1996

Information technology competencies in the accounting profession : AICPA implementation strategies for IFAC International Education guideline no. 11 : implications for education and practice

American Institute of Certified Public Accountants (AICPA)

International Federation of Accountants

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AICPA Implementation Strategies for IFAC International Education Guideline No. 11

Implications for Education and Practice

Includes IFAC International Education Guideline No. 11,
Information Technology In The Accounting Curriculum

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Preface

Information technology (IT) will increasingly affect the value of CPAs' services and their ability to remain competitive in the marketplace. Recognizing the challenges faced by accounting educators to integrate IT into the accounting curriculum and by accounting professionals to keep up-to-date with the rapidly changing IT environment, the AICPA created the Technology Curriculum and Competency Model Task Force to define IT competencies for the accounting profession.

International Federation of Accountants (IFAC) International Education Guideline No. 11, *Information Technology In The Accounting Curriculum*, identifies the IT education requirements for students planning to enter the profession and for professional accountants working in different disciplines. The AICPA task force, concluding that the IT knowledge and skills identified in the IFAC guideline are universally applicable, developed this document to aid and encourage implementation of the guideline in the United States.

This document offers strategies and action plans for accounting educators, professional accountants in public practice, industry and government, continuing professional education providers, and regulators. All of these constituent groups must work together for CPAs to continue to provide valuable services to the public.

We commend IFAC on the quality of its work in developing International Education Guideline No. 11, and are grateful to the organization for permitting us to include the guideline in this document.

July 1996

AICPA Technology Curriculum and Competency Model Task Force of the Academic and Career Development Executive Committee and Information Technology Executive Committee

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Part 1— Information Technology Competencies in the Accounting Profession: AICPA Implementation Strategies for IFAC International Education Guideline No.11

INTRODUCTION

1. The purpose of this document, prepared by the American Institute of Certified Public Accountants' (AICPA's) Technology Curriculum and Competency Model Task Force (the Task Force), is to discuss implementation issues and implications for the accounting profession in the United States of International Education Guideline No. 11, recently issued by the International Federation of Accountants (IFAC), entitled *Information Technology In The Accounting Curriculum*. A copy of the guideline is included with this document as Part 2. Additional copies of the IFAC guideline may be obtained by writing to:

> International Federation of Accountants
> 114 West 47th Street, Suite 2410
> New York, NY 10036
> (FAX) 212–302–5964

2. The IFAC guideline defines information technology (IT) as "hardware and software products, information systems operations and management processes, and the skills required to apply those products and processes to the task of information production and information systems development, management, and control (para. 2)." The Task Force utilizes the same definition in this document.

3. The IFAC guideline also highlights trends, challenges, and opportunities derived from the increasing importance of IT to professional accountants (paras. 3–10), and identifies the IT educational requirements for professional accountants under five main headings (para. 15):

- *General* IT education requirements
- The accountant as *user* of information technology
- The accountant as *manager* of information systems (e.g., financial manager, controller)
- The accountant as the *designer* of business systems (e.g., business system design team, producer of financial information, analyst)
- The accountant as *evaluator* of information systems (e.g., auditor, tax advisor, consultant)

4. The IFAC guideline assumes that, at a minimum, all professional accountants should be proficient in the *general* and *user* educational requirements as well as at least one of the other three roles listed above (*manager, designer, evaluator*), depending on the accountant's work domain. For example, an aspiring management accountant might be interested in the general IT education requirements, user-oriented education requirements and education requirements related to manager and designer roles. On the other hand, an aspiring public accountant might be interested in the general IT education require-ments, user-oriented education requirements and education requirements related to the evaluator role. Detailed guidelines for educational requirements for each of the five headings are listed in the IFAC guideline.

5. The IFAC guideline distinguishes between prequalification and postqualification IT-related education requirements (para. 19) and emphasizes the need for both relevant theoretical knowledge of IT as well as practical IT skills (paras. 24–31).

6. The main text of the guideline (paras. 36–129) sets out the prequalification and postqualification IT knowledge and skill require-ments according to the five headings identified above in paragraph three. The appendixes within the IFAC guideline list the requirements for each of the five headings in more detail.

7. The Task Force considers the IFAC guideline to be very helpful in identifying IT knowledge and skills required of accounting pro-fessionals and herein attempts to address implementation and implications of the guidelines for various constituency groups in the United States. In particular, this document is intended for accounting educators, public accountants, accountants in industry and govern-ment, regulators, and individuals involved in continuing professional education and professional evaluation of accountants. The remainder of the document is divided into the following sections:

- The education domain
- The work domain—including managers, designers, and evaluators of information systems, as described in paragraph three
- The continuing professional education (CPE) domain

- The licensing and regulation domain—including professional examinations and state boards of accountancy

8.   Prior to addressing implementation and implications of the guideline, the Task Force urges the adoption of a new "mind set." IT has grown (and will continue to grow) in importance at such a rapid pace and with such far-reaching effects that it can no longer be considered a discipline peripheral to accounting. Rather, professional accounting has merged and developed with IT to such an extent that one can hardly conceive of accounting independent from IT. When viewed not as two separate disciplines of accounting and IT, but as an integrated whole, the implications of the IFAC guideline for the four domains identified above take on an urgency and importance that might otherwise be minimized or missed.

EDUCATION DOMAIN

9. The objective of accounting education at the university level is to prepare students for positions as professional accountants. In the past, education has focused on technical knowledge. Courses focused on financial accounting recording processes, management accounting techniques, tax rules, and audit procedures. Accounting programs were judged by their ability to develop these technical abilities in students.

10. Three important challenges currently face the accounting profession and thus accounting education:

- Information technologies are affecting the way in which organizations operate.
- Information technologies are changing the nature and economies of accounting activity.
- Information technologies are changing the competitive environment in which accountants participate.

11. As a result of these changes, academic preparation today must include increasing amounts of IT training. The IFAC guideline identifies the appropriate IT knowledge and skills for all beginning professional accountants. Hence, the guideline provides an excellent blueprint for the IT curriculum component of university accounting programs.

General IT Education Requirements

12. All professional accountants, irrespective of their primary work domain or role, must acquire both relevant theoretical knowledge and practical IT skills. The essential body of knowledge of the accounting IT is represented by the following basic content categories:

- Information technology concepts for business systems
- Internal control in computer-based business systems
- Development standards and practices for business systems

- Management of information technology adoption, implementation, and use
- Evaluation of computer-based business systems

13.   Paragraph 40 and appendixes 1 and 2 of the IFAC guideline provide additional specific guidelines in each of these categories.

A Philosophy for Teaching Technology in the College Curriculum

14.   Technology affects how organizations operate, what accounting and information systems professionals do, and how management, accounting, and information systems professionals interact. Accountants do not need a degree in electrical engineering or computer science to become very sophisticated users and appliers of information technology. Advances in technology have made it possible for accountants to dedicate more time to professional and business issues and less time to technology issues, while still becoming effective users of technology. Therefore, when teaching the technological concepts suggested in the IFAC report, it is important to emphasize the need for a strategic, conceptual understanding of information technology as a resource to enable achievement of business objectives.

15.   A *strategic, conceptual understanding* of information technology focuses on:

- The functions of each information technology component.
- The objectives of technology advancements for each information technology component.
- The potential business impact of new technology.

16.   Students do not need to understand the intricacies of each new technology. But, understanding the concepts behind the technology helps students learn to use, evaluate, and control technology more effectively. Without a conceptual understanding, the technology may be misunderstood and thereby employed ineffectively or even inappropriately. More important, a strategic, conceptual understanding of technology encourages accounting students and professionals to concentrate on applying and using technology to achieve business purposes.

Strategies for Implementing a Study of Technology Within the Accounting Curriculum

17. As information technologies change and become more user-friendly and advanced, the opportunity for accountants to more effectively and efficiently support organizational decisions is enhanced. Therefore, the study of IT is integral to the study of accounting. But accounting departments need a strategy before attempting to implement the study of technology within the accounting curriculum. Any strategy to implement a study of IT should address the following four issues:

18. First, it is important to acknowledge from the beginning that technology resources are always changing. Due to continual change, schools must teach students that it is their responsibility, as accounting professionals, to improve their understanding of technology and to remain informed about IT resources throughout their careers. Students should learn that technology, when improperly managed, is a risk or problem, rather than a useful resource. The professional should control the technology, rather than vice-versa.

19. Second, students should be made aware that IT personal-productivity skills are essential for today's professional. These include proficiency in using tools such as spreadsheets, word processors, presentation graphics, databases, etc., to enhance personal efficiency and effectiveness.

20. Third, students should be encouraged to study IT from the perspective of its usefulness, application, and impact. Focus student attention on harnessing the power and use of IT— rather than focusing on technology as an end in itself. It is important to emphasize how technology affects organizations, and how the use of technology can help accounting professionals produce and deliver more valuable information. Remind students that technology is only useful and effective if properly implemented and used. Before designing or implementing a system, a professional must understand the business domain and business objectives that the system will support.

21. Fourth and finally, to the extent possible, the study of technology should be integrated with the study of accounting. Do not treat the two as separate and disjointed disciplines.

Challenge to Educators

22. Few accounting educators dispute that IT is becoming increasingly important for accountants. The issue for most educators is what their role should be in incorporating IT into accounting education. Many have expressed the opinion that IT education should be left to the IT faculty in IT classes. With IT becoming such an integral part of accounting, this approach to IT education seems inappropriate. The message of the IFAC guideline is that accounting education must incorporate increasing amounts of IT. One of the objectives of the IFAC guideline is to provide accounting faculty a model for integrating IT and traditional accounting topics.

Issues to Consider

23. In the process of integrating IT into the accounting curriculum, several critical issues must be addressed. The first is *university and college support*. It is important that the structure in which an accounting program operates is interested in change. Accounting faculty should discuss the needs and benefits of change in the accounting program with university and college administrators. Implications on courses offered to support the accounting program must be addressed. The impact of these accounting curriculum changes on service offered to other programs must also be addressed. Not all topics or issues can be covered in accounting courses. All program courses should be coordinated.

24. A second issue is the *participation of all accounting faculty.* If change is to occur in an accounting program, faculty must be actively involved. The level of participation may depend on the role each faculty member assumes. At the very least, faculty reticent to actively support change should not act to inhibit or prevent the process of change.

25. A third issue is *technical support*. Technical support includes both computer hardware and software as well as resources for technical assistance. It is important that there be adequate hardware and software to incorporate IT issues in the curriculum. Many if not most accounting programs are currently deficient in both hardware and software. Furthermore, ongoing technical support is a necessity. In the same sense that automobiles do not properly operate for years without

periodic visits with the mechanic, computer hardware and software need periodic visits with a technician. Such technical support currently exists in few accounting programs.

26. In addition to technical support, faculty will require *training in IT* areas and skills. Faculty must be trained in both the theory and application of IT. Many resources currently exist within the AICPA and other professional associations as well as corporate or public accounting training programs. This effort will require both time and financial resources. The issue of an adequate budget is critical to the inclusion of IT into the accounting curriculum. Computer hardware and software and the needed technical support and training demands require substantial financial resources as well as a great deal of devoted time and attention.

27. A final issue to consider is that of *accountability and outcome assessment.* Changes must be evaluated and actual outcomes measured against desired outcomes. Educators in general have not felt responsible for curriculum changes to parties outside of the university setting. Since it is outside parties who are demanding these changes, it is important that the results of changes be measured and evaluated.

Leadership

28. The first challenge facing accounting education is the need for leadership. The AICPA, AAA, IMA, IIA and most other major professional accounting organizations have extended calls for changes in accounting education. All of these calls have included the need for substantially more IT training. The large public accounting firms issued a direct challenge to accounting educators with the funding of the Accounting Education Change Commission (AECC). Reports of the AECC, presentations at national conferences, and the IFAC guideline all provide change guidelines. Leadership exists at the national level. What is needed is leadership for change at individual accounting programs.

29. Leadership in curriculum change consists of four roles: visionary, implementor, facilitator, evaluator. These roles may be filled by individuals or groups of individuals. Any one person can participate in multiple roles.

30.   Every change is the product of a vision or view. The *visionary* is not satisfied or bound by current activities and processes. This individual or group of individuals presents a picture of what the change is attempting to achieve. For a program to change, a visionary must step forward. To some extent, this document may help formulate a vision.

31.   Once a vision is identified, specific action steps to achieve the goal must be identified. The *implementor* is typically a detail-oriented person who can work with curriculum scheduling, course development and faculty development. Usually the visionary and the implementor are different individuals.

32.   The role of the *facilitator* is to run interference for the proposed changes. Facilitators work with college and university administrators to clear the impediments to the changes. Working to mitigate faculty dissension is another facilitator role.

33.   The *evaluator* is the individual who can stand back and make an objective or rational evaluation of the proposed changes. The evaluator should have an understanding of the interactions of the changes being proposed and the impact on and vested interests of those involved.

Action Plan

34.   In order for accounting programs to make the changes suggested in the IFAC guideline in an orderly and comprehensive manner, an action plan must be developed and followed. Since the IFAC guideline addresses curriculum content, this document addresses strategy for curriculum innovation. Steps for an action plan might include the following:

- Identify individuals filling the leadership positions discussed in the previous section. The chair or director of the accounting program will most likely assume the facilitator role due to the nature of his/her administrative responsibilities.
- Assess the current state of affairs—at the university, college, department, and individual faculty levels. How well is IT currently integrated into the curriculum?
- Create a common vision of what the program should look like.

- Identify steps for moving toward the vision. Be sure to involve all impacted parties, including other departments (e.g., Management Information Systems Department) or colleges (e.g., Computer Sciences).

- Establish evaluation measures. How do you know that objectives are being met?

- Create a process to continually review and evaluate the program.

35.   Individual steps will differ for each program. The important issue is that without an established action plan, little if any change is likely to occur.

WORK DOMAIN

36.   The accounting profession is diverse and includes accountants operating in many functions. This document combines them all into the work domain, which is intended to include accountants working in the following areas:

- Industry
- Public practice
- Public sector

37.   Many aspects of IT are common among all work domains. It is both possible and desirable to set out some of the broad elements of an educational background that all professional accountants can be legitimately expected to share.

38.   The IFAC guideline assumes that professional accountants will operate within at least two of the roles identified previously (general, user, manager, designer, evaluator). Requirements are further defined as *prequalification* and *postqualification*. Prequalification education requirements may be more standardized and can be more easily monitored by the profession. After prequalification, professional accountants are expected to continue their professional education with appropriate postqualification IT education.

39.   Some of the elements identified in the body of the IFAC guideline are summarized in the table on the following page. In addition to the items in the table, however, the IFAC guideline lists elements in the appendixes that are of equal importance. The reader is encouraged, therefore, to study the IFAC guideline carefully, in its entirety.

Roles	IT Knowledge/Skill
User (Para. 53)	Information systems architecture, hardware, software, and data organization methods
User (Para. 50)	Gathering and summarizing data
User (Para. 58)	Prequalification skills: Ability to use a word processor, spreadsheet, database, and a basic accounting package
User (Para. 59)	Experience with stand-alone and networked systems
User (Para. 60)	E-mail and electronic research on CD-ROM
Manager (Para. 63)	Information systems management
Manager (Para. 66)	Strategic planning for the use of information systems Administrative issues Financial controls Operational issues Systems acquisition, development and implementation Systems maintenance and change End-user computing
Manager (Para. 70)	Communication and interpersonal skills in an IT context Interaction with end users Interaction with technology teams or committees Interaction with vendors and suppliers
Designer (Para. 72)	In-house design of systems or acting as a consultant
Designer (Para. 73)	Understanding of alternative business systems and how to integrate with organizational objectives
Designer (Para. 75)	Basic steps of development, task and practices, and how to incorporate internal controls
Evaluator (Para. 85)	Internal and external audit functions, whether or not identified as such
Evaluator (Para. 86)	Performance evaluation Compliance evaluation Evaluation of controls Evaluation of fairness and completeness of accounting records

40.   The educational requirements are extensive and continue to grow as new technology is introduced. In addition, all organizations are experiencing the following pressures:

- Rapid introduction of new hardware and software
- Support issues
- Training issues
- Increased investment in technology

41.   The following management responsibilities are critical ingredients for the successful integration of IT into the work domain, and are addressed next in detail:

- Leadership and visionary skills
- Technical support
- Training
- Written three-year plan
- Three-year budget
- Accountability and outcome assessment

Leadership and Visionary Skills

42.   *Leadership,* particularly in upper management, is a key ingredient in the development of technology skills. Without leadership from the top, most organizations fail due to financial and political constraints. Technology leaders in accounting have approached the development process in a nontraditional manner. . . ready, fire, aim. Accountants tend to aim, aim, aim, aim, aim and then conduct another study. That is to say, leadership requires risk taking. Leadership in the technology field has developed a culture of rapid decision making and action, due to the rapid changes made in the technology environment. These leaders learn from mistakes and instill the confidence of success throughout the organization. This culture is different from the traditional conservative nature of accountants. Following are some of the characteristics of technology leaders:

- Passion to improve the organization
- Ability to manage risk

- Ability to manage change
- Ability to build a team
- Possess visionary skills

43.   *Visionary skills* are critical. These skills can either be out-sourced or acquired from within, depending upon the size of the organization and internal talent. There is currently a shortage of visionaries who have both accounting and technology-related skills. However, this should improve in the future as qualified personnel advance into critical leadership positions. Professional development of these skills will benefit users, industry, public practice, and public-sector organizations.

Technical Support

44.   In addition to the visionary skills, *technical and training skills* are also required. One person typically does not have all of these skills. Therefore, a team approach is required. The size of the organization generally dictates the justification for either having these skills internally or outsourcing them.

45.   Many organizations have quickly recognized the need for technical skills and have hired the non-accountant technician, who may have the required technical skills, but may have difficulty communicating with owners, management and other professionals. People with technical skills tend to be problem solvers rather than teachers and good communicators. Frustration often results. Additional frustration occurs when management expects the same level of billable hours as other professionals, but the technician's time is consumed with internal responsibilities. A definitive job description and participatory management are both necessary in order to ensure the successful integration of a non-accountant technician.

Training

46.   *Training* is the only way to develop and maintain a highly skilled work force in today's rapidly changing technology environment. The accounting profession typically requires a greater amount of technical expertise than many other industries. This complicates the

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training process because more applications may be on its systems than in other industries.

47.   In identifying quality IT trainers, knowledge of accounting and technology is important, but not the primary consideration. *Training skills* require the ability to communicate one's expertise to others. Good oral and written communication skills are an absolute necessity for the trainer. Organizations will find that good training personnel provide a highly leveraged service.

48.   *Time and cost requirements* for training are considerable. Training and implementation represent approximately 70% of the total cost of automation. Hardware and software account for approximately 30%. Too many organizations focus on the hardware and software with little consideration given to the training and implementation time and cost requirements.

49.   It is estimated it takes the average end user 1–5 hours of on-the-job training per hour of formal training in order to feel comfortable with new technology. Based upon this ratio, it takes 40–200 hours after 40 hours of classroom training in order for an employee to feel productive with new technology. This varies based upon the user and application. A consistent user interface such as Windows™ reduces training and implementation time.

50.   The following *training curriculum,* prepared for the IT membership section of the AICPA, is an example of a 40-hour classroom *introductory* technology-related training program designed to help accountants get the skills necessary to manage information. In the current environment, the necessary skills might be as follows:

Windows/GUI	4 hours
Network orientation and on-line services	4 hours
Spreadsheets	8 hours
Word processing	8 hours
Database basics	8 hours
Integrated financial reporting	8 hours

51.   The following is an example of an *intermediate* technology-related skill-training program:

Tax preparation update	4 hours
On-line research	4 hours
Internet access	8 hours
Intermediate spreadsheet	8 hours
Core accounting systems update	8 hours
Report writing from a database	8 hours

52.   The following is an example of an *advanced* technology-related skill-training program:

Data conversions	8 hours
Network management	8 hours
Networked accounting systems	16 hours
Software updates	8 hours

53.   The training process is ongoing. It is expensive because it requires equipment and time. Personnel start at different levels and learn at different speeds. Therefore, it is impossible to develop and implement a standard program that will fit everyone in the organiza-tion/profession. Hands-on training is generally the best method of delivery. This is especially true at the entry level. As users become more advanced, they can learn efficiently from instructor-based demonstra-tions. The rapid development of computer-based training and multimedia courses indicates significant changes in the methods of training are currently here or on the immediate horizon.

54.   Organizations need to plan for training facilities, either on site or off site. The ideal location depends on a number of factors, such as the organization's size, type of practice, and current applications usage. The advantages of on-site facilities include:

- Local area network connection

- Convenience for personnel

- Easier to conduct shorter sessions

- Easier to schedule frequent sessions

55.   Disadvantages of on-site training include the amount of invest-ment required and the potential for class interruptions.

Written Three-Year Plan

56.   The strategic planning process needs to include a three-year component for IT, based upon organizational priorities. Three years is considered ideal because a shorter time span does not allow enough time for implementation, and more than three years does not allow the plan to be sufficiently specific. The planning process should involve everyone. Executive education and participation ensure success. Group sessions should be held to provide executive education, information about alternatives, peer experiences, and a briefing on future technology. Participants should be given the opportunity to define requirements and identify priorities. It is advisable to allow participation in establishing implementation teams. It is imperative all top managers (owners in a firm) attend the planning sessions.

57.   Year one of the plan should be specific; years two and three should be more conceptual. Each year the plan needs to be revised at an annual technology retreat where the organization celebrates accomplishments, defines current requirements, establishes priorities, and updates the plan.

58.   The written plan should contain the following items:

• Objectives

• List of requirements

• List of priorities

• Identification of project teams, resources, and due dates

• Plan of action

Three-Year Technology Budget

59.   Technology budgeting is relatively new. In the past, technology has generally been included in the organization's capital budget. The advancement and rapid development of technology dictate a separate budgeting process, as a component of the organization's overall strategic plan. Systems now last for 2–3 years rather than 5–10 years. Software is updated at least annually. This includes core business applications, as well as personal productivity tools.

60. The budget should contain the following:

- Three-year projection
- Hardware requirements, including maintenance
- Software requirements, including maintenance and licensing
- Outsourcing requirements
- Contingency and sales tax line items (15% of the total)
- Comparative benchmarks (peer and industry)

61. Organizations should plan on an annual replacement of one-third of their PC-based hardware.

Accountability and Outcome Assessment

62. Technology management is maturing. As it matures, new methods of benchmarking and accounting are being implemented. Many organizations are using the "peanut butter method" of accounting for technology. That is, costs are spread throughout departments and capitalized. Unfortunately, in using this approach, management is generally unable to obtain a complete picture of the total cost of technology. Allocation of technology costs to profit or cost centers is appropriate, but management also needs a mechanism to determine total technology costs incurred by the organization.

63. Organizations should budget and account for technology expenditures for the entire organization. These numbers can then be compared to industry benchmarks such as:

- Percent of revenue
- Amount per employee
- Revenue per employee
- Profitability

64. These benchmarks vary from industry to industry. As an example, leading accounting firms are spending in excess of 5% of gross revenues annually on technology. Many firms are generating increased fees per person with their investments in training, hardware, and software. Management, planning, budgeting, and accounting all play

critical roles in assessing an organization's return on its technology investment.

65.   Different opinions exist as to whether there is a technology payoff. Without benchmarks and statistics it is difficult to prove the return on investment. Organizations must continue to evaluate their procedures and strive to improve efficiency through the reengineering process. Technology management must and will improve. The accounting profession has both an important role and responsibility for its development and improvement.

CONTINUING PROFESSIONAL EDUCATION (CPE) DOMAIN

66.   Development of IT has direct implications for CPE. IT poses an unusual problem for the accounting professional because basic IT knowledge has not previously been part of the required core education. Technology is a part of the accountant's life that has evolved at an extremely rapid pace without any guidance within the profession. As a result, remedial needs are extensive.

67.   General knowledge requirements for the professional without any technical background call for remedial education for a combination of work and training of approximately 360 hours [IFAC guideline, paras. 45, 46, and 62]. Remedial catch-up, at best, is going to be difficult for existing professionals.

Leadership

68.   CPE providers need to take a proactive stance and design remedial programs to aid the professional in qualifying for IT proficiency. Intensive courses and tests of proficiency designed for the existing professional are required. Work domain managers must support the overall concept of required proficiencies.

69.   Remedial CPE should provide the foundations required for general and user IT knowledge (see work domain for examples of 40-hour programs). A test for proficiency should be available for demonstration of practical skills obtained through the work environment.

70.   All audit, tax, and other CPE courses should integrate with IT topics that relate to the subject matter. For example, a course in strategic planning should require that a section be devoted to the assessment of the IT function as it relates to strategic planning. Specialization programs for IT topics should be included as part of the overall CPE curriculum.

Action Plan

71.   The profession needs to support IT training through state and national societies and associations with the following guidelines for IT CPE.

- Remedial CPE training should be completed within a maximum of three years.
- CPE-intensive courses in IT for the remedial topics should be required to follow the outline of general and user knowledge requirements from the IFAC guideline.
- All new CPE courses should be required to include IT coverage.
- All existing CPE courses should be required to be updated to include appropriate IT coverage within two years.
- Specialized IT courses should be incorporated into the National CPE curriculum.

72.   Although the professional remains responsible for obtaining quality CPE, accrediting boards should become accountable for the requirements outlined above.

LICENSING AND REGULATION DOMAIN

73. Many organizations play a part in the licensing and regulation of accounting professionals, and each has a role to play in the regulation of the profession, as summarized briefly below:

- Board of Examiners
- State boards of accountancy
- Accreditation bodies
- Peer review

Board of Examiners

74. The role of the Board of Examiners is to develop uniform examinations that assess knowledge and skills necessary to practice public accounting at entry level. These examinations are relied on by boards of accountancy to help ensure that new CPAs meet minimum standards needed to protect the public interest.

State Boards of Accountancy

75. The boards of accountancy of each state, as represented by the National Association of State Boards of Accountancy (NASBA) have a two-fold role: to develop licensing requirements in terms of knowledge, ethics, business practice, and continuing education; and to ensure that the public is protected and that practitioners are competent to practice public accounting.

Bodies That Accredit Accounting and Business Programs

76. Accreditation bodies, especially in academia, regulate what is taught in accounting programs. These bodies—for example, the American Assembly of Collegiate Schools of Business (AACSB)—are charged to evaluate the adequacy and appropriateness of education programs especially in the academic arena.

Peer Review

77.   The accounting peer review process also has licensing and regulatory impact on the accounting profession. The peer review process is charged with the evaluation of the effectiveness of ongoing accounting firm practices.

Licensing and Regulation Issues and Concerns

78.   There are a number of issues and concerns relating to IT and the accounting profession. They include the following:

- The public's expectations
- Risks to the public if IT knowledge is inadequate
- Lack of awareness of IT's importance among state boards of accountancy
- Resistance to IT as fulfilling CPE requirements

79.   The CPA has traditionally been viewed as a broad-based designation in business. The *public expectation* has been that a CPA has a sound foundation in all major areas of business. Today, information technology completely permeates modern business practices. Can the public's expectation of the accounting professional reasonably exclude information technology knowledge? The answer is clearly no!

80.   There are *risks to the public* if CPAs do not have adequate IT knowledge. In the auditing and attest function IT knowledge is important to perform audits competently. IT is so prevalent in business that no business of even moderate size can effectively operate without good IT. In addition, the use of electronic commerce is rapidly growing to the extent that even if a company could justify not being automated for its own internal purposes, customer demand could force it into the world of electronic commerce. In the business advisory function, accountants can only advise clients on prevalent business issues, such as information technology, if they have adequate competency.

81.   To date, *state boards of accountancy have not acknowledged the need* for knowledge of information technology. The boards have been slow in the recognition of information technology as a vital and necessary area of CPA knowledge.

82. *Some state boards of accountancy do not count IT courses as fulfilling CPE requirements.* But CPAs really need competency in IT as well as competency in other technical areas of accounting. It is equal in importance to other technical areas.

83. One could argue "1 don't intend to practice in information technology; do 1 therefore need knowledge of information technology?" One might ask the same question in more traditional areas of accounting:

> TAX: If I do not have a tax practice, do I need to know about income taxes?

> AUDIT: If I do not intend to ever do audits, do I need to know auditing?

> SEC: If I do not intend to file with the SEC, do I need to know about financial reporting?

84. The CPA needs an understanding in all of the areas mentioned above, because the public expects a minimum competency level in all those areas. The CPA may traditionally specialize in one or more areas and attain a more in-depth understanding in those areas. However, the CPA is still expected to know something about audit, tax, SEC and other aspects of business. Information technology now must be included in those other areas.

Action Plan: Phase One

85. Phase one of the action plan should be implemented as soon as possible and requires the following actions by the groups listed below:

86. The *AICPA* should take the following actions:

- Develop an Information Technology Specialist designation including qualification exam and separate CPE requirements.
- Distribute a letter to the Board of Examiners. The letter should summarize the critical points of the IFAC guideline. It should also contrast the IFAC guideline with the IT content of the previous three to four CPA exams.

- Update the National CPE curriculum to reflect IT content (see CPE section).

87. All *state boards of accountancy* should allow information technology courses to meet general CPE requirements. IT courses should be counted as technical topics.

88. The *Board of Examiners* should gradually add information technology content to the CPA exam by integrating it into the various sections, beginning with the next exam available for modification.

89. *Bodies that accredit accounting and business programs* should add IT content to evaluation criteria of academic programs.

90. The *peer review* process should assess the adequacy of addressing IT issues in the attest function of the firm.

Action Plan: Phase Two

91. Phase two of the action plan should be implemented within two to three years.

92. The *Board of Examiners* should include a minimum of 10% to 15% IT-related questions and content on the uniform CPA examination, integrated throughout the exam.

CONCLUSION

93.   In this document the AICPA's Technology Curriculum and Competency Model Task Force has attempted to highlight the contents of the IFAC's recent guideline, entitled *Information Technology In The Accounting Curriculum*. In addition, the Task Force has specified the implications and implementation issues for four accounting domains: the education domain, the work domain, continuing professional education, and the licensing and regulation domain.

94.   It will only be through a concerted effort by all the domains listed in this document that the accounting profession will come of age, technologically. Action plans for the various domains have been specified in this document. The time for action is already upon us.

Part 2— IFAC International Education Guideline No. 11, *Information Technology In The Accounting Curriculum*

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December 1995

Information Technology In The Accounting Curriculum

CONTENTS

POSTQUALIFICATION IT KNOWLEDGE
AND SKILL REQUIREMENTS

**Appendices—Core IT Knowledge and Skill Areas
for Professional Accountants by Role**

Preface

Information Technology (IT) is pervasive in the world of business. Competence with this technology is an imperative for the professional accountant.

This Guideline has been developed by the Education Committee to provide further guidance to member bodies in developing programs to enhance the competence in IT of their present and future members. It is in a format which both recognizes the different competencies needed for key roles undertaken in the IT area by the professional accountant and distinguishes between pre- and postqualification needs.

The Committee recognizes that member bodies will be adopting different approaches to education in the IT area in the light of their own particular circumstances. Already some will have made much progress, others less so. Recognizing that further developments in IT will not wait on the profession, the Committee advises each member body to review the Guideline promptly and consider how it can best address its recommendations.

The Committee is conscious of the diverse circumstances and resources of member bodies and the significant development costs involved in the implementation of programs of education in IT. It would remind users that this is an area wherein there is significant potential for co-operation between member bodies and consequently avoidance of duplication of development costs.

The IT scene is one of constant change and development. It is the intention of the Committee to review this Guideline every two years in the light of emerging changes in information technology and its uses. In the meantime, it will welcome comment and suggestions from users of the Guideline.

Introduction

1. Information technology plays a vital role in supporting the activities of profit-oriented and not-for-profit organizations. Professional accountants, in addition to extensively using various types of information technologies, often play important managerial, advisory, and evaluative roles in connection with the adoption and use of various information technologies by organizations of all types and sizes.

2. The term "information technology" or IT, as used in this Guideline, encompasses hardware and software products, information system operations and management processes, and the skills required to apply those products and processes to the task of information production and information system development, management and control.

3. Society expects that professional accountants who accept an engagement or occupation have the required level of knowledge and can apply it to practical problems. The accountancy profession as a whole has the obligation to ensure that candidates for membership possess the required breadth and depth of knowledge and skill and the credibility of the accountancy profession depends on its success in fulfilling this obligation. In addition, the accountancy profession has an obligation to ensure that, after qualifying, members keep abreast of relevant developments through continuing professional education.

4. The body of knowledge and skill required of professional accountants includes a variety of important areas. IT is one of the core competencies of professional accountants and requires special attention due to its explosive growth and its rapid rate of change.

5. The following IT trends are particularly noteworthy:

   • wide availability of powerful yet inexpensive computer hardware

   • wide availability of powerful, inexpensive and relatively user-friendly software with graphical user interfaces

   • shift from custom-tailored systems to pre-packaged software

   • new data capture and mass storage technologies leading to increasing computerization of data/information in text, graphic, audio and video formats and emphasis on managing, presenting and communicating information using multi-media approaches

   • increasing availability of computerized data for access in real or delayed time both locally and through remote access facilities

   • shift from mainframes to small computers used alone, or increasingly, as part of networks devoted to information sharing and co-operative computing

   • convergence of information and communication technologies and increasing use of networks to link individuals, intra-organizational units and inter-organizational units through systems such as electronic mail (e-

mail) and the Internet, transaction processing systems such as electronic data interchange (EDI) and electronic funds transfer systems (EFTS)

- mass marketing and distribution of IT products and services such as computers, pre-packaged software, on-line data retrieval services, electronic mail, and financial services

- reduction of barriers to systems use, encouraging wider penetration of information systems into profit-oriented and not-for-profit organizations of all sizes for accounting and broader management and strategic purposes and increasing the role of end-user computing

- wider penetration of information technologies such as computer-assisted design and computer-assisted manufacturing (CAD/CAM), computer imaging systems, executive information systems (EIS), and electronic meeting systems (EMS)

- new system development techniques based around information technologies such as computer-assisted software engineering (CASE), object-oriented programming, and workflow technologies

- continuing development of intelligent support systems incorporating expert systems, neural networks, intelligent agents, and other problem solving aids

- new business re-engineering approaches based on effective integration of information technologies and business processes

6. The growth and change that has come about as a result of these trends has created a number of important challenges which the accountancy profession must address:

- **Information technologies are affecting the way in which organizations operate.** In some cases the changes are dramatic. While there is a continuing need for sound business system design practices and effective financial and management controls, the business planning and design processes and internal control requirements will, of necessity, change with changes in information technologies. Traditionally, professional accountants have been entrusted with the tasks of evaluating investments in business systems, evaluating business system designs and reporting on potential weaknesses. Increasingly, information technology deployments are supported by extensive organizational restructuring around such technologies. To maintain the accountancy profession's credibility and capability in supporting new information technology initiatives, the competence of professional accountants must be maintained and enhanced so that public trust and confidence in professional accountancy bodies is maintained.

- **Information technologies are changing the nature and economics of accounting activity.** The career plans of professional accountants and related training systems must be based on a realistic view of the changing nature of accounting, the accountancy profession's changing role in providing services to business, government and the community at large, and the knowledge and skills required for future success as a professional

accountant. Some IT skills, such as the ability to use an electronic spreadsheet, are now indispensable and professional accounting bodies must ensure that candidates possess core IT skills before they qualify as members of those bodies. In addition, since an increasing number of professional accountants are engaged in providing IT-related advisory and evaluative services, it is important that professional accountancy bodies maintain the quality and credibility of these services through both prequalification and postqualification education requirements.

- **Information technologies are changing the competitive environment in which professional accountants participate.** Information technologies are eliminating some areas of practice which were once the exclusive domain of professional accountants or are reducing their economic attractiveness. For example:

  - Accounting and accounting system development were once the virtually exclusive domain of professional accountants. Today, inexpensive, easy-to-use and powerful pre-packaged accounting software is reducing the demand for those activities or enabling non-accountants to offer those services. At the same time there is an increasing demand for professionals with a combination of business and IT skills to help organizations structure their systems to provide effective and efficient support for their primary objectives and activities.

  - Tax planning and tax return preparation have traditionally represented important activities for many professional accountants. Today, inexpensive, easy-to-use and powerful pre-packaged software is reducing the demand for tax return preparation services. The professional tax planning expertise that was once the private domain of individual practitioners is increasingly being embedded within these same tax packages, reducing the demand for such services as well.

  - In the past, accountants engaged in internal and external auditing activities were needed in great numbers in order to vouch and trace documents, to perform a variety of analyses, and to document audit work. Today, due to the computerization of business records and the availability of computer-assisted auditing tools, these activities can be performed faster and more thoroughly with the assistance of computer-based tools, reducing the demand for such activities.

7. IT changes have created many new opportunities for professional accountants in areas such as information development, information system management, business advisory services, and system evaluation. For example:

- **information development:** professional accountants have a tradition of producing information to enhance management decision-making. With the advent of new information technologies and expanded sources and means of access to information, professional accountants can help bring richer sets of information to bear on specific managerial decisions or help screen out essential information from the potentially overwhelming proliferation of information that is now available. One of the implications of the growth of such services is the need to expand

professional accountants' perspectives beyond their traditional focus on accounting information to other important types of information and performance indicators, including non-financial information.

- **information system management:** information system management has been characterized by a communication gap between top management or functional managers lacking IT skills and technologists lacking in business backgrounds. Professional accountants can provide a valuable service by bridging such communications gaps, adding a sound business perspective to the consideration of IT issues and vice versa. Information system management skills are not primarily technological, but rather, include an understanding of strategic and operational business planning and associated IT issues, the ability to perform appropriate analyses of IT investments, an understanding of IT related benefits and risks, the ability to stimulate and manage organizational change, and the ability to communicate effectively about IT topics.

- **advisory services:** information systems are increasingly viewed as potential means to achieve competitive advantage. Professional accountants, by virtue of their broad business backgrounds, financial skills and objectivity, can provide valuable advisory services related to assessing investments in strategic information technologies and advising about control systems required to meet the needs of management and, in some cases, the requirements of legislators and regulators. Some professional accountants are actively involved in the system development and integration field.

- **information system evaluation:** professional accountants have traditionally provided evaluative services in their roles as internal and external auditors. As information technologies proliferate, there are increasing demands for objective assessments of information system controls such as controls over information privacy and integrity, and controls over system changes. In addition, there are concerns about information system failure and the reliability of information processing continuity provisions in the event of system failure. Other areas of concern are the proliferation of incompatible subsystems and inefficient use of systems resources.

8. All of the areas identified above represent important work domains in which significant numbers of professional accountants participate. Some of these areas are not the exclusive domain of professional accountants and are not commonly associated with the accountancy profession. However, they all represent important opportunities for professional accountants.

9. Professional and academic accountancy bodies throughout the world are grappling with the need to define the body of knowledge and skill that must be possessed by their members. Attempts at defining a common body of knowledge and skill are complicated by several important factors which must be recognized, including the fact that the accountancy profession is a diverse profession whose members operate in several domains, that within each of these domains professional accountants may be engaged in a variety of roles, and that the spread of IT and related accounting services is not uniform throughout the world.

10. Nevertheless, it is evident that IT is fundamentally changing professional accounting whatever the accountant's work domain or role. Consequently, professional accountancy bodies throughout the world must address these changes through their educational processes, by including coverage of important IT concepts and skills in prequalification education programs, prequalification work experience, and postqualification professional education in both general work domains and specialty areas.

SCOPE OF THE GUIDELINE

Work Domains

11. The accountancy profession is a diverse profession whose members operate in several work domains, such as:

- industry and commerce

- public practice

- public sector (government and other not-for-profit organizations)

12. This Guideline is intended to apply to all work domains. The use of an organizing framework built around roles, as discussed in the next section, provides a framework that is sufficiently broad to address the needs of all three of the work domains identified above.

Roles

13. Within each of the work domains, professional accountants may be engaged in a variety of roles, such as:

- user

- financial manager (accountant, controller)

- designer of financial information systems (member of business system design team or task force, producer of financial information, analyst)

- internal financial or operational auditor

- external "advisor" (accountant, auditor, tax practitioner, consultant, insolvency practitioner)

14. In different environments, specific needs and opportunities will vary; however, many aspects of IT are common and it is possible and desirable to set out some of the broad elements of an educational background that all professional accountants can be legitimately expected to share.

15. This Guideline establishes a framework for organizing IT-oriented education for professional accountants, and the core areas of knowledge and skill to be covered. This Guideline identifies the IT education requirements for professional accountants under five main headings:

- general IT education requirements

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- the accountant as *user* of information technology

- the accountant as *manager* of information systems

- the accountant as *designer* of business systems (alone or as part of a team)

- the accountant as *evaluator* of information systems

16. While the four broad roles of user, manager, designer and evaluator are not as specific as the areas in which many professional accountants actually work, they represent the key elements of knowledge and skill required by professional accountants and provide a useful framework by which an educational approach can be organized.

17. The education requirements may be viewed as building blocks in the sense that the general IT education requirements form the foundation for the user-oriented education requirements and these, in turn, form a foundation for the other role-related education requirements. In addition, the education requirements related to the roles of user, manager, designer and evaluator may be viewed as building blocks for one another, in the sense that the accountant's design role may be enhanced by the skills developed as a user, the accountant's managerial role may be enhanced by the skills and insights obtained through a combination of user and design roles, and the accountant's role as evaluator can be enhanced by skills developed in the user, designer, and manager roles. Thus, an aspiring management accountant would be guided by the portions of the Guideline dealing with the general IT education requirements, user-oriented education requirements and education requirements related to the manager role. An aspiring public accountant would be guided by the portions of the Guideline dealing with the general IT education requirements, user-oriented education requirements and education requirements related to the evaluator role.

18. It is acknowledged that a professional accountant may operate in more than one of these roles during a given time period and throughout his or her career. However, this Guideline does not presume that all professional accountants will work through these roles in a sequential fashion.

Prequalification and postqualification

19. This Guideline distinguishes between the prequalification and postqualification IT related education requirements. The Guideline assumes that at the time of qualification, all professional accountants will operate in at least two roles - the user role and one of the other three roles, depending on the member's work domain. After qualification, professional accountants' careers and their IT education requirements may evolve in many diverse ways. Thus, the postqualification IT education requirements are not based on the same assumptions as the prequalification requirements and have a separate section of the Guideline devoted to them.

20. Member bodies should monitor prequalification experience to ensure that it includes IT-related training opportunities in the knowledge and skill areas related to their members' activities.

21. After qualification professional accountants are expected to continue their professional education activities in connection with IT. It is likely that some members' specific activities and related educational requirements will be relatively specialized. The continuing professional education requirements in connection with IT for both specialist and non-specialist accountants at the postqualification stage must be relevant to their current field(s) of activity.

22. IFAC recommends that member bodies work towards developing continuing professional education (CPE) requirements related to IT for their members' postqualification work domains to ensure that a minimum level of service quality is maintained.

23. Member bodies may wish to recognize the qualifications of members who have achieved specialist status in a recognized domain of IT activity by granting them specialist designations or other appropriate recognition.

Knowledge and Skill

24. The field of IT is both conceptual and concrete. In considering IT education requirements it is easy to blur the distinction between conceptual knowledge and practical skills. However, it is important to emphasize the need for both relevant theoretical knowledge of IT and practical IT skills on the part of the professional accountant.

25. Practical experience consists of knowledge and skills acquired from participation in activities performed by professional accountants. It is distinct from the theoretical knowledge obtained from studies of a conceptual nature.

26. Conceptual education generally aims at knowledge and comprehension of specified subject matter. Practical skills include the abilities to apply conceptual knowledge, analyze, synthesize and evaluate information. An education approach that consists solely of conceptual material will not be sufficient for professional accountants in any work domain or for any role. However, it is also generally recognized that the development of practical skills is facilitated by the prior development of knowledge and comprehension. Thus conceptual material must form the foundation for practical skills development.

27. This Guideline simplifies several stages of skills development into two main categories - theoretical knowledge and practical skills. Member bodies may wish to refine the classification used here into more specific knowledge and skill requirements corresponding to more specific education objectives.

28. The inculcation of skills in solving practical problems through the application of theoretical knowledge is one of the prime objectives of professional education. This ability is best developed through relevant practical experience in which conceptual knowledge can be applied to specific problems. To ensure that professional accountants possess entry level competence in core IT knowledge and skill areas, all prospective members must receive training and work experience sufficient to develop core IT knowledge and skills prior to qualifying for membership in their respective

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member bodies. Member bodies must monitor candidates' prequalification experience to ensure that it includes such training opportunities.

29. Core IT knowledge and skill requirements may be viewed from the perspectives of both breadth and depth. In this Guideline, the breadth requirements are addressed by using work domains as a way of categorizing knowledge and skill areas.

30. The depth requirements are addressed by distinguishing two levels of depth — a prequalification level, requiring only general familiarity with topics, and a postqualification level, requiring mastery of those topics. Requirements pertaining to depth of knowledge and skill are further addressed by dividing the education requirements into three building blocks aimed at providing increasing depth of coverage of core IT knowledge and skill sets:

   • a set of general IT education requirements

   • a set of user-oriented education requirements

   • a set of role-related education requirements associated with the manager, designer, and evaluator roles

31. During the prequalification program there will be comparatively more emphasis on fundamental conceptual knowledge and comparatively less emphasis on practical skills, whereas in the postqualification curriculum there will be comparatively greater emphasis on practical skills tied to the specific needs of the work domain and role of the professional accountant, and comparatively less emphasis on conceptual knowledge. Nevertheless, to be effective, both prequalification and postqualification parts of the professional accountant's education program must incorporate both knowledge and practical skills development.

Prequalification Tests of Professional Competence

32. Prequalification tests of professional competence must include coverage of IT concepts and skills appropriate to the primary roles in which accountants striving for qualification in a given membership body will be expected to function at an entry level.

33. Tests of professional competence in connection with IT must go beyond testing knowledge and comprehension and focus primarily on testing higher level skills such as application, analysis, synthesis and evaluation, applied in a context representative of the work domain in which the entry level professional accountant is likely to work.

Postqualification Tests of Professional Competence

34. Postqualification tests of competence in a specialty area must include coverage of IT concepts and skills appropriate to the area.

35. At the postqualification stage, tests of professional competence must be relatively specialized. Their main purpose is to validate that a professional accountant possesses specialist level skills in a particular domain.

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PREQUALIFICATION IT KNOWLEDGE AND SKILL REQUIREMENTS

Introduction

36. This part of the Guideline addresses each of the four roles identified earlier and identifies broad IT knowledge and skill requirements for professional accountants. This broad statement of requirements is supplemented by more detailed Appendices breaking down the knowledge and skill requirements into detailed topics.

37. During the prequalification stage, all professional accountants must obtain the general IT knowledge and skills summarized in paragraphs 40-49 dealing with General Information Technology Education Requirements.

38. In addition, all professional accountants must obtain the knowledge and skills summarized in paragraphs 50-62 dealing with The Professional Accountant as a User of Information Technology.

39. Furthermore, as part of their prequalification education, all professional accountants are expected to concentrate on at least one of the three other roles identified in this Guideline and acquire the knowledge and skills identified for the role(s) in which they are expected to function at an entry level. These roles are discussed as follows:

- Manager of information systems   —   paragraphs 63-71 and Appendix 4

- Designer of business systems   —   paragraphs 72-84 and Appendix 5

- Evaluator of information systems   —   paragraphs 85-97 and Appendix 6

General Information Technology Education Requirements

40. All professional accountants, irrespective of their primary work domain or role, must acquire the following essential body of IT knowledge related to business systems:

- information technology concepts for business systems (Appendix 1)
    - general systems concepts
    - management use of information
    - hardware
    - system software
    - application software
    - data organization and access methods
    - networks and electronic data transfer
    - transaction processing in typical business and accounting applications

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- internal control in computer-based business systems (Appendix 2)
  - control objectives
  - control environment
  - risk assessment
  - control activities
  - monitoring of control compliance
- development standards and practices for business systems (Appendix 5)
  - role of information in organization design and behavior
  - system design techniques
  - system acquisition/development life cycle phases, tasks, and practices and maintaining control over system development processes
- management of IT adoption, implementation, and use (Appendix 4)
  - strategic considerations in IT development
  - administrative issues
  - financial control over IT
  - operational issues
  - management of system acquisition, development and implementation
  - management of system maintenance and change
  - management of end-user computing
- evaluation of computer-based business systems (Appendix 6)
  - legal, ethical, auditing and information system control standards
  - evaluation objectives
  - evaluation methods and techniques
  - communicating results of evaluations
  - following up
  - specific types of evaluations
  - computer-assisted audit techniques (CAATs)

41. Prior to qualification, all professional accountants must have at least a general level of knowledge of each of the content areas identified in paragraph 40.

42. Of particular importance to all professional accountants, regardless of their specific domain of professional activity, is the issue of internal control. Because this topic is of central importance to all professional accountants, it must be given particular emphasis.

43. Professional accountants must have effective practical skills as well as theoretical knowledge. Case studies, interactions with experienced professionals, and similar techniques can be used to help develop practical skills. On-the-job training could also provide valuable practical exposure to these topics. Member bodies must ensure that prequalification education and on-the-job training are designed to provide aspiring professional accountants with opportunities to obtain both theoretical knowledge and practical skills in connection with the topics identified in paragraph 40.

44. Appendices 1 and 2 to this Guideline provide a further breakdown of the specific topics that make up the general IT education to be acquired by all professional accountants prior to qualification. It is acknowledged that specific topics may change over time as IT evolves; however, the broad knowledge and skill areas identified in the Appendices represent the topics widely regarded as the minimum coverage required in an IT curriculum for accounting professionals.

45. It is anticipated that coverage of the knowledge and skill areas identified in paragraph 40 at a general introductory level will require, at a minimum, the equivalent of two post-secondary level courses, although the coverage may be spread over and integrated into a number of courses.

46. As contemplated in this Guideline, a post-secondary course is considered to consist of approximately 40 hours of in-class instruction, as well as an additional 80 hours spent on preparation for class, doing homework assignments, and engaging in other relevant study activities.

47. The amount of time devoted to the knowledge and skill areas identified in this Guideline and the level of material presented should be equivalent to those which would be provided through formal courses at a university. However, it is not necessary for the specified education to be provided through separate IT-oriented courses or exclusively in a university setting.

48. The coverage of some of the topics identified in this Guideline could be spread over and integrated into courses which are not specifically identified as IT courses. For example, coverage of some aspects of computer-based business systems could be integrated within a financial accounting course; coverage of some aspects of management information systems could be integrated within a management accounting course; coverage of some aspects of internal control in a computer environment could be integrated within an auditing course; and so on.

49. Some member bodies may wish to offer their own courses, or to supplement courses at post-secondary institutions with their own training programs or employer-provided training programs. This might be necessary where there are not sufficient resources at post-secondary institutions to offer some parts of the required program of studies or to supplement theoretical knowledge obtained at post-secondary institutions with practical experience.

The USER Role

50. Users of various information technologies employ information systems tools and techniques to help them meet their objectives or to help others

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meet their objectives. These objectives, and hence the types and uses made of IT tools and techniques, can be infinite in their variety. Some typical tasks that users carry out with the help of IT include gathering and summarizing data, choosing alternative courses of action on the basis of analyses applied to data, devising strategies and tactics, planning and scheduling operational activities in an organizational unit, directing the allocation of resources, implementing operations, evaluating performance, documenting observations, judgments and decisions, and communicating with others.

51. All professional accountants must be familiar with these broad tasks and the way in which information technologies and systems can be applied to their completion.

52. In addition to knowledge of broad uses of IT, candidates for membership in professional accountancy bodies require specific knowledge of key concepts and practical skills relevant to the tools and techniques that are widely used by professional accountants and must meet these educational requirements prior to qualification.

Theoretical Content

53. Professional accountants as users of IT are exposed to a wide array of information systems architectures, hardware, software and data organization methods. Information systems come in a variety of forms because they are designed to suit the needs of specific organizations. While no user could be an expert in every type of information system architecture, hardware, software or data organization, there are nevertheless fundamental knowledge and skill sets that all accountants must have.

54. In addition to the general education requirements outlined in paragraphs 40-49, professional accountants, as users of IT, must have the background knowledge and familiarity with information systems concepts and terminology that would enable them to make reasonable decisions in connection with simple systems such as defining their needs, identifying alternatives, deciding whether to acquire a pre-packaged system or develop the system using end-user tools such as spreadsheet packages or database packages, or outsource the development to another branch of the organization or an outside consultant, and selecting the appropriate hardware, software, and supplier.

55. As users of IT, professional accountants must also know how to test and assess the acceptability of a particular system being acquired or being developed for their use and how to operate and manage such a system and keep it up to date.

56. Professional accountants must have the knowledge of basic processes used to keep their system resources organized, and of control processes and practices for safeguarding their systems and data against errors, theft, unauthorized use, software piracy, virus attacks, vandalism and system failure.

Practical Content

57. Professional accountants may use information systems in a variety of contexts. They may be exposed to systems ranging from centralized to decentralized systems, from mainframe to micro platforms, from simple end-user-oriented pre-packaged software to complex custom-tailored software, and from simple data files to complex multi-user, geographically distributed databases. Given this reality, it is impractical and undesirable to prescribe a fixed comprehensive set of user skills for the practical content of a recommended accounting curriculum for all aspiring professional accountants.

58. Nevertheless, there are certain fundamental skills that are widely regarded as the minimum set of skills that all professional accountants must have prior to qualification:

    • ability to use a word processing package

    • ability to use a spreadsheet package

    • ability to use a database package

    • ability to use at least one basic accounting package

    Ideally, these skills would be developed in an accounting context, such as through their use in connection with an accounting course or an assignment in the work place.

59. As well, where feasible, the professional accountant should have experience with at least two different types of systems architectures, for example, a single-user standalone micro computer in a business context and a multi-user local area network system.

60. In addition, the aspiring professional accountant should be able to use electronic mail and to access and retrieve information from an on-line or local database such as a professional research tool utilizing CD-ROM or other data storage medium.

61. Appendix 3 to this Guideline outlines a number of additional knowledge and skill areas which would be desirable, depending on the accountant's work domain.

62. It is estimated that the equivalent of one course, as described in paragraph 46, would be required to enable an aspiring accountant to develop the user skills outlined in paragraphs 53-61. The development of user-oriented knowledge and skills could be spread over and integrated into courses which are not specifically identified as IT courses. Because many of the user-oriented education requirements involve practical skills, they would be best met through a combination of in-class instruction and practical application of skills in a professional work environment.

The MANAGER Role

63. Many professional accountants are involved in financial management roles which bring them into contact with information systems. Although the

growth of IT has spawned many new groups of professionals, including professional information system managers, many accountants in small and medium organizations fulfil information system management functions, in partnership with other managers, or as part of their overall responsibilities.

64. In this capacity, the professional accountant's responsibilities may include participation in strategic planning for use of information systems to support entity objectives, membership on an information systems steering committee, evaluating potential investments in information technologies, developing operational priorities, exercising control over information system productivity, service quality, and economy of information system use.

Theoretical Content

65. To support their role as managers of information systems, professional accountants must have a sound understanding of the business functions that information systems can fulfil and the related managerial processes of planning and co-ordinating, organizing and staffing, directing and leading, controlling and communicating in an IT context.

66. The professional accountant must, therefore, have a conceptual understanding of information system technology issues of importance to different types of entities and environments, and in particular, the following:

- strategic considerations in IT development

- administrative issues

- financial control over IT

- operational issues

- management of system acquisition, development and implementation

- management of system maintenance and change

- management of end-user computing

67. Appendix 4 to this Guideline address these topics. At the prequalification stage, these concepts would be covered at a general level, focusing on the acquisition of general knowledge and understanding of information system management principles and practices related to issues such as those outlined in the previous paragraph.

68. At the prequalification stage, only general familiarity would be required in connection with the topics listed under the column headed "Key sub-topics" in Appendix 4.

Practical Content

69. To support their role as managers of information systems, professional accountants must have effective practical skills in planning and co-ordinating, organizing and staffing, directing and leading, and monitoring and controlling. Both the educational material and the prequalification job content should provide aspiring professional accountants with opportunities

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to obtain the requisite practical IT skills prior to qualification. Education programs could use case studies, interactions with experienced professionals, and similar techniques to help develop practical skills. On-the-job training in a junior managerial capacity could also provide hands on experience with the topics listed in Appendix 4.

70. In addition to the IT skills listed in Appendix 4, the professional accountant's skills must include the communication skills and interpersonal skills required to support the manager's interactions with top management, users, steering committees, and suppliers of information system services, both internal employees and external contractors. In contrast with general communication and interpersonal skill requirements, these skills must be developed in an IT context.

71. It is estimated that, in addition to the general education requirements and the user-oriented requirements, the equivalent of one course, as described in paragraph 46, would be required to enable an aspiring accountant to develop the knowledge and skills outlined in paragraphs 65-70.

The DESIGNER Role

72. Professional accountants, as employees or external advisors, have been involved in the design of financial systems for decades. In the past, such design roles have been in the context of manual record-keeping systems. Today, accountants are expected to continue to provide similar services, albeit in an IT context. This may be as a member of an in-house team or task force working to establish business system requirements, as a member of an in-house system development team for an employer, or as an external advisor helping to design a business system for a client.

73. Professional accountants' design activities will often emphasize the identification of user needs, consideration of costs and benefits of proposed solutions, the appropriate selection and combination of hardware, pre-packaged software, essential control features, and other system components, and the effective implementation and integration of acquired or developed systems with business processes. In this capacity, professional accountants need a sound understanding of business systems and the capabilities of various information technologies to support an organization's objectives, whether it is a profit-oriented, not-for-profit or public sector organization.

Theoretical Content

74. In their design role, professional accountants must know the basic steps to be followed in the design of a system such as:

   • role of information in organization design and behavior

   • system design techniques

   • system development life cycle phases, tasks and practices, particularly maintaining control over system development processes, incorporating controls within systems, and maintaining controls over system changes

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75. The professional accountant must be aware of standards and preferred practices, particularly internal control practices, that could guide information system design practices.

76. A professional accountant's knowledge of information systems must be developed in the context of gaining an understanding of organizations' business and service objectives and their environments. Thus, education programs and courses aimed at developing system design knowledge must have a managerial rather than a technical orientation.

Practical Content

77. It is generally not sufficient for a professional accountant to be familiar solely with the concepts relating to the major phases of system development and the specific tasks required in each phase. A number of important practical skills are also part of the required preparation for this role.

78. While at the prequalification level the depth of practical skill that a candidate could acquire in connection with the design role would, of necessity, be limited, it is nevertheless desirable for candidates to have practical exposure to some of the important techniques that are used in key phases of system design. Both the educational material and the prequalification job content should provide aspiring professional accountants with opportunities to obtain the requisite practical IT skills prior to qualification. Education programs could use case studies, interactions with experienced professionals, and similar techniques to help develop practical skills. On-the-job training could also provide hands on design experience prior to qualification.

79. Since system design skills are generally applied in an interactive context, interpersonal and communication skills in an IT context are an essential ingredient of the skill set required to support the professional accountant's information system design role.

80. A professional accountant's information system design skills must be developed in the context of designing systems to meet organizations' business and service objectives. Thus, IT education programs and courses aimed at developing practical system design skills must have a managerial rather than a technical orientation.

81. While some practical exposure to specific techniques is desirable, the main emphasis in IT education programs aimed at developing system design skills must be on higher order skills necessary to provide effective advisory services such as the ability to analyze design problems, synthesize user information and control requirements and evaluate alternative designs in light of an entity's business or service objectives.

82. Appendix 5 to this Guideline addresses the knowledge and skill requirements related to the designer role. At the prequalification stage, the coverage of these topics would be aimed at developing general knowledge and understanding of the key tasks that must be accomplished, the documentation requirements, the risks that are inherent in each of these phases and the related control requirements. The risks may be economic,

technological, operational or behavioral and all of these risks must be addressed in the education program.

83. At the prequalification stage, only general familiarity would be required in connection with the topics listed under the column headed "Key sub-topics" in Appendix 5.

84. It is estimated that, in addition to the general education requirements and the user-oriented requirements, the equivalent of one course, as described in paragraph 46, would be required to enable an aspiring accountant to develop the knowledge and skills outlined in paragraphs 74-83.

The EVALUATOR Role

85. The role of the accountant as evaluator encompasses the functions of internal audit, external audit and other evaluative roles filled by accountants, whether or not formally identified as audit roles.

86. In these capacities, professional accountants may be engaged for a variety of purposes, including determining the degree of information system effectiveness in achieving organizational objectives, determining the degree of information system efficiency in achieving organizational objectives, determining the fairness of financial representations and the accuracy and completeness of related accounting records, determining the degree of compliance with management policy, statutes or other relevant authoritative regulations, and evaluating internal control strengths and weaknesses, in particular with respect to financial reporting processes, asset safeguarding, data integrity, information security and privacy, and continuity provisions for information system processing.

Theoretical Content

87. In their evaluator role, professional accountants must possess knowledge of legal, ethical, auditing and control standards relevant to IT and must be able to distinguish between various information systems evaluation objectives and approaches such as:

    - evaluation of efficiency/effectiveness/economy of IT use

    - evaluation of compliance with management policy, statutes and regulations

    - evaluation of internal control in computer-based systems

    - evaluation of the fairness of financial representations and the accuracy and completeness of related accounting records

88. Appendix 6 to this Guideline addresses these topics. At the prequalification stage, these concepts would be covered at a general level, focusing on the acquisition of general knowledge and understanding of the key phases and related IT evaluation techniques that could be used for carrying out the engagement types relevant to the primary work domain of the member body, as well as the limitations of those techniques.

89. At the prequalification stage, the skill level requirements in this area would be based around the member body's principal orientations. For example, if the orientation were towards public accounting, the skill level requirements would focus primarily, although not exclusively, on the IT concepts involved in a financial statement-oriented attest audit. If the orientation were towards management accounting, less emphasis would be given to such topics and more emphasis would be given to the IT concepts involved in, for example, evaluating effectiveness and efficiency of information systems and their compliance with relevant policies, statutes and regulations.

90. Since evaluation procedures in an IT context may require the use of computer-assisted tools and techniques, all aspiring candidates working in an evaluative capacity must have an understanding of the types of computer-assisted tools and techniques available, their strengths and limitations and their design, execution and control requirements.

Practical Content

91. Practical IT skills in connection with the accountant's role as evaluator would depend on the evaluation objective. For example, in a public accounting context the skill level requirements would focus primarily on the IT skills involved in a financial statement-oriented attest audit such as:

   • the ability to obtain and document an understanding of the flow of transactions and elements of the control structure relevant to the audit

   • the ability to test and evaluate relevant information systems controls over financial reporting processes and asset safeguarding

   • the ability to test computer-based records to establish their accuracy and to substantiate financial representations

92. In a management accounting context less emphasis would be given to such requirements and more emphasis would be given to IT skills such as:

   • the ability to evaluate effectiveness and efficiency of information systems

   • the ability to assess the degree to which an information system meets the needs of users and serves the objectives of the entity

93. All professional accountants involved in an evaluative role at the prequalification stage must have the ability, with limited supervision, to plan, execute and communicate the results of an evaluation approach tailored to the specific types of evaluations relevant to their work domain in the context of specific circumstances that involve information systems.

94. All professional accountants involved in an evaluative role at the prequalification stage must also have the ability to plan, execute and communicate the results of applying at least the following computer-assisted auditing techniques:

   • audit software

   • test data

95. Since evaluation skills are exercised in an interactive context, interpersonal and communication skills are essential ingredients of the education program aimed at supporting a professional accountant's role as evaluator.

96. At the prequalification stage, only general familiarity would be required in connection with the topics listed under the column headed "Key sub-topics" listed in Appendix 6.

97. It is estimated that, in addition to the general education requirements and the user-oriented requirements, the equivalent of one course, as described in paragraph 46, would be required to enable an aspiring accountant to acquire the knowledge and skills outlined in paragraphs 87-96.

POSTQUALIFICATION IT KNOWLEDGE AND SKILL REQUIREMENTS

Introduction

98. This part of the Guideline addresses postqualification IT knowledge and skill requirements. In general, this part of the Guideline focuses on higher levels of knowledge and addresses more specialized skill sets.

99. In the postqualification curriculum, accountants may choose to continue working in the same domain as prior to qualification, to change to another area or to focus on some more specialized aspect of a more general role. For example, a management accountant who initially qualifies as an accountant in the public sector domain may subsequently choose to work in industry. Similarly, an individual who initially qualifies as a public accountant may eventually choose to work primarily in a management advisory capacity in connection with a specific industry or in connection with a specific hardware or software platform.

100. Postqualification education requirements related to IT are oriented to ensuring that standards of competence and service quality are maintained by professional accountants in their chosen field of IT-related activity after qualification.

Continuing Professional Education

101. Continuing professional education (CPE) is necessary to maintain professional competence in the rapidly changing IT field. CPE can include self-study, teaching, lecturing and presentations, publication of articles, monographs and books, participation in workshops, seminars, conferences, professional meetings and similar activities, and formal courses provided by colleges, universities, professional associations, and software and hardware vendors.

102. Because the IT field is subject to continuing change, all professional accountants must maintain their professional competence in connection with IT subsequent to qualification through appropriate CPE as required by their particular IT-related activities. Alternatives that could be considered range from voluntary CPE to monitored voluntary CPE to mandatory CPE

activities. IFAC recommends that member bodies work towards developing mechanisms for recording and monitoring the CPE activities of their members.

103. After qualification, all professional accountants must, at a minimum, maintain their knowledge and skill levels as users of IT in their particular work domain. In addition, if their area of activity involves management, design or evaluation of information systems, they must maintain the knowledge and skill levels identified for these roles in this section of the Guideline.

104. Professional accountants' areas of activity may be more specialized than these three broad roles. IFAC recommends that, where appropriate, member bodies work towards developing IT- related CPE requirements for such other work domains related to IT to ensure that a minimum level of service quality is maintained.

Specialization

105. After qualification, some professional accountants will choose to focus their involvement with IT by specializing. Examples of specialist areas which are not themselves IT fields, but are fields in which the use of IT may be significant, include treasury and finance, financial planning services, taxation, insolvency and reconstruction, and small business advisory services. Examples of specialist areas which are IT fields are business system development and integration, information system privacy and security, and various areas of industry specialization such as financial institution information systems, health care information systems, and so on.

106. Member bodies may wish to recognize the qualifications of members who have achieved specialist status in a recognized domain of IT activity by granting them specialist designations or other appropriate recognition.

107. Specialist status would normally be achieved through an appropriate combination of prescribed theoretical education, practical skills development, and specific experience in a specialized work domain. Supervised practical experience of a reasonable duration in a given area and, in some cases, tests of professional competence at the specialist level, should be required to qualify the accountant as a specialist.

108. The following sections discuss postqualification knowledge and skill level requirements for each of the four roles identified earlier.

The USER Role

109. Appendix 3 to this Guideline addresses the topics relevant to this role. At the postqualification stage, professional accountants as users of IT will likely focus their use of IT by specializing in the use of particular information technologies that are most appropriate to their work domain.

Theoretical Content

110. At the postqualification stage, professional accountants as users of IT must have a sound conceptual knowledge of the information technologies that are most appropriate to their work domain. For example, management accountants must have a reasonable knowledge of the major types of business systems in use, their inherent risks, and effective internal control practices. Professional accountants working in the tax advisory services domain must have a reasonable knowledge of the main personal and corporate tax preparation packages, their strengths and weaknesses, electronic filing systems, tax planning software and tax research databases. Auditors must have a reasonable knowledge of the main computer-assisted auditing techniques, their strengths, requirements and limitations.

Practical Content

111. At the postqualification stage, professional accountants as users of IT must have practical skills in the use of relevant information technologies. For example, professional accountants serving in an audit role should be able to use at least one major computer-assisted auditing package, a work paper generation package, an on-line or local database system or professional research tool and relevant time management technologies such as time keeping and billing systems. Professional accountants working in the tax advisory services domain should have a working knowledge of at least one personal and one corporate tax preparation package and, where feasible, have practical training in the use of an electronic filing system, tax planning software and a tax research database.

The MANAGER Role

112. At the postqualification stage, professional accountants as managers of information systems will be involved in the specific information technologies that are used in their work domain. Nevertheless, there are general knowledge and skill requirements that are common to all accountants employed as managers of information systems. Appendix 4 to this Guideline addresses the topics relevant to this role.

113. At the postqualification stage, the level of knowledge and skill requirements would include mastery of the topics identified in Appendix 4 under the column headed "Main topic coverage" and the topics listed under the column headed "Key sub-topics."

Theoretical Content

114. At the postqualification stage, professional accountants serving as managers of information systems must have a sound understanding of the business functions that information systems can fulfil and the related managerial processes of directing, leading, controlling and communicating in an IT context. The professional accountant must therefore have a fairly detailed understanding of information system organizations best suited to different entities, approaches to IT staffing, budgeting, personnel development and performance evaluation, computer system operations procedures and

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controls, including environment controls, security, back up and recovery procedures, project management techniques and controls applicable to information systems projects.

115. The level of knowledge required is that necessary to effectively apply the practical skills required to manage in an information system context.

Practical Content

116. At the postqualification stage, professional accountants serving as managers of information systems must be able to plan and co-ordinate, organize and staff, direct and lead, and monitor and control. These skills include communication skills and interpersonal skills required to support the manager's interactions with top management, users, steering committees, and suppliers of information system services, both internal employees and external contractors. In contrast with general communication and interpersonal skill requirements, these skills must be developed in an IT context.

117. The skill level requirements are the ability to manage information systems professionally, adhering to sound business practices and applicable statutes, standards and guidelines.

The DESIGNER Role

118. At the postqualification stage, professional accountants as designers of information systems will be involved in a variety of specific information technologies. Nevertheless, there are general knowledge and skill requirements that are common to all accountants employed as designers of business systems. Appendix 5 to this Guideline addresses the topics relevant to this role.

119. At the postqualification stage, the level of knowledge and skill requirements would include mastery of the topics identified in Appendix 5 under the column headed "Main topic coverage" and the topics listed under the column headed "Key sub-topics."

Theoretical Content

120. At the postqualification level, professional accountants serving in a design capacity must know about alternative system design approaches and techniques, their strengths and weaknesses, and their suitability in a specific context. Also, professional accountants serving in this domain must have a broad familiarity with the major system architectures in use and related hardware and software systems, their strengths and weaknesses, and effective management and internal control practices. In addition, professional accountants working in this domain must have detailed knowledge of relevant codified standards, guidelines and preferred system development methods.

121. The knowledge level requirements at this stage are linked to the practical skill requirements stated as skills sufficient to enable the accountant to

apply, or advise on the application of, appropriate techniques in the development of specific business systems.

Practical Content

122. At the postqualification stage, professional accountants serving in a design capacity must have significant practical exposure to some of the important techniques that are used in key phases of system design, such as preparation of a feasibility study, information requirements elicitation and documentation techniques, data file design and documentation techniques, and document, screen and report design techniques.

123. The skill level requirements at this stage are the ability to apply, or advise on the application of, appropriate system techniques, particularly internal controls, in the development of specific business systems without supervision.

The EVALUATOR Role

124. At the postqualification stage, professional accountants as evaluators of IT will be involved in the specific evaluations conducted in their work domain. Nevertheless, there are general knowledge and skill requirements that are common to all accountants employed as evaluators of information systems. Appendix 6 to this Guideline addresses the topics relevant to this role.

125. At the postqualification stage, the level of knowledge and skill requirements would include mastery of the topics identified the Appendix 6 under the column headed "Main topic coverage" and the topics listed under the column headed "Key sub-topics."

Theoretical Content

126. At the postqualification stage, in their evaluator role, professional accountants must be able to distinguish between information systems evaluation issues and approaches that are appropriate for addressing specific evaluation purposes relevant in their work domain. In this regard, a professional accountant must have detailed knowledge of the steps involved in applying a particular evaluation approach in an IT context, relevant standards and practices governing the conduct of a particular evaluation approach and the potential contribution that a particular evaluation could make in a specific context.

127. The knowledge level requirements in this area are the degree of knowledge that is required to work effectively in this domain.

Practical Content

128. At the postqualification stage, the professional accountant must be able to tailor standard evaluation approaches to specific contexts and to offer practical recommendations for information system improvement where appropriate. In addition, the accountant must be able to apply relevant IT tools and techniques when conducting the evaluation process.

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129. The skill level requirements in this area are that the accountant have the ability to plan, execute and communicate the results of an evaluation approach in an IT context without supervision, while meeting relevant professional standards governing the particular evaluation objective.

Core IT Knowledge and Skill Areas for Professional Accountants by Role

This section contains the following appendices:

These appendices should be read in conjunction with the Guideline.

They define broad areas of knowledge and skills that should be covered in the IT curriculum of professional accountants, organized by role.

GENERAL INFORMATION TECHNOLOGY EDUCATION REQUIREMENTS

Information Technology Concepts for Business Systems

Broad knowledge/skill area	Main topic coverage	Key sub-topics
General systems concepts	Nature and types of systems	General systems theory, system objectives Open/closed systems, well/ill structured, formal/informal, etc.
	System architectures	Sub-systems, networks, distributed systems, mobile Hardware, system software, application software systems, etc. Data organization and access methods Networks and electronic data transfer
	Control and feedback in systems	Objectives, measures, monitoring, feedback and follow-up
	Nature and types of information	Routine, exception, ad hoc, predictive Transaction documents, screens, reports, messages, etc.
	Attributes of information	Timeliness, currency, frequency, accuracy, level of aggregation, etc. Decision value

GENERAL INFORMATION TECHNOLOGY EDUCATION REQUIREMENTS

Information Technology Concepts for Business Systems

Broad knowledge/skill area	Main topic coverage	Key sub-topics
General systems concepts (cont'd)	Role of information within business	Monitoring, problem finding, action, decision support, etc. Reporting concepts and systems Transaction processing system (TPS) Management information system (MIS) Decision support system (DSS) Executive information system (EIS) Expert system (ES), neural network (NN)
Management use of information	Decision theory Human information processing Transaction processing in typical business applications	Process transactions, maintain master files, produce reports, process inquiries, support planning and control, etc.
	Communication of information Financial analysis	

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GENERAL INFORMATION TECHNOLOGY EDUCATION REQUIREMENTS

Information Technology Concepts for Business Systems

Broad knowledge/skill area	Main topic coverage	Key sub-topics
Hardware	Components of a computer configuration	Micro/workstation/mini/mainframe/supercomputer hardware designs Stand alone or multi-user/network
	Processing units	Central processing unit (CPU), server, main memory, etc. Buslines, cables, integrated circuit cards, micro-code, registers, etc.
	Input/output devices, processing speeds, etc.	Keyboard, mouse, text recognition, voice recognition, smart card, pen, display, tape, disk, scanner, printer etc. Control units, buffers, channels, etc.
	Physical storage devices	Data representation by computer, data compression Tape, disk, compact disk read only memory (CD-ROM), write once read many (WORM), computer output microfilm (COM)
	Communication devices	Modem, transmission line, carrier, etc.

GENERAL INFORMATION TECHNOLOGY EDUCATION REQUIREMENTS

Information Technology Concepts for Business Systems

Broad knowledge/skill area	Main topic coverage	Key sub-topics
System software	Software configuration	Micro/workstation/mini/mainframe/supercomputer software designs Open/proprietary systems
	Operating systems	Graphical user interfaces Network, client/server, etc.
	Communications systems	Terminal monitor, etc.
	Security software	Access control software Anti-virus software
	Utility software	Text editor, directory manager, file backup/recovery, file compression, etc. Performance monitoring software, scheduling software, etc.
	Programming languages/compilers	Language evaluation and selection approaches Machine code/assembly/procedural/4th generation languages

GENERAL INFORMATION TECHNOLOGY EDUCATION REQUIREMENTS

Information Technology Concepts for Business Systems

Broad knowledge/skill area	Main topic coverage	Key sub-topics
System software (cont'd)	Programming languages/compilers (cont'd)	Object-oriented languages, multimedia authoring systems, etc.
	Programming aids, interactive programming software	Program generators/computer assisted software engineering (CASE) Programmer workbench tools Methods of program design and development Testing and documentation
	Library management systems	Version control, migration, etc.
	Data management systems	Tape/disk management systems Hardcopy/microfiche/optical imaging On-line, archival Report generators and data retrieval software
Application software	Application software strategy	Competitive advantage Piecemeal vs. organization-wide development/integration of systems

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GENERAL INFORMATION TECHNOLOGY EDUCATION REQUIREMENTS

Information Technology Concepts for Business Systems

Broad knowledge/skill area	Main topic coverage	Key sub-topics
Application software (cont'd)	Application software strategy (cont'd)	Package vs. custom software Distributed vs. centralized processing End user computing
Data organization and access methods	Data structures and file organization	Data coding File/record design
	Access methods and file maintenance	Sequential access Direct access (random access) Indexed sequential access Relational
	Types of data files	Master/transactions/tables
	Data base management systems	Data storage, access, and sharing Design principles—characters/fields/records Data base administration Conceptual data modelling

GENERAL INFORMATION TECHNOLOGY EDUCATION REQUIREMENTS

Information Technology Concepts for Business Systems

Broad knowledge/skill area	Main topic coverage	Key sub-topics
Data organization and access methods (cont'd)	Data base management systems (cont'd)	Defining/documenting data base requirements File layout/schema/data dictionary Model data bases, distributed systems
	Document management	Capture, index, store, retrieve, display/print Computer output microfilm (COM), microfiche, optical imaging systems
Networks and electronic data transfer	Network components, configurations and designs	Local area networks/micro to mainframe links/wide area networks/distributed processing networks/mobile systems Data transmission options, carrier services, etc.
	Data communication and transmission devices/software	Modem, switch, concentrator, bridge, router, terminal monitor, etc.
	Message and document communication	Electronic data interchange (EDI), point of sale (POS), electronic funds transfer system (EFTS), e-mail, etc.

GENERAL INFORMATION TECHNOLOGY EDUCATION REQUIREMENTS

Information Technology Concepts for Business Systems

Broad knowledge/skill area	Main topic coverage	Key sub-topics
Networks and electronic data transfer (cont'd)	Operations, management and control	
Transaction processing in typical business and accounting applications	General application processing phases	Data entry Edit Master file update Reporting, accounting, control, management Query, audit trail, ad hoc reports
	Processing modes	Batch-oriented processing Transaction-oriented processing On-line processing Real-time processing Distributed processing Multi-programming, multi-tasking and multi-processing
	Revenue/receivables/receipts Purchases/payables/payments	Business documents Accounting records

GENERAL INFORMATION TECHNOLOGY EDUCATION REQUIREMENTS

Information Technology Concepts for Business Systems

Broad knowledge/skill area	Main topic coverage	Key sub-topics
Transaction processing in typical business and accounting applications (cont'd)	Inventories/cost of sales	Data bases
	Materials requirements planning and control/costing	Accounting reports
	Production planning & scheduling; tracking, monitoring & control; quality management; computer integrated manufacturing (CIM)/computer assisted design (CAD)/computer-assisted manufacturing (CAM)	Control reports
		Management reports
	Payroll and personnel	
	Fixed assets	
	Treasury/Administration	
	General ledger/budgeting/ information systems	

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GENERAL INFORMATION TECHNOLOGY EDUCATION REQUIREMENTS

Internal Control in Computer-Based Systems

Broad knowledge/skill area	Main topic coverage	Key sub-topics
Control objectives	Risks and exposures in computer-based information systems	Fraud, error, abuse, excessive cost, competitive disadvantage, statutory sanctions, business interruption, social costs, etc.
	The effect of the computer on processing controls	Behavioral considerations Cost/benefit
	Effect of IT audit on organization, controls	
	Responsibility for control	Management, users, IT personnel, auditors
	Effectiveness and efficiency of operations	
	Reliability of financial reporting	
	Compliance with applicable laws and regulations	Prevention/detection of fraud, error and illegal acts
	Cost effectiveness of control procedures	

GENERAL INFORMATION TECHNOLOGY EDUCATION REQUIREMENTS

Internal Control in Computer-Based Systems

Broad knowledge/skill area	Main topic coverage	Key sub-topics
Control environment	Management philosophy and operating style	
	Plan/structure of organization	Segregation of incompatible functions
	Methods to communicate the assignment of authority and responsibility	
	Management control methods	
	Systems development methodology	
	Controls over system selection, acquisition/development	Standards and controls applicable to IS development projects
		Developed/acquired systems
		Structured analysis and design
	Controls over system implementation	Acceptance testing methodologies
		System conversion methodologies

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GENERAL INFORMATION TECHNOLOGY EDUCATION REQUIREMENTS

Internal Control in Computer-Based Systems

Broad knowledge/skill area	Main topic coverage	Key sub-topics
Control environment (cont'd)	Control over system and program changes	Authorization controls Documentation standards and controls Implementation controls Custody Emergency change controls Testing and quality control Copyright, warranty, etc.
	Personnel management methods External controls	
Risk Assessment	Risk exposures Probability of loss Consequences Preventive/detective/corrective strategies	Fraud, error, vandalism, excessive costs, competitive disadvantage, business interruption, social costs, statutory sanctions, etc. Monetary, non-monetary
Control activities	Accounting system	Identification and recording of all valid transactions Proper/timely classification of transactions

GENERAL INFORMATION TECHNOLOGY EDUCATION REQUIREMENTS

Internal Control in Computer-Based Systems

Broad knowledge/skill area	Main topic coverage	Key sub-topics
Control activities (cont'd)	Accounting system (cont'd)	Appropriate measurement/valuation Appropriate timing/cut-off Appropriate presentation
	Control procedures	Authorization Separation of incompatible functions Adequate documents and records Asset safeguards; limitation of access to assets Independent checks on performance; verification of accounting records, comparison of accounting records with assets
	Control design	Effect of general controls Preventive controls Detective controls Computer-dependent controls (edit, validation, etc.) User controls (control balancing, manual follow-up, etc.)

GENERAL INFORMATION TECHNOLOGY EDUCATION REQUIREMENTS

Internal Control in Computer-Based Systems

Broad knowledge/skill area	Main topic coverage	Key sub-topics
Control activities (cont'd)	Control design (cont'd)	Audit trails Error identification/investigation/correction/tracking
	Control over data integrity, privacy and security	Classification of information Access management controls Physical design and access controls Logical access controls (user authorization matrix) Encryption Program security techniques Data security techniques Monitoring and surveillance techniques
	Continuity of processing/disaster recovery planning and control	Threat and risk management Software and data backup techniques (problems of on-line systems, etc.) Alternate processing facility arrangements Disaster recovery procedural plan, testing, documentation

GENERAL INFORMATION TECHNOLOGY EDUCATION REQUIREMENTS

Internal Control in Computer-Based Systems

Broad knowledge/skill area	Main topic coverage	Key sub-topics
Control activities (cont'd)	Continuity of processing/ disaster recovery planning and control (cont'd)	Integration with departmental plans; Insurance
	IS processing/operations	Planning and scheduling Performance monitoring Control over productivity and service quality Library management Input/output distribution and control Security and back up and recovery
Monitoring of control compliance	Roles of management users, internal auditors, external auditors	

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GENERAL INFORMATION TECHNOLOGY EDUCATION REQUIREMENTS

Management of IT adoption, implementation and use
See Appendix 4 "The Professional Accountant as a Manager of Information Systems."
As part of the General Education component, the topics under the column headed "Main topic coverage" would be covered at a general level.

Development standards and practices for business systems
See Appendix 5 entitled "The Professional Accountant as a Designer of Business Systems."
As part of the General Education component, the topics under the column headed "Main topic coverage" would be covered at a general level.

Evaluation of computer-based business systems
See Appendix 6 entitled "The Professional Accountant as an Evaluator of Information Systems."
As part of the General Education component, the topics under the column headed "Main topic coverage" would be covered at a general level.

THE PROFESSIONAL ACCOUNTANT AS A USER OF INFORMATION TECHNOLOGY

Broad knowledge/skill area	Main topic coverage	Key sub-topics
Experience with business and accounting applications	Key IT acquisition decisions and approaches to them	Defining needs and costs Identifying alternatives
		Selecting appropriate hardware and software Deciding whether to acquire/develop/outsource
	Assessing IS	System testing System operation System maintenance
	Organizing system resources	Managing hardware, software, data, assistants, supplies, etc.
	Control and safeguarding of IS	Errors in use Theft of hardware, software, supplies Unauthorized use, vandalism Software piracy Virus attacks System failure

THE PROFESSIONAL ACCOUNTANT AS A USER OF INFORMATION TECHNOLOGY

Broad knowledge/skill area	Main topic coverage	Key sub-topics
Software	Operating systems	DOS, Windows, etc.
	System architectures	Single user, local area network, wide area network, etc.
	Basic accounting packages	
	Small business systems	Industrial automation/CIM/CAD/CAM
		Office automation products
	Financial spreadsheets	Design, documentation, operation, control
	Word processing	Operation
	Business graphics and presentation software	Practices, misleading graphs, operation, etc.
	Data Base (on-line, local, professional research tool)	Data base design
		Operation
		Report generators
		Retrieval software
		DB query language

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THE PROFESSIONAL ACCOUNTANT AS A USER OF INFORMATION TECHNOLOGY

Broad knowledge/skill area	Main topic coverage	Key sub-topics
Software (cont'd)	Utility programs	Text editor Directory manager File backup/recovery File compression software
	Access control software	User profile, menu, password, transaction logging, etc.
	Anti-virus software	Types of viruses, etc.
	Communications software	E-mail, file transfer, micro/server link, etc. Internet, World Wide Web, etc.
	Statistical analysis	Statistical analysis products, uses, etc.
	Tax preparation	Personal Corporate
	Audit software	Data extraction/analysis, work paper generator, etc.
	Decision support and expert systems	Features, strengths, weaknesses, etc.

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THE PROFESSIONAL ACCOUNTANT AS A MANAGER OF INFORMATION SYSTEMS

Broad knowledge/skill area	Main topic coverage	Key sub-topics
Strategic considerations in IT development	Planning of information systems based on business success factors/criteria	Costs/benefits (quantitative and qualitative, impact on management, jobs and office procedures)
	Components of long range plans Integration with business objectives and success factors	Business process re-engineering Technology assessment and capacity planning Allocation of resources/prioritization Management of technology diffusion, including end-user computing
	Participation in strategic planning (membership on steering committee)	Assessment of IT function
Administrative issues	Job functions Organization Reporting relationships of the IT department	IT manager Business analyst Systems analyst Programmers Operations manager and staff

THE PROFESSIONAL ACCOUNTANT AS A MANAGER OF INFORMATION SYSTEMS

Broad knowledge/skill area	Main topic coverage	Key sub-topics
Administrative issues (cont'd)	Reporting relationships of the IT department (cont'd)	Data base administrator/data administrator Network controller Librarian
	Approaches to staffing, personnel development and performance evaluation	
Financial control over IT	IT budgeting and cost control	Capital budgeting Accounting for system costs Systems for tracking costs Expense monitoring Security and back up and recovery
Operational issues	Developing operational priorities	Human factors Impact on management, jobs and office procedures
	Management of computer operations	Planning and scheduling Performance monitoring

THE PROFESSIONAL ACCOUNTANT AS A MANAGER OF INFORMATION SYSTEMS

Broad knowledge/skill area	Main topic coverage	Key sub-topics
Operational issues (cont'd)	Management of computer operations (cont'd)	Control over productivity and service quality Facilities, equipment management and safeguarding Library management Input/output distribution and control
Management of system acquisition, development and implementation	Development acquisition alternatives	In-house/ bureau/ outsourcing
	Standards and controls applicable to IS development projects	System development project management techniques Maintaining consistency and compatibility of hardware and software Managing expectations Determining skill requirements and staffing Requests for proposals Evaluation Reporting and presentation techniques Behavioral and technical management

THE PROFESSIONAL ACCOUNTANT AS A MANAGER OF INFORMATION SYSTEMS

Broad knowledge/skill area	Main topic coverage	Key sub-topics
Management of system maintenance and change	Standards and controls applicable to IS maintenance activities	Version management Migration Custody Authorization Emergency change controls Testing and quality control Copyright, warranty, etc.
Management of end-user computing	Role of information centres	Security Support Advice

THE PROFESSIONAL ACCOUNTANT AS A DESIGNER OF BUSINESS SYSTEMS

Broad knowledge/skill area	Main topic coverage	Key sub-topics
Role of information in organization design and behavior	Data bases and data base management systems	Data organization, acquisition, storage, access, sharing, and control Implications of centralized, distributed, client/server, network
	System development life cycle (SDLC)	Project management/planning/control Documentation requirements
	Risks: economic, technical, operational, behavioral	Main risks and reasons for failure of computer projects
	Controls	Effect of new development techniques and management theories on formal systems development life cycle
System design techniques	Data flow diagrams Entity-relationship model, etc. Decision tables and trees Prototyping	

THE PROFESSIONAL ACCOUNTANT AS A DESIGNER OF BUSINESS SYSTEMS

Broad knowledge/skill area	Main topic coverage	Key sub-topics
System design techniques (cont'd)	Computer aided software engineering (CASE) tools, object methods, etc. Design of data bases/files/ records/forms/screen layouts	
System acquisition/ development life cycle phases, tasks and practices and maintaining control over system development processes	Investigation and feasibility study	Analysis of existing or IT systems Scope of proposed system and information needs Nature and size of business Cost/benefit analysis Statement of application requirements
	Requirements analysis and initial design	Volumes and system sizing Incorporating controls within systems

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THE PROFESSIONAL ACCOUNTANT AS A DESIGNER OF BUSINESS SYSTEMS

Broad knowledge/skill area	Main topic coverage	Key sub-topics
System acquisition/ development life cycle phases, tasks and practices and maintaining control over system development processes (cont'd)	Detailed design specification/documentation	Screen and report design Flowcharting hardware and software requirements Statement of technical requirements
	Hardware evaluation and acquisition	Selection and implementation of computers and related hardware components
	Software evaluation and acquisition /development	Selection of software packages, programming languages/compilers Programming aids Structured, event driven, object-oriented approaches System and data base integration
	Hardware contracts and software licenses	Key issues
	System installation/ implementation	Planning, scheduling, training, etc.

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THE PROFESSIONAL ACCOUNTANT AS A DESIGNER OF BUSINESS SYSTEMS

Broad knowledge/skill area	Main topic coverage	Key sub-topics
System acquisition/ development life cycle phases, tasks and practices and maintaining control over system development processes (cont'd)	Testing (system verification)	Role of specifications; test design, execution, control, etc.
	User procedures and training	Documentation, etc.
	Design of user/operator control procedures	Documentation, etc.
	Testing (system validation)	User Involvement Audit trail Testing transaction flows Testing computerized controls Benchmarking Test data
	System conversion and start-up	Different methods of changeover Pilot running and going live File transfer/conversion/creation

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THE PROFESSIONAL ACCOUNTANT AS A DESIGNER OF BUSINESS SYSTEMS

Broad knowledge/skill area	Main topic coverage	Key sub-topics
System acquisition/ development life cycle phases, tasks and practices and maintaining control over system development processes (cont'd)	Post-implementation review	Achievements and failures Assessment of benefits/costs Impact on management and staff
	Maintenance of hardware and software	Maintaining control over system changes
	Systems documentation and operations manuals	

THE PROFESSIONAL ACCOUNTANT AS AN EVALUATOR OF INFORMATION SYSTEMS

Broad knowledge/skill area	Main topic coverage	Key sub-topics
Legal, ethical, auditing and information system control standards	Legal and ethical requirements Auditing standards relevant to IT Computer control guidelines and standards	Effect of the computer on controls Effect of audit on organization Behavioral and cost considerations
Evaluation objectives	Efficiency/effectiveness/ economy of IT use Compliance with policies, statutes and regulations Evaluation of internal control in computer-based systems Fairness of financial statement representations and the accuracy and completeness of accounting records	Issues and approaches, evaluation phases and tasks (see below)

THE PROFESSIONAL ACCOUNTANT AS AN EVALUATOR OF INFORMATION SYSTEMS

Broad knowledge/skill area	Main topic coverage	Key sub-topics
Evaluation methods and techniques	Planning, scheduling and staffing	
	Obtaining an understanding of systems in business context	
	Documenting systems and elements of control structure	
	Tests of features, controls, transactions and balances	
	Supervision, review and quality assurance	
Communicating results of evaluations	Types of reports, levels of assurance	Effective report writing
	Communication skills	Oral communications
Following up	Frequency, reporting, etc.	
Specific types of evaluations	System acquisition and development	Evaluation of acquisition/development standards and methods

THE PROFESSIONAL ACCOUNTANT AS AN EVALUATOR OF INFORMATION SYSTEMS

Broad knowledge/skill area	Main topic coverage	Key sub-topics
Specific types of evaluations (cont'd)	System acquisition and development (cont'd)	Tests of compliance of development methods with standards Evaluation of acquisition/development controls Evaluation of system development technology (e.g., CASE)
	System implementation	Acceptance testing methodologies System conversion methodologies Post-implementation review
	System maintenance and program changes	Evaluation of system maintenance and program change standards Tests of system maintenance and program change controls Tests of production library security and controls Evaluation of system maintenance and program change controls
	IT asset safeguarding	Evaluation of facilities management and IT asset safeguarding

THE PROFESSIONAL ACCOUNTANT AS AN EVALUATOR OF INFORMATION SYSTEMS

Broad knowledge/skill area	Main topic coverage	Key sub-topics
Specific types of evaluations (cont'd)	Data integrity, privacy and security	Understanding of data protection legislation Consideration of personnel issues and confidentiality Evaluation of security standards and procedures Evaluation of security technologies, physical and logical access controls Tests of compliance with security standards and policies and effectiveness of controls Tests of effectiveness of controls
	Continuity of processing/disaster recovery planning	Evaluation of threat and risk management methods Evaluation of software and data backup techniques Evaluation of alternate processing facility arrangements Evaluation of disaster recovery procedural plan, testing, documentation Evaluation of integration of IS plans with user department plans Tests of compliance of recovery procedures with standards

THE PROFESSIONAL ACCOUNTANT AS AN EVALUATOR OF INFORMATION SYSTEMS

Broad knowledge/skill area	Main topic coverage	Key sub-topics
Specific types of evaluations (cont'd)	Continuity of processing/disaster recovery planning (cont'd)	Tests of effectiveness of recovery procedures with standards
	System processing operations/activities	Evaluation of operational activities Evaluation of performance monitoring methods Evaluation of controls over productivity and service quality Evaluation of technologies used to automate IS operations Tests of compliance with operational policies Tests of effectiveness of controls Tests of performance achievements
	Application processing	Identification of transaction flows Evaluation of strengths and weaknesses Tests of controls Integration of evaluation of application controls and general controls

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THE PROFESSIONAL ACCOUNTANT AS AN EVALUATOR OF INFORMATION SYSTEMS

Broad knowledge/skill area	Main topic coverage	Key sub-topics
Computer-assisted audit techniques (CAATs)	Approaches	Auditing around the computer Auditing through the computer Auditing with the computer
	Professional standards	
	Feasibility considerations	Effort and time required Availability of data files Availability of processing facilities, hardware and software Availability of qualified personnel Economic considerations
	Categories of CAATs	System analysis and documentation (e.g., flowcharting packages, review of program logic, etc.) System/program testing (e.g., test data, integrated test facility, parallel simulation, etc.) Data integrity testing (e.g., generalized audit software, utilities, custom programs, sampling routines, etc.)

THE PROFESSIONAL ACCOUNTANT AS AN EVALUATOR OF INFORMATION SYSTEMS

Broad knowledge/skill area	Main topic coverage	Key sub-topics
Computer-assisted audit techniques (CAATs) (cont'd)	Categories of CAATs (cont'd)	Problem solving aids (e.g., spreadsheet, database, on-line data bases, etc.) Administrative aids (e.g., wordprocessing, audit program generations, work paper generators, etc.)
	Definition and design	Definition of objectives Selection of techniques Design of input, processing and output requirement Testing Review
	Execution and control	Selection and arrangement of facilities and resources Preparation of specifications Desk checking and testing Execution Documentation Control