Reasoning and Decision Systems—A Methodology of the Administrative and other Applied Sciences, forthcoming.


If, for example, Robert E. Jensen, "A Cluster Analysis Study of Financial Performance of Selected Business Firms," The Accounting Review (January 1971), pp. 36-56, and many others.

Stevens' scales were first applied to accounting in 1959 and further concepts of modern measurement theory (e.g., "measurement by fiat") were introduced. Some authors, like Bierman, recognized the significance of these new measurement concepts at an early stage, but, in contrast to accounting in subsequent years, to which these ideas. Among the sixteen papers on accounting measurement presented at the 1965 Seminar on Basic Research in Accounting Measurement there was only a single one quoting Stevens' work and mentioning explicitly its accounting applications. Although today this conceptual apparatus is more frequently referred to by accountants, I have the impression that Mi1re is more frequently referred to by accountants. Although today this conceptual apparatus is more frequently referred to by accountants, and the scientific approach in general. The lengthy controversy between Professor Chambers and myself in Cost and Management: Raymond Chambers "Asset Measurement and Valuation" (March-April 1971), pp. 30-35, and idem., "Measurement and Valuation, Again" (July-August 1971), pp. 12-17; R. Mattessich, "On the Perennial Misunderstanding of Asset Measurement by Means of 'Present Values'" (March-April 1970), and idem., "On Further Misunderstandings About 'Measurement and Valuation; A Rejoinder to Chambers' Article" (March-April 1971), pp. 36-42 and idem., "Asset Measurement and Valuation—A Final Reply to Chambers" (July-August 1971), pp. 18-24. The concept of "measurement by fiat" (Torgerson referring to measurement based on pragmatic hypotheses instead of scientific laws as in case of "fundamental" and "derived measurement"), is of extreme importance for accountants but rarely fully understood. Furthermore the concepts of "fundamental" and "derived measurement" have been misunderstood by accountants or confused with primary (direct) and secondary (indirect) measurement respectively. This seems to be the case in the otherwise excellent "Report of the Committee on Accounting and Information Systems" (1971), pp. 309-10), since accountants hardly ever deal with either derived or fundamental measurement but with measurement by fiat. Y. Ijiri, The Foundations of Accounting Measurement (Prentice-Hall, Inc., 1967), and "Report of the Committee on Foundations of Accounting Measurement," The Accounting Review—Supplement to Vol. 46, 1971, especially pp. 26-32.

Behavioral Research

Accounting, conceived as a normative discipline, cannot rely on formal propositions alone. On the contrary, apart from some normative statements, the substance of accounting ultimately ought to be made up of empirical (positive) propositions. Since most of the latter are of behavioral nature, it falls to behavioral accounting to formulate specific empirical premises.

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which ultimately should fit into a more general framework.

The emergence of this "behavioral accounting" indeed is one of the main features of our transition period. Although Argyris undertook highly original behavioral studies in budgeting as long as twenty years ago, it probably was Stedry's award-winning dissertation which gave the signal to the new trend of looking at accounting from a behavioral point of view. Especially since the middle of the sixties, dozens of accounting papers and books with behavioral implications were written and anthologies were compiled. This border area still is in its infancy and is subject to many controversies. The chief argument is not so much launched against behavioral accounting as such, but against faulty or superficial application of behavioral research within this area. Non-accountants trained thoroughly as behavioral scientists occasionally complain about methodological deficiency as well as the lack of sufficient generality of the behavioral research carried out by accountants. Furthermore the question of where to draw the boundaries of behavioral accounting has been left unanswered. There can be no doubt that this subarea should inquire into the sociological, psychological and economic foundations of accounting, and into the related behavioral traits of the users of accounting information. But less unanimity exists with regard to the question whether it also should inquire into the behavior of the producers of accounting statements and systems or even into the behavior of accounting theorists.

A further issue of behavioral accounting arises from its interdisciplinary character, and concerns the problem of reduction: "The ideal would be to express the foundations of accounting measurement in terms of economics and administrative behavior, to express the foundations of the latter in terms of psychology and sociology, the foundations of these again in terms of biology, then in terms of chemistry, and finally in terms of physics." But at present, we are far away from such an ideal, and there are dangers in present attempts to reduce accounting to more "elementary" foundations. As desirable as this reduction and integration would be, it cannot be done unless the pertinent "laws" of the more basic disciplines are perfectly understood and as long as the causal connections between accounting phenomena and the "laws" of these basic disciplines have been fully disclosed. As long as this is not the case, accountants must do what the chemists did before the periodic table could be explained in terms of subatomic particles; they must construct self-contained theories on the basis of what is known to them. Then slowly, step by step (with the progress of their own discipline as well as that of the more basic disciplines in which accounting is embedded) they will be able to extend their theory by reducing it to explanations in more basic terms. I do not think that

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"C. Argyris, The Impact of Budgets on People (Controllership Foundation, 1952)."
"Andrew C. Stedry, Budget Control and Cost Behavior (Prentice-Hall, Inc., 1960)."
"Don DeCoster and K. V. Ramanathan, "The Influence of Individual Differences, Task Attributes, and Control System Characteristics on Goal Setting and Goal Accomplishment Behavior," Seattle, 1971 (Mimeographed), also raise this kind of criticism in the first part of their paper.
this could be done by accountants conjecturing their own sociological, psychological or economic postulates on a wholesale basis. The foundations of the more basic disciplines must be worked out in earnest search by their own experts. Only then may accountants borrow them and try to add their own modest contributions to these parental disciplines. "Starting with grandiose synthetic views instead of working in a piecemeal analytical way, is characteristically nonscientific."16

In concluding this section, I would like to emphasize that the adaptation of scientific methods to accounting, so far, predominantly stems from "mathematical accounting." But "management scientists and systems analysts during the last decade have gained two important insights: (1) that epistemological research is indispensable for probing the fundamental problems of the management sciences, and (2) that model building, especially the construction of systems, may impart new vistas to epistemology... also, accountants must determine which accounting systems should be accepted for a specific situation and which are not applicable. These central questions concerning the theory and practice of accounting ultimately belong to the science of knowledge."15 Thus, in their fascination with mathematical techniques, accountants seem to have neglected important philosophic aspects. Yet, there is growing awareness of the root of this situation has to be remedied, and recent AAA-research reports6 and articles indicate that accountants are perceiving the most critical spots within those epistemological issues. The remaining part of this paper shall outline the major problems to be solved in this area.

3 Specification of Objectives

The need for different accounting models could not remain unperceived in traditional accounting. The early distinction between financial and cost accounting, and the later distinction between tax accounting and accounting satisfying various commercial laws, are the first modest steps in the direction of that kind of specialization which ultimately could result in a huge taxonomic structure. A further, but much more blurred evidence lies in the weary controversies about the correct accounting method as to valuation basis, realization criterion, depreciation and allocation methods, classification schemes, and so forth. It is "blurred," because rarely is the question asked "which instrumental hypotheses or rules are appropriate for a narrowly defined purpose and which for another one, and so on?" Accountants rather behave as though there existed only one overall purpose of accounting: Thus the inquiry was directed toward the one and only correct set of rules; something bound to lead to numerous futile discussions and misunderstandings. However, the fact that such controversies are still ongoing may indicate that the root of the problem lies much deeper than in mere misunderstandings or a onesidedness of this scholar or that. The heart of the problem might rest in the difficulty to for applying hypotheses.

This task seems experts deem it be by clinging to the old purpose accounting. These pessimists of academic account seem to predominantly who assume a view, believe that cult of a problem a challenge than able number of experts seem to be uncooperative (perhaps not even involved.) If at all because accountants stuck in the dilemmas and dethroned for a specific purpose than managerial systems experts.

The most pro problem still see a limited number of purposes (tax accounting control, long term decision-making, rent operations) from which a purposes may present concepts and a challenge more men hensive. The taxonomy was to a hierarchy o

The difficulty of variety of concept aware that through methods of interpretations of...
culty to formulate specific well-defined purposes, and to match them to a specific set of hypotheses.

This task seems so difficult that many experts deem it hopeless, and seek refuge by clinging to the ill-defined uni- or multipurpose accounting system of the past. If these pessimists are right, then the future of academic accounting would be restricted to predominantly legalistic issues. Those who assume a more optimistic point of view, believe that the high degree of difficulty of a problem should rather constitute a challenge than a deterrent. (A considerable number of accountants, however, seem to be uncommitted in this regard, perhaps not recognizing the crucial issue involved.) If optimism is justified, it is because accountants are not the only ones stuck in the dilemma of identifying objectives and determining the optimal model for a specific purpose; they share this challenge with management scientists and systems experts in general.

The most promising approach to this problem still seems to be the acceptance of a limited number of typical standard purposes (tax accounting, commercial-legalistic accounting, short run planning and control, long-run planning, investment decision-making, decision making in current operations including personnel policy) from which a larger number of subpurposes may be derived. Since different concepts and subconcepts would be required for different purposes and subpurposes respectively, we come back to the previously mentioned need for a comprehensive taxonomic system of accounting concepts. Hence the construction of such a taxonomy would have to be closely tied to a hierarchy of objectives.

The difficulty of such undertaking lies in the variety of concepts and situations. We ought to be aware that through the application of three different methods of depreciation three different interpretations of the income and capital concepts may come into being. If one adds to this three different valuation methods, then we attain, precisely speaking, as much as nine different interpretations of income and of capital. But we know that there exist more than three depreciation and valuation methods, and also that, many more factors beyond depreciation and valuation methods affect the concepts of income and capital. The hypotheses of realization, classification, data-input, duration and relevance are just as indispensable for a precise interpretation of these two concepts as are depreciation (i.e., allocation) and valuation. From all this might result a huge maze of subconcepts or interpretations, the use of which may not immediately be obvious.

But it has to be pointed out that these concepts do not come into being through the suggestion to build a hierarchy of concepts. These concepts have been existing for considerable time in the accounting literature, since one actually operates with many of those combinations. Thus our suggestion does not so much aim toward the creation or invention of these subconcepts but toward making them aware and systematizing them.\footnote{Translated from Mattessich, \textit{Die wissenschaftlichen Grundlagen des Rechnungswesens} (Duesseldorf: Bertelsmann Universitaetsverlag, 1970), p. 46.}

But the problem of specifying objectives is not only tied to that of a conceptual hierarchy, it is no less closely related to the ability of testing whether a purpose has been fulfilled by a specific (information) system. In this area accountants have greatly benefited from information economics and made their own original contribution—a further reason for optimism.

\section*{Testing Management Information Systems}

\textit{In Search of Principles of Testing}

Systematic testing procedures are a crucial element in any scientific approach.\footnote{Williams and Grelln, "On the Nature of Empirical Verification in Accounting," p. 145, assert that "...only minimal attention has been given to questions of certification, or theory validation..." But no serious attempt has been made to identify that which constitutes verification. However, the reader's attention should be drawn to the fact that I devoted the entire Chapter 7 of \textit{Accounting and Analytical Methods} (1964) to empirical hypotheses and their refutation. The following quote summarizes the pertinent conclusion: "...choices between action hypotheses will be made in such a way that those hypotheses—how low..."}
The cognitive sciences must test hypotheses and theories by means of verification and refutation; whereas the applied sciences ought to test the efficiency, relevance, reliability or other properties of a normative theory, or a system, or a machine by a variety of means. Mechanical devices, like motor cars, are tested in many ways and with respect of many properties. Some or all of these properties (price, relative gasoline consumption and other economic aspects, motor strength, acceleration speed, sturdiness and further safety features), or their combinations, are then compared from model to model, and compared with an "ideal pattern" determined by the intended usage. Only then a correct choice for the appropriate purpose can be made. Most readers are quite familiar with this kind of "testing" from their experience in buying various gadgets. Although accounting models or information systems are more than mechanical devices, there can be little doubt that they too belong to the realm of applied science, and thus are subject to similar principles of testing. Obviously, this testing can span a wide spectrum of rigor, from the most informal estimation of certain properties to highly sophisticated measures; but the more complex an information system is, the less satisfactory will an informal testing procedure be. Thus, under consideration of expensive computerized information systems, considerable thought will have to be given to the procedures of testing and, above all, to the principles underlying them. In the pure or cognitive sciences these "principles" are thoroughly examined in epistemology (the science of knowledge). We too are concerned with a kind of knowing, namely with the question "How do we know when a system is satisfactory or optimal?" Therefore, there is no reason why this branch of philosophy cannot aid us in our undertaking. It is true that so far no epistemology of the applied sciences exists, but systems analysis, management science and recently accounting are posing fundamental questions that most appropriately would fall into the epistemology of applied sciences (if this expression sounds too highbrow for accountants, the term "instrumental reasoning" may well be substituted for it). Some of these fundamental questions are not new at all and can be encountered with Kant and many other philosophers.

Other of these questions have a more novel aspect as the following example shall demonstrate: Information is knowledge and thus there exist close ties between information theory and the science of knowledge. Yet, these ties have hardly been explored. Economists worry little about the criteria of knowledge creation, and epistemologists care even less about the value and cost of procuring knowledge or information. The latter issue has recently been taken up by economists as well as accountants, and if both groups would acquire some methodological background, then the perennially neglected economic aspect of epistemology could become a fascinating interdisciplinary meeting place.

The Value of Information

The testing of an information system has many prerequisites; among these the most crucial is information as a resource and related questions of time and space. Thus, the cost of information creation and the cost of information must be considered. Let us now examine the question of whether information is a commodity or an utility, and whether it is to be obtained at a cost. We shall start by considering the nature of information and the nature of information systems.

Information is a phenomenon that is created by a process. This process is called an information system. An information system is a complex of devices, like motor cars, that are tested in many ways and with respect of many properties. Some or all of these properties (price, reliability, efficiency, and cost of procurement) can be compared from model to model, and compared with an "ideal pattern" determined by the intended usage. Only then a correct choice for the appropriate purpose can be made. Most readers are quite familiar with this kind of "testing" from their experience in buying various gadgets. Although accounting models or information systems are more than mechanical devices, there can be little doubt that they too belong to the realm of applied science, and thus are subject to similar principles of testing. Obviously, this testing can span a wide spectrum of rigor, from the most informal estimation of certain properties to highly sophisticated measures; but the more complex an information system is, the less satisfactory will an informal testing procedure be. Thus, under consideration of expensive computerized information systems, considerable thought will have to be given to the procedures of testing and, above all, to the principles underlying them. In the pure or cognitive sciences these "principles" are thoroughly examined in epistemology (the science of knowledge). We too are concerned with a kind of knowing, namely with the question "How do we know when a system is satisfactory or optimal?" Therefore, there is no reason why this branch of philosophy cannot aid us in our undertaking. It is true that so far no epistemology of the applied sciences exists, but systems analysis, management science and recently accounting are posing fundamental questions that most appropriately would fall into the epistemology of applied sciences (if this expression sounds too highbrow for accountants, the term "instrumental reasoning" may well be substituted for it). Some of these fundamental questions are not new at all and can be encountered with Kant and many other philosophers.

The Value of Information

The testing of an information system has many prerequisites; among these the most crucial is information as a resource and related questions of time and space. Thus, the cost of information creation and the cost of information must be considered. Let us now examine the question of whether information is a commodity or an utility, and whether it is to be obtained at a cost. We shall start by considering the nature of information and the nature of information systems.

Information is a phenomenon that is created by a process. This process is called an information system. An information system is a complex of devices, like motor cars, that are tested in many ways and with respect of many properties. Some or all of these properties (price, reliability, efficiency, and cost of procurement) can be compared from model to model, and compared with an "ideal pattern" determined by the intended usage. Only then a correct choice for the appropriate purpose can be made. Most readers are quite familiar with this kind of "testing" from their experience in buying various gadgets. Although accounting models or information systems are more than mechanical devices, there can be little doubt that they too belong to the realm of applied science, and thus are subject to similar principles of testing. Obviously, this testing can span a wide spectrum of rigor, from the most informal estimation of certain properties to highly sophisticated measures; but the more complex an information system is, the less satisfactory will an informal testing procedure be. Thus, under consideration of expensive computerized information systems, considerable thought will have to be given to the procedures of testing and, above all, to the principles underlying them. In the pure or cognitive sciences these "principles" are thoroughly examined in epistemology (the science of knowledge). We too are concerned with a kind of knowing, namely with the question "How do we know when a system is satisfactory or optimal?" Therefore, there is no reason why this branch of philosophy cannot aid us in our undertaking. It is true that so far no epistemology of the applied sciences exists, but systems analysis, management science and recently accounting are posing fundamental questions that most appropriately would fall into the epistemology of applied sciences (if this expression sounds too highbrow for accountants, the term "instrumental reasoning" may well be substituted for it). Some of these fundamental questions are not new at all and can be encountered with Kant and many other philosophers.

Other of these questions have a more novel aspect as the following example shall demonstrate: Information is knowledge and thus there exist close ties between information theory and the science of knowledge. Yet, these ties have hardly been explored. Economists worry little about the criteria of knowledge creation, and epistemologists care even less about the value and cost of procuring knowledge or information. The latter issue has recently been taken up by economists as well as accountants, and if both groups would acquire some methodological background, then the perennially neglected economic aspect of epistemology could become a fascinating interdisciplinary meeting place.

The Value of Information

The testing of an information system has many prerequisites; among these the most
crucial is an awareness of the value of information procured by the pertinent system. Without some notion of the benefit, the cost and the net value of the information created, it is neither possible to test whether this information is worth creating, nor whether another system could create the same information more efficiently. As in many other cases of systems' operation, the cost of doing so is relatively easy to determine—at least compared to the often elusive benefit of gross value of information. Recent studies in information economics have contributed toward a rigorous formulation of several aspects of this problem, touching the very core of accounting and management information systems analysis. Thus accountants not only have to be aware of the present stages of this kind of research, but should be in a position to put its results into a broader context. That means they should be able, on one side, to relate these new insights to the more traditional aspects of their discipline, and on the other, to understand the philosophic roots of these insights.

Information economics regards information as a resource having a value, a cost and related features. This branch is a natural extension of statistical decision theory which, among other things, attempts to improve prior probabilities by means of additional information, converting the former into posterior probabilities (Bayesian approach). Thus the question "How much is this (additional) information worth?" already looms in many decision theoretical issues, even without further elaboration. Feltham and Demski made an exciting contribution by constructing operational information models adapted to accounting situations. Even the applied or specific model still has to make many simplifying assumptions and is hardly designed for immediate application in actual practice. Nevertheless it constitutes one of the best examples of serious accounting research performed in recent years (indeed, the paper received the AICPA-Award for 1970) and ought to be taken as a prototype for the kind of research (at least its analytical part) desirable during the "transition period."). It demonstrates that fundamental research in accounting must start from simplified situations which then have to be refined slowly step by step; it also shows that the decisive matter about fundamental accounting research is not an immediate practical application, but conceptual and methodological clarification to attain new insights into the complex relations of information creation and evaluation.

But there exists another recent publication (incidentally also an award winning article: one of the winners of the American Accounting Association Manuscript Contests for 1971) which supplements the above mentioned research in an important way. Mock's paper draws attention to the fact that the concept of information value used in information economics is only one among several concepts or interpretations, and that it is paramount for accountants to distinguish clearly between the three types: the economic value of information, the model value of information and the feedback value of information. Mock's classification of the value of information concept may not be the ultimate solution, but it seems plausible that the present economic information value concept alone provides too narrow a basis for management information systems; surrogate valuation methods might have to be incorporated.

Finally one may take into consideration the fact that information theory and information economics, thus far, have been treated on a predominantly stochastic basis. Thus the question arises whether additional interpretations of the “value of information” also require probabilistic models or whether some further aspects can be treated deterministically.

Apart from the interpretation issue a further important problem emerges: What other criteria besides the “value of information” are required to test an accounting system? It seems that there exist many more criteria indeed; for example the degrees of relevance, of efficiency, of effectiveness, of accuracy, of reliability, of timeliness and so on. These could be taken into consideration as additional qualitative characteristics, or, as information economists would suggest, one could incorporate them into the value of information concept. In other words one would assign a higher value to a system with higher degrees of relevance, efficiency and accuracy. To what extent and in which way these criteria can be incorporated is still a matter to be explored. One possibility might be the assignment of multi-dimensional utilities to the information model or of distinguishing a greater number of information signals than otherwise. With regard to “response time” (degree of timeliness) the problem could be solved by constructing dynamic information models, i.e., models taking into consideration the time dimension and thus the interdependencies between information and benefits located in different time segments.

Among other vehicles for testing systems and operations research models, sensitivity analysis is mentioned most frequently. Indeed, it is a necessary but, often, not a sufficient tool for testing a system. As far as information systems are concerned we may refer to the AAA Report on Accounting and Information Systems:

Observe that sensitivity analysis is asking essentially the same type of questions about information that were considered information economics. However, sensitivity analysis is a more ad hoc way of asking these questions. The basic reason for the more ad hoc approach is that mathematical models usually assume that the parameter predictions are deterministic when, in fact, they are uncertain. Recognition of this uncertainty increases the complexity of the models and the resulting increase in the cost of solution may not be warranted.

THE GENERAL THEORY

Accounting research during the last fifteen years not only greatly matured but also spread into many directions. The centrifugal force at work in our discipline during the transition period is well manifested in the great variety of modern accounting topics. This force and the dynamics behind it might prove for accounting either highly beneficial or destructive, depending on how accountants are able to harness it. If the many fugitive parts and pieces of our discipline can be held together and integrated, accounting as an academic discipline will survive, if not it might dissolve and be absorbed by neighboring fields. The present state of accounting research resembles a jigsaw puzzle where some areas slowly grow into meaningful configurations but...
without yielding the entire picture. Indeed, the individual fragments seem to spread outwards and not towards a common center.

The need for a deliberate effort of integration in our discipline is by no means of recent vintage, but it becomes ever more urgent in a time of opulent growth and specialization. The many endeavors to formulate the basic assumptions of accounting fusing them into a postulational system goes back fifty years to Paton's first attempt. The search for accounting postulates since the second half of the fifties by Aukrust, Chambers, Ijiri, Moonitz and others, gives evidence for the acute awareness of these needs. As long as we do not possess an overall accounting theory, a good deal of the advantages of mental economy and generalized thinking will be lost. Where no general theory is available, specific theories have to be devised anew, over and over again, like better conceptualization and interpretation and rigorous employment of scientific methodology, lose a great deal of their ultimate raison d'être. I also believe that this concern for integration should not be restricted to a few specialists. Every accounting researcher should have at least a rough vision of the overall framework into which his specific research will have to fit sooner or later.

To some extent not only postulation of business accounting (or national accounting in Aukrust's case), but integration on a broader basis has been undertaken in accounting over the span of the last fifteen years. The first proposal to integrate all areas of micro- as well as macro-accounting by means of a postulational system was launched in 1957 and further elaborated in 1964 and 1970. In most recent times a full integration of micro- and macro-economic input-output analysis, with special emphasis on the accounting aspects, has been launched by Butterworth and Sigloch. Even more recently this generalized input-output approach has been fused in a most interesting way to the theory of information economics. In such cases of overall integration the most crucial question concerns the empirical premises. Can a truly general theory of accounting be successfully constructed on the comparatively narrow empirical basis of decision theory and information economics, or do we need a larger number of factual premises? Those affirming the first part of the question might claim that behavioral accountants have not yet supplied any empirical hypotheses suitable as foundation stones of a general accounting theory. While those

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5 While much research has been focused on the analysis of minute segments of knowledge, there has been increasing interest in developing larger frames of reference for synthesizing the results of such research. The attention has been focused more and more on overall systems as frames of reference for analytical work in various areas. R. A. Johnson, F. E. Kaas and J. E. Koennweig, "Systems Theory and Management," Management Science (January 1964), pp. 368.

6 W. A. Paton, Accounting Theory (Ronald Press Co., 1922) Ch. 20.

7 John W. Buckley, Paul Kircher and Russell L. Mathews, "Methodology in Accounting Theory," The Accounting Review (April 1968), pp. 274-83. These authors not only criticize the deficient definitional, conceptual, and methodological work of traditional accounting research, but also put great emphasis on the need for an over-all theoretical structure. For a further plea in favor of the axiomatic method see George Pellegrini, "The Axiomatic Method in Business Economics: A First Approach," Abacus, (December 1969), pp. 119-31.


ventures, which are nothing more than such experiments, tried to solve this problem of combining uniformity with variety by offering a framework consisting of two kinds of premises: (1) basic assumptions and (2) specific or auxiliary assumptions (also called specific hypotheses). The basic assumptions manifest the general characteristics of all accounting systems and provide place-holders for the specific assumptions. The latter enable adaptation to a variety of particular purposes through the choice of exchangeable alternatives (these specific hypotheses will be shortly discussed in the following subsection).

Contrary to some erroneous opinion, most of the basic assumptions were formulated as empirical propositions which are, unlike tautologies, not 'true by virtue of their logical structure. Most of these basic assumptions are existential propositions and possess refutability, the best witness for empirical content.

Although the literature of management information systems persistently points at the need for specifying the purpose of a management information system, traditional accounting often failed to do so. Therefore, Die wissenschaftlichen Grundlagen introduced a new basic assumption (only implicitly present in Accounting and Analytical Methods) which requires the articulation of the pertinent information purpose through an additional specific assumption (to be chosen from the many alternative objectives).

Interpretation through Instrumental Hypotheses

Whereas the basic assumptions ought to constitute a common frame of accounting
systems in general, the specific assumptions may serve to give interpretation to the overall theory. In this connection we may refer the reader to the beginning of this paper where the neglect of and need for "interpretation" in accounting was discussed. From the very outset of my proposal I pointed at illustrations of specific hypotheses and repeatedly stressed their exigency by such phrases as:

While the preceding assumptions (containing a priori as well as empirical notions) are of truly general nature, a series of secondary, empirical assumptions (in the following called hypotheses) are required. But one of the important tasks of accounting theory is the formulation of various alternative sets of hypotheses required for specific purposes. Yet, before this task can be explored (see Chapters 7, 8 and 9) it was indispensable to acquire a clear notion about the foundation on which our discipline rests.

To disregard these specific empirical hypotheses means to misunderstand the very essence of the theory outlined in Accounting and Analytical Methods. Yet Williams and Griffin seem to limit their glance only to its mathematical aspect and say "... the mathematical formulations of the accounting processes by Mattessich (a footnote refers to Accounting and Analytical Methods)—are examples of theoretical expositions which rely for their validation on the truth criteria of mathematics." But the theoretical structure, presented in Accounting and Analytical Methods as well as in the revised German version, must be verified or refuted through empirical means, above all by testing the specific hypotheses—something that cannot be emphasized strongly enough.

It may be of interest to learn that some auxiliary propositions can be formulated either as conclusions (theorems) or as auxiliary assumptions (obviously, only in the latter case do they belong to the set of premises). Whether the one or the other alternative is chosen might be a matter of taste, but definitely depends on the inclusion or exclusion of a basic assumption calling for articulation of the information purpose as a placeholder. If this assumption is explicitly stated then some of the auxiliary propositions might be derivable as conclusions; if it is not included in the general part then most of the auxiliary propositions become premises (from which further specific conclusions will follow). This latter version was used in Accounting and Analytical Methods in contrast to Die wissenschaftlichen Grundlagen des Rechnungswesens which uses a general placeholder for specific goal propositions and therefore contains 19 instead of 18 basic assumptions. But the latter version therefore requires a smaller number of auxiliary premises and thus may be deemed more elegant.

Conclusion and Testing of the General Theory

On the basis of the preceding subsections we may now draw some major conclusions and formulate, what I consider, the chief message of this paper:

1. The testing (verification or refutation) of a general theory of accounting must invariably be tied to the specific empirical propositions governing particular accounting systems for use in actual practice. Accounting cannot be anything else but an empirical (normative) discipline, and hence there cannot exist purely abstract or nonempirical accounting theories; what may exist are uninterpreted

19 The reader ought to be aware that interpretation of a calculus or uninterpreted theory may be achieved by either a separate set of rules of interpretations or by incorporating these rules as premises. In the latter case Carnap speaks of meaning postulates; see Rudolf Carnap, Introduction to Semantics (Harvard University Press, 1942).

20 Accounting and Analytical Methods, p. 41.

21 Ibid., p. 45.


23 Chapter 4 of this book demonstrates in which way specific or auxiliary propositions can be derived as conclusions from the basic assumptions including the goal assumption.
calculi of accounting, but they are meaningless unless at least provisions for possible interpretations are made (as pointed out such provisions were made in Accounting and Analytical Methods and more elaborately in Die wissenschaftlichen Grundlagen des Rechnungswesens).

2. A particular accounting system is tested by trying to determine systematically whether it is the most "satisfactory" system "under the circumstances," i.e., for a well-specified purpose. That this involves many conceptual and methodological difficulties was discussed in the present paper. But the statement holds quite independent of these difficulties. In my view it is this testing of particular accounting and other management information systems which ought to be the central concern of theoretical as well as practical accountants.

3. A general theory of accounting must be created in a recursive but noncircular way: starting from the basis of an operational definition of accounting (see the second section of this paper), fairly sharp but preliminary boundaries of what constitutes an accounting system should be drawn on the basis of past experience and existing information needs. Then, all systems obeying the conditions of the operational definitions ought to be tested. If some of those specific accounting systems do not fulfill the specified purpose to the degree desired, the "why?" must be determined. If the failure is due to some auxiliary propositions then these hypotheses have to be exchanged or amended, thus the structure of the specific accounting system, but only of that, changes. If, however, the failure is due to some basic assumption, the latter has to be exchanged or amended; thus the structure of both the general theory and the specific system will change. In this way the general theory is verified or refuted every time a specific system is put to test.

This testing of a general accounting theory by way of the empirical verification or refutation of its interpreted systems, seems to me the only way of conforming to the requirements of an empirical discipline. Thus factual refutation, even of a general theory, is conceivable and circularity is avoided.

Indeed, refutations and consequent revisions of the general theory are expected, perhaps frequently in the experimental stage, and hopefully less frequently in the mature phase.

4. The methodology thus described is independent of the boundaries of the general theory. Thus by choosing a narrower or broader set of basic assumptions, accountants may agree to concern themselves only with double-classificational models or with management information systems of wider scope. Most (but certainly not all) of my basic assumptions will hold for any management information system which requires a numerical scale for measuring values, scales for measuring quantities and time intervals, economic objects, subjects, entities, structures and business events, articulation of a purpose and interpretations of "value" and "income," a classification system, a certain degree of aggregation and some kind of periodization. These basic assumptions may not be very exciting from a behavioral point of view, but they are an excellent means to counteract the centrifugal tendencies of modern accounting and related areas. Furthermore, the

... Without interpretative rules, a theory would reduce to an uninterpreted calculus which points to nothing beyond itself. It would be as empirically irrelevant as the game of chess." (C. J. Mowry, "Professor Samuelson on Theory and Realism: Comment," American Economic Review (December 1965), p. 1159.

Circularity for example would be involved in the following situation: (1) The general theory and analytical definition stipulate the basic assumptions (conditions), (2) the basic assumptions determine the specific system, and (3) the general theory is verified by testing whether the specific systems fulfill the conditions stipulated in the analytical definition. The attentive reader will have noticed that my suggestion for verification of the general theory is radically different from this circular one, because the former depends on the fulfillment of well-defined factual purposes by the interpreted systems, whereas the latter merely hinges on the observance of definitional conditions.
articulation of these conditions in a general way and their subsequent interpretation were previously not self-evident at all. For instance, several of these conditions like specialization of purpose, interpretation of value, economic subjects, and degree of aggregation were made only implicitly or quite unsystematically in traditional accounting.

5. The formulation of hypotheses for specific accounting purposes through behavioral research is (together with analytical research and methodological clarification) one of the major tasks faced by future accountants. Williams and Griffin offer a most revealing classified survey of major empirical research projects carried out during the second half of the sixties. By glancing at this survey or scanning recent accounting literature, the reader will notice that most empirical accounting research is of peripheral nature from the viewpoint of designing accounting systems. That is to say, there exists an insufficient number of empirical research projects that deal with such important questions as the following: (a) How purpose-oriented are users of accounting information, and which kind of information would they desire or need for which purpose? (b) What is the effect of different interpretations of value, income and realization on users of accounting, and above all, which interpretation matches which purpose? (c) What is the effect of different allocation and classification schemes, different degrees of aggregation, different periodizations (interim reports) on users of accounting, and above all, which scheme matches which purpose?

Only if behaviorally oriented accountants answer these and many other relevant questions to a high degree of reliability will the analytical accountants and methodologists be able to fuse the pertinent results to a theory that provides testable management information systems for specific objectives. Academic history offers ample proof that only through cooperation and mutual understanding of observers and experimentors on one side and theorists or formalists on the other, can knowledge be advanced in the long run. Kepler could not have developed his analytical scheme of the planetary orbits without the observational results of Tycho Brahe, nor could Einstein have developed his relativity theory without any knowledge of the experiments of Faraday, Galilei, the Michelson-Morley team and others. Although accounting is no pure science but pursues a predominantly instrumental task, as an academic discipline it has grown complex enough to justify a division of research according to inclinations and talents. Such a division of labor is as indispensable as is the close cooperation between those specialists.

6. Finally, the cathartic task of our transition period lies in the slow but serious endeavor to convert rules of thumb into well-grounded, purpose-oriented or instrumental hypotheses. Such a process of conversion must not be based on the fallacious notion that action is the test of theory, but rather on the insight that action can be improved, in the long run, by cognition of relationships with high degrees of reliability.


9 A rule is grounded if and only if it is based on a set of law formulas capable of accounting for its effectiveness. The rule that commands taking off the hat when greeting a lady is groundless in the sense that it is based on no scientific law but is conventionally adopted. On the other hand, the rule that commands greasing cars periodically is based on the law that lubricators decrease the wearing of parts by friction: this is neither a convention nor a rule of thumb like those of cooking or politicking: it is a well-grounded rule. We shall elucidate later on the concept of having a rule on a law.” Bunge, Scientific Research II, pp. 132-33.