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Accounting Essays by Professor William W. Cooper: Revisiting in Commemoration of his Ninety-Fifth Birthday

Over a career extending back to the late 1930s Professor William W. Cooper has published books and articles in the field of accounting, mathematics, operations research, management science, engineering, economics, public policy and the behavioural sciences, reflecting wide interdisciplinary scholarship. To commemorate his ninety-fifth birthday in 2009, we publish excerpts from twelve of his accounting essays, together with postscripts adding to their historical context. We also publish Thomas Burns' Citation when Cooper was inducted into the Accounting Hall of Fame in 1995 and Professor Cooper's Response to the Citation. Two appendixes list all Cooper's books and articles in the field of accounting, and the honours and awards he has received in a long and distinguished career.

Key words: Auditing; Economic accounting; Enterprise accounting (managerial and financial); Mathematical models; Social accounting.

Over a long and remarkably productive career, Professor William W. Cooper (born on 23 July 1914) has made many pioneering contributions in a variety of fields. He has 545 scientific professional publications (and still counting), with 34 publications in accounting. The remaining 511 non-accounting articles and books are in the field of mathematics, operations research, management science, engineering, economics,

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This research is dedicated to Ruth Cooper (JD, Esq.), William W. Cooper's wife and best friend. A lawyer in the state of Pennsylvania, she fought for women's social issues and supported underprivileged families. Earlier, during World War II, Ruth Cooper worked for the War Relocation Authority which had charge of the Japanese relocation camps. Shocked by the treatment that these U.S. citizens were receiving with no recourse to lawyers permitted, she decided to help underprivileged people and was one of the first individuals to understand the importance of women's social issues. She decided to dedicate her life to helping women and underprivileged families and the best way to do this was to become a lawyer. She became a true lawyer who worked for the betterment of American society.

public policy and the behavioural sciences, reflecting Cooper's wide interdisciplinary scholarship.¹ More importantly, Cooper's former doctoral students now number over 200 (and again, still counting) actively engaging in research in various disciplines and countries.

To commemorate his ninety-fifth birthday, we considered a collection of newly written essays by Cooper's former students, a special issue of a journal on his contribution, or 'revisiting' essays written by him. We chose revisiting because the recent financial crisis made the revisit particularly worthwhile. When Cooper's mentor, Eric Louis Kohler (American Accounting Association Past President), passed away in 1976, Kohler's 87 essays were republished in their entirety in a volume of 573 pages, entitled *Eric Louis Kohler: A Collection of His Writings (1919–1975)*, edited by W. W. Cooper, Y. Ijiri, and G. Previts (the last two are also AAA Past Presidents) and published by the Academy of Accounting Historians in 1980.

In this effort, however, we direct ourselves in the same direction but at substantially reduced length to fit the needs of journal, as opposed to book, publication. Thus, we decided to use an 'excerpt method' (*à la Reader's Digest* on a smaller scale), using only twelve (that is, 40%) of the accounting essays, adding postscripts (i.e., commentaries) for each essay, and a closing section to integrate Professor Cooper's interest in macro-accounting (e.g., social accounting) and micro-accounting (e.g. enterprise accounting). In the appendixes we list all Cooper's books and articles in accounting, and the honours and awards he has received.

In August 1995, Professor Cooper was inducted into the Accounting Hall of Fame at the Ohio State University. The Citation written by Thomas J. Burns was an excellent one, covering his subject's academic and personal history in some detail. Furthermore, Cooper's Response was even more superb and inspirational, touching upon some of the twelve essays excerpted here and explaining in his own words why the merging of theory and practice is necessary. Hence, with permission, we put the Citation at the start of our paper and the Response just above the Conclusion.

Professor Cooper's first published article was an economic analysis entitled 'The Yardstick of Public Utility Regulation' that appeared in June 1943 in the *Journal of Political Economy* (Vol. 51, No. 3, pp. 258–62). In fact, still earlier in 1938, he published a proceedings paper for the Committee on Capital Gains Taxation of the National Tax Association which he co-authored with E. L. Kohler. In July 1945 Cooper and Kohler published in *The Accounting Review* an article, 'Costs, Prices and Profits: Accounting in the War Program' (see Essay 1 below). On 31 August that year the American Institute of Accountants (currently the American Institute of CPAs) established a new award and chose their article as the most significant contribution to accounting in the year of its publication.

In addition to the 1945 paper, we review eleven more accounting essays to highlight varieties of issues covered in Cooper's accounting papers. In implementing our excerpt approach, we present a brief introduction to each paper, followed by a highly

¹ Glover and Sueyoshi (2009) summarize the contributions of Professor Cooper in operations research and management science. The references in their review article contain more than 200 selected articles prepared by Professor Cooper. See also Cooper (1996).

condensed central portion of the paper and ending with conclusions. At the end of each essay, a postscript is added to cover supplemental information that is pertinent to the essay. Our focus is not so much on the individual essay but on the network of essays which involve dynamic patterns and resulting contributions. For this reason, we decided to present the essays chronologically.

Due to space limitations, we omitted mathematical formulas, tables, figures, original footnotes, etc. Fortunately, JSTOR (Journal Storage) is now widely available and reproduces many old journal articles. In fact, most of our selected articles are downloadable from JSTOR. It is hoped that many readers will go beyond the excerpts in order to evaluate the entire contribution.²

INDUCTION OF W. W. COOPER TO THE ACCOUNTING HALL OF FAME

Citation by Professor Thomas J. Burns, Fisher College of Business, The Ohio State University, at the American Accounting Association Annual Meeting in Orlando, Florida, 14 August 1995.

He has been a catalyst of change on a world-wide basis for more than 50 years: In his research inspired teaching, as an editor for many periodicals, and as a consultant to private, governmental, and public institutions. A prodigious author, his writings often focused on quantitative and creative approaches to management. Equally important have been his contributions to management education as noted in Ford and Carnegie Foundation reports. Working with others, he has authored 17 books and over 450 articles including ones with Hall of Fame members Robert Trueblood, Eric Kohler, and Yuji Ijiri. With his long-time collaborator, the mathematician Abraham Charnes, he was known everywhere as 'Mr Linear Programming', partly because, together, they developed whole new areas of uses and research such as 'goal programming', 'chance constrained programming', and more recently 'data envelopment analysis'.

Born in Birmingham, Alabama in 1914, his father was a bookkeeper and later a distributor for Anheuser-Busch. When he was three years old, the family moved to Chicago where his father owned a chain of gasoline stations that he lost in the Great Depression. He continued in high school only until the end of his sophomore year. With his father in ill health and no family revenue, he had to work at whatever he could find. This included everything from professional boxing to spotting pins in bowling alleys and caddying at golf courses.

While hitchhiking to a golf course one day, he met Hall of Fame member, Eric Kohler, who thereafter became his life-long mentor. This included a loan of funds which enabled him to start a non-degree track at the University of Chicago. He quickly learned to like the academic atmosphere and soon took the college entrance examinations, intending to become a physical chemist because that seemed to offer the best chance of a job. At about this time, Kohler, then a principal with Arthur

² Since the excerpted portions published here have been reviewed and updated by Professor Cooper, the downloaded journal articles may not match these excerpts exactly. Also some sentences are repeated a few times intentionally as, by the nature of excerpts, we repeated them for ease of access by readers.

Andersen, asked him to look over the mathematics used in a patent infringement suit in which Andersen had been retained by the defendant. He found errors in the mathematics used by the plaintiff's engineers and Andersen hired him full-time in the summer and part-time during the school year. This awakened his interest in accounting, and so he changed his major from chemistry to economics at the University of Chicago, and Kohler helped him to learn accounting. He graduated Phi Beta Kappa in economics in 1938.

Kohler had by then left Andersen and assumed the position of Controller for the Tennessee Valley Authority. Kohler brought him to the TVA to head up work on 'procedural auditing' (what would now be called 'performance auditing') as well as to advise Kohler on the mathematics of cost allocation and other disputed matters in which the TVA was involved. This included helping Kohler to prepare testimony on these and other matters to be investigated by a Joint House-Senate Investigation Committee. Most of the work was completed by mid-1940 so he left to become a PhD candidate at Columbia University, where he had been awarded a doctoral fellowship in the School of Business. After passing his prelims in 1942, he again left academia to join the Division of Statistical Standards at the U.S. Bureau of Budget (now the OMB) where, as part of the U.S. war effort, he was placed in charge of coordinating all of the Federal Government's accounting and accounting-related statistics programs. By late 1944, with the war coming to an end, he left to teach at the University of Chicago.

In 1946, he returned to Washington to chair a committee to decide the fate of various war-time programs in financial statistics. He then transferred to Carnegie Institute of Technology (now Carnegie Mellon University) where he helped found, first, the Graduate School of Industrial Administration and, later, the School of Urban and Public Affairs. There was time out, however, to develop 'end-use' audits that Kohler wanted to institute as Comptroller of the Marshal Plan. In 1976, after 30 years at CMU, he went to the Harvard Business School to help reorient their doctoral programs while holding the chair in accounting named for Hall of Fame member Arthur Lowes Dickinson. This task completed, in 1980 he went to the University of Texas where he was initially appointed to Professor of Management, Accounting and Management Science, and Information Systems, and is now the Foster Parker Professor of Finance and Management (Emeritus) and the Nadya Kozmetsky Scott Centennial Fellow in the IC² Institute.

He has been awarded honorary doctor of science degrees by the Ohio State University, Carnegie-Mellon University, and will soon be awarded the degree of *doctor honoris causae* by the University of Alicante in Spain. In 1945, he received an award for the most valuable article on accounting, the first ever awarded by the American Institute of Accountants (now AICPA). A fellow of the Econometric Society, he was founding president of the Institute of Management Sciences, and he was also president of the Accounting Researchers International Association. He was the Director of Publications for the American Accounting Association. In 1990, he was named an Outstanding Accounting Educator by the same organization. He was Visiting International Lecturer for the AAA, travelling abroad in 1986 to lecture on accounting topics and visit with scholars in Latin America. In 1982, he was

co-recipient of the John Von Neumann Theory Medal, jointly awarded by the Operations Research Society of America and the Institute of Management Sciences. In 1988, he received the Distinguished Service to Auditing Award from the Auditing Section of the AAA as well as an award for serving as the founding editor of *Auditing: A Journal of Practice and Theory*. He has also received three McKinsey Foundation Awards for the most valuable article of the year on a management topic, and he has been a consultant to more than 200 institutions including the Marshall Plan, the U.S. General Accounting Office, UNESCO, and others. He believes that one of his greatest contributions was keeping his student, Hall of Fame member Yuji Ijiri, in accounting when he was almost ready to switch disciplines under the influence of Nobel Laureate in Economics, Herbert A. Simon. His wife Ruth, always his teammate, is a lawyer who practised actively as a member of the bar for 30 years in Pittsburgh. Just back from serving as plenary speaker at the meetings of the European Operations Research Societies' research conference in Israel, he is the fifty-fifth member of the Accounting Hall of Fame: William Wager Cooper.

TWELVE EXCERPTS FROM ACCOUNTING ESSAYS BY
WILLIAM W. COOPER

Essay 1: E. L. Kohler and W. W. Cooper, 'Cost, Prices and Profits: Accounting in the War Program', *The Accounting Review*, Vol. 20, No. 3, July 1945, pp. 267–308. (Winner of the AICPA award for the most significant article on an accounting topic in the year of publication.)

One of the most recurrent problems within the field of accounting occurs when expenditure is recognized as an expense or potential expense is its allocation or spread over periods of time, and over common uses or benefits within a single period of time. The unwisdom of establishing universal rules in the face of the wide lack of governing accounting principles was almost universally recognized; yet decisions in individual cases, often involving the inclusion or exclusion of millions of dollars, had to be made promptly in the interest of a vigorous prosecution of the war. Individual judgments can not generally be a substitute for commonly employed rules of thumb, particularly where the claim of an individual enterprise is adversely affected; a decision based on such judgment runs the risk of being regarded as arbitrary and unilateral. Standards for the distribution of joint costs have been proposed many times, and the government's administrative agencies, under pressures to institute uniformity as well as substantial justice in their procedures, have frequently been on the point of devising them. In the interests of sponsoring, or at least carefully guiding, the formation of standards followed by the profession, accountants might well explore the possibility of obtaining some agreement on the problems of cost spreads with which administrative agencies have been dealing and with which they will likely be concerned for years to come.

Further developments in the field of accounting and statistics will undoubtedly be made. The reconversion pricing program of the OPA (Office of Price Administration) as an example involved forecasts of costs, particularly for items on which production was discontinued, and statistical devices must be brought to bear if such

forecasts are to achieve any high degree of dependability. Close pricing, company pricing, and predetermined termination charges also involve statistical forecasts of costs, prices, and profits. In the development of these programs, the customary representatives of business played a less important role because of their inability to discuss the basic problems of cost and production. Further development of accounting-statistical techniques may impose a similar fate on the accountant who limits his future usefulness by his preoccupation with past events.

Another field of interest has been developing with the introduction of such measures as the Murray 'Full-Employment' bill. If such programs are to be undertaken, the Federal Government will need vast quantities of current accounting information for the building up of estimates of national income, corporate savings, capital expenditures, and other figures for planning purposes. A step in this direction has already been taken by the SEC (Securities and Exchange Commission) in quarterly collections from registered corporations of data on working capital and capital expenditures. In the field of small business, such agencies as the Smaller War Plant Corporation, and even the U.S. Congress, through the Senate Committee on Small Business, pointedly indicate that they have been hampered by lack of adequate information on small, unincorporated enterprise.

The Securities and Exchange Commission's *Survey of American Listed Corporations* and the Federal Trade Commission's *Industrial Corporation Reports* were discontinued as a result of the war. The Act under which these agencies operate seems to imply, however, a rather positive and continuing Federal responsibility for the disclosure of corporate financial information. Further expansion in this direction is quite likely. Measures have been introduced in Congress which would extend the jurisdiction of the SEC to all corporations with more than a few hundred stockholders. It is interesting to speculate on the effects of similar requirements for disclosures of costs. Such measures would have far-reaching implications, especially on the development and control of monopolistic practices. The assumptions of a competitive economy require that the purchaser have full and free access to any and all information which, to him, is relevant. The widespread nature of Government programs during the war acquainted large numbers of persons, including many Federal officials who will return to private business, with new uses of such information. On the other hand, many business managements have for the first time been exposed to the necessity of making disclosures of an intimate nature with respect to costs and financial operations; but, as already noted, their fears were dispelled once they enjoyed the benefits which may follow such disclosures.

In any great emergency the public has come to expect that the Government will limit prices. The control may take the form of establishing minimum prices, as in the NRA (National Recovery Association during the great depression) did, or it may take the form of setting maximum prices; in either case, cost details and other financial information would be required. Another crisis such as the present one would undoubtedly extend the field of profit control, despite conflict with the full utilization of the profit motive as a means of guiding and stimulating production. But if such control and certain pressure shall be undertaken, it seems futile, as well as discriminatory, at least on economic grounds, to penalize only war contractors. A

‘total’ war effaces the distinction between military and civilian production. Profit control, such as that intended by the present renegotiation statute, would be economically and administratively more desirable if the whole economy were blanketed under the measure. To single out and penalize business concerns from which something more than the utmost is expected has been justly criticized. Moreover, controls over prices and profits and the devices adopted for the checking of inflation might well be centred in a single agency.

Postscript Essay 1: The authors emphasized: ‘In the successful operation of any of these programs, accounting information plays a vital role. Predictions as to further developments may be hazardous, but it is a safe guess that the responsibilities of the accounting profession would be multiplied. And when and if a national crisis is again faced, the existence of an articulate, coordinated, self-imposed body of standards would add immensely to the worth of the profession to the nation.’ The last sentence poses a serious question to the profession. About 65 years later, the war with Iraq started. Financial debacle of the nation and the world in 2008–09 added a further challenge to the accounting profession. Will the accounting profession be able to meet the challenge? Further questions include: Are ‘wartime accounting’ and ‘peacetime accounting’ fundamentally different? Essay 1 is particularly interesting because it delineates what kind of crisis the authors had to be particularly prepared for.

Essay 2: W. W. Cooper, ‘Statistical Use of Accounting Information in Federal Economic Policy Formation’, *The Accounting Review*, Vol. 23, No. 3, July 1948, pp. 244–50.

The purpose of this paper is to discuss recent developments in the statistical utilization of accounting data by the federal government. In particular, attention will be focused on the statistical utilization of accounting information for what may be called ‘top-policy’ purposes. Most accountants are familiar to some extent with the utilization of accounting data by various federal agencies for direct administrative purposes. In the administration of tax laws and for regulatory bodies, accounting data have proved indispensable for handling individual cases. Moreover, most accountants are probably familiar with the fact that individual case information is frequently compiled into statistical information as a means of orienting agency policy, setting standards, and serving as a basis for recommendations to the Congress.

At times information collected for administrative purposes is combined with data from other sources for purposes of analysis and recommendations looking toward the formulation of policies for grappling with problems affecting large sections of the economy. Frequently it has been necessary to gather supplementary information beyond that required and already secured for administrative purposes. In some cases the statistics which could be prepared from the files of administrative agencies have proved so unsatisfactory that it has been necessary to devise a statistical collection which would of itself serve the purpose on hand.

Such statistical collections have, for the most part, been confined to a single collection designed to aid in the solution of a particular problem. With the assumption of federal responsibility for maintaining full and stable employment, the growth of interest in promoting and encouraging small business, and the attempt to place the antimonopoly programs on a more systematic basis than reliance on complaints, it has become necessary to provide for continuing and current statistics on business operations. Federal activities in this direction have grown rapidly since

the war. It is with the statistical compilation of accounting data for such general economic analysis and policy formation that the present article will be most concerned.

There have been three major defects in our knowledge of business financial operations: (1) lack of currency; (2) lack of coverage (a) of important items and (b) of important areas; and (3) lack of reliability in data secured. Each of these items must be viewed in terms of economics, accounting, and statistics before criteria of satisfactoriness can be established—and achieved. Administrative feasibility, both from the point view of the collecting agencies and the suppliers of information must, of course, weigh heavily in all program considerations. The deficiencies in our knowledge of what has been and is happening in the small business area have been particularly conspicuous and difficult to repair: The number of organizations to be covered is large and diverse; the high birth and death rates of small business result in a constantly shifting universe which makes comparisons and interpretations of trends difficult; record-keeping practices are inadequate and diverse. Despite the difficulty, these problems must be solved. Small business is an important area of policy decisions in its own right, and it is an important component of any over-all analysis of the economy.

In a sense these recent developments in business financial statistics represent extensions of accounting to new areas of great importance. These extensions require the development of new techniques and point of view, and it is hoped that the instrumentalities of classification and analysis made possible by accounting will gain in the process. Full utilization of the potentialities of accounting will occur, however, only if accountants can be persuaded to take a continuing interest in these developments and to acquire the necessary familiarity with the problems involved to adapt their technique to the requirements. It is not necessary to raise questions of precedence between accounting, economics, and statistics; in this field there is an opportunity for fruitful contribution on the part of all three disciplines to the solution of important problems of public policy and to the steady advancement of knowledge. The possibility of contributing to either or both of these fields constitutes a challenge which the profession should willingly accept.

Postscript Essay 2: This essay, published when Cooper was 34 years old, already indicates his strong macroeconomics orientation. He is calling for help from the accounting profession to assist the federal government for its economic policy formulation, in particular the statistical utilization of accounting information for what may be called 'top-policy' purposes. Cooper states, 'There have been three major defects in our knowledge of business financial operations: (1) lack of currency; (2) lack of coverage (a) of important items and (b) of important areas; and (3) lack of reliability in data secured. Each of these items must be viewed in terms of economic, accounting, and statistics before criteria of satisfactoriness can be established—and achieved.' He ends the paper with the strong appeal to accountants. 'In a sense these recent developments in business financial statistics represent extensions of accounting to new areas of great importance. These extensions require the development of new techniques and point of view, and it is hoped that the instrumentalities of classification and analysis made possible by accounting will gain in the process.'

Essay 3: W. W. Cooper, 'Social Accounting: An Invitation to the Accounting Profession', *The Accounting Review*, Vol. 24, No. 3, July 1949, pp. 233–9.

Today, in the sphere of social accounting and national-income analysis, an extensive development of accounting is occurring which neither W. Sombart³ (1916) nor H. M. Robertson (1933)⁴ had visualized. This development is going forward rapidly in the United States and other countries (including non-capitalist countries such as Russia), and on the international as well as the national level. Not only are the international agencies such as the United Nations and World Bank interested in furthering these developments but the Economic Cooperation Administration (ECA), the United States agency for administering the Marshall Plan, also utilized its considerable resources in this direction, particularly under the influence of Kohler and Cooper who worked as controller in the ECA.⁵ The concepts of national income and related totals represent a cornerstone of U.S. government policy as is clear from the prominent place and extensive discussion accorded these data in the various *Economic Reports of the President to Congress*.

To date this work has progressed almost entirely without participation from accountants. This lack of participation has been unfortunate. Accounting participation might have served to accelerate certain developments. It should not have taken so long to realize, as Hagen⁶ notes, 'that national-income measurement is best thought of as double-entry bookkeeping'—a perception that at once made clear 'the exact relationship between income and output'. Moreover, the process of analysis has not been carried through to its ultimate conclusion. It is particularly deficient on the balance-sheet, and especially the equity, side. In the hands of economists it was only natural that emphasis should rest on income measurement. Only recently, and imperfectly, has attention begun to be devoted to the balance sheet. To date, however, resolution to the equity accounts has not been successfully carried out. It

³ Werner Sombart (1863–1941) was a German economist and sociologist. He was the head of the 'Youngest' Historical School and one of the leading Continental European social scientists during the first quarter of the twentieth century. See Sombart (1916) for one of the most important contributions.

⁴ The original article dated the publication of Robertson as 1935. However, an Internet survey indicates original publication was in 1933.

⁵ Kohler was the controller of the ECA, which was responsible for conducting the Marshall Plan, and Professor Cooper was in charge of the end-use audit. During World War II (1942–45), Professor Cooper was employed as a principal economist in the division of statistical standards of the executive office of the President, which was responsible for coordinating all federal government statistical activities. Professor Cooper was placed in charge of all accounting statistics at the end of World War II. He chaired an interagency committee that was responsible for developing a postwar program that would take into account both pending changes in the economy and the changes that occurred during the war. In the process, he was responsible for an order that required the U.S. Internal Revenue Service to make information available to the national income unit of the Department of Commerce that would otherwise have been legally treated as highly confidential.

⁶ Mr Hagen was a consultant of the Marshall Plan. The Marshall Plan (officially the European Recovery Program) was the primary plan of the United States for rebuilding and creating a stronger foundation for the allied countries of Europe, and repelling communism after World War II. The initiative was named for Secretary of State George Marshall and was largely the creation of State Department officials, especially William L. Clayton and George F. Kennan.

is difficult to believe that this 'balance-sheet backwardness' would have occurred if accountants had participated more systematically in these developments.

To use a common term of commercial accounting, Mr Hagen's interest lies in the direction of system design and installation. In the case of Marshall Plan aid, administered by ECA for the United States and coordinated by OEEC (Organization for European Economic Cooperation) for Europe, the administrative needs for the techniques of social accounting were great. Countries cannot plan nor could ECA review the programs in any systematic fashion without something in the way of social accounting. The need may be most vividly illustrated by reference to the so-called 'end-user audit' for which the controller's office of ECA is responsible. The function of the end-use audit is to determine (a) whether materials are being used in accordance with the approved program and (b) to examine, in the field, the efficacy of the program. To trace through each transaction—for example, to follow each shipment of wheat to the final consumer—was an exceedingly costly operation. The parallel might be drawn in terms of an attempt to trace and audit each transaction and flow of goods in a large multi-company operation without the benefit of systematic records. Just as in the case of commercial audit it is more expeditious to work backwards from prepared statements and functioning systems (which permits the confident use of 'spot checks' and other devices developed in commercial accounting) so the process of ECA audit could have been facilitated if the countries had develop themselves as their own systems and statements.

It might seem that attention should be restricted to commodities furnished with U.S. Government aid. If locomotives which had been requested by a particular country for hauling coal were discovered being used for hauling pleasure passengers, ECA might take administrative action. But little would be gained if the country corrected the situation by using ECA locomotives to haul coal and diverted an equivalent number of its own locomotives to hauling pleasure passengers. Hence, the need for end-user audits was found in general instances of such substitutions.

Since assets furnished by ECA constituted only a small (but critically important) portion of the total assets of the participating countries, sensible judgments could be made only by systematic examination of the use of all the resources of the economy. This can only be done if the countries themselves had developed the necessary social accounting systems.

The Federal Reserve Board is, of course, interested in money flows as a focal point for policy decisions. In Copeland's analysis the intra-sector transactions are consolidated or 'netted out'. His analysis proceeds on a gross basis between sectors. His statement may be viewed in terms of the usual gross statement of sources and uses of funds in which primary emphasis is placed on operating statement accounts and in which the working-capital section is segregated for special attention. It is natural that he then proceeded from double-entry to quadruple-entry accounting. In studying both parties to a transaction he must, of course, analyse the double-entry on each side of the transaction. The quadruple-entry approach thus epitomizes a logical extension of accounting from the private to the social sphere.

Postscript Essay 3: ‘Social accounting’ is one of the several issues about which Cooper feels strongly. From his macro-perspectives, he wishes to expand the concept of ‘accounting entity’ from the corporation to the nation and to the society as a whole. Here, accounting entity is not a corporation with its shareholders but a society with its members. Instead of net income, it is a social performance measure. Cooper’s further extension is ‘national income accounting’. He says, ‘It should not have taken so long to realize . . . “that national-income measurement is best thought of as double-entry bookkeeping”—a perception that at once made clear “the exact relationship between income and output”. Moreover, the process of analysis has not been carried through to its ultimate conclusion. It is particularly deficient on the balance-sheet, and especially the equity, side. In the hands of economists it was only natural that emphasis should rest on income measurement. Only recently, and imperfectly, has attention begun to be devoted to the balance sheet.’ What is amazing is not just that Cooper advocated but, in four years he and his co-author, J. M. Crawford at the Statistical Office of the United Nations, demonstrated the feasibility of what they advocated. That is the main thrust of Essay 4.

Essay 4: W. W. Cooper and J. M. Crawford, ‘The Status of Social Accounting and National Income Statistics in Countries Other Than the United States’, *The Accounting Review*, April 1953, Vol. 28, No. 2, pp. 221–38.

In the paper, a distinction will be drawn between national income statistics and social accounting, despite the close relation that exists between the two fields. The former field is viewed as being concerned with compilation and publication of isolated aggregate figures such as national income or gross national product which purport to provide over-all pictures of a nation’s total economic activity. Social accounting, however, is concerned with details of structure and intra-sector flows in the context of a double-entry system of accounts. As a proper part of the system of social accounts various national income statistics may be synthesized. But social accounting provides much more in the way of detail and systematic analysis.

Despite its relatively recent origin, social accounting and auditing possesses marked advantages over the more traditional national-income-statistics approach. Rooted in the latter field it has taken a step forward in the way of subjecting these statistics to systematic accounting treatment. Hence, its concepts, or at least its basic methodology, lie closer to the practices with which accountants are already familiar. Thus, it seems appropriate to approach this review from the viewpoint of social accounting despite the fact that most countries have not evolved to this stage of development.

A review of the status of social accounting in countries throughout the world reveals certain salient features: (a) the paucity of published literature on this subject, (b) the existence of wide differences in country concepts and execution, and (c) the important promise held for the future.

Under the impetus of the Marshall Plan much progress was made in developing standardized definitions of the various concepts and accounts, and in fitting the available estimates for a number of European countries into a uniform system of national accounts. The former has been largely the work of the OEEC and is embodied in its publication, *A Standardized System of National Accounts*. In separate studies of the OEEC, this system has been applied to the national accounts data

for a number of countries. Using a somewhat more simple accounting system, the ECA (Economic Cooperation Administration) prepared, in so far as data were available, national accounts on a comparable basis for most of the countries participating in the Marshall Plan.

Actually the report, *A Standardized System of National Accounts*, is in the nature of an accounting manual with accompanying definitions, statements of objectives and methods. In recognition of the backward stage of social accounting in most countries, an effort has been made to arrange this manual on the simplest level that will portray the major elements of structure and function of an economy.

At the simplest level the manual provides for a social accounting structure based on three sectors and six accounts. The three sectors for which the manual recommends that accounts be kept are: (a) business enterprises, (b) general government, and (c) private households and private non-profit institutions. The six 'accounts' recommended are (1) National product and expenditure account, (2) national income account, (3) consolidated appropriation account for general government, (4) consolidated appropriation account for households and private non-profit institutions, (5) consolidated capital transactions account, and (6) consolidated account for the rest of the world. These 'accounts' may be viewed as controlling accounts for a more detailed series of accounts. Actually their status is more in the character of an accounting statement or report for classifying and summarizing transactions.

The nature and function of these major accounts may be classified by reference to each sector: (a) production accounts, (b) appropriation account, (c) capital transactions account, and (d) external accounts. The ambitions of social accounting lie far beyond their present achievements. The OEEC manual and similar efforts at present constitute little more than a hope. But this hope may be more pregnant for the future than the facts of current practice. Comparisons of the facts of today with the facts of little more than a decade ago show remarkable achievements in the spread and development of social accounting and national income statistics. Under the impact of necessity and with the help of energetic and wise leadership the developments of the next decade or so may prove even more remarkable.

Before concluding this section it may be well to list some of the advantages of social accounting. As contrasted with the 'global' approach, the advantages of social accounting are set forth as follows in *National Income Statistics 1930-1948*.

- (a) Even if no attempt is made to measure all the items in the working system of accounts, this approach permits the structure of transactions to be set out in a consistent way. Therefore, it provides a means of handling conceptual problems when passing from general theoretical definitions to their empirical equivalents. It also allows the logical relationships between the definitions of the national income totals and related aggregates to be seen clearly.
- (b) Since it enables one to indicate, in a systematic way, the interrelation of various sets of transactions, including the equivalents to any aggregate, it makes possible the most efficient use of the statistical information available. If various sets of aggregates which are connected by logical relationships are measured or

estimated directly, statistical discrepancies may arise. The necessary adjustments may be carried out in a general way starting from the accounting approach.

- (c) A social accounting system offers a framework for a systematic collection of information on transactions. It makes it possible to review the statistical material available and to indicate where the gaps exist, and thus it may serve as a program for research.
- (d) A system of social accounts can be drawn up in different ways depending on the particular theoretical system on which it is based. By means of an accounting approach, the practical implications of any theoretical system can readily be worked out in detail. A social accounting approach thus provides a means for developing classifications of transactions which satisfy both theoretical and practical criteria.
- (e) The social accounts provide a means for describing the structure of an economy and the way in which its parts and various aggregates are related. Thus, the social accounts . . . are particularly useful in connection with economic planning and forecasting, since any attempt to predict the magnitudes of economic variables must necessarily take into account the logical relationships among various aggregates. Obviously, single unrelated totals, such as the national income, cannot be very useful in this respect . . .

Postscript Essay 4: We now wish to introduce social accounting framework briefly. 'The six "accounts" recommended are (1) National product and expenditure account, (2) national income account, (3) consolidated appropriation account for general government, (4) consolidated appropriation account for households and private non-profit institutions, (5) consolidated capital transactions account, and (6) consolidated account for the rest of the world. These "accounts" may be viewed as controlling accounts for a more detailed series of accounts. Actually their status is more in the character of an accounting statement or report for classifying and summarizing transactions. The nature and function of these major accounts may be classified by reference to each sector: (a) production accounts, (b) appropriation account, (c) capital transactions account, and (d) external accounts.' The relations between these various accounts and the manner in which transactions are handled is shown in detail, including intra-sector transactions.

Essay 5: R. M. Trueblood and W. W. Cooper, 'Research and Practice in Statistical Applications to Accounting, Auditing and Management Control', *The Accounting Review*, Vol. 30, No. 2, April 1955, pp. 221-9.

More than two years ago, in response to the evidence of increasing interest in exploring the possibility of statistical applications to auditing, a small group was formed in Pittsburgh to investigate this area. The group, from inception, has consisted of accountants and statisticians who reflect both academic and practising points of view. The statisticians involved had some background in accounting and a strong interest in the application of statistics and related techniques to business problems. The accountants in the group have considerable familiarity with the literature dealing with statistical applications and some knowledge of statistical methods. It was considered neither necessary nor practical to require that all participants be skilled specialists in both fields.

During much of the period in which research was conducted by the Pittsburgh group, no formal arrangements were in effect between an academic institution and the public accounting firm. In the usual academic tradition, no restrictions were placed upon publication of any results thought to be significant either to the theory or to the practice of accounting or statistics. In consequence, both oral and written reports were frequently made to professional groups. In addition, the work was subjected to the detailed criticism of nationally recognized statistical and accounting consultants who were not members of the working group.

An effort was made to maintain a professional attitude toward the research underlying the activities of the group. The primary research aim was to further fundamental knowledge bearing on the marriage of statistics and accounting in ways that would serve to advantage practice as well as research in both fields. Every effort was made to proceed carefully, by testing conclusions in a rigorous, professional manner before giving them effect in practice.⁷

Initially, the existing literature was examined critically to establish and to appraise the accomplishments of others. After preliminary discussion of probable interest areas by the group and after the literature had been carefully reviewed, specific problem areas were selected for study. The applicability of statistical methods was tested by reference to concrete cases and study results reported in that form. Only live data were used. The advantages the case studies offer in the form of concrete detail were not allowed to obscure larger and more important issues because conscious effort was made to generalize results beyond the particular cases and ample opportunity was supplied for exploring relevant theoretical questions in both accounting and statistics.

In conclusion, it may be well to recapitulate the major features of this report. Significant points include the importance of the team approach, the need for obtaining guidance from fundamental requirements of accounting and auditing, and the necessity for proceeding in a fashion which protects the professional integrity of the statistician, as well as that of the accountant. The more rapid progress achieved in the area of accounting procedures and management control devices, as contrasted with purely audit problems, has been specifically noted.⁸

The need for new devices and approaches is acute. Among those who can be helpful in this connection are persons interested in the development of analytical models and in the application of electronic data-processing equipment, as well as statisticians and accountants. There are many benefits which can be achieved from

⁷ These consultants were led by E. L. Kohler for accounting and W. Edward Deming for statistics, both of whom responded positively to an invitation from Cooper, who was known personally to both of them because of prior working relations.

⁸ *Sampling Techniques in Accounting* (1957) by Robert M. Trueblood and Richard M. Cyert, two of the leaders of the Pittsburgh team, was the first book published on this topic. It had widespread effects on the use of statistical sampling techniques by CPA audit firms and the practice became so widespread that it received endorsement from the American Institute of Accountants (AIA). We might also note that Trueblood subsequently became President of the AIA and Cyert President of Carnegie Mellon University. Both continued their interests in the use of analytical techniques by management. See, for instance, Cyert (1975).

progress in these directions. There is also a very real danger of potential harm. The danger can be minimized if provision is made for performing research and its use in an atmosphere that uses thorough testing prior to any attempts to place these developments in practice on an extensive scale. Further, it is important that provision be made for adequate accounting guidance through all stages, from initiation to completion.

A large problem of applying statistical methodology to accounting control still lies ahead. It is believed that various materials recently published are evidence that progress is being made. Nonetheless, practitioners, as well as researchers, cannot afford to view the further development of the statistical approach with complacency. Only a concentrated attack, by both accountants and statisticians, on the entire battery of questions, like those described here, will develop a suitable basis for the complete integration of statistical techniques into accounting, auditing and management.

Postscript Essay 5: The use of statistical methodology in accounting is strongly advocated. 'Only a concentrated attack, by both accountants and statisticians, on the entire battery of questions . . . will develop a suitable basis for the complete integration of statistical techniques into accounting, auditing and management.' An important aspect of Essay 5 is Cooper's interest in implementing the idea. Working with Robert Trueblood, a partner in Touche, Niven, Bailey Smart, he developed a small group of accountants and statisticians in the Pittsburgh area. As will become evident, Cooper is not only a superb theorist but also a superb empiricist. In recapitulating the major feature of the report, Cooper states the significant points include 'the importance of the team approach, the need for obtaining guidance from fundamental requirements of accounting and auditing, and the necessity for proceeding in a fashion which protects the professional integrity of the statistician, as well as that of the accountant'.

Essay 6: A. Charnes, W. W. Cooper and Y. Ijiri, 'Breakeven Budgeting and Programming to Goals', *Journal of Accounting Research*, Vol. 1, No. 1, Spring 1963, pp. 16-43.

This paper explores some applications of Linear Programming (LP) to breakeven analysis with special reference to ways in which accounting and mathematics might be joined to influence an extended and uniform approach to problems in financial and budgetary planning.

LP was then relatively new, both as a branch of mathematics and as a tool for accounting. However, the mathematical techniques associated with LP have received widespread attention as well as some managerial applications under such names as 'operations research', 'management science', and the like. These, too, are now finding their way into accounting. Jaedicke (1961), for example, suggested an LP emphasis on optimizing objectives (e.g., maximum profit or minimum cost) may offer advantages over an analysis that centres on merely breakeven.

The pursuit of an optimum objective plays a prominent role in LP. However, this does not mean that *applications* are restricted to situations where optimization has been stated as an actual managerial objective. A variety of artefacts are available for use when other objectives are at issue and some of these same artefacts may be used to handle various kinds of *nonlinear* problems via mathematical models that are

suitably arranged for applying any of the standard *linear* programming solution methods.

These topics will be illustrated, at least in a simple way, by means of what is called a ‘goal programming model’ in LP. Comment will be interjected at various points to suggest how most of the objectives that have been discussed in the breakeven literature can be achieved via suitable variations on this approach.

By means of very simple examples, the preceding sections have endeavoured to show how LP might be joined with accounting in order to produce a coordinated budgetary planning model. This is, of course, only an ‘in principle’ illustration and it should not be interpreted to mean that a literal translation and extension of this particular model should be undertaken in every conceivable circumstance. Further research, especially on the network aspects of these accounting models, will probably be necessary in order to devise suitable artefacts that will avoid unwieldiness and achieve the efficiency that will undoubtedly be needed when actual applications to large-scale management problems are essayed. However, considerable progress has been made (and is being made) on the uses of LP in other areas—e.g., production scheduling—and there does not appear to be any obvious reason why similar kinds of research should not be equally successful when oriented in the direction of accounting. In fact, the incidence (network) models of LP have been the most successful of all so-called ‘model types’ in producing especially efficient solution methods and simplifying artefacts. This, of course, was one of the reasons that the model in the paper was oriented so that its double-entry accounting aspects could be brought mathematically into network form in the sharpest possible manner.

It is also worth observing that mathematical research has established that every LP model carries along with it another problem, called its dual. These mathematically established duality relations can also be used to effect still further simplifications. Furthermore, the standard methods of LP automatically, and without extra effort, supply solutions to both the model and its dual. This has proved to be especially useful in supplying guides whereby top management can evaluate the implications of its various policies as these are reflected as the constraints. Thus, still another feature of the budgetary coordination that can be secured from this quarter is brought into view by reference to the top- and down-the-line information guides that are simultaneously obtained when LP methods are employed that simultaneously solve both an original problem and its dual.

We now briefly examine some of the possible relations between mathematics and accounting. First we observe that, from a purely technical standpoint, the trial balance is the most fundamental of all accounting documents. It is, in fact, ‘the chart of accounts with relevant entries exhibited on its face’. But the extended spread sheet that we have just exhibited is only an alternative way of drawing up a trial balance and so it, too, achieves this same fundamental status.

Next we observe that, from a mathematical standpoint, any spread sheet is simply a matrix. LP also rests heavily on the mathematical theory of matrices and so the spread sheet idea provides a very natural bridge between mathematics and

accounting. This does not necessarily mean, of course, that either LP or the theory of matrices will be the only mathematics that could prove useful in accounting. This has not been true in the past and the future is not likely to prove more confining than past history has already suggested on those occasions when accounting and mathematics have been joined together.

There is, of course, a past tradition of association between mathematical developments and management practices. Werner Sombart, for example, the great German historian, virtually dates the origin of capitalist (industrial) development from the translation and extension of the Hindu-Arabic number system as published (in the *Liber Abacci*) by the Italian mathematician Leonard Pisano⁹ in 1202. This mathematical theory, which was thereby made available for use in western commercial enterprises, almost certainly constituted a necessary precondition for the development of accounting in its many modern aspects.¹⁰

The first clear and systematic exposition of double-entry accounting (at least for the modern Western world) was published in a tract on mathematics¹¹—Fra Luca Pacioli's *Summa de Arithmetica, Geometria, Proportione, et Proportionalita*¹²—and it is possible that historical research will yet reveal that the development of accounting was rather closely attended by the work of other mathematicians.¹³ Writings by Fibonacci and Pacioli already occupy a position of prominence and the

⁹ Better known as Fibonacci in the literature of modern mathematics. See Struik (1948).

¹⁰ *Vide*, Sombart strongly emphasized that Pisano (also called Leonardo da Pisa) in fact provided the basis for an exact science of commercial calculation. See also G. E. de Ste Croix, 'Greek and Roman Accounting', pp. 62 in Section 44.2 of Littleton and Yamey (1956).

¹¹ The divisions of Pacioli's book are given as follows by R. Emmett Taylor in Section 44.4, p. 179, of Littleton and Yamey (1956): 1. Arithmetic and Algebra, 2. Their Use in Trade Reckoning, 3. Book-keeping, 4. Money and Exchange, and 5. Pure and Especially Applied Geometry. See also p. 180 for Pacioli's recognition of his debt to Leonardo da Pisa.

¹² An English translation of Pacioli's treatise on bookkeeping may be found in *Introduction to Contemporary Civilization in the West* (Columbia University Press, 1946) as adapted from Crivelli (1924). D. Rosenblatt has, in this connection, also called our attention to another important (but less widely known) book by Pacioli—*De Divina Proportione*—which was illustrated by Leonardo da Vinci. (No English translation appears to be available but the *Quellenschriften für Kunstgeschichte und Kunsttechnik des Mittelalters und der Neuzeit* provides a German accompaniment to the original in *Fra Luca Pacioli Divina Proportione*, Constantin Winterberg, Wien, 1889. See also Sartor (1957, pp. 222, 230, 236).

¹³ Standard American writings on accounting history have not always been wholly aware of the issues raised by European historians of capitalism with respect to the roles they have assigned to accounting and related developments (e.g., Hindu-Arabic arithmetic) in achieving a widespread rationalistic view towards business capital along with an ability to reckon and control the processes of capital accumulation. See, for example, Littleton (1933). It is also true, of course, that these historians did not always pay adequate attention to the developments in American accounting. Sombart, for example, relies heavily on Leo Gomberg's *La science de la comptabilité et son système scientifique* and also his *Histoire critique de la théorie des comptes*. One reason is, perhaps, that Gomberg, by reasoning from accounting considerations only, had already achieved an explicit recognition of the fact that the double-entry principle carried with it a splitting apart of ownership and control which, only at a later date, was formulated by the American lawyer-economist, A. A. Berle.

somewhat later work by Simon Stevin¹⁴ appears to be achieving a greater degree of recognition.¹⁵

There are other mathematicians whose work might have influenced—or been influenced by¹⁶—accounting and managerial developments (and problems).¹⁷ But this would not be the place to discuss this topic in detail even if the evidence were at hand. We can, indeed, close with the following statement by Arthur Cayley, nineteenth-century mathematician, and one of the founders of modern matrix algebra¹⁸: ‘Bookkeeping is one of the two perfect sciences’.

Perhaps Cayley meant that, at bottom, the two are only one. In any event, from a mathematical standpoint, the notions of optimality, equilibrium, breakeven and linearity are all closely related to one another.¹⁹ So are the concepts of matrices and double-entry principles.

Postscript Essay 6: Cooper was long interested in public accounting with multiple social attributes until he encountered LP. The research that we have here described is originated from the PhD thesis of the first author,²⁰ who first discussed how to formulate breakeven analysis by LP. In the formulation process, Cooper and his co-authors found the formulation of goal programming (GP). The GP formulation is non-linear but it can be solved by any LP algorithm via their research effort. In addition to the LP-based breakeven analysis, the research discusses an accounting network model to express a balance sheet in a time horizon. It is clear that Cooper’s research interest has shifted from social accounting

¹⁴ See Section 44.5 prepared by ten Have in Littleton and Yamey (1956).

¹⁵ This statement is drawn from Sartor (1957, p. 254) in his discussion of Stevin’s *Livre de compte de prince à la manière d’Italie* . . . The references in Stevin (1955) were called to our attention by D. Rosenblatt and Section 65.1 pp. 1–24 contains an excellent sketch of Stevin’s life and work.

¹⁶ See *vide* in Leontief (1951, pp. 9–11).

¹⁷ Allowance should perhaps also be made for negative as well as positive influence. See, for instance, the reference on p. 65 in Section 44.2 (Littleton and Yamey, 1956) to the *Arte dei Cambi*, the guild regulations of 1299 which forbade the use of Arabic-Hindu numerals in the accounts of Florentine bankers. See also (Struik, 1948, p. 105). Another vivid example of delayed effects, and missed opportunities, is supplied by Charles Babbage, the British mathematician, whose early work on computing machines has now aroused a new interest in his other work on management. See also, Garner (1947, pp. 65–6).

¹⁸ From Littleton, (1933). See also Cayley (1895, Vol. VIII, p. XXIV in Biography), where it is noted that ‘Financial matters and accounts interested him [Cayley]; and only a few months before his death he published a brief pamphlet on book-keeping by double entry, which he had been known to declare one of the two perfect sciences. He could not resist some reference to the subject in his Presidential Address; marking the remark that the notion of a negative magnitude “is used in a very refined manner in book-keeping by double entry”.’

¹⁹ *Vide* the references to Cronhelm’s and Jocet’s equations on p. 311 of Littleton and Yamey (1956).

²⁰ This essay has fine memories for the first author of this review paper (Y. Ijiri), as it was his first accounting journal publication. Professor Cooper served as a chairperson of Ijiri’s PhD thesis committee. In the process of working with his mentor, Ijiri learned a lot about research. Working for a doctoral dissertation in accounting, he was able to explore many avenues for research. Dividing each transaction into debit and credit, and not allowing an imbalance between the two, the use of spread sheet (a square matrix) was highly useful. When a need eventually occurred to use rectangular matrices, he also learned ‘generalized inverse’ which exists even if the matrix is square or rectangular.

originated from economics to the methodological development (e.g., GP) originated from LP. A common feature between his social accounting and LP-based methodology development is that Cooper has been interested in how to deal with multiple social attributes. The development of GP was an initial step toward multi-objective optimization.

Essay 7: N. C. Churchill and W. W. Cooper, 'A Field Study of Internal Auditing', *The Accounting Review*, Vol. 40, No. 4, October 1965, pp. 767–81.

This paper is a report on the results of a field inquiry directed to ascertaining some of the behavioural consequences of auditing on the perceptions and subsequent behaviours of persons who have been subjected to one or more phases of an audit process. It is part of an extensive research effort into the control functions of management—as distinguished from planning and decision making—and, more particularly, into auditing as a major instrument of organizational control.²¹

The need for such a field study was pointed up by an experiment that was conducted to ascertain how an audit might affect the performance of laboratory subjects. Important parts of the design for this experiment were contingent upon ways in which subjects might perceive any audit to which they were exposed. Thus a precise structuring of the audit variable was necessary. Recourse to the literature of accounting and psychology produced only vague or tangential suggestions, apparently because no previous studies had been directed to the particular topic.

Thus, to secure the pointed insights that were wanted for the experiment, an investigation was initiated in two Pittsburgh firms. Results obtained from this inquiry were sufficiently interesting, however, to suggest that it might be worth extending this line of inquiry in its own right. This was done, and a 'second-phase' field study was initiated by extending the original inquiry to include a total of eight firms. The objective was still one of securing insight, and no attempt was made to secure representative samples from which statistically valid inferences might be drawn. Furthermore, given the state of knowledge on this subject, it seemed best to conduct face-to-face, unstructured interviews.

This kind of research produced results that were not as precise as might be desired for the kind of content-analysis techniques that were employed. Particular difficulty was experienced in attempts to classify or categorize some of the responses. Hence it was deemed necessary to extend the study to a 'third phase' by means of a questionnaire follow-up mailed to approximately 20% of the respondents who had previously been contacted in phase two. It is these last two phases of the total study with which the present paper is concerned.

A content analysis must, of course, lose some information from such unstructured interviews. On the other hand, even if a content analysis cannot completely reflect all ingredients, it does provide a means of systematically capturing certain significant aspects of the total study that can then be expanded by reference to a general outline of the material.

²¹ Charnes and Cooper (1961) categorized methodologies for management into (a) planning, (b) operation and (c) control. See also the sixth edition of Cooper and Ijiri (eds), *Kohler's Dictionary for Accountants* (1983), where control is defined as 'ability to influence behaviour in desired directions and amounts with the degree of conformance providing a measure of the state of control'.

Further insight comes from relating variable 12 [Question: Whom the internal auditor is most like?—Responses; Teacher (11%), Policeman (58%), Attorney (23%), and Mixed (8%)] and variable 16 [Question: The purpose of the internal audit as seen by Responder—Responses; Procedural check (76%), System evaluation (4%), Accuracy check (11%), and Other (9%)]. Sixty-three percent of those who characterized the audit as primarily a procedural check also felt that the auditor was most similar to a policeman. This was 87% of the selections and it suggests a possible correspondence in which the respondents mentally relate *looking* to see whether things are going according to plan and *ensuring* that the plan is followed. That is, the auditor is here being viewed as policing all actions to ensure that the plans of higher management are, in fact, being followed.

This paper constitutes a report of findings from a limited field inquiry. This inquiry was mainly pointed toward sharpening the issues so that this rather subtle area of management can be made the subject of further and better research. First, it was observed that the area of managerial control has not been a subject of rigorous and systematic scientific inquiry. Second, it was observed that a further evolution of scientific methods will probably be needed before many of the significant dimensions of the audit-control function can be adequately studied in a broad context such as face-to-face field interviews, questionnaire, etc. This was illustrated at many points in the preceding analysis and brought sharply into focus by this discussion of perceived 'behavioural effects' at the close of the last section.

To be sure, controlled laboratory investigations are in order, such as those referred to above. These, too, are only a way station, however, and further elaboration and assistance will be required from suitable mathematical-statistical models that can be developed to handle the numerous and complex interactions that are involved in such control procedures. On the other hand, as we have already observed, a good deal more is needed in the way of preliminary study before the task of synthesizing such models can be fruitfully undertaken. Indeed, even the laboratory investigations required recourse to field inquires to define the pertinent variables for study.

The field inquiry reported here was itself a product of this need. It was hoped that the continuum, of which this present study is a part, will ultimately point up areas where research in mathematics, management, and the social sciences may be joined to the end that new scientific knowledge and new methods of management will emerge. Just as the advent of operations research has produced a more easily tapped field of inquiry in the area of management planning, so may we anticipate a similar evolution in the more subtle activity of management control could have the effect of symbiosis with the behavioural sciences. The methodology that such research may produce can then, perhaps, lend itself to social inquiry as well. It may also facilitate the reporting and study of the kinds of 'social facts' that can emerge from managerial applications which are effected by means of these same tools and constructs.

Postscript Essay 7: This is a well-planned and a well-executed innovative field study. As stated at the end, 'the methodology that such research may produce can then, perhaps, lend itself to social inquiry as well. It may also facilitate the reporting and study of the kinds of "social facts" that can emerge from managerial applications which are effected by means of

these same tools and constructs.' Furthermore, many variables are utilized in more than one dimension, as shown in Exhibit 2 of the essay with its heading, 'Content Analysis Variables and the Categories of Each'. Thus variables become 'multi-dimensional'. Use of matrices become more acceptable. This can lead to a merging of research methodology.

Essay 8: A. Charnes and W.W. Cooper, 'Some Network Characterizations for Mathematical Programming and Accounting Approaches to Planning and Control', *The Accounting Review*, Vol. 42, No. 1, January 1967, pp. 24–52.

Network characterizations are developed for effecting contacts between accounting and mathematical programming. En route to these objectives some of the customary uses of double-entry accounting are altered and related to suitable generalizations of classical network ideas such as the Kirchoff node conservation laws. Extensions of the usual node-link incidence relations provide a basis for effecting these contacts.

Concrete illustrations are supplied including a goods-flow-funds-flow model which is preceded by a simpler example involving a PERT (Program Evaluation Review Technique)-Critical Path application. The latter is examined in the context of a physical flow of task or project times, while the former suggests how double entry can be extended to flows that involve a variety of different dimensions. Issues of accounting in different dimensions are thus examined and further issues of accounting for multiple objectives in different and even non-commensurable measures are also indicated. A possibility for joint coordinated uses of programming and accounting in management planning is indicated and amplified and some of the implications for alterations in accounting practice are then examined.

Suggestions for further extensions include probabilistic formulations and related risk considerations and evaluations. In an addendum the node-link incidences are further related to the node-link incidences in the context of dyadic representations such as are encountered in the transportation type models of linear programming or the spread-sheets and articulation statements of double-entry accounting.

As a first example we shall examine some of the ideas of PERT-Critical Path Scheduling. The latter generally proceed by reference to so-called 'project graphs' which will here be transformed into corresponding networks. This will then enable us to exhibit these PERT-Critical Path ideas in the form of certain linear programming problems. This route seemed to offer certain advantages in that it utilizes mathematical 'incidence relations' which also provide a convenient way to effect some of the indicated contacts with accounting.

Thus, via these contacts which the indicated incidence relations supply—it should be possible to develop various ways in which accounting might be used in association with such optimizations as when, for instance, a critical path analysis is required by the solicitation to bid on a government contract. This was also designed to indicate shortcomings in some of these PERT-Critical Path constructs when viewed from an accounting standpoint. For instance, the focus in such analyses is rather naturally directed to project tasks or components which are critical—e.g., from a time-of-delivery standpoint—and this, in turn, leads to what might be called 'selective accounting'. This meant that the double-entry routine is applied only to these

'critical' aspects of the total program whereas, as should be evident, accounting may also be required to consider related tasks and times which are *not* critical but which must nevertheless be recorded and reported for other purposes of planning and control.

To be sure, the latter requirements can also be accommodated and this can be done in numerous ways by evident extensions and adaptations of Critical Path ideas. Even when this is done, however, certain shortcomings will still remain and these will require attention for still further uses in accounting. However, we shall not here examine any of the ways in which such extensions might be effected for the accounting rules and interpretations. Instead, we shall proceed to extend classical network constructs in order thereby to accommodate some of the more general situations that may be encountered in accounting applications.

Conversely this article extends some of the customary accounting applications of double-entry analysis in planning and control contexts. Thus, in particular, it relaxes the usual accounting presentations which proceed only in terms of a single dimension (e.g., dollars) and replace these with ones that proceed by reference to whatever dimensions are pertinent for the plans or controls that are to be implemented. For instance, at some point a projected program (or plan) may best be presented in financial terms while at other points the presentation may be better oriented toward physical units. This is all to be done analytically, however, with reference to the underlying models and the double-entry discipline which can be associated with these models via routes that are indicated in this article. For this purpose, then, it is evidently desirable to extend the use of such models from a 'selective' to a more 'complete' accounting basis where the latter term is now intended to include transformations to the various dimensions that are deemed to be relevant for the indicated plan or program.

This 'complete accounting' also extends to various types of costing and evaluation schemes which are needed for a variety of managerial purposes. For instance, historical costs or their projections might then be employed for purposes of delineating the program possibilities under indicated policies and conditions. They may evidently also be needed for purposes of control as well when, for instance, a particular program has been selected from among the available alternatives. On the other hand, when conditions are to be altered so that still further alternatives can be admitted, then the approaches designated in this article may also yield the opportunity costs (in physical or dollar terms) that are then pertinent and required for these considerations. This is explained by the duality relation of linear programming.

Postscript Essay 8: This essay attempts to deal with many of the network type of the models using accounting and mathematical programming. Issues of accounting in different dimensions are thus examined and further issues of accounting for multiple objectives in different and even non-commensurable measures are also indicated. Mathematics and accounting are often intricately related, especially by networks. In particular, it has been known widely among mathematicians and accountants that a prominent British mathematician, Arthur Cayley, published *The Principles of Book-Keeping by Double Entry* in which he said, 'The Principles of Book-Keeping by Double Entry constitute a theory which is mathematically by no means uninteresting: it is in fact like Euclid's theory of ratios an absolutely perfect one'.

Essay 9: W. W. Cooper, N. Dopuch and T. F. Keller, 'Budgetary Disclosure and Other Suggestions for Improving Accounting Reports', *The Accounting Review*, Vol. 43, No. 4, October 1968, pp. 640–8.

Budgetary disclosure has typically been considered from the standpoint of its possible immediate adoption in practice. Here, a somewhat different course is followed in order to portray budgetary disclosure as a possible guiding concept which can help to illuminate, adjust and unify other proposals that have been advanced for altering or extending customary accounting reports. Continuation of the latter (i.e., the customary forms and bases of financial reporting) is then regarded as essential for the attainment of reliable and meaningful budgetary disclosures. A more comprehensive system of reporting—which an evolution toward budgetary disclosure can supply—can also eliminate supposed conflicts between customary practices and suitably modified versions of such proposals as accounting uses of index number adjustments, current costs, etc. These topics are dealt with and illustrated in early portions of this paper. Other parts of this paper deal with problems requiring attention in budgetary disclosure, including extensions of audit to reporting of budgetary changes as well as managerial explanations of deviations between budgetary projections and subsequent realizations. A program for research is also suggested which will include studies of the effects of different disclosure practices.

A proposal for budgetary disclosure as a desirable extension of corporate reporting seems to have been first introduced in the literature of accounting by Stuart A. Rice (1947). Thus, in a speech by Dr Rice before the Sixtieth Annual Meeting (1947) of the AICPA (American Institute of Certified Public Accountants), the following statement appears: 'In the government it is the custom to publish budgets but not the final result of operations. In private accounting the custom is the reverse. I should like to see business firms undertake to publish their budgets as well as financial statements because (1) it will give valuable information to stockholders and enable them to judge the planning ability of their managers and (2) provide valuable information on business plans and business operations . . . for economists and statisticians.'

After remaining dormant for some years, this idea has begun to attract further attention on the possibility of *budgetary disclosure* meaning (1) the published projection of next-period balance sheet, income and funds flow statement and (2) its critical comparison with actual results in a stockholders' report at the end of each period. Supplementary budget data, such as capital budgets and projections beyond the next reporting period, may also be required for supplying perspective to the projected statements included in the report. Similarly, interim reports and comparisons may be necessary to reflect changing conditions. As we envision it, responsibility reporting requires at least an annual comparison of results with the original projections thus supplying a broader basis for judging management performance.

Budgetary disclosure will amplify but also complement the practices that are now generally followed in published accounting reports. Indeed, we stress the need to continue the present basis of reporting actual costs and the usual forms of financial

statements. The budgetary statements at the start of a period are to be regarded as projections of what the records of actual transactions and cost allocations will reveal at the end of the budget period so that, *inter alia*, the accounting profession will be able to continue its reliance on documentation of actual transactions. In this respect, the suggested approach involves both procedurally and in substance an extension of accounting practices that have been used over a long period and in many different contexts.

The characterizations and the research suggested in the preceding section do not constitute the sole (or even the main) point of the present article. They should rather be regarded as additionally illustrative of ways in which the concept of budgetary disclosure can be used to suggest future courses for developing accounting and related management practices.

As was noted previously, many other proposals (e.g., index number adjustment, use of current-costs bases of reporting) can also be regarded as responses to the fact that accounting has not yet reached a point where systematic and continuing budgetary disclosure, supported by adequate audit and attest extensions, are a part of regular management reporting processes. By placing these proposals in the wider context of budgetary disclosure, it is possible to ascertain the alternatives that might be required for their use in this context. On the other hand, the concept of budgetary disclosure does not require any alteration in the customary bases and forms of financial reporting. On the contrary, retention of these bases appear to be necessary in order to achieve improvements that are promised by extending present reporting practices in order to include budgetary disclosure. Thus, the latter concept (*viz.*, budgetary disclosure) can immediately supply perspective and sharpened insight with respect to traditional accounting as well as with respect to proposals that have been made for altering or extending it. It can thus also provide a unifying basis for guiding the further development of accounting and auditing.

Postscript Essay 9: This essay deals with disclosure of financial budgets of corporations. There was a dramatic change in the attitude of accountants, investors and regulators with respect to forecast and budgetary disclosure. The SEC's attitude, since its inception in 1930s, has been to prohibit its disclosure for the fear that it may be misused. In 1975, SEC changed their attitude 100%, considering the mandatory disclosure, so that information would be distributed equitably. By the end of 1970s, the SEC attitude changed to making such disclosure optional . . . Now after observing the financial fiasco of 2008–09, the debate between historical cost versus market value reappeared at the SEC. The trade-off is between 'trustable historical cost' vs 'timely market value', although use of both may be allowed.

Essay 10: A. Charnes, C. Colantoni, W. W. Cooper and K. O. Kortanek, 'Economic Social and Enterprise Accounting and Mathematical Models', *The Accounting Review*, Vol. 47, No. 1, January 1972, pp. 85–108.

As used in this article, the term 'model' refers to any set of relations arranged to represent another set of observed or hypothesized relations which may be of interest—immediately, or ultimately. Models may take the form of concrete representations as when, say, an automobile designer uses a 'clay mockup' to model for (or from) a blueprint, or when wood figures are positioned or moved about on a table

top, e.g., by a planner, to model possible city layouts. Models may also be formed in abstract symbols, or diagrams, with accompanying verbal instructions and interpretations as when, say, a set of accounts is being designed for a factory or when an electronic computer code is 'flow-charted'.

In this usage, a 'reality' or an 'application' designates only a set of relations, hypothesized or observed, which is regarded as terminal for some series of possible modelling efforts. Furthermore, a sequence of modelling efforts need not begin with an already existing observed reality. That is, the models may *precede* the 'reality' which they are designed to influence, produce, or alter. Notice, for instance, that a clay mockup may be used to model an automobile (for production) even before the latter exists. The clay mockup may also be subsequently transformed into production blueprints, computer codes and mathematical formulas, at least until the automobiles are actually produced. The latter is then the terminus—i.e., the 'reality' or the 'application'—which ultimately guides or motivates these efforts.

Mathematical models, naturally, are represented by means of mathematical relations. The mathematical models of interest in this paper generally proceed via the special kinds of mathematical relations called 'functions', which are used to represent some or all of the relations. Extensive research in the use of such mathematical models in economics, management and the social sciences has led to new developments in mathematics. This, in turn, has made it possible to extend the use of such models into still wider areas. It has also made it possible to relate apparently disparate topics across a variety of disciplines and practices in various ways that we shall try to illustrate. This will be done in the sections that follow by reference to topics such as double-entry accounting, input-output (inter-industry) analysis, and so forth which have been found to be useful for social and (individual) enterprise planning in the United States, the U.S.S.R., and other countries.

Of course, these are only very simple illustrative transactions. They suffice to show, however, that various types of accounting statements and budgetary (planning) projections can be prepared for accounting or economic planning. Moreover, this type of double-entry accounting representation can also be modelled and interpreted mathematically in ways which can enhance management's ability to explore and plan for the future.

Concluding Comment: It would be possible to deal with still other aspects of modelling, including non-linear functions and related treatments. Although some aspects of these topics are treated in the article, this topic is not pursued in detail. Instead, a variety of possibilities is illustrated for modelling in economics, management and social planning, and mathematical aspects are stressed.

The point was to relate these models to one another in ways that might increase our understanding and enhance the usefulness of these models for potential applications that might arise because of their underlying similarities. Nor does this exhaust the possibilities, since other types of models might also be joined to the class of models examined here and doubtless still other types and classes of models can also be developed to extend those which have been produced from research in economic, management and other types of modelling in recent years.

They quote later Professor Churchman (1971) who invites accountants to ‘join [other] professional associations in looking at today’s problems of society and suggesting some ways of assigning numbers to social change that make a difference—with all the humility, humour and purposefulness possible’. Churchman was, for the most part, addressing himself to the development of social indicators at the individual enterprise level. Other efforts to extend the customary accounting applications and uses have also been essayed. For example, Brummet *et al.* (1968, 1969), among others, sought such extensions by attempting to include human (and possibly other) resources in asset and income calculations at the enterprise level. The models of the preceding section could also be adapted to use at the enterprise level, providing one is willing to consider (and evaluate) enterprise operations in multi-dimensional instead of only the more usual scalar (dollar) dimension. In this context, as well as in the context of general social planning, it is useful to observe that the tradeoff terms can be all given, each in their own measure (e.g., life expectancy) in the above models and that they are also related to the ‘production function’, or GNP relation, in a way that enables one to trace the further overall system consequences of utilizing any of these tradeoffs. The point is that the dollar dimension need not be lost while preserving the separate identities in other dimensions for bringing the quality of life aspects to the fore—e.g., in a tradeoff analysis. This preservation of all relevant identities was a major feature of the representations developed by Terleckyj (1970). The mathematical developments introduced in this paper extend this even further by making contact with the duality theory, sensitivity analysis and other aspects of mathematical modelling that are now available as a result of past and recent research.

As before, all of the above can also be related to double-entry accounting and even reduced to dollar dimensions, if desired. On the other hand, as has just been suggested, something may be gained by leaving the model and even its matrix representation in multi-dimensional form. In that form it can be suitable for use in association with some of the other new concepts, such as program budgeting, that are also being added to the tools and concepts of accounting and management practice. Finally, persons interested in ‘environmentalist’, ‘quality of life’ or other extensions of present reporting practices might also want to consider possibilities that the foregoing developments may suggest for ways of disclosing processes of management decision making in new (multiple dimensional) forms for public scrutiny and evaluations. When properly developed, this might then also be an example of a ‘model’ advancing a social-economic and managerial reality which might then be represented or adjusted in a variety of mathematical forms.

Postscript Essay 10: Cooper’s desire to produce ‘social accounting’ elaborated in Essay 2 may seem to have made a good progress. The essay deals with a contrast between ‘reality’ and ‘application’, as illustrated in ‘Effect of Activities on Goal Output Indicators 1970-1980’ (prepared by N. Terleckyj, mentioned in Essay 10) and how such large scale information can be meaningfully presented. Essay 9 is particularly helpful to understand the interaction of mathematics and accounting emphasized in Essay 7. Arthur Cayley, mentioned in Postscript 7, is an inventor of matrix algebra which physicist Werner Heisenberg praised as indispensable for the development of quantum mechanics. No wonder Essay 9 has a heavy dosage of matrices in dealing with accounting problems.

Essay 11: C. S. Colantoni, W. W. Cooper and H. J. Dietzer, 'Accounting and Social Reporting', *Objectives of Financial Statements*, Vol. 2, Ch. 5, American Institute of CPAs, 1974.

The developments we shall be concerned with have been called 'social accounting' or 'social audit' and may have been accorded other names as well. They have appeared in the economic and social spectrum of national income as well as individual company reporting and accounting of both external and internal nature. However, this paper restricts its focus to company (as distinct from society-wide) levels. Thus, the term 'social reporting' for the activities discussed in the article deals only with reporting that is not like national income accounting and its social accounting extensions. The term 'audit' is reserved for the customary usage that associates it with independent examination and verification (or validation) of accounting reports.

Extensions in accounting can be (and have been) effected in a variety of ways. They have occurred when established practices or principles are extended to such new areas as the extension of double-entry principles to national income accounting. They may also occur when concepts or methods are altered or otherwise extended, such as the extension of stewardship reports in a single measure (i.e., a scalar) to multi-dimensional (or multiple metric) uses, as may be found in areas such as cost/benefit analyses in public management. As also noted, their separation in practice may be difficult, and even conceptually it may also be advantageous to consider them simultaneously as discussed by Leo Herbert.

Both national income and corporate accounting were presently being re-examined and studied for a possible alteration and extension to areas that are of concern in this paper. It was useful therefore to commence by observing that both have been restricted, by and large, to the categories of economics and commerce such as sales, investments, and other such expenditures that are (a) market related and (b) measured or evaluated in the dimension of money prices. This was also the main orientation of managers, investors, and other like users of these reports.

Here, social reporting is regarded as being concerned with phenomena that are not adequately (1) reflected in the market mechanism and (2) directed to audiences that extend beyond those customarily concerned with company reports.

We can observe that this characterization admits possibilities for changing the way social reports are developed and presented over time. Consider, for instance, the case of the FICA contributions associated with the U.S. Social Security legislation, first enacted in the 1930s, and contrast this with the Occupational Safety and Health Act (OSHA) legislation enacted in 1970. The latter may be singled out for special attention in a social report while the former is not. It may be argued that this is entirely proper because the FICA contributions have now 'shaken down' into equilibrium. They have thus become a part of the structure and are considered a cost of doing business by virtually every firm. The OSHA administration, however, was sufficiently recent at this time so that there are large 'transients' with attendant differentials in costs in different firms. Some firm may be ahead and others behind in meeting these 'social responsibilities' and hence there may be an interest in distinguishing these features in a 'social report'.

As another example, we may consider an 'externality' which occurs because the operation of a factory produces a pollutant that damages third parties (local residents) who do not enter into the market as transactors with this company. One possibility might be to impose a tax in order to deal with this 'externality' in a socially acceptable way, and another approach might be to enact a regulation requiring the company to alter its behaviour. Suppose, however, that a technological innovation converts the pollutant to a valuable commercial product at some subsequent time. Just as users indicated for FICA, then, one might argue that this situation is adequately reflected in the market and hence ought to make its appearance in the regular manner of ordinary financial statements. Failure to allow for such developments may weaken the dimensions of ordinary financial reporting and could open the way to a variety of abuses as well.

As we have already indicated, the character of new audiences may also need attention. Such audiences may also shift in time, but in any event, there may be a need to recognize interests whose information requirements are not adequately served by the dimension of financial information and its customary categories. For instance, minorities may be primarily interested in the number of persons employed from their groups, while environmentalists may be concerned with the emission and disposal of certain pollutants and have only an ancillary interest in related economic consequences. However, as we indicated toward the end of this paper, it may be possible to relate these different categories and dimensions (or metrics) to their economic consequences (as well as to each other) and to do so in a way that is more illuminating than simply treating each interest in isolation from the others. This is to say that some experimentation in extending the nature of accounting reports may be in order if the extension of accounting to these new areas is to be effected in a manner that represents the interests of these groups. Hopefully, this can be done in ways that will enhance the intelligence of all concerned, a main purpose of accounting insofar as the information it supplies leads directly or indirectly to actions by the management of these corporate entities.

Many of these considerations bring us back to some of the arguments on whether business as well as accountants should undertake any such activities at all. These arguments will undoubtedly continue, but our own best guess (or judgment) is that such activities will be undertaken by business. Hence it is our belief that it will be prudent for the profession to begin now to encourage and support further studies and experiments in anticipation of these developments. The point, of course, is that such anticipatory studies can help guide such developments into more intelligent channels.

In concluding this discussion, we should perhaps stress that such studies and experiments should extend to audit as well as accounting or reporting activities since these, too, are capable of alteration and extension. Having begun this paper with a discussion of how accounting might be (and has been) extended, it now seems suitable to close with a quotation from Paul F. Lazarsfeld, one of the leaders in the development of modern systems of social inquiry. Writing in 'Accounting and Social Bookkeeping', Professor Lazarsfeld notes that 'The need for the attest function in society is growing. Not only is this true in the areas of business, as every accountant

knows, but in the social sciences as well there are a lot of activities that need attesting.’

Postscript Essay II: Toward the end of Essay 11 Cooper wrote: ‘The statements we have suggested are best regarded as only initial attempts to meet both of the criteria that we delineated for social reports in our opening section. That is, (1) they should report items, such as the OSHA acceleration activities, which are not adequately reflected in market data with its associated “least cost” orientation, and (2) they should also be directed toward other audiences besides the customary ones for corporate reports, but in a way that does not weaken the latter. Naturally, we expect that this is not a last attempt and other such suggestions should also be forthcoming. At least we hope that this will be the case.’ As a further development in the direction of social accounting, this essay was included in the Study Group on the Objectives of Financial Statements of the American Institute of CPAs, with Robert M. Trueblood as its chairperson. The Group produced two volumes. The first one is a small volume for distribution to a large group of corporations, investors, analysts and regulators. Volume 2 is a large volume of papers collected during the study. This essay was included in the volume under the title of ‘Accounting and Social Reporting’, by Cooper *et al.* (1974).²²

Essay 12: A. Charnes, C. S. Colantoni and W. W. Cooper, ‘A Futurological Justification for Historical Cost and Multi-Dimensional Accounting’, *Accounting, Organizations and Society*, Vol. 1, No. 4, October 1976, pp. 315–37.

This essay attempts to survey a range of potential applications for ideas that we shall characterize by the name of ‘multi-dimensional accounting’. Here the term ‘accounting’ will refer to double-entry principles or mechanics for recording, analysing and reporting transactions. ‘Dimension’ has the ordinary mathematical meaning of a portion of space (more precisely a subspace) which is independent and hence may be used to portray properties of transactions which cannot explicitly be represented when that portion of available space is removed. Hence, multi-dimensional accounting refers to uses of double-entry principles to portray transactions in more than one dimension. As such it opens possibilities for uses of accounting information by others besides customary groups—like investors, managers, government officials, etc., who have been interested, for the most part, in the more restricted ranges of accounting possibilities.

To be sure, ordinary accounting can also be given a multi-dimensional characterization. For example, if desired, one can distinguish a manufacturing and a sales dimension to relate, say, properties of cost of goods manufactured to cost of goods sold as aspects of manufacture and sales to be studied in different dimensions at the same time. Nevertheless, the above definitions and distinctions point in correct directions and, as a matter of emphasis, can help to clarify possible new uses and views of accounting for serving a variety of potential additional groups and interests.

The above ideas are made more concrete in the paper which also tries to relate them to past and existing practices in governmental and corporate accounting. We shall also explore possible extensions to the spheres of societal and social

²² This is the so-called Trueblood Report, because the AICPA committee was chaired by Robert M. Trueblood, who we noted earlier as one of the members of the Pittsburgh team.

accounting, too, as we try to clarify other possible relations between present and potential developments.

The above discussions have been confined to considerations such as ‘costs’, ‘prices’, and related aspects of relative worth and substitutability. Such ideas are familiar not only from past practices in accounting but also from concepts of market economics where such prices, costs, etc. provide information as to the terms on which alternative choices may be effected. Here, however, the topic is pushed on to other kinds of problems, such as those involving human life or health or national survival, in which extensions of these multi-dimensional accounting ideas to considerations other than prices and costs might be needed as guides for planning and analysis. In other words, extensions are effected to categorizations in which no such substitutions between categories can be considered, at least *a priori*.

Thus, the paper attempts to explore future ways in which accounting might be made to respond to some of the social forces and movements that are affecting society, and hence management, not only in the United States but also in Japan, the nations of Western Europe and Canada as well. While trying to be mindful of the vast scope and wide variety of possible developments and adaptations that are possible, this paper concentrates on those in the United States with which are more familiar.

In this sense this paper conducts a ‘futurological exploration’ which includes methods for ‘the future’. This focus is on the *distant* future and tries to show how it might be influenced by indicating how certain practices now present, at least in embryonic form, may be elaborated and developed for this purpose. Finally, this paper attempts to relate the proposed extensions to current practices (and discussions) in accounting. Thus, for more pertinence and point, it tries to resolve such issues as current cost vs historical cost recording and reporting in favour of the latter. This assumes that the two are mutually exclusive and, of course, this is not necessarily the case. Nevertheless, proceeding in this manner helps to point up the nature of the proposals and also provides an added perspective for considering current suggestions for revising present practice in the *near-term* future.

This paper attempts to conduct futurological explorations in a way that includes both corporate and governmental accounting in a unified manner. It also indicates further extensions which are applicable in other, less orthodox, domains—such as the suggested use of multi-objective budgeting by the Food and Drug Administration, on the one hand, and the National Planning Association’s national goals accounting project on the other hand. The examination also indicates additional extensions that can relate multi-dimensional accounting to multi-objective planning devices in a variety of ways. This includes extensions from metric to non-metric constructs which are associated with a variety of ‘pre-emptions’, ‘impossible goals’, etc. This opens new possibilities for budgeting and accounting in the future. These uses are not confined to market phenomena such as prices, costs, etc. Neither are they divorced or separated entirely from them. Indeed, we emphasize the need to continue to *relate* these new dimensions of budgeting and planning to the more customary dimensions. This was done in a manner that maintains contact with past traditions for their own sake but also because of the convenience

supplied thereby at very basic levels via full contact with the discipline of double-entry accounting.

With this perspective in mind we now return to the issues of historical vs opportunity costs which were examined at the outset of this essay. Following Professor Cooper, these characterizations suggested that the latter (including current cost approximations) were originally devised and best utilized as *ex ante* planning devices while the former (historical costs) are best used as a control. To be sure, it might be argued that there is no real conflict and that *both* might be used with current cost, say serving as a control to produce better planning by corporate management. As already indicated, however, we think that a better case might then be made for budgetary and related planning disclosures followed, as we have elsewhere argued (Cooper, Dopuch and Keller, 1968 [see Essay 9]) by a historical cost comparison and an audited explanation of significant discrepancies.

This enables us to close the present essay by saying that the latter approach should provide a comparison of ‘actual vs plan’ to outsiders which is analogous to the ‘actual vs plan’ or ‘actual vs standard’ which is presently available to inside corporate management—along with the kinds of audited explanations that the latter presently enjoy. This, too, is in the spirit of the Trueblood Report and even more in the spirit of the U.K. Corporate Report (Accounting Standards Steering Committee, 1976) with its already noted emphasis on improved reports to outsiders. The futurology suggests an accounting consideration used by Professor Cooper that such an extension of plans and reports, followed by audited comparisons, is a real possibility for the future. It can be done (in multiple dimensions) with respect to practices in governmental as well as business units and it can be extended to the ‘social accounts’, and related new institutions, if these are required, along the lines we have already indicated.

In this way, we think it is possible to provide a new route to social evolution which is more rational or at least less violent than some of the ones which society has utilized in the past.

Postscript Essay 12: We wish to reproduce the abstract of Essay 12 in its entirety, as it depicts the contents of that article concisely: ‘Futurology as a forecast or, even better, as projections intended to influence the future, is applied to justify retention of historical costs in the context of proposed multidimensional accounting extensions for business, government and national goals accounting. Budgetary disclosures supported by opportunity costs and tradeoffs are also examined via multiple-objective models of goal programming varieties. Independent audit and attest is suggested not only for the mathematical model but also for managerial explanations of subsequent discrepancies from plan in each pertinent dimension. In addition, the essay shows probably the most confident and strongest statements by Professor Cooper, who built his arguments on the need for “inventing the future”.’

W. W. COOPER, RESPONSE TO CITATION

‘Research and Practice in Contemporary Accounting’, by William W. Cooper, Foster Parker Professor of Finance and Management, Emeritus, The University of Texas at Austin, upon his induction to the Accounting Hall of Fame, 14 August 1995.

Mr Chairman, Ladies and Gentlemen, Friends, Colleagues, and Former Students: I greatly appreciate your attendance on this occasion when I am to be given the great honour—the very great honour—of being inducted into the Accounting Hall of Fame. Among my many satisfactions, this will allow me to join the very distinguished company of Eric Kohler, my former teacher, and Yuji Ijiri, my former student—and, hopefully, others of my former students and colleagues will join us in the future.

I would now like to have you join me in some reflections on the current state of affairs with respect to research—especially academic research—and its relevance to the practice of accounting. Before entering into this topic, however, I would like to make some acknowledgments:

First to my parents. Bertrand Russell once remarked that one should exercise great care in choosing one's parents since a good choice of parents is likely ensure good genes, good character, and a good start in life. This I owe to my parents, William Wager and Rae Rossman Cooper—now deceased so they cannot be here on this memorable occasion.

I have already mentioned my teacher, Eric Kohler, and my former student, Yuji Ijiri, and I would also like to add my other present and former students and colleagues to whom I am also indebted. These are persons from whom I have learned much and to whom I owe a great debt as a constant source of new problems and stimulating ideas in exchanges that I have experienced with them over these many years.

I also owe much to the schools and the professional societies—including the American Accounting Association—with which I have been associated, for they have provided me with a rich variety of opportunities and experiences over the period of many years. I should perhaps dwell on this for a moment since (again owing to Eric Kohler) I am probably the only person present who was in attendance at the 1935 founding meeting of the American Accounting Association—the society whose 1995 meeting we are all attending on this occasion here in Orlando, Florida. Then the newly founded AAA was intended to have a new (double) orientation toward research and practice with strong interactions between academic research and accounting practice also intended. It is partly from this perspective that I am concerned by what I now perceive as an increasing tendency for the two of them to follow separate paths.

Of course a great deal has happened since 1935. For further perspective, I might add that my graduate and undergraduate education occurred on one side of World War II while much of my research and subsequent experience occurred on the other side of that great dividing event in world history. Only those who have seen both sides can appreciate how different the worlds were on the two sides of the divide provided by that war and the events that terminated and followed it.

The research in accounting that occurred on the pre-world War II side of this divide was largely applications (practice) oriented and generally accorded the form of 'textbook' presentations. This is one part of what the AAA undertook to change with its monographs and research programs. One should be careful, however, to

avoid belittling the preceding record of accomplishments. In a chapter entitled 'Early Development of Accounting Standards and Principles', Carman Blough, the first Chief Accountant of the SEC, notes that these early texts and writings 'provided the models that were subsequently used for reforms and standard setting'. (The quotation is from the chapter by Blough in W. W. Cooper and Y. Ijiri, eds, *Eric Louis Kohler, Accounting's Man of Principles*, 1979.)

This 'practice oriented' research, however, lacked the rigour that is needed to provide a foundation for scientific generalization and testing to determine how far and in what manner extensions might be affected beyond the realm of particular problems and practices. The contemporary research literature now supplies this kind of rigour, but in a way that often seems remote from practice. One way to summarize what is happening is to say that much of this contemporary research is pointed toward 'pure science' whereas an 'applied science' is what is (or should be) wanted if our research is to interact with practice in a mutually beneficial way.

This is not to say that the contemporary research I am describing is bereft of interest in the problems of our profession. It is to say that this research often takes a form that can be described as 'theory driven applications' rather than 'applications driven theory'. The latter is needed—or at least it is needed in greater abundance—if we are to maintain fruitful contact with the rapidly changing scenarios of contemporary practice and, I might add, it is also needed if you are to serve as a vehicle for attracting contributions from other disciplines for added contributions to accounting. Indeed, an ability to formulate problems as well as solutions in general and rigorous terms is needed to obtain this type of inter-science cross-fertilization. This is what is intended by 'applications driven theory'. The application is driven by problems of actual practice with a solution that is also extended and stated with sufficient rigour and generality to be understood by others (including persons in other disciplines).

In principle, at least in some cases, this kind of application driven research is best accomplished in collaboration with persons involved in decisions or policies directed to these problems. In this way we can ensure that the complex and sometimes elusive nature of the problems at issue are identified fully. En route to the desired solutions and generalizations one may also envision situations where team combinations may be used that also involve collaborative efforts with persons from other disciplines—such as statistics, operations research, and computer science.

An example of such 'applications driven theory' is provided by the work of Louis Pasteur on the silkworm diseases that were ravaging the French silk industry in the early nineteenth century. We quote from *Science* (December 1972) which notes that 'at the conclusion of his research [conducted in collaboration with practitioners] Pasteur found that he had not only solved the problems that were destroying sericulture in France, but he had also pointed out the importance of practical [*sic!*] experimental research on microorganisms for the sciences of microbiology and pathology. Thus, as indicated, this research had the desired effects in (a) improved practice with (b) impacts on other sciences.'

This was not an aberration. In similar activities, Pasteur helped to improve the production of wine, vinegar and beer, and his research on the anthrax that was harming the sheep in France laid the foundation for the modern germ theory of disease and the development of immunology as a whole new science. Evidently, it is possible to be basic as well as applied in such research (depending on how it is conducted) and the impact on other disciplines provides one test of whether its achievements are fundamental.

Returning to accounting research and practice, I recall participating (in the early 1950s) in what Hall of Famer Robert M. Trueblood referred to as the 'Monongahela Project' to study (and test) the possible use of statistics in accounting and auditing. This was done with very concrete applications, first at the National Supply Company (now a part of Armco Steel) and then at Kaufman's Department Store (now a part of the May chain of stores). This work was done on a fee-free basis in collaboration with researchers from the Carnegie Institute of Technology (now Carnegie Mellon University) and controllers and staff from companies where research was conducted. The work was then followed by write-ups and reviews some of which were submitted to W. Edwards Deming (from statistics) and Eric Kohler (from accounting), who were asked to appraise the work and its claimed generalizations from the standpoint of the discipline with which they were associated. All of these tests had to be passed in fully satisfactory form before Trueblood would allow his firm to offer these services to clients. Once these tests were passed, an abundance of publications followed and this work soon began to affect practice in accounting. It also affected research in statistics and, in fact, the use of statistics in accounting (now attended to by many others) has recently received recognition in the form of a full-blown National Academy of Sciences report entitled *Statistical Models and Analysis in Auditing* (Washington, 1988).

To this point, our focus has been on financial accounting, but one also needs to accord recognition to pre-World-War II accomplishments in managerial and cost accounting. Here we may single out developments like standard costing, flexible budgets, and differential and variable costing as major contributions to accounting and management practice. Standard costing, which has its roots in the work of F. W. Taylor and his associates, is the only one of these developments that exemplifies attempts at scientific rigour and generalization. The other developments are, of course, important to the topics we are addressing but, for the present, we simply note that it was only standard costing that made its way from internal management use—when it was argued that inventory should be reported at standard cost values in financial statements with accompanying disclosures of 'efficiency' and 'inefficiency' gains and losses.

Financial statement disclosures in terms of efficiency gains and losses now seem to have fallen out of favour, both in practice and research. In some way this is unfortunate, since efficiency evaluations are important topics for both public policy and investor evaluations of management performance. In another way, however, the lack of contemporary research on these topics brings us to yet another facet which we explore in this postwar 'pure science' emphasis in research.

If I may be permitted a personal experience, I can report that DEA (data envelopment analysis) represents yet another attempt to develop better methods for evaluating managerial performance with special reference to activities using multiple inputs to produce multiple outputs with no easily identified ‘bottom-line’. Now a part of the literature of operations research and economics, DEA²³ is being used to evaluate activities of police forces, schools, hospitals, etc. in many different parts of the world.

Why was DEA not developed as a part of the accounting literature? At a very early stage, David Sherman and I submitted an article to one of our peer reviewed journals in accounting only to have it summarily rejected by the editor who refused even to send it to referees because, as I subsequently discovered, it had no ‘theory’. What the editor had in mind was what I shall refer to as ‘substantive theory’ as distinguished from the ‘methodological theory’ on which DEA is based. The former, i.e., ‘substantive theory’, is exemplified by what is wanted in the search for regularities (or laws) based on ideas like the behaviour of ‘homo economicus’ in economics. The latter, i.e., ‘methodological theory,’ is exemplified by the kind of research and theory that underlies the statistical tools used in much of the ‘pure science’ oriented research we are considering.

At this point, it seems fair to recall accounting’s origin as a methodologically oriented discipline in Pacioli’s book on mathematics and, for years, double-entry accounting was known as the ‘Italian method’ of bookkeeping. The opportunities for methodologically oriented research are also far from exhausted in both financial and managerial accounting. Witness, for instance, the ‘triple-entry’ system of Yuji Ijiri which can now provide integrated explanations of the income statement changes together with balance sheet changes in a manner that extends the classical ‘double-entry’ use of income statements to ‘explain’ changes in successive balance sheets. Recent activity in areas such as ‘ABC costing’ has also attracted research attention with needs now becoming apparent for more rigorous treatment of topics like complexity, flexibility, etc.—which are increasingly being encountered in dealing with accounting problems in high-tech industries.

Having addressed topics like financial and managerial accounting, I would be remiss if I did not also mention auditing in these all too brief comments. Here, too, I am struck by the fact that a major development like ‘performance auditing’ has developed both in governmental and internal auditing with very little attention in the research literature that I am considering.

I should add, however, that I have no doubt that the abilities of contemporary researchers are up to supplying what is required to develop more fruitful and mutually beneficial interactions (a) with practice and (b) with other sciences. Some kind of shifting about and experimentation with present institutional arrangements might help to bring this about. The accounting profession has shown itself capable of responding to challenges in the past and the challenges here are

²³ See the bibliography in Emrouznevad *et al.* (2008, pp. 151–7). The review article records that more than 4,600 articles, books and monographs that apply DEA, with a great variety of applications in more than 42 countries, have appeared after the first publication of Charnes *et al.* (1978).

certainly not beyond its capabilities. Here, however, the challenge is not so much a threat but rather a series of opportunities for improvements in both research and practice.

This drifting apart between research and practice has roots, I think, in the preparation provided by our current PhD education. This usually takes a form in which students are taught to draw their research problems from the literature in which they intend to publish. This is fine for theory development with ‘theory driven applications’, perhaps, resulting at a later stage. It falls short of what is required, however, in research which is to take the form of ‘applications driven theory’.

A few years ago, the Bedford Committee issued a report which has led to important changes in education for practice—at least in some institutions of higher learning. A similar committee might now begin to examine changes in the way we provide preparation for research. The trick in accomplishing what is required, I think, will involve effective arrangements to bring this type of education and research into focus on what is going on and needed to help improve professional practice without losing the rigour that is needed to maintain contact and influence what is going on in the science. The results could be large rewards for practice, for research, and for science and society generally.

[This talk, on the occasion of my being elected to the Accounting Hall of Fame, is dedicated to Ruth F. Cooper, my wife and companion, who has affected all phases of my life, my thoughts and my feelings for more than 50 years.]

CONCLUSION

Before closing, we wish to emphasize Professor Cooper’s macroscopic and social perspectives which appear in a majority of his essays. Cooper is not only blessed with mathematical talents but also with eyes for big pictures. For that reason he appeals to accountants to think in terms of big pictures and to participate in social and governmental activities.

Cooper’s pioneering contributions to the fields of accounting have left an enduring legacy, making a particular impact on business education and research. He was instrumental in fashioning fundamental concepts and mathematical models in economic and social accounting as well as enterprise accounting (managerial and financial). Cooper also developed critical business-related concepts and research areas within various accounting areas and public policy, all of which serve as pedagogical and research bases in modern business and business education. It is expected that his influence will continue and expand in the years to come.

This review work has left an indelible imprint on many domains, and serves as a continuing foundation for investigations by researchers around the globe. In this celebration of his ninety-fifth birthday, it is appropriate to pay Professor William W. Cooper special tribute for his many advances that have lifted the realm of accounting to new levels, and that have helped to lay the foundation for expanding accounting analysis and its applications.

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APPENDIX A

ACCOUNTING PUBLICATIONS BY PROFESSOR WILLIAM W. COOPER

Books

- 1971 *Studies in Budgeting*, North Holland Press. Co-editor with R. F. Byrne, A. Charnes, O. A. Davis and Dorothy Gilford.
- 1979 *Eric Louis Kohler, Accounting's Man of Principles*, Reston Publishing Co. Memorial volume, edited with Y. Ijiri.
- 1980 *Eric Louis Kohler: A Collection of His Writings (1919–1975)*, The Academy of Accounting Historians. Co-editor with Y. Ijiri and G. Previts.
- 1983 *Kohler's Dictionary for Accountants*, 6th ed., Prentice-Hall Inc. Co-editor with Y. Ijiri. Translated into Spanish as *Dictinario Kohler Para Contadores* (Mexico: Limusa/Noriega Editores, 2005).

Articles

- 1945 'Cost, Prices and Profits: Accounting in the War Program', *The Accounting Review*, Vol. 20, No. 3, pp. 267–308 (with E. L. Kohler).
- 1948 'Statistical Use of Accounting Information in Federal Economic Polity Formation', *The Accounting Review*, Vol. 23, No. 3, pp. 244–50.
- 1949 'Social Accounting: An Invitation to the Accounting Profession', *The Accounting Review*, Vol. 24, No. 3, pp. 233–9 (with E. Hagen, I. Friend and M. Copeland).
- 1950 'Use of Index Numbers in the Adjustment of Financial Statements', *Bulletin of the Illinois Society of Certified Public Accountants*, Vol. 13, No. 1, pp. 15–23.
- 1953 'The Status of Social Accounting and National Income Statistics in Countries Other Than the United States', *The Accounting Review*, Vol. 28, No. 2, pp. 221–38 (with J. M. Crawford).
- 1955 'Research and Practice in Statistical Applications to Accounting, Auditing and Management Control', *The Accounting Review*, Vol. 30, No. 2, pp. 221–9 (with R. M. Trueblood).
- 1959 'Application of Linear Programming to Financial Budgeting and the Costing of Funds', *Journal of Business of the University of Chicago*, Vol. 32, No. 1, pp. 20–46.
- 1963 'Breakeven Budgeting and Programming to Goals', *Journal of Accounting Research*, Vol. 1, No. 1, pp. 16–43 (with A. Charnes and Y. Ijiri).
- 1964 'Auditing and Audits Per Se in Field and Laboratory Contexts', in C. Bonini, R. Jaedicke and H. Wagner (eds), *Management Controls: New Directions in Basic Research*, McGraw Hill (with N. C. Churchill and T. Sainsbury).
- 1965 'A Field Study of Internal Auditing', *The Accounting Review*, Vol. 40, No. 4, pp. 767–81 (with N. C. Churchill).

- 1966 'Accounting and Analytical Methods and Simulation of the Firm Through a Budget Computer Program' (invited review of two books by R. Mattesich and P. Zitlau), *The Accounting Review*, Vol. 41, No. 1, pp. 201–05.
- 1967 'Some Network Characterizations for Mathematical Programming and Accounting Approaches to Planning and Control', *The Accounting Review*, Vol. 42, No. 1, pp. 24–52.
- 1967 'Some New Approaches to Risk', *The Accounting Review*, Vol. 42, No. 4, pp. 18–37 (with R. Byrne, A. Charnes and K. Kortanek).
- 1967 'Comments on the Use of Accounting in Internal Decision Making', in T. J. Burns (ed.), *The Use of Accounting in Decision Making*, College of Commerce and Administration, The Ohio State University (with A. Charnes).
- 1968 'Budgetary Disclosure and Other Suggestions for Improving Accounting Reports', *The Accounting Review*, Vol. 43, No. 4, pp. 640–8 (with N. Dopuch and T. F. Keller).
- 1972 'Economic Social and Enterprise Accounting and Mathematical Models', *The Accounting Review*, Vol. 47, No. 1, pp. 85–108 (with A. Charnes, C. Colantoni and K. O. Kortanek).
- 1974 'Accounting and Social Reporting', Chapter 5 in *Objectives of Financial Statements*, Vol. 2, American Institute of Certified Public Accountants.
- 1976 'A Futurological Justification for Historical Cost and Multi-Dimensional Accounting', *Accounting, Organization and Society*, Vol. 1, No. 4, pp. 315–37 (with A. Charnes and C. S. Colantoni).
- 1979 'Accounting and Accountability Relations', in W. W. Cooper and Y. Ijiri (eds), *Eric Louis Kohler, Accounting's Man of Principles*, Reston Publishing Co.
- 1979 'A Preface and a Memorial', in W. W. Cooper and Y. Ijiri (eds), *Eric Louis Kohler, Accounting's Man of Principles*, Reston Publishing Co.
- 1979 'Auditing and Accounting—Past, Present, and Future', in W. W. Cooper and Y. Ijiri (eds), *Eric Louis Kohler, Accounting's Man of Principles*, Reston Publishing Co.
- 1980 'Auditing and Accounting for Program Efficiency and Management Efficiency in Not-for-Profit Entities', *Accounting, Organizations and Society*, Vol. 5, No. 1, pp. 87–107.
- 1980 'Preface', in *Eric Louis Kohler: A Collection of His Writings (1919–1975)*, The Academy of Accounting Historians (with Y. Ijiri and G. Previts).
- 1988 'Quantitative Directions in Research on Creative and Innovative Management—a Commentary', in Y. Ijiri and R. L. Kuhn (eds), *New Directions in Creative and Innovative Management*, Ballinger.
- 1990 'Performance Auditing and Corporate Social Reporting', in M. J. Barrett, W. H. Beaver, W. W. Cooper, A. Milburn, D. Tweedie and D. Solomons, *Report on Accounting and Auditing Measurement*, American Accounting Association.

- 1991 American Accounting Association 75th Anniversary Articles. 'Recollections: 1935–50. In Search of an Identity', *Accounting Education News*, March, pp. 2–3 (with Paul Garner).
- 1991 American Accounting Association, Committee on Accounting and Auditing Measurement Report, 1989–1990, *Accounting Horizons*, No. 5, September, pp. 80–101 (with D. Solomons [Chair], M. J. Barrett, W. H. Beaver, J. Alex Milburn and David P. Tweedie). See also Minority Report by W. W. Cooper, pp. 102–3.
- 1995 'Accounting for Complexity in Costing High Tech Manufacturing', *European Journal of Operational Research*, Vol. 85, pp. 316–26 (with K. K. Sinha and R. S. Sullivan).
- 2002 'Auditing and Accounting: Some Effects of R. M. Cyert's Research', in M. Augier and J. G. March (eds), *The Economics of Change, Choice and Structure: Articles in Memory of Richard M. Cyert*, Edward Elgar Publishing.
- 2008 'The Sarbanes-Oxley Act and the Production Efficiency of Public Accounting Firms in Supplying Accounting, Auditing and Consulting Services: An Application of Data Envelopment Analysis', *International Journal of Services Sciences*, Vol. 1, No. 1, pp. 3–20 (with H. Chang, H. L. Choy and M.-H. Lin).

APPENDIX B

HONOURS AND AWARDS RECEIVED BY PROFESSOR WILLIAM W. COOPER

- 1940–41 University Fellow, Columbia University.
- 1941–42 Special Scholar, Columbia University.
- 1945 Co-recipient (with E. L. Kohler) American Institute of Accountants Award for the year's most significant and valuable article on an accounting subject (the first such award given).
- 1956 Fellow, Econometric Society.
- 1958–59 Ford Distinguished Research Professor, Carnegie Institute of Technology.
- 1962–63 Ford Foundation Faculty Fellowship.
- 1963 Fellow, American Association for the Advancement of Science.
- 1979 *Quantitative Planning and Control: Essays in Honor of Professor William Cooper on the Occasion of His 65th Birthday*, edited by Y. Ijiri and A. Whinston, Academic Press.
- 1982 William W. Cooper Professorship—Chair established by Carnegie-Mellon University with O. A. Davis as first occupant.
- 1982 Co-recipient (with A. Charnes and R. Duffin) of John von Neumann Theory Prize awarded jointly by the Institute of Management Sciences and Operations Research Society of America.

- 1983 Nadya Kozmetsky Scott Centennial Fellow, IC2 Institute, The University of Texas at Austin.
- 1984 Award for Outstanding Research Contributions, Graduate School of Business, The University of Texas at Austin.
- 1986 American Accounting Association Distinguished International Visiting Lecturer in Accounting to lecture on accounting at universities in Costa Rica and Peru.
- 1986 Professional Achievement Citation of the University of Chicago Alumni Association.
- 1986 U.S. Comptroller General Award for Significant Contributions to the U.S. General Accounting Office as a member of the Research and Education Advisory Committee, 1970–86.
- 1987 Award for Research Excellence, Graduate School of Business, University of Texas, Austin.
- 1988 Distinguished Visiting Faculty Member, American Accounting Association Doctoral Research Consortium, Lake Tahoe City, June 1988.
- 1988 Distinguished Service to Auditing Award by Auditing Section of the American Accounting Association.
- 1988 Auditing Section, American Accounting Association Award for serving as founding editor of *Auditing: A Journal of Practice and Theory*.
- 1988 William W. Cooper Fellowships established at The University of Texas Graduate School of Business.
- 1989 William W. Cooper Fellowship awards initiated by Carnegie Mellon University, School of Urban and Public Affairs (now the H. John Heinz III School of Public Policy and Management).
- 1989 Naming of auditorium in honour of William W. Cooper by Carnegie Mellon University Graduate School of Industrial Administration.
- 1990 Elected to Hall of Fame, Graduate School of Business, The University of Texas at Austin.
- 1990 Designated Outstanding Accounting Educator by American Accounting Association.
- 1990 *Bill and Ruth Cooper and Their Friends*, a book containing a collection of testimonials in honour of Bill and Ruth Cooper, edited by Yuji Ijiri, Carnegie Mellon University Press.
- 1991 Notable Contributions to the Accounting Literature Award from the Governmental and Nonprofit Section of the American Accounting Association ‘for his work in the area of Data Envelopment Analysis’.
- 1991 Appointed as Erskine Fellow to lecture to students and faculty at the University of Canterbury, Christchurch, New Zealand, and other universities and government agencies during the month of June.
- 1992 Appointed as Distinguished Visiting Professor under IBM (Japan) sponsorship to present a course in Systems Science and Management Information System in June 1992 at the School of International Politics, Economics and Business at Aoyama Gakuin University, Tokyo, and again in June 1993.

- 1993 *Creative and Innovative Approaches to the Science of Management*, a volume in honour of William W. Cooper on his seventy-fifth birthday, edited by Yuji Ijiri, Quorum Books.
- 1995 Elected to Accounting Hall of Fame, the Ohio State University.
- 1995 Fellow, Alicante University [Alicante, Spain] Science Faculty.
- 1996 Distinguished Alumnus, Carnegie Mellon University.
- 1997 Omega Rho Distinguished Lecturer, Dallas Meetings of INFORMS (Institute for Operations Research and Management Science), October. Omega Rho is the international honour society of the OR/MS Profession.
- 1997 PMS Blakett Memorial Lecturer, November meetings of British Operational Research Society.
- 1998 William W. and Ruth F. Cooper Professorship established by Carnegie Mellon University in its H. John Heinz III School of Public Policy and Management.
- 2002 Lifetime Contributions to Management Accounting Award from the Management Accounting Section of the American Accounting Association (the first such award ever given).
- 2002 *Journal of Productivity Analysis*, No. 17, January 2002, pp. 1–174, Special Issue edited by Subash Ray, Peter Bogetoft, Subal C. Kumbhakar and Jesus T. Pastor in honour of W. W. Cooper
- 2002 University Co-op Robert W. Hamilton Award for Career Research Excellence, University of Texas.
- 2002 Fellow, INFORMS.
- 2004 Gold Medal awarded by the International Society of Multi Criteria Decision Making.
- 2004 Robert L. Mehr award, *Journal of Risk and Insurance*, given by the American Risk and Insurance Association ‘for that article published 10 years ago that has best withstood the test of time’. Co-authored with P. L. Brockett, Linda Golden and Utai Pitaktong.
- 2005 *International Journal of Technology and Decision Making*, Special Issue in honour of W. W. Cooper, edited by Z. Huang, S. Li and J. Zhu.
- 2006 *Annals of Operations Research*, Vol. 145, ‘Performance Evaluation and Beyond: Data Envelopment Analysis Research Frontiers’, Special Issue in honour of W. W. Cooper, edited by Wade Cook and Joe Zhu.
- 2006 Inducted into International Operational Research Hall of Fame by the International Federation of Operational Research Societies.
- 2006 IMPACT Award by INFORMS.
- 2007 POMS (Production and Operations Management Society) Award for contributions to operation research and production and operations management.