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System Diagramming Techniques: An Analysis of Methods Used in Accounting Education and Practice

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ABSTRACT: System diagrams (SD) are an integral component of system documentation and have become increasingly important in response to heightened awareness surrounding process improvement and documentation as well as compliance concerns with legislation such as the Sarbanes-Oxley Act. SD is also an important concept in accounting information systems and auditing education. This study examines SD commonly included in accounting curricula and compares the methods with those used by accounting practitioners. The SDs included in the study are system flowcharts, entity-relationship diagrams, data flow diagrams, resource-event agent models, process maps, and Unified Modeling Language. The results include analyses of frequency of use, purpose of use, and strengths and weaknesses based on several dimensions. Using a survey of accounting practitioners, we find that SD use in practice is not entirely consistent with what is included in accounting curricula. This study can be useful to accounting educators by providing insight into SD use in practice and comparing that to methods emphasized in accounting education. Educators can use the results to plan and modify their curricula, particularly in accounting information systems and auditing courses. Additionally, the practice community may find the results useful as they suggest differences in how, when, and why an SD method may be useful. Practitioners can also benefit from the descriptive analysis of current techniques employed across industries and accounting job functions.

Keywords: system diagram; system documentation; system flowcharts; process maps; data flow diagrams; REA model; E-R diagram; UML; accounting education; accounting practice.

Data Availability: Data is available upon request.

I. INTRODUCTION AND MOTIVATION

The purpose of this study is to provide insight into system diagram (SD) frequency and purpose of use, strengths, and weaknesses of various SD methods, as well as common SD practices in the accounting profession. Specifically, the following types of SD methods are included in the analysis presented in this study: system flowcharts,

entity-relationship (E-R) diagrams, data flow diagrams (DFD), resource-event-agent (REA) models, process maps, and Unified Modeling Language (UML). The study compares SD use among 403 accounting practitioners with SD content taught by both accounting information system (AIS) and auditing educators, included in major AIS, and auditing texts. The results are useful for accounting educators as they seek to keep course content relevant and up to date. The results also are informative for accounting professionals as it reveals current SD use in practice across a wide range of organizational sizes, industries, job titles, and responsibilities. This is especially important in light of recent authoritative guidance as well as governmental legislation (e.g., SAS 55, 78, 94, 96, and 99 and Section 404 of the Sarbanes-Oxley Act [SOX] [AICPA 1988, 1995, 2001, 2002a, 2002b; U.S. House of Representatives 2002]) where SD are critical for supporting internal control and process documentation requirements.

More than ever, organizations are focusing on system documentation efforts to gain an understanding of increasingly complex information systems (IS) and embedded systems-based controls. SD play a vital role in documentation by graphically depicting internal controls, data flows, and information flows related to key processes that support an organization. All types of accounting practitioners who work internally at an organization or externally in an assurance function, must be able to read and/or prepare SD, which oftentimes are prepared in conjunction with other types of system documentation such as narratives, interview transcripts, and checklists (Bagranoff and Simkin 2000; Lehman 2000). Being able to read and/or prepare SD is also fundamental to activities such as system requirements analysis, gap-fit analysis, reengineering, and data and business process modeling.

As a result of SOX, there has been a renewed interest in system documentation techniques (Harrington 2005). In particular, Section 404 of SOX requires that annual filings of publicly traded companies include: a statement of management's responsibility for establishing and maintaining an adequate internal control structure and procedures for financial reporting, and an assessment of the effectiveness of the company's internal control structure and financial reporting procedures. In addition, external auditors must attest to and report on management's assessment of internal controls, and SD methods play an important role in complying with these requirements. Additionally, many companies are adopting software tools that allow for continuous updating of business process documentation in terms that managers, investors, and lenders can understand (Winters 2004). Knowledge of SD is vital to effectively incorporating these tools into an ongoing compliance program and ultimately gleaning the most value from their integration.

Professional examinations are also placing greater emphasis on SD. For example, the newly restructured CPA exam has an expanded emphasis on SD in its "Business Environment and Concepts" section. CPA exam preparation materials include content related to system flowcharts, DFDs, E-R diagrams, and REA models (Whittington and Delaney 2004). Additionally, the CPA Exam Auditing and Attestation Content Specification, which includes SOX-related content, requires examinees to document their understanding of internal control systems (AICPA 2005). Finally, the CMA examination also includes system documentation in its "Management Accounting and Reporting" section (IMA 2006).

This paper is organized as follows: Section II describes major SD and includes a content review of AIS and auditing textbooks as well as survey results regarding SD usage by accounting educators. Section III presents our research questions; Section IV discusses sample selection and methodology; Section V reveals the results of our study; and Section VI concludes with discussion, study limitations, and future research directions.

II. SYSTEM DIAGRAM METHODS

Historically, accounting education has focused on traditional SD methods such as systems flowcharts and DFDs. In the more recent past, varied types of SD methods, such as process maps, REA models and UML, have emerged in practice, but these techniques have been slow to find their way into accounting curricula. One study attempted to determine usage of SD methods in practice, although the sample was limited to IS professionals (Kievit and Martin 1989). The study found that systems flowcharts and DFDs were the two most popular techniques (97.6 percent and 62.5 percent, respectively). Smith and Smith (2003) report on frequency of use of system development tools based on a survey of business managers at multinational firms. They asked participants to rank tools from most to least used; however, they do not report sample size. There is a lack of research in both the accounting and IS areas examining emerging issues in SD use. Additionally, previous research does not analyze differences in SD use between accounting practice and education.

SD provide various ways of modeling systems and frequently focus on process, procedures, or conceptual design. The techniques commonly use an object-oriented, logic or physical approach (Satzinger et al. 2000; Valacich et al. 2001). Based on discussions with internal and external accounting professionals and reviews of professional examination material (e.g., the CPA exam) and AIS and auditing textbooks, we base our study on the following types of SD techniques: (1) system flowcharts; (2) DFDs; (3) E-R diagrams; (4) REA models; (5) process maps; (6) UML. System flowcharts, DFDs, and process maps are commonly used to model logical processes, although system flowcharts can be used to model the physical elements of a process as well. REA models and E-R diagrams are examples of conceptual system modeling tools, and UML diagrams are frequently used in logic- and object-oriented modeling. E-R and DFDs are dominant forms of software specification and design, and research demonstrates that their use is supported by cognitive theory (Hungerford et al. 2004).

Accounting students are more likely to learn SD in AIS and auditing courses, but it also can be an important topic in other courses such as system analysis and design and enterprise resource planning (ERP) systems. Following is a brief description of each of the SD methods included in the current study.

System Flowcharts

System flowcharts are used to show informational processes such as logic flows, inputs, outputs, data storage, and operational processes such as physical flows, activities, and entities (Gelinas et al. 2005). They present a logical and physical rendering of the "who, what, how, and where" of the components of a system at a fine level of detail (Gelinas et al. 2004). This method of visually depicting systems has long been considered *the* principal charting technique for system documentation (Jones et al. 2002). According to Hunton et al. (2004), system flowcharts, also referred to as internal control or audit flowcharts, are primarily used to highlight internal controls during an audit.

Data Flow Diagrams (DFDs)

The DFD emerged from the management information system (MIS) field and is used to depict a system's processes, data flows among the processes, and sources, destinations, and storage of data (Demarco 1978). There are two types of DFDs: logical DFDs focus on activities in the system, while physical DFDs depict the "who, where, and how" of the system (Romney and Steinbart 2005). The DFD has traditionally been a popular technique taught and used in MIS until object oriented was developed (Wang 1996).

Entity-Relationship (E-R) Diagrams

A third SD method developed by Chen (1976) is the E-R diagram, a graphical technique used to portray database schema (Romney and Steinbart 2005). E-R diagrams illustrate the logical structure of databases by depicting the entities in a system (the objects about which we collect and store data) and the relationships, or cardinalities, among those entities (Gelinas et al. 2005). E-R diagrams are used not only to design and modify databases, but also to document and understand existing databases and to reengineer business processes (Romney and Steinbart 2005).

Resource, Event, and Agent (REA) Models

The REA model is a conceptual tool specifically designed to provide guidance and structure in designing relational AIS (McCarthy 1982; Dunn and McCarthy 1997). The REA data model classifies entities into three distinct categories: the resources the organization acquires and uses, the events in which the organization engages, and the agents participating in these events. Similar to E-R diagrams, REA models identify entities to be included in a system and depict the relationships among entities (Romney and Steinbart 2005). The REA model's central premise is that an IS should support the information needs of all users in an organization; thus, the REA approach provides a central repository from which various users can construct views specific to their information needs, both financial and nonfinancial, a characteristic lacking in traditional accounting applications (Hall 2001).

Process Maps

Process mapping is an SD technique developed by General Electric in the 1980s and used by many organizations to document, analyze, streamline, and redesign their business activities (Hunt 1996). Process maps are often used to show how work is currently accomplished in an organization (i.e., the "as is" state) and how it could be improved (i.e., the "could be" state) (Bradford et al. 2001). They represent a snapshot in time and show the specific combination of functions, steps, inputs, and outputs that an organization employs to provide value to its customers (Damelio 1996). Process maps are commonly associated with business process design and redesign and implementation of ERP systems and Six Sigma (Kettinger et al. 1997; Greenfield 2002; O'Leary 2000). Recent research indicates that process modeling techniques are successfully used by leading organizations (Bandar et al. 2005). Since General Electric's successful use of process maps, this documentation tool has gained widespread acceptance in manufacturing, systems consulting, and internal and external auditing environments (Adams 2000).

Unified Modeling Language (UML)

UML is also an established SD used in object-oriented system analysis and design (Amescua et al. 2004; George et al. 2004). UML has evolved through the practices of researchers and is now standard in many types of software solutions used for system development. Commonly considered as a tool for modeling software applications, UML is a technique useful for a variety of modeling activities, including business process modeling. A particular type of UML diagram included in the current study, the activity diagram, depicts the sequence of steps in a business process, leading to a more complete understanding of the information flow. The strength of UML lies in a standard set of symbols allowing the flexibility of UML activity diagrams to be constructed at various levels of detail (Fowler 2003).

Systems Diagram Methods in Accounting Curricula

In order to ascertain the coverage of SDs in accounting curricula, we use a two-pronged approach. First, we perform a content analysis of major AIS and auditing texts. Second, we survey AIS and auditing professors to determine if actual classroom coverage of SD is consistent with textbook coverage of SD.

Table 1 presents results of the content review of major AIS and auditing texts. Coverage of SD is coded as *extensive, moderate, minimal,* or *none*. End of chapter assignments are classified as requiring students to *read, prepare, discuss, and/or complete objective-type questions* related to SD.[1] Our analysis reveals that AIS texts discuss system flowcharts, DFDs, and E-R diagrams more extensively than the other SD methods. Few AIS texts include the REA model, and only two mention process maps, with the extent of coverage being limited to only a brief description. Only one AIS text incorporates UML (Jones and Rama 2006). The only SD method included in the auditing texts we review is the system flowchart. However, in two information technology (IT) audit texts, DFDs and E-R diagrams are also mentioned, albeit minimally.

There is a general consistency among auditing and AIS texts regarding purpose of use for each SD technique. Textbooks describe system flowcharts as a tool for assessing internal control, describing business processes, and evaluating current systems; DFDs are used for describing business processes, evaluating current systems, and designing/changing systems; E-R diagrams and REA models are used primarily for designing/changing systems; process mapping is used for describing business processes; UML is used for describing business processes, designing/changing systems, evaluating current systems, and assessing internal control.

Because an analysis of texts only tells "part of the story," we also survey AIS and auditing educators to determine SD coverage in the classroom. A link to a web-based survey was emailed to members of the AIS Educator's Association.[2] Of 375 emails delivered, 54 surveys were completed, representing a 14 percent response rate. In the past three years (which we consider as current teaching experience in an area), 94 percent of respondents have taught either undergraduate or graduate courses in AIS, and 44 percent of respondents have taught either undergraduate or graduate auditing (including IT auditing) courses. The majority of respondents teach at four-year institutions that offer either doctoral or masters' degrees in Accounting (65 percent), and information systems is their primary area of research (56 percent). The sample reveals a fairly equal distribution of faculty ranks, and the majority of faculty has greater than three years of experience teaching AIS (84 percent) or auditing (67 percent). Only 40 percent of faculty has any IS or auditing work experience in the previous five years. Survey results reveal that 100 percent of faculty teaching graduate courses in AIS incorporate SD methods into their curriculum, while 98 percent of faculty include SD in undergraduate AIS courses. Auditing instructors in our sample include SD methods in their courses less often (80 percent graduate and 82 percent undergraduate).

Table 2, Panel A summarizes educator coverage of SD methods. Overall, SD exposure in textbooks is consistent with what is taught by educators. AIS educators teach systems flowcharts (96 percent), DFDs (82 percent), and E-R diagrams (80 percent) more frequently

[1] Most accounting texts use a combination of end of chapter exercises and problems as learning materials. Exercises and problems related to reading and/or preparing diagrams are the most common types included in the textbooks.

[2] Members of the AIS Educator's Association are primarily AIS and auditing instructors. Approximately 30 percent of members of the AIS Educator's Association teach auditing courses.

TABLE 1
Systems Diagram Method in AIS and Auditing Textbooks[a]

Textbook Authors	Systems Flowcharts	Data Flow Diagrams	E-R Diagrams	REA Models	Process Maps	UML
AIS Textbooks						
Bagranoff, Bryant, and Hunton (2002)	Moderate (P, D)	Moderate (P, D)	Minimal	—	Moderate (P, D)	—
Bodnar and Hopwood (2004)	Extensive (R, P, MC, D)	Extensive (R, P, MC, D)	Minimal (MC)	—	—	—
Dunn, Cherrington, and Hollander (2005)	Extensive (P, MC, D)	Extensive (P, MC, D)	—	Extensive (R, P, MC, D)	—	—
Gelinas, Sutton and Hunton (2005)	Extensive (R, P, D)	Extensive (R, P, D)	Extensive (R, P, D)	—	—	—
Gelinas, Sutton and Fedorowicz (2004)	Extensive (R, P, D)	Extensive (R, P, D)	Extensive (R, P, D)	—	—	—
Hall (2001)	Extensive (R, P, MC, D)	Moderate (P, MC)	Moderate (P, MC, D)	Extensive (P, MC, D)	—	—
Jones and Rama (2006)	—	—	—	—	—	Extensive (R, P, D)
Moscove et al (2003)	Extensive (R, P, D)	Extensive (P, D)	Moderate (R, P, D)	Moderate (R, P, D)	Moderate (R, P, D)	—
Romney and Steinbart (2005)	Extensive (R, P, MC, D)	Extensive (R, P, MC, D)	Extensive (R, P, MC, D)	Extensive (R, P, MC, D)	—	—

(continued on next page)

TABLE 1 (continued)

Auditing Textbooks						
Arens, Elder and Beasley (2003)	Moderate (R, D)	—	—	—	—	—
Hall and Singleton (2005)	Minimal	Minimal	Minimal	—	—	—
Hunton, Bryant, and Bagranoff (2004)	Moderate (P, D)	—	—	—	—	—
Messier (2003)	Moderate (R, P, D)	—	—	—	—	—
Robertson and Louwers (2002)	Minimal	—	—	—	—	—
Weber (1999)	Moderate (D, MC, P)	Minimal (MC, P)	Minimal	—	—	—

[a] Extensive coverage was determined if a book thoroughly described the technique and its symbols, including guidelines for drawing, examples of the technique, and multiple end of chapter problems. Moderate coverage was determined if a book included descriptive text, symbols, and only one or two examples or problems. Minimal coverage was ascertained if the book described the technique but did not explain the symbols, give examples, or offer end of chapter problems (other than multiple choice or discussion questions). The types of end of chapter problems include R (reading a diagram), P (preparing a diagram), MC (multiple choice), and D (discussion).

TABLE 2
Emphasis on System Diagram Method in AIS and Auditing Courses

Panel A: Instructors Who Teach SD Method

	System Flowcharts	Data Flow Diagrams	E-R Diagrams	REA Models	Process Maps	UML
AIS	96% Mean = 3.19	82% Mean = 2.70	80% Mean = 2.53	66% Mean = 2.45	28% Mean = 1.43	19% Mean = 1.20
Auditing	92% Mean = 3.08	25% Mean = 1.42	17% Mean = 1.33	15% Mean = 1.46	34% Mean = 1.67	0% Mean = 1.00

Panel B: Auditing and AIS Instructor Purpose of Teaching SD Methods

	Used to Describe Business Processes	Used to Evaluate Current System	Used to Design or Change System	Used to Assess Internal Control Environment
System Flowcharts n = 43	79%	86%	37%	79%
Data Flow Diagrams n = 37	92%	49%	43%	27%
E-R Diagrams n = 31	68%	29%	71%	19%
REA Models n = 31	72%	32%	74%	19%
Process Maps n = 6	100%	67%	50%	50%
UML n = 4	100%	50%	100%	75%

and place the greatest emphasis on systems flowcharts in their courses (mean = 3.19).[3] Fewer AIS instructors teach the REA model (66 percent). Ninety-two percent of auditing professors in our sample teach systems flowcharts, but they place less emphasis on it in the classroom than AIS instructors (mean = 3.08 versus 3.19). Process maps and UML are taught by few educators. However, it is interesting to note that auditing instructors in the sample teach process maps more than AIS instructors do (34 percent versus 28 percent) and place greater emphasis on it (mean = 1.67 versus 1.43), which suggests that auditing texts are being supplemented with additional material possibly from the practice community. Overall, although instructors incorporate SD in their classes, relative to other topics, they place minimal to average emphasis on SD as evidenced by Likert scale means.

III. RESEARCH QUESTIONS

A key objective of this study is to compare SD taught in accounting education with SD used in accounting practice. Based on our findings in the prior section, we expect that system flowcharts, DFDs, and E-R diagrams are used more predominantly in the accounting profession. If accounting educators are preparing students for practice, and minimal course coverage is allowed for REA, process maps, and UML; we expect fewer participants to use these techniques. Furthermore, we are interested in whether the purposes of SD use in

[3] A scale of "1" to "5" is used for this question, with "1" representing no emphasis and "5" representing strong emphasis (see questions 28 and 29, Appendix B).

education are consistent with the purposes of each method in accounting practice. Based on a content review of texts and the pilot phase of our study, we determined that four major purposes of SD use are: (1) describing business processes; (2) evaluating current systems; (3) designing/changing systems; (4) assessing the internal control environment. Thus, the following two research questions (RQ) are proposed:

RQ1: Which SD methods are used more frequently in accounting practice?

RQ2: What are the purposes behind the use of each SD method in accounting practice?

IV. SAMPLE SELECTION AND METHODOLOGY

To answer RQ1 and RQ2, a survey of accounting practitioners is used (see Appendix A). The survey was pretested using 401 accounting and IS graduates from two universities as well as members of a local accounting professional organization. Feedback from the pretest was used to refine the final survey instrument and provide content validity. The inclusion of the six SD methods in the final survey was validated with the pretest instrument in addition to the content review of techniques used in AIS and auditing texts (as previously described), CPA exam review materials, and practice aids for accounting practitioners. In order to obtain a diverse sample of accounting practitioners (e.g., different industries, job titles, company sizes), we chose members of the Institute of Management Accountants (IMA) as target respondents. Since documentation is ultimately the responsibility of a firm's management and not their auditors, we believe this population is optimal for providing input to our research study.

The IMA supplied a random sample of 2,200 professionals with job titles of controller, assistant controller, manager, director, staff accountant, senior accountant, CFO, financial analyst, internal auditor, and external auditor.[4] The IMA emailed members a link to our online survey that included a description of the research project and ensured participant anonymity. Upon completion, participants were invited to email one of the authors for selected results of the survey.

The IMA monitored incorrect and delivery failure email addresses. Approximately 275 email messages were returned as undeliverable. Completed surveys were received from 403 IMA members; the corresponding response rate for the survey is 21 percent.[5]

Of the 403 IMA members who responded to the survey, nearly half are controllers or assistant controllers of their company (Table 3). Over 50 percent listed their area of responsibility as general or corporate accounting. Forty percent are in the manufacturing industry, with a wide variety of other industries represented to a lesser degree. Nearly fifty percent of the practitioners work in companies with sales less than $50 million, and 64 percent work for organizations with less than 500 employees. While half of the participants hold no professional certifications, the other half possess a CPA (28 percent), CMA (27 percent), CIA (4 percent) and/or CFM (4 percent) certificate.[6]

With respect to educational background, most of the respondents have a bachelor of accounting (70 percent), while 26 percent hold a masters in business administration (MBA) and 7 percent have a masters in accounting. Almost half of the subjects have been in their

[4] The IMA is a professional membership organization of approximately 69,000 members comprised of accounting practitioners of all different levels and across all industries. The IMA supplied us a list of titles from their membership database, which we used to choose the appropriate subset of their membership. Our sample is similar to the entire IMA membership based on industry grouping, organizational size, and certification.

[5] This response rate exceeds the typical response rate of 9–10 percent reported by IMA for other member surveys.

[6] Other certifications reported by our sample (representing less than 2 percent combined) include CFE, Chartered Accountant, CBM, CIPM, and CRP. Fifteen percent of participants hold two or more certifications.

TABLE 3
Panels A–C—Profile of Survey Participants; Panels D–H—Profile of Survey Participants

	Frequency	Percent
Panel A: Position		
Controller/Assistant Controller	183	45%
Manager/Director	59	15
Staff/Senior Accountant	49	12
CFO	49	12
Financial Analyst	35	9
Internal/External Auditor	21	5
Other	7	2
Total	403	100
Panel B: Responsibility		
Corporate Accounting	116	29
General Accounting	107	27
Finance	72	18
Cost Accounting	33	8
Internal/External Auditing	24	6
Budgeting and Planning	22	5
General Management	19	5
Other	10	2
Total	403	100
Panel C: Industry		
Manufacturing	161	40
Other Service	40	10
Wholesale and Retail Trade	32	8
Government and Nonprofit	26	6
Finance, Real Estate and Insurance	24	6
Medical and Healthcare	24	6
Computer Hardware/Software	19	5
Other	77	19
Total	403	100
Panel D: Sales (millions)		
$0–25	143	35%
$25–49	58	14
$50–99	44	11
$100–249	48	12
$250–500	24	6
$500+	69	17
Did Not Answer	17	4
Total	403	100

(*continued on next page*)

TABLE 3 (continued)

	Frequency	Percent
Panel E: Number of Employees		
0–50	75	19
51–100	51	13
101–499	130	32
500–999	35	9
1000–2499	33	8
2500–4999	26	6
5000+	53	13
Total	403	100
Panel F: Certification[a]		
No Certification	203	50
CPA	112	28
CMA	108	27
CIA	14	4
CFM	16	4
Panel G: Educational Background[a]		
Bachelors in Accounting	281	70
Masters in Business Administration	105	26
Masters in Accounting	27	7
Other	41	10
Panel H: Tenure		
Less than 3 Years	70	17
3–6 Years	99	25
6–9 Years	41	10
Greater than 9 Years	193	48
Total	403	100

[a] Frequency does not add to 403, as many respondents hold multiple certifications/multiple degrees.

current position for nine or more years. The profile of participants is consistent with summary demographics given to the researchers by IMA for members with the corresponding job titles.

V. RESULTS

Use of SD in Accounting Practice and Comparison with Accounting Education

RQ1 and RQ2 focus on frequency of SD use and purpose of use in accounting practice. The first section of the survey asked respondents to indicate their use of the six SD techniques.[7] Multiple answers were allowed on this portion of the survey. The results are presented in Table 4.

[7] Along with the name, we designed the survey to display illustrations of each technique. We felt this was important to control for the possibility that an SD is used by a participant but known as something different by the participant.

TABLE 4
Frequency and Purpose of Use of System Diagram Method

(1) System Diagram Method	(2)[a] Participants Indicating Use of Technique n (%)	(3)[b] Used to Describe Business Processes %	(4)[b] Used to Evaluate Current System %	(5)[b] Used to Design or Change System %	(6)[b] Used to Assess Internal Control Environment %
System Flowcharts	187 (46%)	79%	58%	45%	47%
Data Flow Diagrams	85 (21%)	68	51	47	35
E-R Diagrams	56 (14%)	61	36	25	36
REA Models	81 (20%)	65	49	30	49
Process Maps	115 (29%)	76	47	23	38
UML	24 (6%)	38	46	33	42
No Technique	164 (41%)	n/a	n/a	n/a	n/a

[a] Column 2 percentages are based on total sample of 403 participants. More than one technique can be used by a participant.
[b] Columns 3–6 indicate percentages based on participants using each method. For example, 79 percent of participants that indicate use of system flowcharts use them to describe business processes.

Consistent with the results of our textbook analysis and educator survey, participants indicated they used systems flowcharts more than other methods (46 percent). However, this percentage is much lower than the percentage of AIS and auditing educators who teach this method (96 percent and 92 percent, respectively). Participants stated they primarily use system flowcharts to describe business processes (79 percent). This is somewhat different from instructor focus on system flowcharts (Table 2, Panel B), which is to evaluate the current system (86 percent). In addition, it is different from textbook focus, which is that flowcharts are primarily used to assess internal control (only 47 percent of our sample use flowcharts to assess internal control).

While only briefly mentioned in two AIS texts and not discussed in any auditing texts, process maps are the second most frequently used SD method by our participants (29 percent). Consistent with its main purpose in accounting education, process maps were used by most accounting practitioners to describe business processes (76 percent). They were also used to evaluate the current system (47 percent), a purpose noted in practitioner literature (e.g., used in conjunction with organizational reengineering initiatives). This is consistent with instructor focus, which revealed that 100 percent of respondents use process maps to describe business processes, and 67 percent use them for evaluating the current system (Table 2, Panel B).

Although discussed extensively in every AIS text, only 21 percent of our survey participants indicated use of DFDs. Comparing this with Kievit and Martin's (1989) findings, DFDs may be more of an IS-specific SD technique as they report 56 percent of IS professionals use DFDs, second only to system flowcharts. Accounting practitioners that employed DFDs did so mainly for describing business processes (68 percent) and evaluating current systems (51 percent). This use is consistent with texts that described DFDs as a process-modeling tool and with instructor focus (Table 2).

The REA model is used by only 20 percent of our sample, which is consistent with the emphasis given in accounting texts but not consistent with instructor (AIS) focus (66 percent). Participants utilized REA models mainly for describing business processes (65

percent), followed by evaluating current systems and assessing internal control (both 49 percent), and designing/changing IS (30 percent). The results are not consistent with textbook or instructor focus (74 percent), which stated that REA is used primarily for designing/changing IS.[8]

E-R diagrams were used by only 14 percent of the participants, who mainly employed them for describing business processes (61 percent). Similar to REA models, the results are in contrast to textbooks and instructors (71 percent) where designing/changing systems was the primary purpose given for E-R diagrams.

Consistent with the fact that UML is given minimal attention in accounting textbooks, this method was used by only 6 percent of our participants. Table 2 reveals that only four accounting educators (7 percent) who responded to our survey taught UML. Anecdotal evidence suggests that the use of UML will increase as it matures as an SD method, just as it has in more technical fields such as systems analysis and design (Fowler 2003). Due to the small sample size, UML is excluded from further analyses.

Interestingly, 164 (41 percent) of respondents reported they did not use (read or prepare) any of the SD included in the survey.[9] This is consistent with the assumption that SD is not the only way to accomplish the purposes outlined previously in this study. Anticipating this, we included two questions on the survey (see questions 34 and 38 of Appendix A) to inquire about other SD used by practitioners not included in the study or whether practitioners use other types of systems documentation methods. Twenty-five respondents (6 percent) stated that they use document flows in order to manage segregation of duties issues. A similar question was also included in the survey sent to accounting educators, who also mentioned the use of document flowcharts. Document flowcharts are considered a simplified version of systems flowcharting and show the flow of electronic and paper documents in an organization. Nearly 70 practitioners stated that they use other types of documentation methods. The majority of these indicated use of narratives, checklists, walk-throughs, and questionnaires to obtain an understanding of systems. Several respondents stated that "preparing narratives alone takes less time, but augmenting narratives with flowcharts offers a much richer level of detail."

The previous results can be used to answer our research questions. For our sample of accounting practitioners—system flowcharts, process maps, and DFDs were the most widely used SD. Our findings are somewhat inconsistent with SD coverage in accounting education as follows: (1) process mapping, the second most widely-used SD in our practitioner sample, is not included in most accounting texts and was not widely taught by AIS and auditing educators (28 percent and 34 percent, respectively); and (2) E-R diagrams were only used by 14 percent of our practitioner sample, but are emphasized a great deal in accounting texts and by AIS professors (81 percent). Generally, practitioners mainly used SD to describe business processes. While the texts cite a main purpose of system flowcharts is for internal control analysis, our results did not show this. With respect to REA models,

[8] Initial results revealed that 32 percent of respondents use the REA model. However, we included a question on the survey (see Appendix A) after each SD method to make sure respondents were not confused as to what the SD method represented. Some of our respondents erroneously thought REA was something else (e.g., flowchart, process map, block diagram, flow analysis diagram). After eliminating these participants, REA modeling is used by only 20 percent of our sample, which is more consistent with its emphasis in accounting education.

[9] To ascertain that major differences did not exist between respondents that do not use SD ($n = 164$) and those that do ($n = 239$), we performed t-tests of the means across demographic variables in Table 3. Nontabulated results reveal that means are not equal for financial analysts, manufacturing firms, and larger firms. Respondents in these categories are more likely to use SD ($p < 0.05$). General accountants, those that work in retail and respondents with certifications are less likely to use SD ($p < 0.05$). It is not expected that these results will change the paper's conclusions or implications.

we expected that the majority would use this technique for designing/changing systems, but most participants indicated they use it for describing business processes.

Perceived Strengths of System Diagram Techniques

Practitioners may prefer a specific SD method for various reasons. To inquire into SD preferences, we asked participants to indicate strengths of each SD on the following dimensions determined during the pilot test phase of the study and in the content analysis of texts: (1) ease in preparation; (2) ease in understanding; (3) employee familiarity with the method; and (4) conceptual soundness of the technique.[10] Table 5 presents perceived strengths of each SD technique based on the total number of participants using that method.

Most participants reported use of a particular SD mainly because it is easy to understand (63–81 percent). Process maps and system flowcharts received the highest marks of any technique on this dimension, (81 percent and 75 percent, respectively). Process maps, a technique consisting mainly of boxes and arrows, has especially been known in the business world for being relatively straightforward and easy to understand (Hunt 1996). Our results also indicate that ease of preparation is the second most important reason for using a particular SD (36–51 percent). Participants were more familiar with system flowcharts than any other method (43 percent) and least familiar with REA models (14 percent). System flowcharts were viewed as more conceptually strong (38 percent), followed by DFDs (35 percent). Based on these results, although a high percentage of the participants indicate that many of the methods were easy to understand, less practitioners found the SD methods easy to prepare, conceptually strong, or highly familiar to employees. Generally, systems flowcharts and process maps received higher ratings across dimensions.

TABLE 5
Perceived Strengths of System Diagram Method[a]

(1) System Diagram Method	(2) Number of Participants Indicating Use of SD N	(3)[a] Easy to Prepare n (%)	(4)[a] Easy to Understand n (%)	(5)[a] Employee Familiarity n (%)	(6)[a] Conceptual Soundness n (%)
System Flowcharts	187 (46%)	81 (43%)	140 (75%)	80 (43%)	71 (38%)
Data Flow Diagrams	85 (21)	31 (37)	59 (70)	21 (25)	29 (35)
E-R Diagrams	56 (14)	29 (51)	38 (67)	12 (21)	9 (16)
REA Models	81 (20)	29 (36)	51 (63)	11 (14)	19 (23)
Process Maps	115 (28)	56 (49)	93 (81)	36 (31)	34 (30)
Total Number of Responses for Each Strength[b]	524	n = 229	n = 380	n = 160	n = 162

[a] Percentages in columns 3–6 are based on responses from total number of participants that use the technique. For example, 43 percent (n = 81) of system flowchart users indicate that they are easy to prepare, which preparation" is a strength of the technique.
[b] 931 total responses received related to documentation technique strengths.

[10] The survey also included an open-ended response for this question. An analysis of the responses revealed similarity in nature to the other four strengths, thus were classified into these strengths.

Perceived Weaknesses of Systems Diagramming Techniques

Perceived weaknesses were also determined based on a content review of open-ended responses in the pilot test phase of the survey instrument. Participants noted the following weaknesses with the SD methods: (1) difficulty in preparation; (2) employee unfamiliarity with method; (3) inadequacy in depicting complicated processes; and (4) limited in usefulness.[11] Table 6 presents the survey results related to SD weaknesses.

The main criticism across SD methods was the perception that they are inadequate for complicated processes (n = 254 responses). REA models (68 percent) and E-R diagrams (53 percent) were cited most frequently on this dimension, which is expected based on previous findings related to perceived conceptual soundness of these techniques. Open-ended responses, which were recoded into this weakness, included quotes such as: "[The SD is] too easy for documenter to over-simplify processes, thus eliminating the ability to identify control gaps," "need additional narratives to explain process," and "does not indicate *why* something is done." These responses point to the likelihood that although SD are widely used, other types of systems documentation oftentimes accompany them to aid in interpretation.

A higher frequency of practitioners viewed REA models as limited in usefulness (31 percent). Very few participants viewed the methods as difficult to prepare (7–19 percent), with system flowcharts being viewed as the most difficult (likely due to the increased number of symbols). Participants were most unfamiliar with REA (25 percent) and DFDs (21 percent), supporting previous findings. Overall, participants gave substantially fewer responses for weaknesses (n = 527) than strengths (n = 931), which supports the statement

TABLE 6
Perceived Weaknesses of System Diagram Method[a]

(1) System Diagram Method	(2) Number of Participants Indicating Use of SD N	(3)[a] Difficult to Prepare n (%)	(4)[a] Employees Unfamiliar n (%)	(5)[a] Inadequate for Complicated Processes n (%)	(6)[a] Limited Usefulness n (%)
System Flowcharts	187 (46%)	36 (19%)	22 (12%)	93 (50%)	38 (20%)
Data Flow Diagrams	85 (21)	13 (15)	18 (21)	25 (30)	13 (15)
E-R Diagrams	56 (14)	4 (7)	7 (12)	30 (53)	9 (16)
REA Models	81 (20)	13 (16)	20 (25)	55 (68)	25 (31)
Process Maps	115 (28)	17 (15)	13 (11)	51 (44)	25 (22)
Number of Responses for Each Weakness[b]	n = 524	n = 83	n = 80	n = 254	n = 110

[a] Percentages in columns 3–6 are based on responses from total number of participants that use the method. For example, 19 percent (n = 36) of system flowchart users indicate that "difficulty in preparation" is a weakness of the method.
[b] 527 total responses received related to documentation technique weaknesses.

[11] Very few participants cited that the techniques were difficult to understand or conceptually weak, thus these categories were excluded from data analysis in Table 6. Also, few responses were received for the "Other Weakness" category, and most of these were coded into one of the above weaknesses due to similarity. Other weaknesses cited include "time consuming to prepare" and "difficult to keep current as processes change."

made by many respondents in an open-ended question "employees prefer pictures and diagrams."

Ad-hoc Analyses: Systems Documentation, Industry Practices, and Nonparametric Tests

The practitioner survey also included questions related to industry practices for systems documentation in general. First, we were interested in whether accounting practitioners felt that, in their current position, it was important to be able to read or prepare SD. The results of these questions are presented in Table 7, Panel A. Of 255 responses received, the majority indicated that the ability to prepare SD was very important or somewhat important (60 percent) in their current position. More respondents considered it very important or somewhat important (77 percent) to be able to read SD. Nonparametric analyses reveal some associations between the individual and organizational variables in Table 3. First, there is an association between the ability to read SD and size of company ($p = .022$).[12] The larger the organization, the more important it is to be able to read SD. An association is also found between educational background and ability to read SD. Survey respondents with an accounting background believed it to be more important to read SD ($p = .043$). No other associations were found between reading SD and the variables in Table 3. The same test

TABLE 7
Importance of System Diagrams and General Systems Documentation Industry Practices

Panel A: Reading and Preparing Systems SD

	n	Very Important n (%)	Somewhat Important n (%)	Neither Important or Unimportant n (%)	Somewhat Unimportant n (%)	Very Unimportant n (%)
Preparing SD	255	62 (24%)	92 (36%)	60 (24%)	17 (7%)	24 (9%)
Reading SD	255	102 (40)	91 (37)	36 (14)	12 (5)	14 (5)

Panel B: Systems Documentation Approval

		Upper Level Management	Business Units	Controller	Committee	Other
Approval of System Documentation	176	89 (51)	23 (13)	22 (12)	17 (9)	15 (9)

Panel C: Systems Documentation Update Communication

		Informally (verbal/ email/ intranet)	Formal (meetings/ memos)	Not Communicated
Communication of Updates to Systems Documentation	162	82 (51)	57 (35)	23 (14)

[12] Both Pearson chi-square and Kendall's tau-b tests were used to analyze the data. Kendall's tau-b was appropriate when both rows and columns contain ordered data as is the case between ability to read SD and size of company (see Appendix A questions 4 and 36). Pearson chi-square was used to analyze the other variables.

was performed on the ability to prepare SD. No associations were found between the importance of being able to prepare SD and the individual and organizational demographic variables. Overall, our results indicate that reading SD is more important than actually preparing SD, and this is especially true for accounting practitioners in larger organizations who hold accounting degrees.

Results in Table 7 also provide insight into documentation approval (including SD approval) at the participant's organization, an issue that has become increasingly important with recent legislation. The findings in Panel B (n = 176 responses) indicate that in the majority of cases, upper-level management is responsible for documentation approval (51 percent). These results are consistent with the requirements of SOX Section 404, which requires management's assessment of the organization's internal control structure. Also, the participants indicated that business units (13 percent), the controller (12 percent), and a committee (9 percent) approve documentation. Most of the responses in the "other" category stated that systems documentation approval responsibility is associated with the internal audit function.

Table 7, Panel C indicates that updates to documentation are more commonly communicated in an informal manner, such as verbally or by using email or the corporate intranet (51 percent) in contrast to formal communication, such as meetings and memos (35 percent). Fourteen percent of those that responded to the question stated that updates to documentation are not communicated. SOX requirements related to managements' approval of the internal control environment dictate that more formal methods of communication regarding process and procedure changes should be used in practice. The fact that our sample represents smaller companies, and thus likely private, may be the primary reason for this result. Additionally, the timing of our survey (2004) may be another reason for this result, and practices due to "SOX awareness" may not have gained momentum.[13]

VI. CONCLUSIONS, LIMITATIONS, AND FUTURE RESEARCH

System diagramming is an important topic in light of today's regulatory environment and increasing systems complexity. This study provides insight into SD used in accounting practice and included in AIS and auditing curricula and texts. Overall, reading and preparing SD is important to accounting practitioners and, therefore, should be stressed in accounting education. The results of our survey indicate that traditional SD methods such as system

[13] During the time period of data collection for the practitioner survey (early 2004), publicly traded companies were in the midst of complying with their initial SOX filing deadlines. Although our study is not specific to publicly traded companies, we extended our analysis with another survey in October 2005 to determine if this legislation impacts our results related to purpose and use of SD techniques. This second survey, which focused only on frequency and purpose of use of SD, was administered to a smaller group of IMA members with identical job titles as the first population. Sample demographics are similar.

We received 102 responses to the 2005 survey (response rate of 5 percent) and the results are consistent with the 2004 survey with the exception of REA use. We found that system flowcharts and process maps are still the main SD used, followed by data flow diagrams, and E-R diagrams. Participants apparently had no confusion regarding REA as was suggested by the 2004 survey, and only 5 percent indicate use of this technique. We excluded UML from the 2005 survey based on the findings from the earlier survey. The purposes of use are consistent with 2004 findings, with the majority using SD to describe business processes.

The 2005 results indicate that reading SD is *very important* (42 percent) or *somewhat important* (27.5 percent), and the differences are not statistically significant from the 2004 survey. Results for preparing SD are fairly consistent at *very important* (22 percent) and *somewhat important* (36 percent). Upper level management is still the unit in charge of approving documentation (64 percent), although this new sample suggests the accounting department is more responsible for the approval process (22 percent). The approval process has become more formal since the first survey was administered (47 percent as compared to 35 percent previously) as we would expect. Overall, SOX has not significantly impacted the findings of this study regarding SD use.

flowcharts are still being used by accounting practitioners, but newer techniques such as process maps are also being adopted. The results also indicate that certain SD techniques used in practice are not well represented in curricula and texts. Also, the purposes behind practitioners' use of SD methods are in many cases inconsistent with purposes indicated by accounting educators and textbook authors. Choice of method may depend on perceived strengths and weaknesses of a particular technique.

Accounting educators should find these results useful as they present SD in the classroom. For instance, SD, while widely used and generally viewed as easy to understand, is also considered by practitioners to be inadequate for complicated processes. Therefore, educators may choose to have students read or prepare SD in conjunction with other types of documentation. Indeed, practitioners noted using narratives, checklists, document flowcharts, and control matrices as supplements to SD preparation. Currently, SD methods are given minimal to moderate emphasis in the classroom. In response to this study, educators may want to consider what types of SD they present and the level of coverage. In fact, over 50 percent of our educators stated they were considering increasing SD emphasis in future courses. In addition, accounting faculty involved in curriculum issues must realize that if their accounting program does not require AIS, students will be graduating with minimal exposure to SD methods even if they take auditing. However, many AIS books do not sufficiently cover emergent methods; therefore, supplemental material should be introduced to give students broader exposure. An example resource for obtaining SD material to augment texts is the *Compendium of Classroom Cases and Tools* published by the Information Systems section of the American Accounting Association.

The results also show gaps between practice and pedagogy and where accounting textbooks can be improved. The study can give guidance to textbook authors on the type of SD to include in future editions and how to present this material (e.g., emphasizing reading of SD perhaps more than preparing). It appears that practice has shifted from using SD for internal control purposes to using it more for describing business processes and evaluating current systems. Perhaps textbooks should emphasize the easiest-to-understand and most widely used methods for each "use" rather than including all methods and stating that they are used similarly for each objective.

Practitioners can benefit from our findings in that they provide a descriptive analysis of current SD employed across industries and job functions. In our study, SD are examined based on frequency, purpose of use, and perceived strengths and weaknesses. The results indicate that many accounting practitioners still rely heavily on traditional SD methods such as system flowcharting, but also use more business process-focused methods such as process maps. While practitioners are embracing more emergent SD methods, they may be unclear about the names of the methods (e.g., REA) and their purposes for using the methods may differ from those prescribed in textbooks (e.g., most accounting practitioners were using SD to describe business processes). Practitioners in our study agreed that both reading and preparing SD were important in their current occupations, with more emphasis placed on reading. These findings suggest that practitioners may benefit from training on SD including how, when, and why a method may be useful.

A possible study limitation is the composition of the population from which we drew our sample. Since public accountants are not heavily represented in the population, our study lacks generalizability to this group (e.g., only one-third of auditors in our sample are external auditors); however, the population we drew from does have its advantages. We specifically surveyed IMA members because of their diverse backgrounds, which enabled us to gather data representing a broad range of accounting practitioner responsibilities,

industries, educational backgrounds, and company sizes. Additionally, accounting practitioners in industry have primary and ultimate responsibility for documentation of their own systems—a practice emphasized more than ever with SOX.

Another caveat of the study is that we make no recommendations for education other than accounting education. For example, our study is not generalizable to computer science or MIS education because we did not specifically target IT-related job titles.

A further potential limitation of the study is the survey methodology. Greater confidence in the types of SD techniques practitioners are using and the purposes of use might better be obtained by direct examination of a sample of companies' actual systems documentation and documentation procedure manuals.

Future research to examine inconsistencies found between accounting education and practice may be insightful. If new SD methods are being developed and educators are slow or reluctant to adopt them in the classroom, students will not be as prepared for practice as they could be. When asked whether educators had any information systems or auditing work experience in the past five years, only 35 percent of AIS instructors and 42 percent of auditing instructors stated they had recent and relevant work experience. Faculty could benefit from more exposure to practice including sabbaticals or summer internships to keep abreast of changes. Awareness of new methods can also be obtained through attendance at practitioner-led conferences or continuing professional education (CPE). However, if practice is not keeping up with academic innovations, this can also be an issue. In academia, we must find ways to disseminate our ideas and inventions to nonacademicians. Presenting our ideas at practitioner conferences and CPE courses and publishing in practitioner journals can facilitate this. More effort needs to be made to educate accounting practitioners on academic innovations.

Future research endeavors could be aimed at determining how documentation of systems is used in public accounting and more specifically in assurance and compliance-related services. One interesting question could be "Is SD being used consistently in public accounting and industry? If not, what are the reasons?" Also, an academic study undertaking a pre- and post-SOX comparison of documentation practices may be helpful. Although our second practitioner sample reveals no changes in SD method use with the introduction of SOX, a larger sample taken as SOX compliance evolves over the next few years may reveal different results (e.g., the focus of diagramming techniques could shift towards assessing of internal control, and practitioners' emphasis on reading and preparing SD could increase). More research is needed to see how SOX impacts SD in practice and consequently, accounting education. Based on our sample, it appears that SD is now being used more predominantly for describing business processes. There are multiple methods for achieving this goal. An educational study that compares each type of method and their respective effectiveness in illustrating business process concepts may be useful for curriculum design.

Another area of research could focus on the *type* of task rather than the *tool being used* in a task. It is important for students to be exposed to the types of tasks they will be performing as they begin and progress through their careers. The tasks being performed by accountants in practice could be identified and compared to what is being taught to identify potential differences. While our survey addressed the types of tasks being performed in relation to the SD techniques, it would be useful for accounting educators to consider other system-related tasks that are not included in this study.

APPENDIX A
FLOWCHARTING AND SYSTEMS DOCUMENTATION PRACTITIONER SURVEY

I. Survey Administration

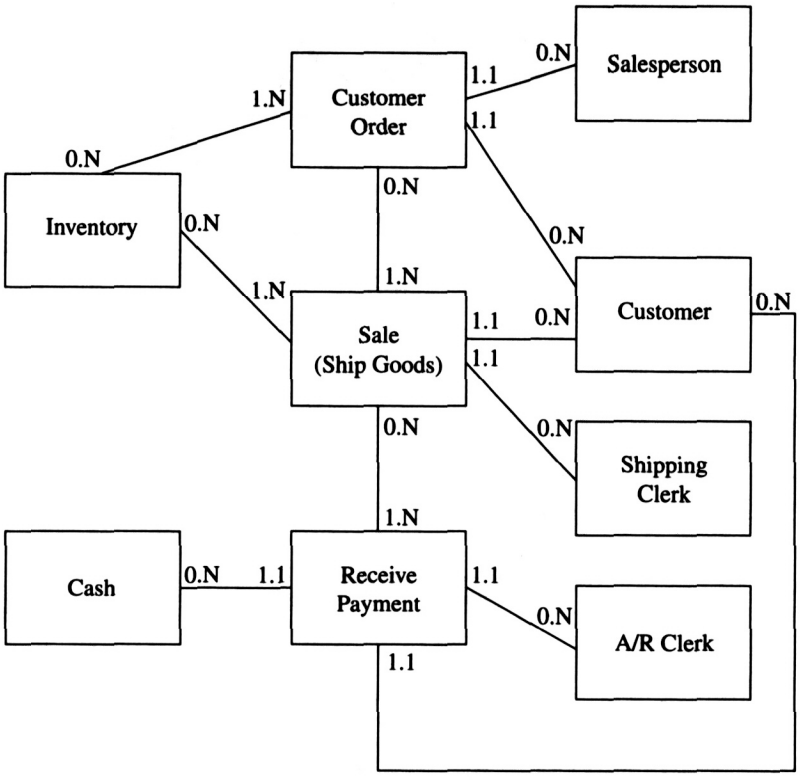
1. Which of the following best describes your position?
   a. Staff Accountant
   b. Senior Accountant
   c. Financial Analyst
   d. Internal Auditor
   e. Auditor/Public Accountant
   f. Systems Analyst
   g. Systems Programmer
   h. Manager
   i. Controller
   j. Chief Financial Officer (CFO)
   k. Executive Officer (Other than CFO)
   l. Other (please specify)
2. What is your area of responsibility?
   a. Finance
   b. Risk Management
   c. Budgeting and Planning
   d. Taxation
   e. Information Systems
   f. Internal Auditing
   g. External Auditing
   h. Corporate Accounting
   i. Government Accounting
   j. Cost Accounting
   k. General Accounting
   l. General Management
   m. Other (please specify)
3. What industry do you work in?
   a. Agriculture, forestry, fisheries
   b. Mining
   c. Contract construction
   d. Manufacturing
   e. Transportation, communications and utility services
   f. Wholesale and retail trade
   g. Finance, insurance and real estate
   h. Medical and health care services
   i. Educational services
   j. Public accounting
   k. Other service
   l. Government
   m. Nonprofit
   n. Other (please specify)
4. Approximately what were your organization's sales last year?
   a. $0–25 million

b. $25–49 million
c. $50–99 million
d. $100–249 million
e. $250–500 million
f. $500+
g. Don't Know

5. Approximately how many employees are in your organization?
   a. 1–50
   b. 51–100
   c. 101–499
   d. 500–999
   e. 1,000–2,499
   f. 2,500–4,999
   g. 5000+
6. What certifications do you currently have? (Check all that apply)
   a. I do not hold any professional certifications
   b. CPA (Certified Public Accountant)
   c. CMA (Certified Managerial Accountant)
   d. CFM (Certified in Financial Management)
   e. CISA (Certified Information Systems Auditor)
   f. CIA (Certified Internal Auditor)
   g. MCSE (Microsoft Certified Systems Engineer)
   h. CISSP (Certified Information Systems Security Professional)
   i. Other (please specify)
7. What is your educational background? (Check all that apply)
   a. Bachelors in Accounting
   b. Masters in Accounting
   c. Bachelors in Information Systems (CIS/MIS)
   d. Masters in Information Systems (CIS/MIS)
   e. Masters in Business Administration
   f. Other (please specify)
8. How long have you been in your present occupation?
   a. less than 3 years
   b. 3–6 years
   c. 7–9 years
   d. 9+ years

II. Resources, Events, and Agents Model

This is an example of an REA model (Resources, Events, Agents). If you review or prepare this type of documentation (or something that closely resembles this, whether it is called REA or not) in your position, please answer the following questions. If not, click NEXT at bottom of page.

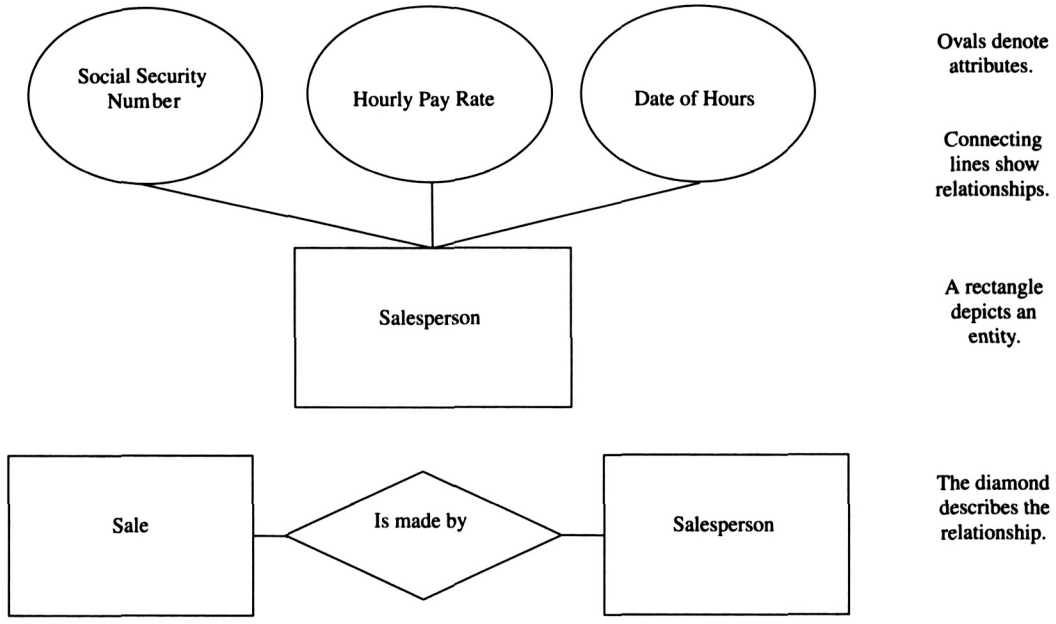


Source: Moscove et al. (2003)

9. What do you use this type of model for? (Check all that apply)
   a. Evaluating current systems
   b. Describing business processes
   c. Designing or changing information systems
   d. Assessing internal control environment
   e. Other (please describe below)
10. What do you think are the strengths of using this method? (Check all that apply)
   a. Easy to prepare
   b. Easy to understand
   c. Employees are familiar with this method
   d. Method is conceptually strong
   e. Other (please specify)
11. What do you think are the weaknesses of this method? (Check all that apply)
   a. Difficult to prepare
   b. Difficult to understand
   c. Employees are not familiar with method
   d. Method is conceptually weak
   e. Not adequate for complicated processes
   f. Limited in usefulness
   g. Other (please specify)
12. Do you know this method by another name? If so, what do you call this method?

III. Entity Relationship Model

This is an example of an ER (entity-relationship) model. If you review or prepare this type of documentation (or something that closely resembles this whether it is called ER or not) in your position, please answer the following questions. If not, please click NEXT at bottom of page.

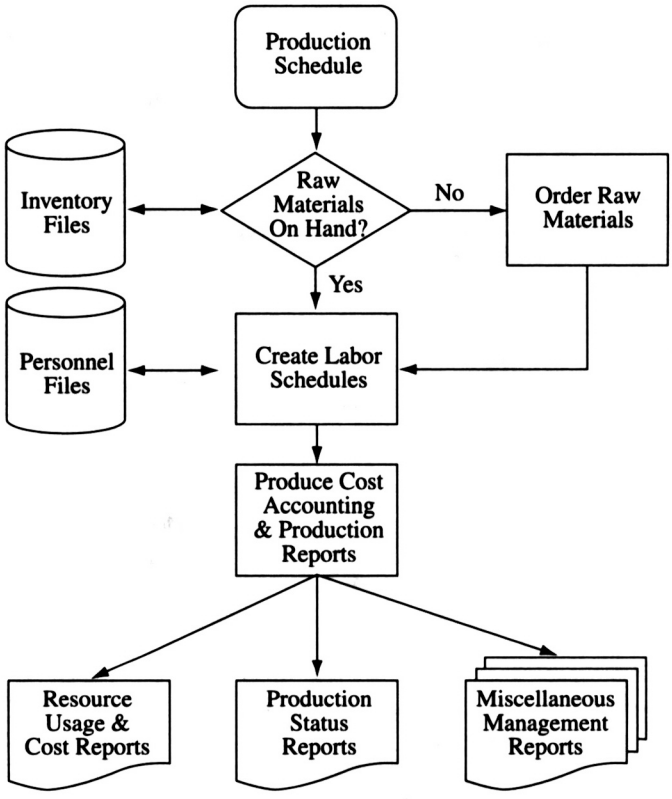


Source: Moscove et al. (2003)

13. What do you use ER modeling for? (Check all that apply)
    a. Evaluating current systems
    b. Describing business processes
    c. Designing or changing information systems
    d. Assessing internal control environment
    e. Other (please describe below)
14. What do you think are the strengths of using this method? (Check all that apply)
    a. Easy to prepare
    b. Easy to understand
    c. Employees are familiar with this method
    d. Method is conceptually strong
    e. Other (please specify)
15. What do you think are the weaknesses of this method? (Check all that apply)
    a. Difficult to prepare
    b. Difficult to understand
    c. Employees are not familiar with method
    d. Method is conceptually weak
    e. Not adequate for complicated processes
    f. Limited in usefulness
    g. Other (please specify)
16. Do you know this method by another name? If so, what do you call this method?

IV. System Flowcharting

This is an example of a systems flowchart. If you review or prepare this type of documentation (or something that closely resembles this whether it is called a system flowchart or not) in your position, please answer the following questions. If not, please click NEXT at bottom of page.



Source: Moscove et al. (2003)

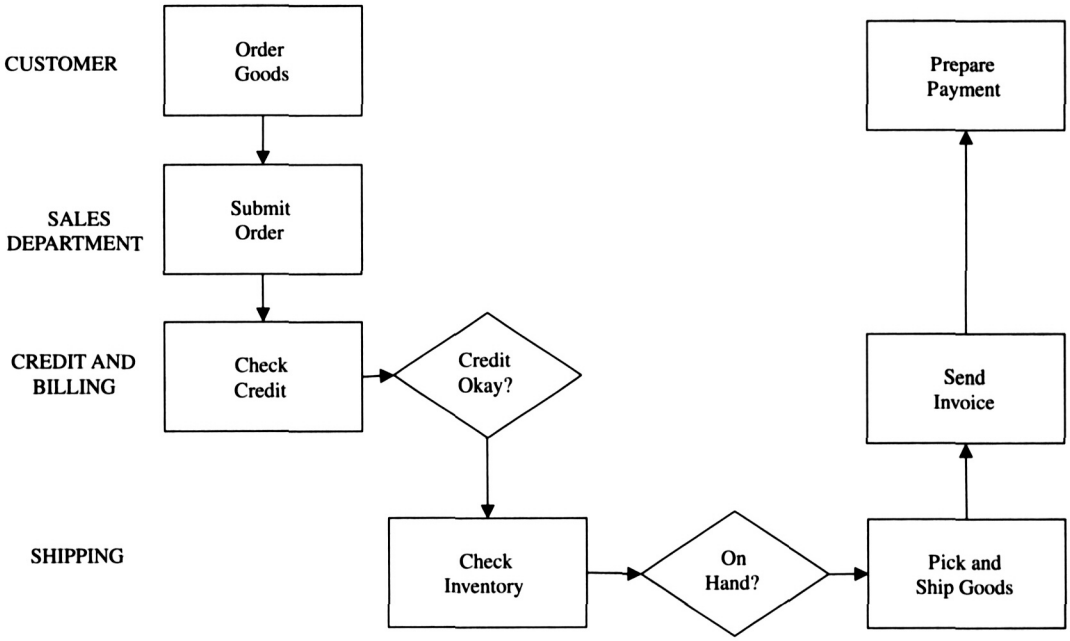
17. What do you use system flowcharting for? (Check all that apply)
    a. Evaluating current systems
    b. Describing business processes
    c. Designing or changing information systems
    d. Assessing internal control environment
    e. Other (please describe below)
18. What do you think are the strengths of using this method? (Check all that apply)
    a. Easy to prepare
    b. Easy to understand
    c. Employees are familiar with this method
    d. Method is conceptually strong
    e. Other (please specify)
19. What do you think are the weaknesses of this method? (Check all that apply)
    a. Difficult to prepare
    b. Difficult to understand

c. Employees are not familiar with method
d. Method is conceptually weak
e. Not adequate for complicated processes
f. Limited in usefulness
g. Other (please specify)

20. Do you know this method by another name? If so, what do you call this method?

V. Process Mapping

This is an example of a process map. If you review or prepare this type of documentation technique (or something that closely resembles this whether it is called a process map or not) in your position, please answer the following questions. If not, click NEXT at bottom of page.



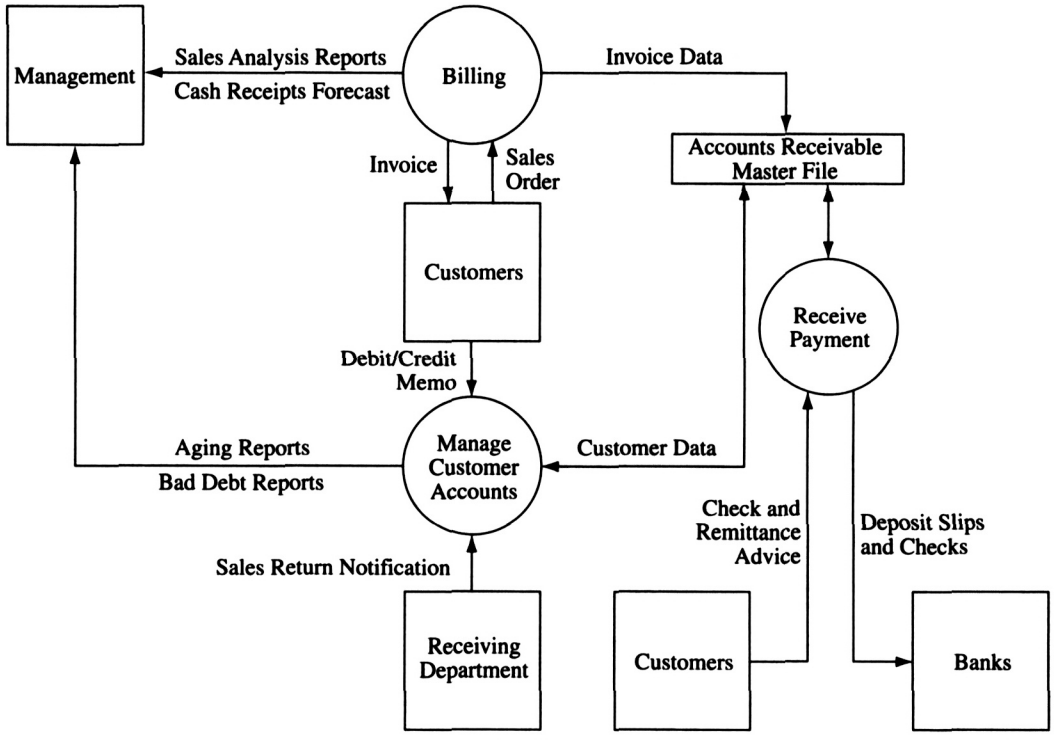
Source: Moscove et al. (2003)

21. What do you use process mapping for? (Check all that apply)
    a. Evaluating current systems
    b. Describing business processes
    c. Designing or changing information systems
    d. Assessing internal control environment
    e. Other (please describe below)
22. What do you think are the strengths of using this method? (Check all that apply)
    a. Easy to prepare
    b. Easy to understand
    c. Employees are familiar with this method
    d. Method is conceptually strong
    e. Other (please specify)

23. What do you think are the weaknesses of this method? (Check all that apply)
    a. Difficult to prepare
    b. Difficult to understand
    c. Employees are not familiar with method
    d. Method is conceptually weak
    e. Not adequate for complicated processes
    f. Limited in usefulness
    g. Other (please specify)
24. Do you know this method by another name? If so, what do you call this method?

VI. Data Flow Diagrams

This is an example of a data flow diagram (DFD). IF you review or prepare this type of documentation (or something that closely resembles this whether it is called a DFD or not) in your position, please answer the following questions. If not, click NEXT at bottom of page.



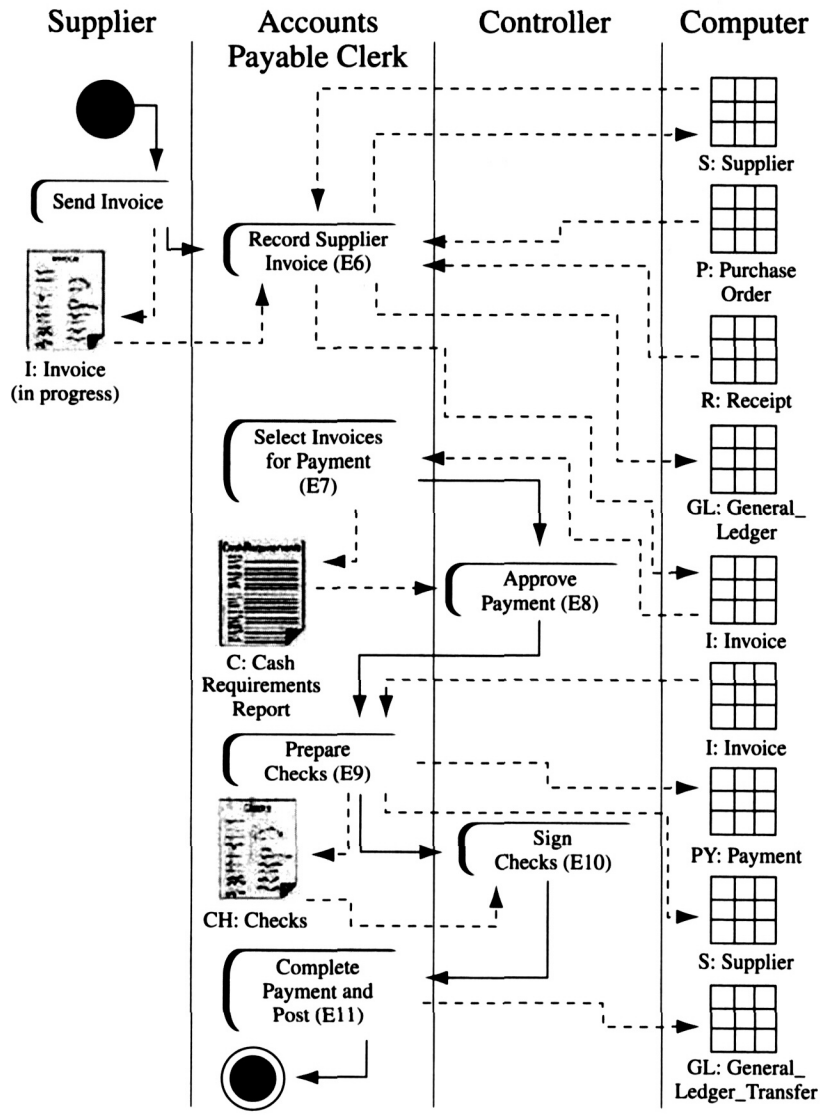
Source: Moscove et al. (2003)

25. What do you use data flow diagrams for? (Check all that apply)
    a. Evaluating current systems
    b. Describing business processes
    c. Designing or changing information systems
    d. Assessing internal control environment
    e. Other (please describe below)

26. What do you think are the strengths of using this method? (Check all that apply)
    a. Easy to prepare
    b. Easy to understand
    c. Employees are familiar with this method
    d. Method is conceptually strong
    e. Other (please specify)
27. What do you think are the weaknesses of this method? (Check all that apply)
    a. Difficult to prepare
    b. Difficult to understand
    c. Employees are not familiar with method
    d. Method is conceptually weak
    e. Not adequate for complicated processes
    f. Limited in usefulness
    g. Other (please specify)
28. Do you know this method by another name? If so, what do you call this method?

VII. Unified Modeling Language

This is an example of a Unified Modeling Language diagram (UML). If you review or prepare this type of documentation (or something that closely resembles this whether it is called UML or not) in your position, please answer the following questions. If not, click NEXT at bottom of page.



Source: Jones and Rama (2006)

29. What do you use UML for? (Check all that apply)
    a. Evaluating current systems
    b. Describing business processes
    c. Designing or changing information systems
    d. Assessing internal control environment
    e. Other (please describe below)

30. What do you think are the strengths of using this method? (Check all that apply)
    a. Easy to prepare
    b. Easy to understand
    c. Employees are familiar with this method
    d. Method is conceptually strong
    e. Other (please specify)
31. What do you think are the weaknesses of this method? (Check all that apply)
    a. Difficult to prepare
    b. Difficult to understand
    c. Employees are not familiar with method
    d. Method is conceptually weak
    e. Not adequate for complicated processes
    f. Limited in usefulness
    g. Other (please specify)
32. Do you know this method by another name? If so, what do you call this method?

VIII. General Questions

Please answer these additional questions.

33. We are interested in what software packages you currently use to assist in documentation. Which of the below (if any) do you use? Check all that apply.
    a. Microsoft VISIO©
    b. Microsoft Office Suite© (Word©, PowerPoint©)
    c. MicroGrafx FlowCharter©
    d. SmartDraw©
    e. Visible Analyst©
    f. Other (please specify)
34. Are there any other types of modeling techniques you use or believe are important (that are left out in this survey)? If so, what are they and what did you use them for?
35. How does your organization develop or customize its information systems?
    a. Using primarily internal resources (e.g., information technology personnel)
    b. Using primarily external resources (e.g., consultants, outsourcing)
    c. Using both internal and external resources.
    d. Most systems are purchased from vendors and are not modified
    e. Don't know
    f. Other (please specify)
36. How important is it for you (in your present position) to be able to read or understand diagrams/models such as the ones presented in this survey?
    a. Very important
    b. Somewhat important
    c. Neither important nor unimportant
    d. Somewhat unimportant
    e. Very unimportant
37. How important is it for you (in your present position) to be able to prepare diagrams/models such as the ones presented in this survey?
    a. Very important
    b. Somewhat important
    c. Neither important nor unimportant

d. Somewhat unimportant
e. Very unimportant

38. If you do not use any type of diagramming or graphical documentation tools in your occupation, and you have to obtain an understanding of information systems, what other techniques do you use (e.g., for auditing purposes, you might use checklists or narratives to obtain an understanding)?
39. Who approves the documentation at your organization?
40. How are updates to documentation communicated at your organization?

APPENDIX B
FLOWCHARTING AND SYSTEMS DOCUMENTATION EDUCATOR SURVEY

I. Survey Administration

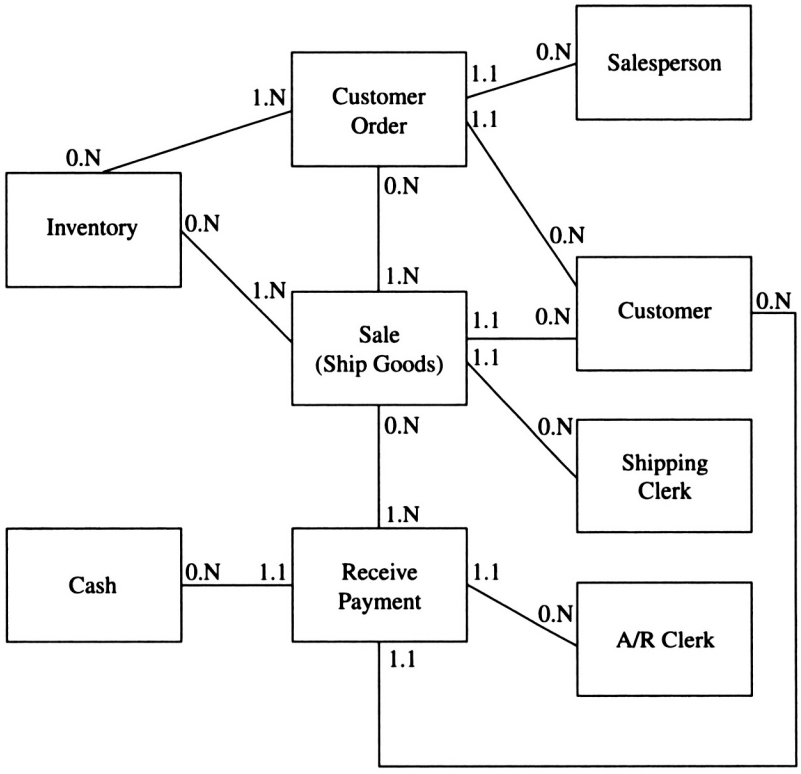
1. In the past three years, have you taught any of the following classes? (Check all that apply)
   a. Undergraduate AIS or similar
   b. Graduate AIS or similar
   c. Undergraduate Auditing
   d. Graduate Auditing
   e. None of the above
2. How many years of experience do you have teaching AIS?
   a. None
   b. Less than 3 years
   c. 3–6 years
   d. 6–10 years
   e. Greater than 10 years
3. How many years of experience do you have teaching Auditing?
   a. None
   b. Less than 3 years
   c. 3–6 years
   d. 6–10 years
   e. Greater than 10 years
4. What is your MAIN area of research?
   a. Information Systems
   b. Audit
   c. Financial accounting
   d. Managerial accounting
   e. Tax
   f. Other (please specify)
5. Which of the following BEST describes the educational institution where you teach?
   a. Two-year College/Junior College
   b. Four-year WITH Masters or Ph.D. in Accounting
   c. Four-year WITHOUT Masters or Ph.D. in Accounting
   d. Other (please specify)
6. Which of the following BEST describes your position title?
   a. Lecturer/Adjunct
   b. Assistant Professor

c. Associate Professor
d. Full Professor

7. Do you hold any of the professional certifications listed below? (Check all that apply)
   a. None
   b. CPA
   c. CISA
   d. CMA
   e. CIA
   f. Other (please specify)
8. Have you had any information systems/technology-related or auditing work experience (outside academia) in the past 5 years?
   a. Yes
   b. No
9. Do you teach systems diagramming techniques in any of your courses? (For clarification, do you use flowcharts, models, or diagrams to illustrate information systems)?
   a. Yes
   b. No

II. Resource Event and Agent Model

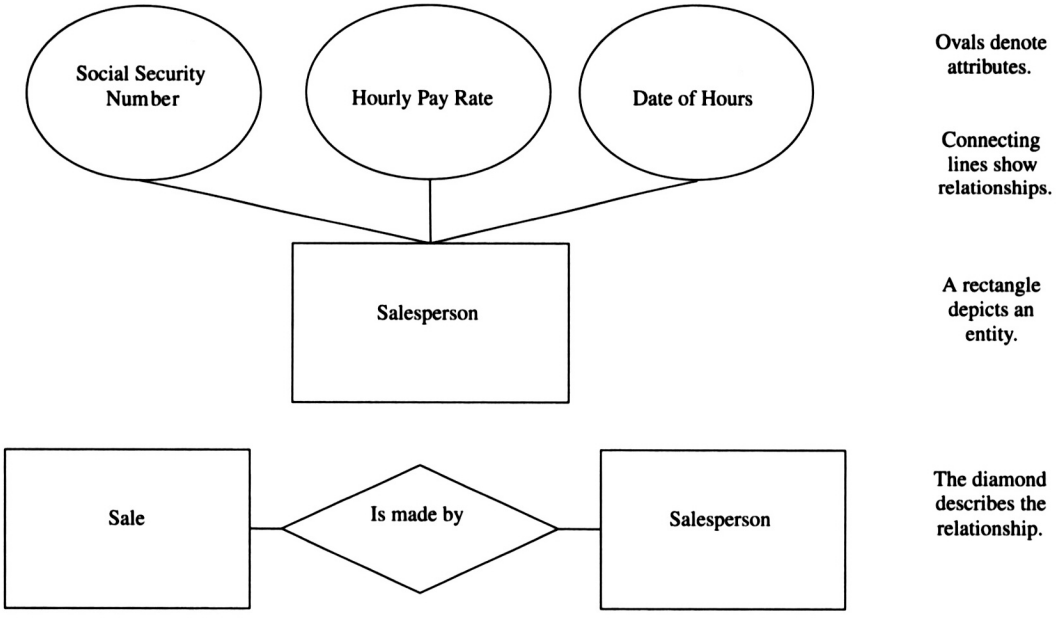
Below is an example of a REA (Resource Event Agent) model. If you teach REA in your courses, please answer the following questions. If you DO NOT teach REA, click NEXT at bottom of page.



10. What course(s) do you include REA models in? (Check all that apply)
    a. Undergraduate AIS or similar
    b. Graduate AIS or similar
    c. Undergraduate Auditing
    d. Graduate Auditing
    e. Other (please specify)
11. Do you use REA models to illustrate the following? (Check all that apply)
    a. Evaluating current systems
    b. Describing business processes
    c. Designing or changing information systems including data modeling
    d. Assessing internal control environment
    e. Other (please describe below)
12. Please state specifically why you teach REA in your classes other than the purposes stated in question #11 above (e.g., it's a major part of your text; conceptually it is sound; easy to understand).

III. Entity-Relationship Diagram

This is an example of an E-R (Entity-Relationship) diagram. If you teach E-R diagrams in your courses, please answer the following questions. If you DO NOT teach E-R diagrams in any course, click NEXT at bottom of page.

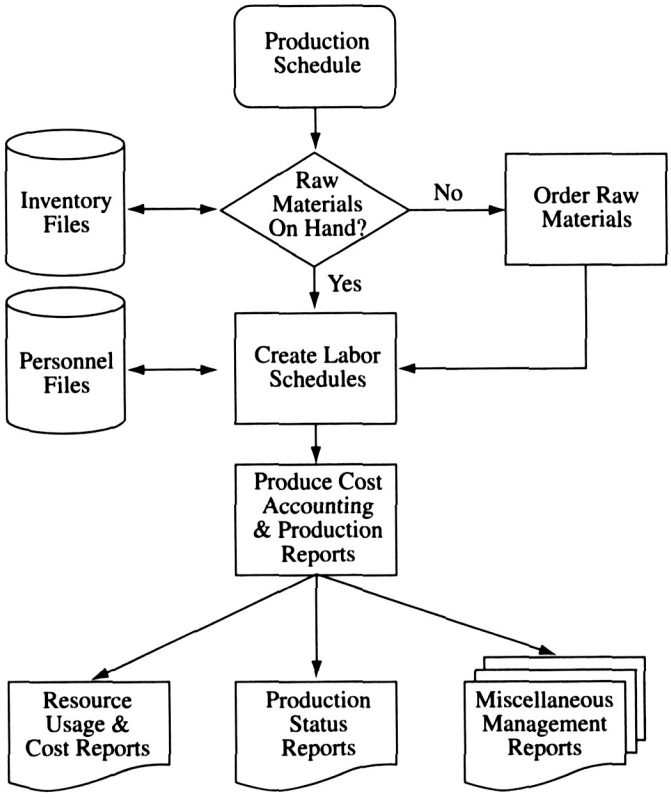


13. What course(s) do you include E-R diagrams in? (Check all that apply)
    a. Undergraduate AIS or similar
    b. Graduate AIS or similar
    c. Undergraduate Auditing
    d. Graduate Auditing
    e. Other (please specify)

14. Do you use E-R diagrams to illustrate the following? (Check all that apply)
    a. Evaluating current systems
    b. Describing business processes
    c. Designing or changing information systems including data modeling
    d. Assessing internal control environment
    e. Other (please describe below)
15. Please state specifically why you teach E-R diagrams in your classes other than the purposes stated in question #14 above (e.g., it is a major part of your text; conceptually it is sound; easy to understand).

IV. Systems Flowcharting

This is an example of a systems flowchart. If you teach systems flowcharting in your courses, please answer the following questions. If you DO NOT teach systems flowcharting in any courses, click NEXT at bottom of page.



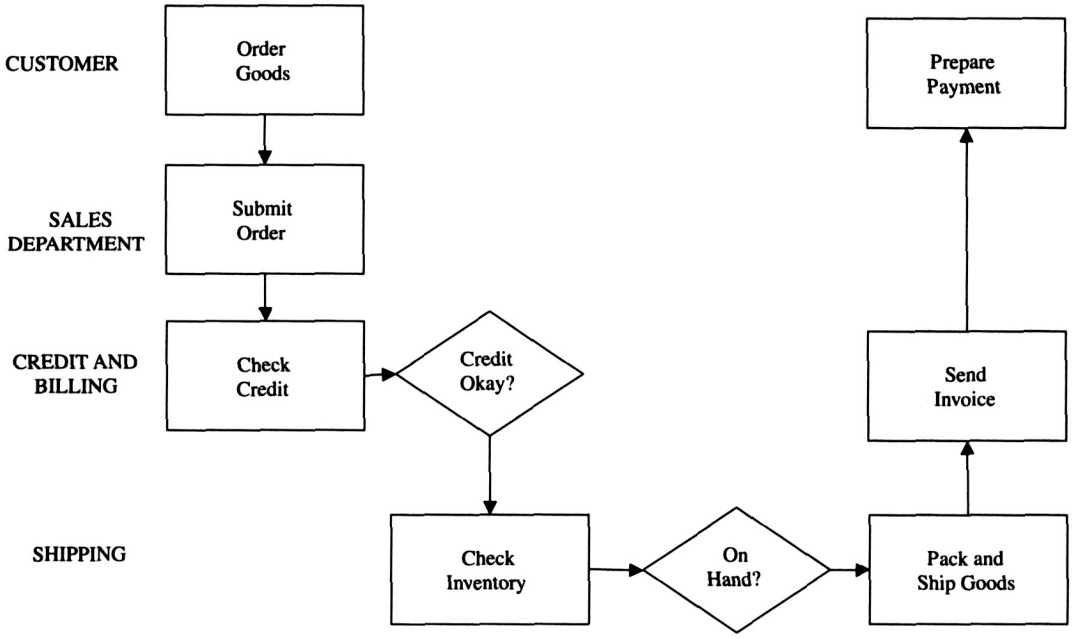
16. What course(s) do you include system flowcharting in? (Check all that apply)
    a. Undergraduate AIS or similar
    b. Graduate AIS or similar
    c. Undergraduate Auditing
    d. Graduate Auditing
    e. Other (please specify)
17. Do you use systems flowcharts to illustrate the following? (Check all that apply)
    a. Evaluating current systems
    b. Describing business processes

c. Designing or changing information systems including data modeling
d. Assessing internal control environment
e. Other (please describe below)

18. Please state specifically why you teach systems flowcharts in your classes other than the purposes stated in question #17 above (e.g., it's a major part of your text; conceptually it is sound; easy to understand).

V. Process Maps

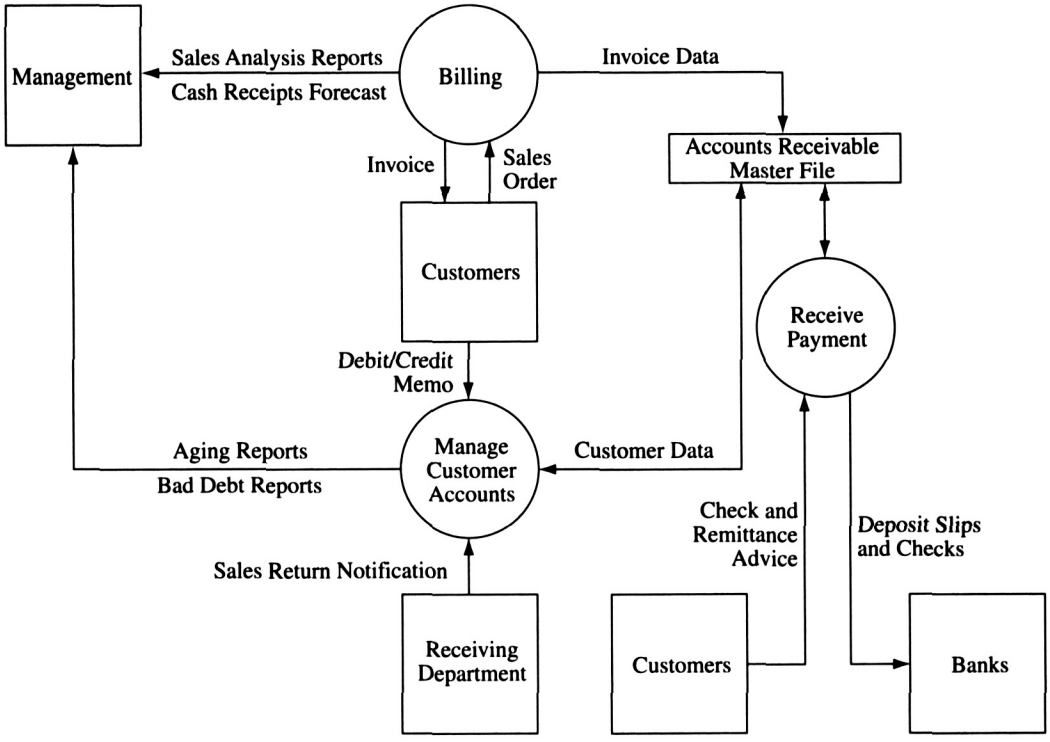
Below is an example of a process map. If you teach process maps in your courses, please answer the following questions. If you DO NOT teach process maps in any course, click NEXT at bottom of the page.



19. What course(s) do you include process mapping in? (Check all that apply)
    a. Undergraduate AIS or similar
    b. Graduate AIS or similar
    c. Undergraduate Auditing
    d. Graduate Auditing
    e. Other (please specify)
20. Do you use process maps to illustrate the following? (Check all that apply)
    a. Evaluating current systems
    b. Describing business processes
    c. Designing or changing information systems including data modeling
    d. Assessing internal control environment
    e. Other (please describe below)
21. Please state specifically why you teach process mapping in your classes other than the purposes stated in question #20 above (e.g., it's a major part of your text; conceptually it is sound; easy to understand).

VI. Data Flow Diagrams

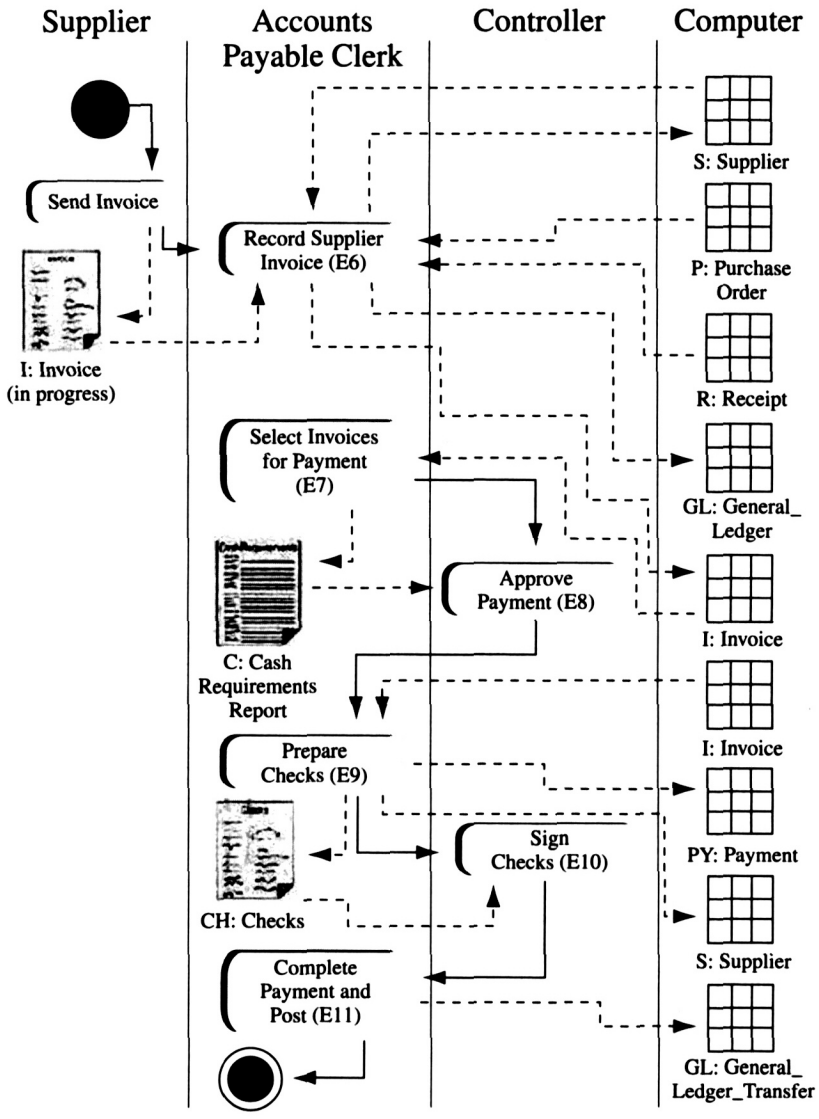
This is an example of a data flow diagram (DFD). If you teach DFDs in your courses, please answer the following questions. If you DO NOT teach DFDs in any course, click NEXT at bottom of page.



22. What course(s) do you include DFDs in? (Check all that apply)
    a. Undergraduate AIS or similar
    b. Graduate AIS or similar
    c. Undergraduate Auditing
    d. Graduate Auditing
    e. Other (please specify)
23. Do you use DFDs to illustrate the following? (Check all that apply)
    a. Evaluating current systems
    b. Describing business processes
    c. Designing or changing information systems including data modeling
    d. Assessing internal control environment
    e. Other (please describe below)
24. Please state specifically why you teach DFDs in your classes other than the purposes stated in question #23 above (e.g., it's a major part of your text; conceptually it is sound; easy to understand).

VII. Unified Modeling Language

This is an example of a Unified Modeling Language (UML) diagram. If you teach UML in your courses please answer the following questions. If you DO NOT teach UML in any course, click NEXT at bottom of page.



25. What course(s) do you include UML in? (Check all that apply)
    a. Undergraduate AIS or similar
    b. Graduate AIS or similar
    c. Undergraduate Auditing
    d. Graduate Auditing
    e. Other (please specify)
26. Do you use UML to illustrate the following? (Check all that apply)
    a. Evaluating current systems
    b. Describing business processes
    c. Designing or changing information systems including data modeling
    d. Assessing internal control environment
    e. Other (please describe below)

27. Please state specifically why you tech UML in your classes other than the purposes stated in question #26 above (e.g., it's a major part of your text; conceptually it is sound; easy to understand).

VIII. General Questions

Please answer these additional questions

28. Of the following diagramming techniques, how much emphasis do you place in undergraduate or graduate AIS courses? Compare this to what you think or know other professors teach or what is included in your text. Skip this question if you do NOT teach AIS.

	No Emphasis	Minimal Emphasis	Average Emphasis	Above Average Emphasis	Strong Emphasis
REA Model					
E-R Diagram					
Systems Flowchart					
Process Map					
Data flow Diagram					
Unified Modeling Language					

29. Of the following diagramming techniques, how much emphasis do you place in undergraduate or graduate AUDITING courses? Compare this to what you think or know other professors teach or what is included in your text. Skip this question if you do NOT teach auditing.

	No Emphasis	Minimal Emphasis	Average Emphasis	Above Average Emphasis	Strong Emphasis
REA Model					
E-R Diagram					
Systems Flowchart					
Process Map					
Data flow Diagram					
Unified Modeling Language					

30. If you teach AIS, which text have you been using the most over the last several years? (please state authors)

IX. System Diagramming and Modeling Tools of Choice

31. Which of the following would be your TOOL OF CHOICE to illustrate to students the concept of evaluating current information systems?
    a. Resource Event Agent (REA) Models
    b. Entity-Relationship (E-R) Diagrams
    c. Process Maps
    d. Data Flow Diagrams (DFDs)
    e. Unified Modeling Language (UML)
    f. NONE of the tools listed above
    g. Other (please specify)
32. Which of the following would be your TOOL OF CHOICE for illustrating to students how to describe business processes?
    a. Resource Event Agent (REA) Models
    b. Entity-Relationship (E-R) Diagrams
    c. Process Maps
    d. Data Flow Diagrams (DFDs)
    e. Unified Modeling Language (UML)
    f. NONE of the tools listed above
    g. Other (please specify)
33. Which of the following would be your TOOL OF CHOICE for illustrating to students how to design or change information systems including data modeling?
    a. Resource Event Agent (REA) Models
    b. Entity-Relationship (E-R) Diagrams
    c. Process Maps
    d. Data Flow Diagrams (DFDs)
    e. Unified Modeling Language (UML)
    f. NONE of the tools listed above
    g. Other (please specify)
34. Which of the following would be your TOOL OF CHOICE for illustrating to students the concept of assessing an internal control environment?
    a. Resource Event Agent (REA) Models
    b. Entity-Relationship (E-R) Diagrams
    c. Process Maps
    d. Data Flow Diagrams (DFDs)
    e. Unified Modeling Language (UML)
    f. NONE of the tools listed above
    g. Other (please specify)
35. Are there any other types of techniques you use in class to analyze systems, describe business processes, design or change systems (including data modeling), or evaluate internal controls other than pictorial representations/diagramming? If yes, please describe below.
36. Do you expect to change your emphasis on system diagramming to address SOX and internal control issues in the future from what you are currently doing in the classroom?

REFERENCES

Adams, L. 2000. Mapping yields manufacturing insights. *Quality Magazine* 39 (5): 62–66.

American Institute of Certified Public Accountants (AICPA). 1988. *Consideration of the Internal Control Structure in a Financial Statement Audit.* Statement on Auditing Standards No. 55. New York, NY: AICPA.

———. 1995. *Consideration of Internal Control in a Financial Statement Audit: An Amendment to Statement on Auditing Standards No. 55.* Statement on Auditing Standards No. 78. New York, NY: AICPA.

———. 2001. *The Effect of Information Technology on the Auditor's Consideration of the Internal Control Structure.* Statement on Auditing Standards No. 94. New York, NY: AICPA.

———. 2002a. *Audit Documentation.* Statement on Auditing Standards No. 96. New York, NY: AICPA.

———. 2002b. *Consideration of Fraud in a Financial Statement Audit.* Statement on Auditing Standards No. 99. New York, NY: AICPA.

———. 2005. *Uniform CPA Examination Content Specifications.* New York, NY: AICPA.

Amescua, A., J. Garcia, M. Velasco, and P. Martinez. 2004. A software project management framework. *Information Systems Management* 21 (2): 78–86.

Arens, A., R. Elder, and M. Beasley. 2003. *Auditing and Assurance Services: An Integrated Approach.* Upper Saddle River, NJ: Prentice Hall Inc.

Bagranoff, N., and M. Simkin. 2000. Picture that. *Journal of Accountancy* 189 (2): 43–47.

———, S. Bryant, and J. Hunton. 2002. *Core Concepts of Consulting for Accountants.* New York, NY: John Wiley and Sons, Inc.

Bandar, W., G. Gable, and M. Rosemann. 2005. Factors and measures of business process modeling: Model building through a multiple case study. *European Journal of Information Systems* 14 (4): 347.

Bodnar, G., and W. Hopwood. 2004. *Accounting Information Systems.* Upper Saddle River, NJ: Prentice Hall Inc.

Bradford, M., D. Roberts, and G. Stroupe. 2001. Integrating process maps into the accounting students' toolset. *Review of Business Information Systems* 5 (4): 61–67.

Chen, P. 1976. The entity-relationship model—Toward a unified view of data. *ACM Transactions on Database Systems* 1 (1): 9–36.

Damelio, R. 1996. *The Basics of Process Mapping.* Boston, MA: Quality Resources.

DeMarco, T. 1978. *Structured Systems Analysis and Design.* New York, NY: Yourdon Press.

Dunn, C., and W. E. McCarthy. 1997. The REA model: Intellectual heritage and prospects for progress. *Journal of Information Systems* 11 (Spring): 31–51.

———, O. Cherrington, and A. Hollander. 2005. *Enterprise Information Systems: A Pattern-Based Approach.* Boston, MA: McGraw-Hill Irwin.

Fowler, M. 2003. *UML Distilled.* Boston, MA: Addison-Wesley.

Gelinas, U., S. Sutton, and J. Fedorowicz. 2004. *Business Processes and Information Technology.* Cincinnati, OH: Thomson South-Western College Publishing.

———, ———, and J. Hunton. 2005. *Accounting Information Systems.* Cincinnati, OH: Thomson South-Western College Publishing.

Gleim, I., and D. Flesher. 2005. *CMA Review.* Gainesville, FL: Gleim Publications, Inc.

George, J., D. Batra, J. Valacich, and J. Hoffer. 2004. *Object-Oriented Systems Analysis and Design.* Upper Saddle River, NJ: Prentice Hall.

Greenfield, M. 2002. Process Mapping's Next Step. *Quality Progress* 35 (9): 50–51.

Hall, J. 2001. *Accounting Information Systems.* Cincinnati, OH: Thomson South-Western College Publishing.

———, and T. Singleton. 2005. *Information Technology Auditing and Assurance.* Cincinnati, OH: Thomson South-Western.

Harrington, C. 2005. The value proposition. *Journal of Accountancy* 200 (3): 77–82.

Hungerford, B., A. Hevner, and R. Collins. 2004. Reviewing software diagrams: A cognitive study. *IEEE Transactions on Software Engineering* 30 (2).

Hunt, D. V. 1996. *Process Mapping: How to Reengineer Your Business Processes.* Ontario, Canada: John Wiley and Sons.

Hunton, J., S. Bryant, and N. Bagranoff. 2004. *Core Concepts of Information Technology Auditing.* New York, NY: John Wiley and Sons, Inc.

Institute of Management Accountants. 2006. Content specification outline for CMA exam. Available at: www.imanet.org.

Jones, F., and D. Rama. 2006. *Accounting Information Systems: A Business Process Approach.* Cincinnati, OH: Thomson South-Western College Publishing.

Jones, R., J. Tsay, and K. Griggs. 2002. An empirical investigation of the cognitive fit of selected process model diagramming techniques. *The Review of Business Information Systems* 6 (4): 101–108.

Kettinger, W., J. Teng, S. Guha. 1997. Business process change: A study of methodologies, techniques, and tools. *MIS Quarterly* 21 (1): 55–81.

Kievit, K., and M. Martin. 1989. Systems analysis tools—Who's using them? *Journal of Systems Management* 40 (7): 26–30.

Lehman, M. 2000. Flowcharting made simple. *Journal of Accountancy* 190 (4): 77–85.

McCarthy, W. 1982. The REA accounting model: A generalized framework for accounting systems in a shared data environment. *The Accounting Review* 57 (July): 554–578.

Messier, W. 2003. *Auditing and Assurance Services: A Systematic Approach.* New York, NY: McGraw-Hill Irwin.

Moscove, S., M. Simkin, and N. Bagranoff. 2003. *Core Concepts of Accounting Information Systems.* New York, NY: John Wiley and Sons, Inc.

O'Leary, D. 2000. *Enterprise Resource Planning: Systems, Life Cycle, Electronic Commerce, and Risk.* New York, NY: Cambridge University Press.

Robertson, J., and T. Louwers. 2002. *Auditing and Assurance Services.* New York, NY: McGraw-Hill Irwin.

Romney, M., and P. Steinbart. 2005. *Accounting Information Systems.* Upper Saddle River, NJ: Pearson Education, Inc.

Satzinger, J., R. Jackson, and S. Burd. 2000. *Systems Analysis and Design in a Changing World.* Cambridge, MA: Thomson Course Technology.

Smith, K., and L. Smith. 2003. Tools and techniques for documenting accounting systems. *Internal Auditing* 18 (5).

U.S. House of Representatives. 2002. The Sarbanes-Oxley Act of 2002. Public Law 107-204 [H. R. 3763]. Washington, D.C.: Government Printing Office.

Valacich, J., J. George, and J. Hoffer. 2001. *Essentials of Systems Analysis and Design.* Upper Saddle River, NJ: Prentice Hall Inc.

Wang, S. 1996. Two MIS analysis methods: An experimental comparison. *Journal of Education for* Business 71 (3): 136–141.

Weber, R. 1999. *Information Systems Control and Audit.* Upper Saddle River, NJ: Prentice Hall Inc.

Winters, B. 2004. Choose the right tools for internal control reporting. *Journal of Accountancy* 197 (2): 34–40.

Whittington, O. R., and P. Delaney. 2004. *Wiley CPA Examination Review.* Hoboken, NJ: John Wiley and Sons.