

Quantitative/Mathematical Approaches in Management Accounting: Based on a Survey Concerning With Research and Education in Japan

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Abstract

This paper reports the results of a survey to indicate the state of the art of quantitative and/or mathematical approaches to management accounting in Japan. The most important result indicates that, as far as these approaches are concerned, the accusation of 'Relevance Lost' leveled at management accounting research and education also applies. In order to close the gap between theory and practice, it is suggested that more attention must be paid to implementation problems and information costs and that more empirical, more practical implementation-oriented studies such as Action Research are essential.

1 Introduction

In the late 1980s, the existence of a gap between the theory and practice of management accounting was vociferously pointed out. Researchers such as H. Thomas Johnson and Robert S. Kaplan, who are trying to address contemporary Western management accounting problems, believe that management accounting research has become divorced from practice and, because of its domination of managerial education and training, it has frustrated rather than facilitated solutions to new problems [Johnson and Kaplan, 1987]. Johnson and Kaplan wrote their book, *Relevance Lost: The Rise and Fall of Management Accounting*, with a clear message: management accounting had a golden age from the late 19th century to the early 20th, but now it has lost its relevance.

From their point of view, the gap between the theory or conventional wisdom and practice seemed to become larger, particularly when several quantitative techniques, e.g., linear programming, statistical regression analysis and decision theory, were introduced actively into management accounting research and education.

This paper reports the results of a survey to indicate the state of the art of quantitative and/or mathematical approaches in management accounting in Japan. Our objectives in writing

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this paper are as follows:

- (1) To provide some insights into the development of such kinds of management accounting research in the academic literature over the preceding ten years, referred to in Japan as the 'Lost Decade'.
- (2) To ascertain whether 'Relevance Lost' also applied or not in the 1990s.

To these ends, several data will be provided. In the next section, we describe the theoretical background, motive, and purpose of our survey. And then, sections dealing with our survey follow in turn. After summarizing the results, the 'Relevance Lost' problem in Japan will be discussed.

2 Theoretical Background of the Survey

Before we explain the details of our survey, it will be useful to clarify the theoretical background of the survey. The motive for this study stems from the following serious background.

In the field of management accounting, highly complex quantitative models and techniques were introduced actively into Japan in the late 1960s and 1970s. They formed much of the most impressive management accounting research in those days [Kosuga, 1983]. *Handbook of Management Accounting* (1969) edited by the Center for Accounting Research, Kobe University, summarizes and systematizes several techniques. According to this handbook, it is clear that management science or operations research has had a significant impact on management accounting researchers.

Nowadays, quantitative/mathematical approaches are recognized as an integral part of management accounting research and education. The major topics in the field of those approaches to management accounting appear in Appendix A. Apart from a few exceptions all of them are the same as the contents of *Handbook of Management Accounting* (1969).

In spite of these academic efforts, however, these models and techniques seem to be unattractive to practitioners in Japan [Kato, 1989]. We have little evidence of linear programming and other quantitative/mathematical techniques for budgeting, decision making, and so on. That is a general lack of sophisticated models/techniques in Japanese management accounting practice. It means that a serious gap between theory and practice exists in this area.

To sum up the major points of the skepticism voiced by leading management accounting researchers in the UK and USA [Scapens, 1985; Johnson and Kaplan, 1987], the following opinions are worth listening to.

- (1) The quantitative techniques and/or models produced by the researchers were not developed for or tested on actual enterprises.

- (2) The greatest concerns of researchers are not practical implementation problems or information costs, but rather the mathematical elegance of the quantitative techniques.
- (3) The mathematical models that the researchers developed were not necessarily used in business because of the high costs of using them.

First, as many critics pointed out, academics tend to focus on issues and phenomena that have no bearing on what practitioners must know to run a competitive and profitable organization in the real world. Very few people are concerned with problems that face managers. For this reason, the quantitative techniques and/or models produced by researchers were not developed for or tested on actual enterprises.

Second, the researchers prefer hard empirical testing of scientific hypotheses because of the quest for academic rigor. They are extremely interested in mathematical elegance and/or scientific rigor, and their efforts are to mimic what they defined as the research paradigms of the physical sciences. The academic rigor has two features. One is the reduction of real world complexity to terms expressed in mathematical models, and the other is the use of large-sample statistical data to test hypotheses.

Moreover, the mathematical models in management accounting emphasize profit maximization or cost minimization subject to several constraints. Those models allow one to calculate optimal quantities or prices of outputs and inputs assuming that no change occurs in a number of stated and unstated conditions or constraints. Of course, holding constraints constant recognizes the impossibility of mathematically finding equilibrium solutions in a system where all things can change at once. There is nothing wrong with using mathematics to make choices where resource scarcities exist. However, the most important matter for managers is to remove such constraints continuously in the real world.

For these reasons, there is a general lack of sophisticated mathematical techniques and/or models in management accounting practice. It is the simpler techniques and/or models that tend to be preferred in most instances. We feel that this is the state of affairs in the field of quantitative/mathematical approaches to management accounting in Japan.

In this paper we would like to examine whether Japanese researchers have made efforts positively to resolve the 'Relevance Lost' problem in the area of those approaches. *Relevance Lost* (1987) by Johnson and Kaplan, and *Management Accounting: A Review of Recent Developments*, second edition (1991) by Scapens were translated into Japanese and published in 1992. In those days, Japan started on a long-drawn-out, unprecedented business depression, which is still continuing. In such a bad situation, management accounting researchers should strive to break the deadlock, as has been done in the USA from the late 1980s to the present. Our concern here is whether Japanese management accounting researchers have done so or not. By investigating the state of the art of quantitative/mathematical approaches in management accounting research and education in Japan, we would like to reply to such a

question.

3 Survey on Quantitative/Mathematical Approaches in Management Accounting Research and Education

3.1 Academics Strive for Relevance? 1991-2000

The question we have to ask in this section is whether 'Relevance Lost' in the field of quantitative/mathematical approaches in management accounting research and education still applied in the Japan of the 1990s. As little is known about this matter, the question is still open.

For this study, we carried out a survey, which was intended to clarify the state of affairs in the period 1991-2000. The data to be discussed below were collected in the following way. On the research side, we collected and examined papers (almost all are in Japanese), and, on the educational side, we investigated the contents of the major textbooks (in Japanese) published during 1991-2002, including some translated editions. Based on the results of the survey, we will focus particularly on progress in management accounting research and education, and try to find how management accounting could be improved or advanced in the near future to regain 'Relevance'.

3.2 Selecting Objects for the Survey

To gain insights into the situation of management accounting research and education with quantitative/mathematical techniques and models in the 1990s, we needed to gather data with regard to the Japanese researchers/educators in the field of management accounting. So, as the first step, the following eight academic accounting associations were scanned.

- (1) Japan Accounting Association (founded in 1937, 1,758 members as of 2001; President: Professor Ryuji Takeda, Osaka Gakuin University)
- (2) Japan Cost Accounting Association (founded in 1975, 516 members as of 2001; President: Professor Michiharu Sakurai, Senshu University)
- (3) Japan Association of Management Accounting (founded in 1991, 875 members as of 2002; President: Professor Takao Tanaka, Aoyama Gakuin University)
- (4) Accounting History Association (founded in 1982, 235 members as of 2001; President: Professor Etsuzo Kishi, Toa University)
- (5) Japanese Association for International Accounting Studies (founded in 1984, 548 members as of 2001; President: Professor Kazuo Hiramatsu, Kwansei Gakuin University)
- (6) Japanese Association of Book Keeping (founded in 1985, 860 members as of 2001; President: Professor Hiroshi Toda, Kobe Gakuin University)

- (7) Japanese Corporate Social Accounting and Reporting Association (founded in 1988, 175 members as of 2002; President is Professor Kentaro Nomura, Oita University)
- (8) Japan Auditing Association (founded in 1978; President: Professor Yasuhiko Katou, Konan University)

Then we focussed on the Japan Cost Accounting Association and the Japan Association of Management Accounting, most of whose members are supposed to be involved particularly in management accounting research, education, and practice. From the membership lists of these two academic bodies, it was found that 990 persons (554 researchers/educators, 316 practitioners, and some others (occupations unknown) made up the Japanese academic world of management accounting.

3.3 Searching and Sorting the Papers

As our next step, we searched for each member's papers published during the period 1991-2000 using three data sources: the reference of Institute for Industrial Research (Kwansei Gakuin University), Magazine Plus (Nichigai Associates)¹, and *Quarterly Bibliography of Economics* published by Kinokuniya Company Ltd. As a result of this search, 6,541 papers were found.

These papers are not only concerned with management accounting but also with financial accounting and other areas in business administration. So, we set the two rules to sort and collect management accounting papers. First, the paper must be only about management accounting. And, second, it must be a monograph-type paper and/or article, rather than just a brief essay. Based on these rules, we judged and classified these 6,541 papers only by looking at their titles. Using these criteria, we chose 2,223 papers (34% of all papers) by 379 writers from 990 persons (38% of the total)².

For the third step, we focused even more closely on these 2,223 papers and picked out only the papers whose contents mainly treated the quantitative/mathematical techniques and models. The criteria of the judgment for screening papers depended on the contents (that is, concepts, techniques, models, etc.) that are described in the *Dictionary of Management Accounting* (2000) edited by the Japan Association of Management Accounting (as to the details, see Appendix A). As a result of this screening process, we found that 171 papers were the samples to be examined (only 7.7% of all papers, that is 171/2,223, written by 80

¹ Nichigai Associates provide various kinds of database to individuals, universities and other institutions for a fee.. Refer to the web-site: <http://www.nichigai.co.jp/> (only in Japanese).

² Only 34% of all papers were recognized as relevant to the survey. This fact means that the themes of the rest (that is, 4,318 papers) could not be classified into management accounting and their writers are not regarded as management accounting researchers. But, interestingly, they (including so many non-management accounting researchers) still belong to the associations as members for some reason. This seems to be peculiarity of academics in the Japanese accounting world.

persons).

Finally, we checked all the 171 papers in hand to judge their validity as samples for the survey. As a result, only 88 papers (4.0% of all, that is 88/2,223, written by 49 persons wrote them) were selected as the samples to be used for the survey. These papers were used here to examine the state of management accounting research in the 1990s.

3.4 Collecting and Examining the Textbooks

As the next step, we collected the major textbooks on management accounting published in Japan during 1991-2002. These were written or translated by the members of the Japan Cost Accounting Association and/or the Japan Association of Management Accounting, and have been used in many major universities in Japan. To realize the relevance of management accounting again in the real business world, the role of management accounting education is quite important.

Thirty textbooks in total were selected and examined in this survey. The details of these books appear in Appendix B.

4 Findings and Limitations of the Survey

4.1 Major Research Topics and Their Features

Table 1 shows the distribution of the 88 papers by year of publication. We should point out that the number of the papers based on quantitative/mathematical approaches is quite small. The peak was in 1991, just before the Japanese editions of Johnson and Kaplan's book and Scapens' book were published.

Table 1 Distribution of the Papers

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Total
Number of Papers	23	13	6	11	3	4	10	2	5	11	88

The techniques and models used in the 88 papers were various kinds. For example, agency theory, simulation models, fuzzy theory, and DEA (data envelopment analysis) could be mentioned. Table 2 shows how these quantitative/mathematical techniques and models were related to management accounting research.

Table 2 Examples of Research Topics

Techniques and Models	Number of Papers	Examples of Research Topics
Agency Theory	7	<ul style="list-style-type: none"> • Evaluation of practices of US and Japanese firms. • Analysis of the management control systems • Efficiency on the multiple stages for the performance evaluation systems, etc.
Simulation Model	3	<ul style="list-style-type: none"> • New business development as a strategic investment plan • Decision making for the construction firm • Application for capital budgeting for the direct investment on overseas
Fuzzy Theory	14	<ul style="list-style-type: none"> • Efficiency evaluation for the budgeting system • Applying for the management • Decision making for multi purposes • Evaluation of management • Target costing (for creating product value and setting the target cost), etc.
DEA	9	<ul style="list-style-type: none"> • Pricing based on marginal approaches • Efficiency on management of the business entity • Applying to the multi-planning for the opening the stores, etc.

In addition, there are many other research topics such as allocation of common costs using the Shapely value, business planning model with the structured matrix, performance evaluation and/or CVP analysis with linear and/or nonlinear models.

Of these 88 papers, almost all the authors are scholars, with only 8 papers being written by practitioners. From the results of the survey, it is reasonable to suppose the following:

- (1) The knowledge of quantitative/mathematical techniques and models is produced at the hands of researchers along well-specified paradigms governed and controlled by well-established scientific methods.
- (2) The researchers failed to respond correctly to changes in the global competitive environment, or they did not make efforts to tackle existing challenges.

(3) Those researches are generally lagging behind the times.

4.2 Major Topics for Education

Just after Johnson and Kaplan published their book, *Relevance Lost*, in 1987, a noteworthy management accounting textbook was published in Japan. This was *Analytical Methods for Management Accounting* (Tokyo: Dobunkan, 1988) edited by Professor Akira Nishimura, Kyushu University. It is an impressive work explaining the relationships between management accounting and several quantitative/mathematical techniques and models. This book consists of thirteen chapters. Table 3 shows the contents of the book.

Table 3 Contents of the Textbook Edited by Nishimura (1988)

Chapter 1:	Developments and Problems of Management Accounting
Chapter 2:	Cost Behavior and Cost Estimation
Chapter 3:	CVP Analysis and Profit Planning
Chapter 4:	Profit Variances Analysis Using Linear Programming
Chapter 5:	Costing Systems and Variances Analysis Using Lagrange Multiplier
Chapter 6:	Common Costs Allocation and Core Theory
Chapter 7:	Decentralization and Transfer Pricing
Chapter 8:	Inventory Control and Performance Measurement
Chapter 9:	Investment Analysis
Chapter 10:	PERT System for Project Management
Chapter 11:	Information Value and Information Evaluation
Chapter 12:	Agency Model and Performance Measurement
Chapter 13:	Implications and Limitations of Quantitative Models

This is the first textbook in Japan that summarizes and systematizes several mathematical techniques. But after the publication of *Relevance Lost*, we no longer see textbooks of this type.

Now, we would like to consider the result of the survey on management accounting education. The major educational topics on quantitative/mathematical techniques and models in the Japanese textbooks are enumerated below (see Table 4).

Table 4 Topics for Education: 1991-2002

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- (1) Application of Linear Programming
 - a. Production/Sales Planning with Constraints
 - b. CVP Analysis with Constraints
 - (2) Cost Prediction Using Regression Analysis
 - (3) Information Analysis for Investment Decision
 - a. Evaluation of Economic Value of Investments
 - b. Investment Decisions under Uncertainties
 - (4) Inventory Models
 - (5) Agency Models
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We found that only one book included all five topics and others included some of them. The one textbook is *Fundamentals of Management Accounting* (Tokyo: Zeimu-Keiri-Kyokai, 1999) by Professors Muneharu Otsuka and Masao Tsuji, Waseda University. 'Cost Prediction Using Regression Analysis', 'Evaluation of Economic Value of Investments', and 'Inventory Models' are included in all the textbooks.

In summary, it is clear that quantitative/mathematical techniques and models are treated as minor topics for management accounting education. Both the number of topics explained and the number of pages devoted to them in the textbooks have been decreased since 'Relevance Lost' was pointed out³.

Referring to the previous sections, in the late 1980s 'Relevance Lost' was already true in the field of quantitative/mathematical approaches in management accounting. And it is still so today. Few researchers have done enough work to solve the 'Relevance Lost' problem.

Finally, we also would like to point out that we doubt the relevance of the quantitative/mathematical techniques and models themselves. It would seem reasonable to expect that those approaches advocated in the literature would be more widely used if they offered real benefits to practitioners. In general, new techniques/models will be implemented quite quickly in the real world if they assist decision makers to maximize their profits. But, as we already mentioned in the previous section, the quantitative/mathematical techniques and models require too much information, some of which is extremely difficult to obtain, for their

³ Less attention has been paid to the quantitative techniques in management accounting textbooks. Some of the reasons for this are as follows. First, the university students' basic skills in mathematics have deteriorated. Second, many educators or teachers also lacked the detailed knowledge of mathematics. Third, the more important and new concepts and/or tools emerged, the less quantitative techniques would be focused. Fourth, there is a resistance or anxiety to teaching topics whose practical usefulness and/or practical applicability is exceedingly dubious.

implementation, and the models presented in the textbooks ignore the costs of providing such information.

4.3 Limitations of the Survey

Naturally, this survey is subject to some limitations inherent in the methodological procedures. They are as follows.

- (1) We counted 'one' for each writer even though the paper was a joint work by more than one person.
- (2) We focused on only the monograph-type papers and articles.
- (3) We searched and picked out the papers only by looking at their titles except in the final stage of the selection process.
- (4) The selection of the papers was made by personal judgment.
- (5) We carried out the survey with a limited number of the sources.
- (6) The criteria used to choose papers and classify the topics are heavily based on *Dictionary of Management Accounting* (2000). Indeed, using the contents of this dictionary is somewhat problematic. However, no adjustment was made because we wanted to avoid personal biases and we did not have any appropriate alternative.

In spite of these limitations, the results of the survey appear to be useful to understand the state of affairs. The effects of these limitations on the analysis of the results are insignificant.

5 Conclusion

Based on the survey, this paper shows several pieces of evidence as to the existence of 'Relevance Lost' in the field of quantitative/mathematical approaches to management accounting in the 1990s. Moreover, the results reveal that the research based on these approaches is still now very sparse and most of them are analytical/mathematical elegance-oriented papers. Which is to say that these researchers seem to be reluctant to conduct a practical implementation-oriented research. This fact may imply that there is insufficient academic effort on the researchers' side in Japan to close the gap between theory and practice.

Of course, academics have striven to develop more realistic models to close the gap. However, as researchers attempted to be more realistic in their modeling, the proposed techniques became more and more complex. When one moves away from simplistic textbook situations to complex real world situations, it may not be possible to obtain the information required as an input into the models. Striving for reality in modeling without adequate attention to implementation problems and information costs (e.g., the absence and/or unreliability of the required data, the inability of some users to understand complex techniques, and the lack of time to apply them) may have less value. Unless the researchers'

models are sufficiently complex to incorporate notions of information costs and benefits, they are unlikely to provide valid prescriptions for practice [Scapens, 1985, p.87]. As Scapens mentioned, the use of simple techniques in practice may be an optimal response to the decision-making situation and not an irrational rejection of textbook models.

Faced with these criticisms researchers and practitioners ought now to become aware of the mutual benefits which can be obtained from closer cooperation. In order to do so, more empirical research and field surveys are required⁴.

In conclusion, it may be the worst of times for management accounting researchers and educators. A gap between research and practice has become a more and more serious matter. Much of the prevailing knowledge is coming to be regarded with skepticism by academics. Moreover, it has never been overwhelmingly accepted in practice. In order to achieve 'Relevance Regained', management accounting research and practice need to be updated and modified to accommodate the novel and different information needs of managers [Kosuga, 1988]. In this sense, it may also be the best of times for management accounting researchers.

Model building by quantitative approaches has provided an excellent conceptual framework for management accounting. We expect that models will continue to be important in facilitating our understanding of complex processes in the real world. They will be invaluable decision aids for managers in their planning and control activities. To remove the gap and regain 'Relevance' in the real world, it is necessary to move from the simplified settings to the complicated settings of real organizations with adequate attention to implementation problems and information costs.

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⁴ As a result of the survey, we found 17 papers that were based on empirical studies, such as actual condition survey, and analysis of management accounting using the statistical techniques. Appendix C shows the distribution of themes of these papers by the year. It is reasonable to suppose that Action Research is effective to close the gap because it inevitably demands a relationship with practice.

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Appendix A: Quantitative/Mathematical Approaches in Management Accounting

In the *Dictionary of Management Accounting* (2000)⁵ edited by the Japanese Association of Management Accounting, quantitative/mathematical approaches in management accounting are systematically classified into three areas, namely, (1) the mathematical programming for management accounting (linear programming models and nonlinear programming models), (2) several mathematical techniques for management accounting, and (3) statistical approaches. These details are summarized in the following Tables.

Table 5 Mathematical Programming for Management Accounting

1. Linear Programming Models

- (1) Application of Linear Programming Models
- (2) Application of Goal Programming
- (3) Application of Piecewise Linear Programming
- (4) Applications of Multiple Objective Linear Programming
- (5) Other Linear Programming: Fractional Programming and Interval Linear Programming
- (6) Applications of Data Envelopment Analysis (DEA)

2. Nonlinear Programming Models

- (1) Applications of Nonlinear Programming (Convex Programming)
 - (2) Applications of Quadratic Programming
 - (3) Other Nonlinear Programming: Case of Concavity Constraint Set
 - (4) Application of PERT/CPM
 - (5) Application of Integer Programming
 - (6) Application of Probability Programming
 - (7) Application of Dynamic Programming
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⁵ This book was published in 2000. About 150 writers (including scholars and practitioners) contributed to it. It took more than six years to publish. So, we can call it one of the great compilations of contemporary knowledge on management accounting in Japan.

Table 6 Mathematical Techniques That Support Management Accounting

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- (1) Application of Nonlinear Models: Differential Model, Integral Model, and Minimization Problems Using Marginal Analysis
 - (2) Application of Game Theory
 - (3) Application of Probabilistic Techniques: Decision Theory, Queue, and Stochastic Process and Its Application
 - (4) Application of Information Economics: Cost-Benefit Analysis of Management Accounting Information, and Choice of Management Accounting Information
 - (5) Application of Fuzzy Theory
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Table 7 Statistics and Analytical Techniques

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- (1) Use of Descriptive Statistics: Frequency Distribution, Average and Variance
 - (2) Use of Regression Analysis
 - (3) Use of Multivariate Analysis
 - a. Multiple linear regression analysis
 - b. Principal components analysis
 - c. Discriminant analysis
 - d. Factor analysis
 - e. Cluster analysis
 - (4) Use of Quantification Theory
 - (5) Use of Time Series Analysis
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In addition to the above techniques, we can identify some management engineering techniques such as IE (industrial engineering), TQM (total quality management), VA (value analysis), System Engineering, Reliability Engineering, Human Engineering, and Information Engineering.

Also, some tools such as simulation models (for budgeting, strategic management accounting, and business planning), Capitalization, Annuity Calculation, Economic Value of Investments (e.g., net present value approach, etc.), Capital Budgeting, Capital Structure and Working Capital Management would be important.

Appendix B: Major Management Accounting Textbooks in Japanese**Tabel 8 Major Textbooks Published During 1991-2002**

Author, Editor, Translator	Title	Construction	Year	ISBN
Otojiro Kubota, ed.	Management Accounting, new edition	12 chapters, 332 pages	1991	4641110867
Fumio Yoshimura	Management Accounting and Organizations	6 chapters, 178 pages	1992	4770703996
Yoshiro Ito	Techniques of Manage- ment Accounting	16 chapters, 316 pages	1992	4495155814
Osamu Nishizawa	Lecture Notes of Manage- ment Accounting, revised edition	10 chapters, 329 pages	1993	4793104452
Takao Tanaka, Yoshitaka Kobayashi, ed.	Guidance of Management Accounting	13 chapters, 195 pages	1993	4502208728
Yasuyuki Kazusa	Management Accounting	12 chapters, 316 pages	1993	4915787354
Yasuhiro Monden, ed.	Management Accounting Textbook	12 chapters, 283 pages	1995	4419022701
Koichi Furukawa, Muneya Sato	Management Accounting	15 chapters, 154 pages	1995	4595544510
Tugio Kono	General Theory of Management Accounting	14 chapters, 334 pages	1996	4419025565
R. S. Kaplan et al., Takayuki Asada, Noboru Ogura, trans.	Advanced Management Accounting, second edition	17 chapters, 712 pages	1996	4502211338 4502211435
Michiharu Sakurai	Management Accounting	17 chapters, 403 pages	1997	4495161415
Kohei Yamada, ed.	Basic Knowledge of Management Accounting	20 chapters, 264 pages	1998	4887090676
Koichi Machida, Moritoshi Fujinuma	Management Accounting Theory	10 chapters, 207 pages	1998	4794411278
Hiroshi Torii	Introduction to Manage- ment Accounting	7 chapters, 178 pages	1998	4502215236
Takayuki Asada, Makoto Yori, et al.	Introduction to Manage- ment Accounting	15 chapters, 331 pages	1998	4641120609

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Naoki Murata, Sin-ichi Korogi, ed.	Guidepost of Management Accounting	12 chapters, 213 pages	1999	4419034068
Muneharu Otuka, Masao Tsuji	Fundamentals of Management Accounting	11 chapters, 328 pages	1999	4419024399
C. T. Horngren et al., Shunsuke Watanabe, trans.	Introduction to Management Accounting	15 chapters, 436 pages	2000	481320077X
Yasuhiro Monden, ed.	Management Accounting Textbook, second edition	17 chapters, 381 pages	2000	4419034084
Osamu Nishizawa	On Management Accounting, second edition	18 chapters, 303 pages	2000	4561223355
Shokichi Nakahara, ed.	Management Accounting	18 chapters, 322 pages	2000	4419035099
Muneya Sato	Management Accounting	13 chapters, 222 pages	2000	4419035102
Michiharu Sakurai	Management Accounting, second edition	19 chapters, 529 pages	2000	4495161423
Yoshiro Ito	Management Accounting Theory	15 chapters, 212 pages	2000	4495164813
Misao Yamaguchi, ed.	Essence of Management Accounting	10 chapters, 266 pages	2001	4502218634
Yasuhiro Monden	Management Accounting	19 chapters, 380 pages	2001	4419036680
Yasuhiro Takeda, ed.	Management Accounting Theory	21 chapters, 345 pages	2001	479441191X
Shimura Tadashi et al.	Management Accounting Textbook	10 chapters, 244 pages	2001	4887091117
Susumu Ueno	Management Accounting	17 chapters, 447 pages	2001	4419036990
Kohei Yamada, ed.	Basic Knowledge of Management Accounting, revised edition	19 chapters, 285 pages	2002	488709115X

Appendix C: Empirical Research and Field Survey with Quantitative Techniques**Table 9 The Number and Themes of the Papers**

Year	Number of Papers	Themes
1991	1	Cost and benefit analysis of R&D expenditure
1992	1	Interactive control
1993	3	Contingency theory with the target costing Effect on the measurement of R&D
1994	1	Multiple strategies of the companies
1995	1	Effect of the performance improvement with IT
1996	2	Input-output analysis of R&G expenditures
1997	3	Efficiency and effectiveness of the performance Selling & general administrative cost Measurement of the effects on investment for the R&D expenditure
1998	1	Management based on standard costing
1999	2	Relationship between management accounting system and financial performance Allocation of factory overhead cost
2000	2	Accounting system and environment of cost accounting Effect of relationship on cost reduction Using Target Costing