ACCOUNTANT'S GUIDE TO COMPUTERS AND INFORMATION TECHNOLOGY

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CONTENTS

CHAPTER 1
ACCOUNTING INFORMATION SYSTEMS AND PACKAGES

Learning Objectives:

After studying this chapter you will be able to:

1. Understand what accounting information systems are and their components.
2. Select effective accounting software.
3. Explain what information technology compliance software involve
4. Select and utilize write-up software.
5. Evaluate audit preparation software.
6. Use spreadsheets.
7. Understand how to outsource some accounting functions to Web-based accounting.
8. Describe the purpose of extensible business reporting language (XBRL).

Accounting information systems record, report, and analyze business transactions and events for the management of the business enterprise. It encompasses six essential accounting systems including order processing, inventory control, accounts receivable, accounts payable, payroll, and general ledger. This chapter discusses several software applications of particular interest to accountants. The discussion includes the major players in the area and some important features to look for when considering a particular type of software.

ACCOUNTING INFORMATION SYSTEMS

Accounting information systems are the oldest and most widely used information systems in business.

Computer-based accounting information systems:

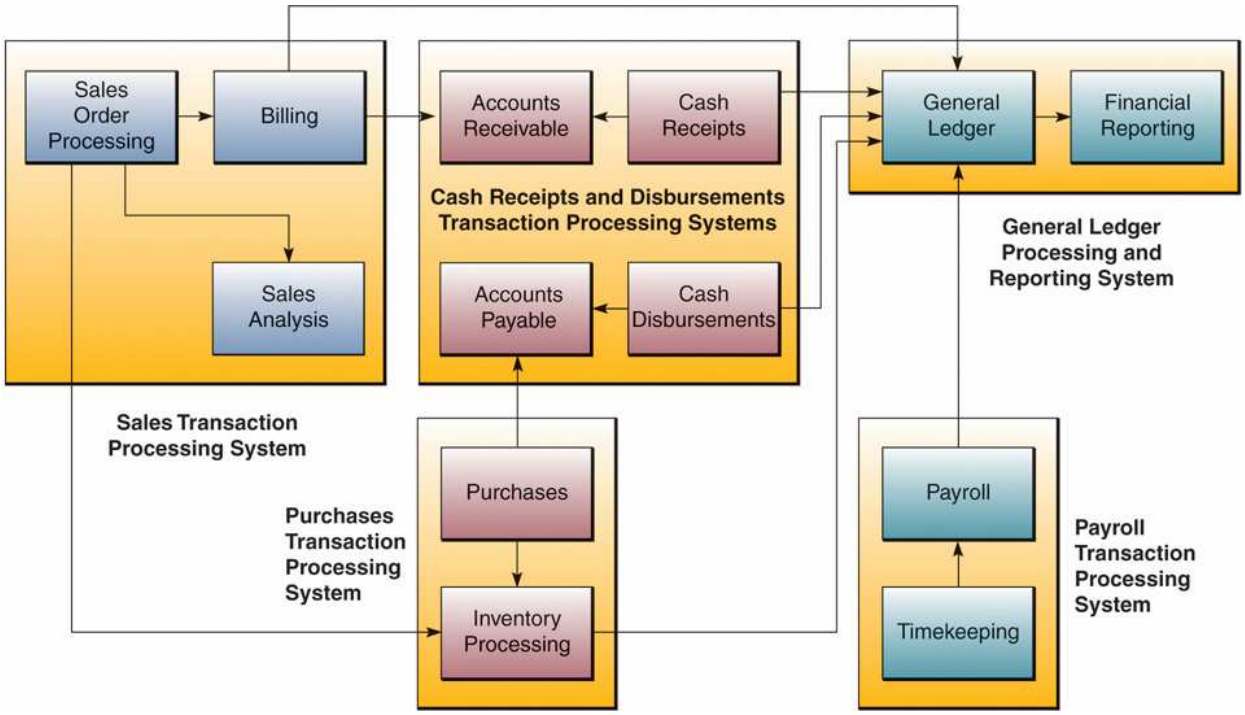
- Record and report the flow of funds through an organization on a historical basis and produce important financial statements such as balance sheets and income statements
- Produce forecasts of future conditions such as projected financial statements and financial budgets
- Operational accounting systems focus on transaction processing systems. They emphasize legal and historical record-keeping and the production of accurate financial statements.
- Typically, operational accounting systems include:
  1. Order Processing: Captures and processes customer orders and produces data for inventory control and accounts receivable.
  2. Inventory control: Processes data reflecting changes in inventory and provides shipping and reorder information.
  3. Accounts receivable: Records amounts owed by customers and produces customer invoices, monthly customer statements, and credit management reports.
  4. Accounts payable: Records purchases from, amounts owed to, and payments to suppliers, and produces cash management reports.

5. Accounts payroll: Record employee work and compensation data and produces pay checks and other payroll documents and reports.
6. General ledger systems: Consolidates data from other accounting systems and produces the periodic financial statements and reports of the business.

- Management accounting systems focus on the planning and control of business operations. They emphasize:
  1. Cost accounting reports
  2. Development of financial budgets and projected financial statements
  3. Analytical reports comparing actual to forecasted performance

Figure 1 illustrates the interrelationships of several important accounting information systems. Many accounting software packages are available for these applications.

FIGURE 1
ACCOUNTING INFORMATION SYSTEMS
FOR TRANSACTION PROCESSING AND FINANCIAL REPORITNG



ONLINE ACCOUNTING SYSTEMS

Accounting information systems are being affected by Internet and client/server technologies. Using the Internet, intranets, extranets, and other network changes how accounting information systems monitor and track business activity. The online, interactive nature of such networks calls for new forms of transaction documents, procedures, and controls. Many companies are using or developing network links to their trading partners through the use of the Internet or

other networks for applications such as order processing inventory control, accounts receivable, and accounts payable.

ACCOUNTING SOFTWARE

There are many factors that must be weighed when selecting a computer software package. Besides determining the software features currently needed and required in the future, the buyer must have a thorough understanding of the firm's existing system, and whether proposed software will integrate with all areas of that system and business.

Some of the basic considerations include: features and capabilities, compatibility and integration, ease of customization, ease of use, written documentation and technical support, price, and vendor's reputation and stability.

The fundamental task of accounting software is to automate the routine chore of entering and posting accounting transactions. This information is organized in an electronic format so as to produce financial statements and can be accessed immediately to assist in the management of the firm.

An accounting software package consists of a series of highly integrated modules. Each module corresponds to a specific accounting function (e.g., payroll, accounts receivable, and accounts payable). In an integrated system, after the details of the transaction are entered in one of the modules, the chart of accounts from the general ledger is "read." The transaction is then automatically posted to the accounts in the general ledger. For example, when a sale on account is entered in the accounts receivable module, a debit is automatically made to the accounts receivable account in the general ledger and an offsetting credit made to the general ledger sales account.

Module Descriptions

The basic features typically required by a firm and often integrated in an accounting software package include the following: general ledger, accounts receivable and invoicing accounts payable and purchase order processing, inventory, payroll, job costing, and fixed assets.

General Ledger

The general ledger is the heart of the accounting system. It contains the chart of accounts of the business. A general ledger module should contain a sample chart of accounts which can be customized to a particular business. In addition, it should contain predefined reports that support budget data and prior year comparisons which can be tailored to a firm's specific needs. Other essential features include the capability to generate automatic reversing and recurring journal entries, having at least 13 periods open at one time, and the ability to make prior period adjustments or post entries to another year without closing the current year.

Accounts Receivable and Invoicing

The accounts receivable and invoicing functions are often combined in the same module. This module allows you to enter sales data and permits extensive sales analysis. It provides customer receivables management by tracking customers' balances, generates invoices and/or monthly

statements, as well as aging reports. It should allow for setting up credit limits for each customer, provide for flexible billing options, and the ability to apply partial payments to specific invoices or to the oldest balance. For faster processing, online inquiry should show the complete customer record at a glance including balances and unpaid invoices, and allow you to make changes "on the fly."

Accounts Payable and Purchase Order Processing
Accounts payable and purchase order processing can also be combined in a single module. The module tracks obligations to vendors and determines a best payments schedule, prints checks, and provides for the distribution to accounts. It should allow for enhanced management of order processing by tracking orders from the start to the receipt of goods. It should be able to detect supply problems and thus permit early planning for alternate sources. To analyze vendor performance, it must track the complete purchase and delivery history of vendors and allow for easy access to this information.

Inventory
This module automatically tracks inventory as purchases or sales are made, and maintains cost and price data for each inventory item. In an integrated system, the Inventory main file, which stores the product's number, is checked when a sales invoice is created in the accounts receivable module. If sufficient inventory is on hand, the amount of the sale is reduced from the balance. Likewise when inventory is purchased, the inventory quantity is automatically increased. The module should help improve inventory management by alerting the user when to reorder, identifying slow moving items, and analyzing performance by item and category.

Payroll
The payroll module maintains default information for each employee (e.g., rate of pay and income tax withholding information). The module calculates the wages to be paid, prints checks, and keeps track of deductions, sick and vacation days, and other such information. It maintains information for government reporting (e.g., 941, W-2, unemployment, and state tax forms). For cost control, it should be able to provide for expense distribution or integrate with a costing module.

Job Costing
A job costing module allows you to track and report on the costs, income, and profitability of individual jobs or projects. This is done by assigning a job ID number to purchases, sales, and employee hours. A job cost module should provide for an accurate audit trail, detailed income, expenses and committed costs, as well as the tracking of other user-defined categories. For example, Maxwell Business Systems' JAMIS is a job costing accounting package that tracks costs by project, contract, or organization over multiple years.

Fixed Assets
Fixed assets usually represent a significant investment by a firm, thus it is essential to keep track of them, but extremely tedious to do so. Tracking fixed assets and the repetitive calculation of depreciation is well suited for the computer. Most accounting software packages include the fixed asset module or capabilities to control fixed assets. It is also possible to purchase dedicated stand-alone fixed asset packages.

Fixed asset software can handle large amounts of data and a variety of depreciation methods for financial accounting and tax purposes. It should be able to maintain detailed information about each asset, including a description of the asset, its location, date placed in service, and estimated useful life. It should also be able to track additions and disposal, as well as basis adjustments. An example of a fixed asset package is Decision Support Technology's BASSETS Fixed Asset System.

Before purchasing an accounting package, check if it has a fixed asset module, or capabilities sufficient for your needs. If not, ask if the vendor produces a stand-alone version, or would recommend a third party vendor. Before purchasing a stand-alone fixed asset software package, make sure that it allows for easy sharing of information with your general ledger, tax packages, and other data repositories.

MARKET LEADERS

There are a number of accounting software products. They can conveniently be categorized as (a) low-end, (b) mid-level, and (c) high-end packages.

TechRepublic (http://techrepublic.com.com/) provides a list of these packages.

High-End

High-end applications serve both midsize, regional companies and large, multinational corporations. They're flexible, easy to implement, and can be modified to meet the users' needs. Although this category of software isn't inexpensive, high-end packages aren't in the same league as AS/400 or ERP installations and therefore won't enter that $100,000 range.

AccountMate Software—Visual AccountMate (http://www.accountmate.com/EN/products/)
Client/server software available to almost any size business.

ACCPAC International—ACCPAC for Windows Corporate Series
(http://www.accpac.com/products/finance/accwin/cs/default.asp)
Multi-tier business management system, multi-currency and multilingual support, e-business and sales force automation capabilities, customization options.

Damgaard—Axapta (http://www.damgaard.com/)
Internet-enabled, object-oriented, single code base for all countries, and a three-tier client/server environment.

Epicor—Platinum for Windows and Platinum ERA
(http://www.epicor.com/solutions/accounting.asp)
Integration between front office and back office applications, customization options.

Great Plains Software—Great Plains Accounting (http://www.greatplains.com/accounting/)
Twenty modules and tools for automating labor-intensive processes.

Infinium—Infinium Financial Management (http://www.infinium.com/html/fm.html)
Freestyle reporting capabilities; multinational, multi-currency processing of payments, invoices, and receivables; Web-enabled accounts receivable function.

Macola Software—Progression Series
(http://www.macola.com/macola/product/solutions/default.asp)
Allows multiple budgets and prior year's data to be maintained.

Navision Software U.S.—Navision Financials (http://www.navision.com/)
Integrated development environment; provides customization tools for customer-specific solutions.

Peachtree Software—Peachtree 2000 (http://www.peachtree.com/peachtree2000/)
Designed for small to medium-size businesses; features multi-user capabilities.

Sage Software—Acuity Financials (http://www.us.sage.com/acuity/)
Designed for larger businesses or company divisions (100 to 1,000 employees; integrates Microsoft Office and BackOffice suites.

Solomon Software—Solomon IV (http://www.solomon.com/product/series/series_fin.htm)
Full suite of financial management tools, including accounts payable/receivable, cash manager, and general ledger.

Tecsys—ControlSeries Project Financial Management (http://www.tecsys.com/)
Client/server, activity-based management software package.

Mid-Level
Buyers of mid-range programs are tough to define by revenue, but they usually include four or five accounting users and have needs that are technically sophisticated. These buyers generally require more robust, multi-user features and management reporting while still retaining tools that are required for a small business. Essential features of a package include client/server architectures, custom report design, and Internet/intranet-enabled functions.

AccountMate Software—Visual AccountMate (http://www.accountmate.com/EN/products/)
Client/server software available to almost any size business.

CheckMark Software—MultiLedger (http://www.checkmark.com/ML_Win.html)
Integrated, cross-platform accounting program combining general ledger, accounts receivable/payable, and inventory.

Cyma Systems—Cyma IV Accounting for Windows (http://www.cyma.com/products/fms.asp)
Full suite of accounting modules, including system manager, general ledger, accounts receivable/payable, and payroll; available in workstation, peer-to-peer, and client/server configurations.

PC Accountant—ProBooks (http://www.pcaccountant.com/). Features integrated, point-and-click accounting.

Sage Software—BusinessWorks (http://www.us.sage.com/businessworks/). Features 10 fully integrated modules; can support up to 48 concurrent users.

SBT Accounting Systems—VisionPoint (http://www.sbt.com/products/vp.html). Designed for small to midsize enterprises; based on open architecture.

Syspro Impact Software—Impact Encore (http://www.syspro.com/). Features a relational database; integrates with other desktop productivity tools such as Microsoft Word, Outlook, and Excel.

Windsoft International—Bottomline Accounting (http://www.windsoft.com/index2.htm) Designed for small and midsize companies that want to automate accounting data.

Low-End
Products in the low-end category are not short on capabilities or features. Rather, they are made for sole proprietorships, partnerships, and corporations that are closely held with only a few employees. These users need a package that will help them balance checkbooks, prepare payroll reports and deposits, and keep track of bills and customer invoices. They want features including single points of entry for data, on-the-fly updating, tight integration with the Internet, sophisticated customized reporting, built-in job costing, and electronic payroll and bill paying services.

Aatrix Software—Mac P&L Accounting (http://www.aatrix.com/1.800.426.0854/macpandl/index.html). Full suite of applications at low cost, including general ledger, payroll, and inventory management.

ACCPAC International—Simply Accounting (http://www.accpac.com/products/finance/simply/default.asp). Entry-level package for the small office/home office user.

Intuit—QuickBooks (http://www.intuit.com/products_services/small_business.shtml). Features include time tracking, job costing, and estimations; integrated with Microsoft Excel, Word, Outlook, and Symantec ACT!

MYOB—Accounting Plus (http://www.myob.com/us/products/plus/index.htm). Features more than 100 accounting and financial management reports; supports multiple-currency accounting.

Peachtree Complete—One-Write Plus (http://www.onewrite.com/). Designed for small businesses converting from manual accounting systems.

SBT Accounting System—VisionPoint (http://www.sbt.com/products/vp.html). Designed for small to midsize enterprises; based on open architecture.

SELECTING ACCOUNTING SOFTWARE

In selecting accounting software, consider the following:

Customization: Can the package be customized? Can it be customized enough to meet user requirements? Items to be customized include reports, forms, input screens and source code. Vendor reliability: Can we rely on the vendor? Do they have sufficient resources? Are they profitable and supported by sufficient, knowledgeable staff?

Reporting: Can the package produce required financial statements in a timely and accurate manner? Do the reports include the required ratios? Do they include graphical output? Do they incorporate third-party products FRx (offers reporting capabilities for the general ledger module) and Crystal Reports (extracts and reports event data from all modules) into their packages?

Database: Do the databases available with the package match the user's needs? Databases available include Btrieve, Microsoft SQL Server, Oracle, and IBM DB2. The user's number of transactions is a typical determinant of the database required.

Client/Server: Does the package come with a client/server version? This version allows the user to save the bandwidth and time on the LAN and to distribute single processes across multiple computers throughout the organization.

Account number structure: Does the account number structure accommodate the number of segments—for subsidiaries, divisions, accounts, subaccounts, departments, programs, and funds—and total number of characters required by the user?

Internet: Does the pack include the following internet-related features?

- Publish web catalogs directly from, and made links to, the software's inventory module.
- Retrieve orders directly from the web site and import them to the sales module.
- Print reports to a web page (HTML) format.
- Allow users access reports and accounting data across the web.
- Support remote data entry across the web.

International: Does the package process multiple currencies? Does the package support foreign languages?

User friendliness: Does the package contain user-friendly features such as graphical guidance; default-rich settings; and clear, simple, intuitive screens and labels.

Other features: Does the package include pivot tables and hotlinking? Does the package alert users when certain conditions, such as cash on hand, gross margin, and inventory balances, reach user-defined levels?

Note: For more in-depth analysis of various accounting packages, you may want to consult these professional organizations and manuals, some of which offer advice on purchasing software. They include:

- Institute of Management Accountants (http://www.imanet.org)
- Family Firm Institute (http://www.ffi.org/)
- National Society of Accountants (http://www.nsa.org)
- The American Institute of Certified Public Accountants (http://www.aicpa.org/)
- Accounting Technology (http://www.electronicaccountant.com), a great site for industry news, special reports, and product reviews.
- CPA Software News (http://www.softwarenews.net
- CPA Technology Report (http://cpatech.hbpp.com)

- SoftWorld's Accounting and Finance Expo (http://www.softworld.com). These frequent trade shows are the best place for buyers to get hands-on demos of the latest accounting and finance products, both in North America and Europe.

WRITE-UP SOFTWARE

With the development of easy-to-use and inexpensive accounting software, many companies who previously relied on CPAs to keep their books are doing it themselves. CPA firms can counter this trend with dedicated Write-up software which is easy-to-use and provides more features so as to add value to their write-up services.

Write-up software should allow you to do more than just record transactions. One of the biggest features to look for is the ability to easily create an array of printouts and reports that a client might need. This includes being able to link and transfer data from other software packages and applications.

Another important feature is the ability to customize the input screen, so that it is consistent with the layout of the client's source documents, thereby reducing unneeded keystrokes. Easy setup is another means to reduce the cost of write-up service. The package should contain sample company data, and the ability to copy common information and make changes to default information included in the setup "on the fly."

Figure 2 lists five products included in both reviews.

FIGURE 2
WRITE-UP SOFTWARE

Client Write-Up System
Pro Systems, Inc
www.prosystems.com

Write-Up Solutions
Creative Solutions
www.creativesolutions.com

CYMA Client Write-Up
CYMA Systems, Inc.
www.cyma.com

Xpert Write-up
Micronetics International
www.axpert.com

COMPLIANCE SOFTWARE

On July 2002, the U.S. Congress passes the **Sarbanes-Oxley Act**, the most significant change to U.S. business regulations in 70 years. The Act creates tough new penalties for corporate fraud, prevents accounting firms from offering consulting services to audit clients and places restrictions on financial analysts. Section 404 (Management Assessment of Internal Controls**)** requires each annual report of an issuer to contain an "internal control report", which shall:

1. State the responsibility of management for establishing and maintaining an adequate internal control structure and procedures for financial reporting; and
2. Contain an assessment, as of the end of the issuer's fiscal year, of the effectiveness of the internal control structure and procedures of the issuer for financial reporting.

Six Technologies That Can Assist with Compliance

Much of compliance is a matter of putting rules in place and ensuring that they are followed. Technology can provide the solutions to the corporate governance and compliance problem. It includes computer software for: business intelligence, business process management, document management, e-mail management, financial and accounting software, and enterprise resource planning (ERP).

Business intelligence Regulatory requirements for "real-time" disclosure of factors that affect financial performance mean that executives need access to timely, relevant data from all areas of the business. By drilling down into financial and company data and providing sophisticated reporting and analysis tools, business intelligence software can help ensure the accessibility of information.

Business process management (BPM) Businesses have traditionally been built around functional "silos", making it difficult to share information and obtain a consistent, enterprise-wide view. By extracting businesses processes from the underlying application code into an independent management layer, BPM software can help improve visibility.

Document management New corporate governance standards mean that companies need an efficient system for storing and retrieving important records and documents. Software packages that maintain audit trails of documents and set controls over how, where and for how long files are stored can help companies meet these obligations.

E-mail management As the volume of e-mail continues to soar, the logistics of storing essential e-mails and being able to retrieve them quickly become increasingly complex. And with new regulatory requirements around internal controls and disclosure obligations, the need for comprehensive e-mail management software becomes ever-more compelling.

Financial and accounting software To help comply with new standards such as Sarbanes-Oxley, many vendors are giving their traditional financing and accounting software a boost with additional modules that help with risk management, more accurate budgeting and forecasting, financial analysis and the establishment of internal financial controls.

Enterprise resource planning (ERP) ERP software can give organizations a consistent financial view across all divisions, thereby helping to maintain the accuracy of financial information. Many ERP providers are adding modules to their software to assist with compliance with Sarbanes-Oxley

and other corporate governance standards. *Note:* Appendix A provides a guide to compliance software.

TAX PREPARATION SOFTWARE

Computer technology has had a significant impact on the way tax returns are prepared. Computerized tax return preparation lets the user prepare a return quickly and accurately, and allows the user to quickly analyze different tax planning strategies. Some software packages have built-in tools for tax research and permit for the electronic filing of tax returns. This software also lets the user easily do "what if" planning and then quickly makes all the necessary changes. Furthermore, data can be imported directly from accounting packages or electronic spreadsheets into tax preparation software.

While tax preparation software can help with tax planning, one should consider a dedicated tax research package for serious tax research. Most Compact Disk (CD)-based tax services can effectively replace the printed version of tax services. A major advantage of using CD-based tax services is having the ability to do electronic key-word searches. This can greatly facilitate the tax research process, and make it much more efficient. In addition, it is easier to maintain and store all this information on a CD, thereby saving a good deal of library storage space.

The industry is going through rapid and significant changes in terms of features and key players in the marketplace. As with other software, improvements are continuously being made.

The tax software industry is fiercely competitive and continues to go through consolidations and shakeouts. Thus it makes sense to deal with the larger, better-known vendors whose products are more likely to be supported in the future.

Market Leaders

The leading tax software packages can be categorized into segments:

Lower-Cost Alternatives. The price for this category is generally under $1,000. In spite of their low price, their features compare favorably with the higher priced products. The five products included in this category are listed in Figure 3.

Mainstream. These packages are suitable for mainstream tax practices. They are generally easy to use and learn, but are not intended to handle every situation that may arise. The packages in this category are generally more powerful than those in the lower-cost category.

High-End. This group is marketed for use by multistate regional and national firms. These packages are able to handle the most complex returns and track their progress through large offices.

FIGURE 3
TAX SOFTWARE

Lower-Cost Alternatives

ProSeries
Intuit
www.proseries.com

Tax/Pack Professional
Alpine Data
www.alpinedata.com

Tax Relief
Micro Vision Software
www.mvsinc.com

TAX$IMPLE
Tax$imple, Inc
www.taxsimple.com

Am-Tax
Drake Software
www.amtax.xom

Mainstream

CPASoftware
CPA Software
www.cpasoftware.com

Lacerte Tax Planner
Lacerte Software
www.lacersoftware.com

Professional Tax System
Taascforce
www.taascforec.com

TaxWorks
Laser Systems
www.taxworks.com

Ultra Tax
Creative Solutions Inc.
www.csisolutions.com

High-End

TurboTax ProSeries
Intuit
www.intuit.com/proseries

Go Systems
RIA
www.riahome.com

Prosystem fx
CCH Inc.
www.prosystemfx.com

AUDIT SOFTWARE

Audit software is used by accountants to perform audits efficiently and effectively. Software audit tools include automated workpapers, data extraction software, and trial balance software. Products such as APG (Audit Program Generator) by the American Institute of Certified Public Accountants (AICPA) and the optional add-on modules allow you to prepare customized audit programs. It eliminates the photocopying, cutting, and pasting usually required when creating the audit program and guides users through the engagement.

Data extraction software, such as IDEA (Interactive Data Extraction and Analysis), also by the AICPA, allows auditors to access clients' files for audit testing. The auditor can either access the client's live data or obtain a copy of the company's data files on tape or disk. Data extraction software allows the auditor to audit "through the computer." The auditor can, for example, select a sample of accounts receivables for confirmations, or perform analytical reviews and do ratio analysis. Transactions may be compared to predetermined criteria. Linton Shafer's Audit Sampling Software packages select random numbers and dates. It handles multiple ranges and evaluates results. It performs compliance and substantive testing.

Trial Balance software, such as the AICPA's ATB (Accountant's Trial Balance), helps the auditor organize client's general ledger balances into a working trial balance. The auditor can then perform adjustments and update account balances. The calculation of financial ratios is extremely simple with trial balance software. This type of software aids in the preparation of financial statements. While trial balance software is designed primarily for audits, it can be used instead of write-up software for compilation and review services.

Price Waterhouse Researcher is an accounting, auditing, and reporting research system on a single CD-ROM disc. Equivalent to a 100,000 page library, PW Researcher includes generally accepted accounting principles (GAAP), generally accepted auditing standards (GAAS), Securities and Exchange Commission (SEC) regulations, and U.S. Cost Accounting Standards. The information on the CD includes American Institute of CPAs (AICPA), Financial Accounting Standards Board (FASB), SEC, and Emerging Issues Task Force (EITF) publications, along with Price Waterhouse guidance, analysis, and interpretations. The CD is updated quarterly and also includes International accounting and auditing standards. The easy-to-use database may be searched using a key word or phrase. Users may make personal notes and markers. The authors highly recommend this excellent product.

Price Waterhouse TeamMate is an electronic working paper system that helps automate the working paper preparation, review, reporting, and storage process. It includes standard and free form schedule templates, and automatic tick mark system and a powerful cross referencing capability. PW TeamMate also integrates popular spreadsheet, word processing and imaging software. There are hypertext links between documents and applications enabling the auditor to jump backward through related numbers in reports or spreadsheets to the original data. The search, cross referencing, and retrieval capabilities allow the auditor to automatically correct errors in all affected documents. The working paper review features include automatic exception reporting, a working paper navigation system, and text and voice annotation. For example, the auditor can obtain a directory of all review notes pertaining to a document. The reporting features include key audit point summarization, report drafting, audit status reports, and time summaries. Financial data is quickly accessed by the sorting and filtering tools. A standard index provides a branch and node system for all papers. There is a simultaneous multi-user feature so auditors/reviewers can work with the same document set even if they are working in various locations. PW TeamMate improves the quality, productivity, and effectiveness of the auditor's work.

Price Waterhouse Controls facilitates the documentation, evaluation, and testing of internal controls. The software expedites the collection and summarization of controls in place, appraises their effectiveness, and identifies areas of risk exposure. PW Controls can be used by auditors to document particular business processes. Control weaknesses are identified with resultant recommendations for improvement. The auditor can view control effectiveness at different levels within the company (e.g., by activity, by business unit). A comparison and analysis may be made of the relative control performance of different operating units.

Price Waterhouse Chekhov is a software package that automates the completion of checklists.

CaseWare International **(**www.caseware.com), as the producer of engagement and reporting software, offers a software package supports you through all stages of client engagement (compilation, review, or full audit). This package features real-time updates, unrivalled flexibility, and also has its own integrated document-generator.

Figure 4 contains a number of audit software packages. They contain one or more features previously discussed.

FIGURE 4
AUDIT SOFTWARE

ACL
ACL Services Ltd.
www.acl.com

CaseWare Working Papers
Case Ware International
www.caseware.com

ATB
AICPA
800-862-4272

CA-PanAudit Plus/PC
Computer Associates
www.cai.com

Digital Analysis Tests and Statistics
Richlanza.com
www.auditsoftware.net

ProSystem fx Audit
ProSystem
www.prosystemfx.xom

AUDITING AUDIT SOFTWARE

Recent corporate meltdowns (for example, recent Enron debacle) are putting internal auditors under greater pressure. Internal auditors are under pressure to play an even greater role in strengthening internal control and governance by providing their companies with wider, deeper data analysis on a regular basis. Auditors need to spend quality time on solving exceptions, rather than finding them. This allows them to go beyond routine policing and take on more value-adding responsibilities, including risk management. One of the most striking changes to take place within internal auditing is the growing use of applications that fall under the banner of business intelligence. A number of vendors specializing in business intelligence are now pushing their offerings into the auditing arena. The pushers include Business Objects, SAS Institute, Coda, Hyperion, Crystal Decisions, Cognos, and Adaytum. Still, many businesses continue to rely on spreadsheet software to extract and analyze data.

SPREADSHEETS

More than any other product, the electronic spreadsheet has done more to make the capabilities of microcomputers evident to the business community. An electronic spreadsheet allows the user to work with data in a huge number of rows and columns. The user works with this data in a columnar spreadsheet, a format familiar to accountants. A big advantage of the spreadsheet is that it eliminates the need to perform manual calculations and can perform powerful computer-aided operations.

The spreadsheet has become a valuable tool in business planning, since it permits the user to perform "what if" scenarios. Inputs can be continuously changed, and the results will automatically be recalculated throughout the spreadsheet. Thus, the effect of alternative decisions is easily determined and planning greatly facilitated. The use of templates is another important feature of spreadsheets. Templates provide the format and contain the formulas which are used to repeatedly solve various business applications. Since one doesn't have to be a

programmer to construct a template, all firms could now more easily use the vast power of the computer to help make better decisions in the management of a firm.

Major Players and Selection Considerations

The chief players in the spreadsheet field have been reduced to three:
(1) Microsoft's Excel, (2) Lotus 1-2-3, and (3) Quattro Pro

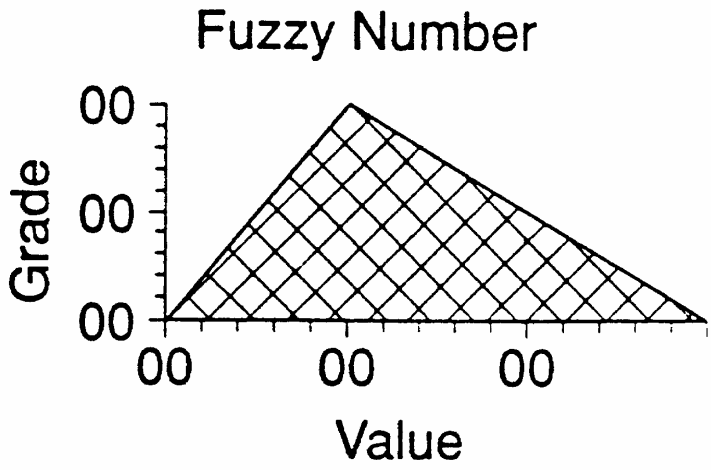
In actuality, all the players have the same basic features. Although a particular feature may currently be lacking in a specific spreadsheet, that feature may very well be included in the next upgrade of that product. Therefore the decision of which product to buy should not be based primarily on features. More importantly, be certain the planned spreadsheet supports and is compatible with the major applications of your business. Thus, make sure that the spreadsheet can directly access your databases and that any macros or templates that have already been developed are compatible with the proposed acquisition.

Managing Risk Using Fuzzy Analysis

A unique spreadsheet, FuziCalc, takes the computational complexity out of fuzzy arithmetic. This spreadsheet allows us to easily incorporate ranges or intervals in our analysis, and assign the ranges different weights. Implicit in any type of decision analysis is the assumption that judgmental inputs can be accurately represented by a single precise number. However, it generally is not possible to quantify judgment with such precision. Most of the traditional tools for decision analysis are crisp. By crisp we mean that the tools require precise inputs. In contrast, most of the problems facing managers are fuzzy, vague, or imprecise. Traditionally, managers have incorporated imprecision in their analysis through probability theory. An alternate framework, based on the fuzzy set theory, allows imprecision in data analysis. It allows the decision-maker to benefit from the structure of quantitative decision analysis, without forcing the user to provide very precise numerical inputs.

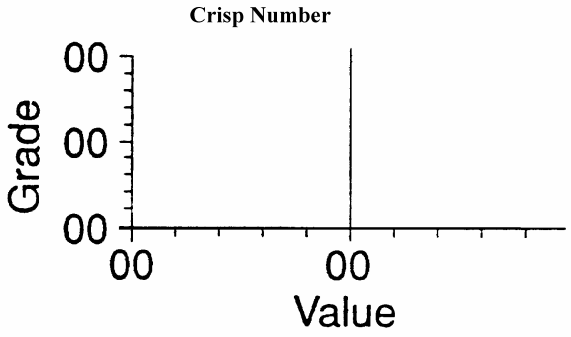
From a practical perspective, fuzzy analysis is easy to do using the FuziCalc spreadsheet. There are no new techniques to learn. Anyone familiar with a conventional spreadsheet can quickly adapt to the FuziCalc spreadsheet. All fuzzy data can be represented by "belief graphs." Belief graphs are the heart of the FuziCalc spreadsheet. Fuzzy data inputs are made using belief graphs. The simplest way to represent a fuzzy number is to use a triangular shape. You need a minimum of three points to represent any fuzzy number. A triangular fuzzy number has many practical applications. To construct a triangular fuzzy number of sales price, we need to determine the highest, the most likely, and the lowest sales price. Let's assume our estimates for the highest, the most likely, and the lowest sales price are $35, $25, and $20, respectively. A belief graph of this fuzzy triangular number can then be constructed as shown in Figure 5.

FIGURE 5



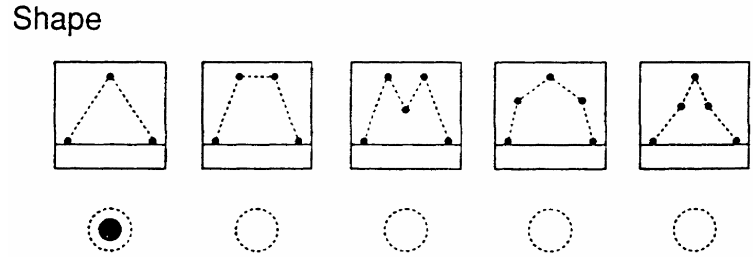
Let's contrast the fuzzy number in Figure 5 with the crisp number 25 in Figure 6. A crisp number does not have a range of values; its belief graph is a straight line.

FIGURE 6



FuziCalc provides five common shapes to represent fuzzy data. The five shapes from FuziCalc's Gallery are shown in Figure 7.

FIGURE 7



The triangular shape was discussed earlier; its use is appropriate when the user has a single best estimate of the most likely value and can specify the endpoints of the range. Sometimes it is not possible for the user to give one best estimate of the most likely value. A trapezoidal fuzzy number would be most appropriate when only a range of most likely values can be given. The user may select the multi-peaked shape to represent fuzzy numbers where the low and high values are more likely than the middle values. The tent shape is most appropriate where all of the values in the range have a high possibility of occurring. The rocket shape might be used when the user believes a wide range exists, but a narrow range within it has a much better possibility. The five shapes will be sufficient for the needs of most users. However, FuziCalc allows users to easily alter the shape to represent any fuzzy number.

It is possible to add, subtract, multiply, and divide fuzzy numbers just like regular or "crisp" numbers. The advantage of using the FuziCalc spreadsheet is that users don't need to concern themselves with the complex underlying computations.

FuziCalc's primary strength is in modeling under uncertainty. Beyond that, FuziCalc offers little to spreadsheet users. As a spreadsheet, FuziCalc offers only the very basic features. Users of conventional spreadsheets might even find working in FuziCalc a little frustrating. Many of the features that one is accustomed to in conventional spreadsheets are missing in FuziCalc. Thus it would be used to supplement, rather than to replace, a conventional spreadsheet. FuziCalc is sold by FuziWare, Inc. 800-472-6183.

OUTSOURCING SOME ACCOUNTING FUNCTIONS TO THE WEB— WEB-BASED ACCOUNTING SYSTEMS

Web-based software packages are transforming business. Functions such as accounting, cash-flow management, customer relationship management (CRM), inventory control, and marketing can be performed electronically anytime and anywhere for a low monthly fee. For example, a small business can use ePeachtree, Intacct eledger, or QuickBooks Online to process transactions for as little as $14.99 per month. Intuit offers payroll services on the Web, and a small business can outsource its payroll function for as low as $129 per year. Not only can a business owner view and manage employee compensation via the Internet, but the outsourced services allow employees to access personal information, including earnings, income tax withholdings, retirement plans, and vacation days, without creating an added burden for the company.

Reliable and efficient access to information has become a must for business firms to stay competitive. To embrace web-based software and to stay competitive, small businesses must first set up a computer network. With networking technology, staff members or users at any location can share information simultaneously. The fast pace of information technology (IT) advances makes it difficult for accounting professionals to stay current

Implementing Web-based Accounting Systems
The following are easy-to-follow procedures to implement a web-based accounting system that will leverage current IT tools to improve profitability and efficiency.

Set up a system network.
To connect local and remote computers for sharing information and resources, Ethernet networking is a good choice for small business local area networks (LAN) because it is inexpensive and reliable. Ethernet networking strikes a good balance between cost and speed, is built into most newer PCs, and can support nearly all popular network protocols. For older computers, installing a network interface card (NIC) is easy, and all major networking manufacturers (e.g., D-Link, Linksys, and Netgear) offer reliable and inexpensive NICs. Fast Ethernet is based on the same protocol as traditional Ethernet, and small businesses can realize significant network performance boosts affordably.

Ethernet networks have practical limits, however. A primary concern is the length of the shared cable. Data can travel on the cable quickly, but signals weaken as they travel. In addition, electrical interference from the surrounding devices may interfere with the signals. This issue places a limitation on the maximum distance between two devices on an Ethernet network. Although distance is seldom an issue for small business networks, if a company has several branch offices with some distance between them, one option is to set up a virtual private network (VPN). Furthermore, if the structure of the office makes it economically unfeasible to run Ethernet cables, a company may prefer to set up a wireless network.

Small businesses with 50 employees or less can use Microsoft Small Business Server or Windows XP Professional to function as either a dedicated or a nondedicated server. With Windows XP, the network administrator can manage the access to data, files, printers, and other resources on a small network. If the business lacks qualified IT staff or wants to set up more complicated networks, another option is to hire a consultant or value-added reseller (VAR) to do the wiring and system configuration. Linux is a growing alternative in the server software market. Linux's low cost, reliability, and high performance make it a promising choice; however, setting up a Linux server may require someone with extensive networking and Linux-specific experience.

A business must also have the bandwidth capacity that broadband Internet access provides in order to use web-based accounting packages effectively. The process of choosing the right ISP can be complicated, and a company must consider several factors, including price, performance, access numbers (for alternate dial-up service), and technical support/services.

Select and subscribe to software
All web-based accounting packages listed in this section offer free trial periods of from 14 to 30 days. Businesses should make sure that the provider offers all the required features before

subscribing to the service. A business should select a web-based accounting package based on the company's information needs and the features offered by the software. For example, QuickBooks Online cannot provide detailed inventory information and thus is not suitable for most retailers. Neither QuickBooks Online nor ePeachtree can handle product costing, but the user can accumulate service or manufacturing costs by project. The Sidebar lists several important factors for a small business to consider when selecting web-based accounting software.

Customize the accounting system
Web-based accounting packages are general-purpose software, and a company needs to use and customize only the features required for its business. Working from the predefined chart of accounts, forms, and reports, a small business can set up and customize its accounting system in hours.

Prepare system documentation.
Companies need to prepare system documentation so that new staff can learn how to use the system. System documentation should provide detailed procedures, including system activation and deactivation, chart of accounts, sales cycle, purchase cycle, employee and payroll cycle, cash receipts, cash disbursements, journal entries, inventory, financial reports and queries, and error corrections. The system designer should copy the predefined forms, screens, and reports and include them within the system documentation.

Good system documentation should be easy to read, make it easy for users to find specific information (i.e., include a table of contents, page numbers, and an index), and be well organized (i.e., by cycles or accounts). The procedures should be complete, in easy-to-follow steps (e.g., showing all relevant forms, screens, and reports). The overall presentation should be professional, and the system documentation should be kept in a safe place.

Web-based accounting makes the data easily accessible to multiple remote users at one time, and of course it offers the usual benefits of Web-based software: server-side upgrades, maintenance, and backups. For example, you can farm out your general ledger, accounts payable and receivable, invoicing, and reports functions to companies such as ACCPAC International (www.accpac.com), and Intacct Corp. of Los Gatos, Calif. (http://us.intacct.com/).

ACCPAC International
ACCPAC accounting solutions sells what it calls a complete business management system integrating an electronic storefront with a complete back-office system. It serves businesses doing e-commerce with a system connecting everything from inventory to invoicing. The ACCPAC system automates inventory control, purchase orders, Web site orders, credit checking, fraud protection, accounts payable and receivable, general ledger and even payroll.

Intacct
Intacct sees itself as "an accounting utility company." The company serves businesses employing up to 500 people with a full-function package--general ledger, financial reporting, budgeting, accounts payable and receivable, invoicing, expense reporting, human resources reporting and even a payroll service. If you're a small operation looking for low cost and ease of use, you want to pick

something like Intuit Quickbooks. If you're a small or medium-size operation and you need functionality and scalability, you need something richer.

Intuit's Quickbooks

Quickbooks may be the market leader in small-business accounting software, but the company has lagged in developing a Web-based version. QuickBooks for the Web (http://quickbooks.intuit.com/) launched late last year, and it's a significantly stripped-down version of the desktop product. Oddly, one thing it lacks is the ability to import QuickBooks data (something NetLedger does offer). Other no-shows in the Web incarnation include estimates, graphs, online banking or bill paying, custom fields, time tracking, and the ability to export data into a spreadsheet or other file format. But the Web version is easy to set up, and it lets you bill customers by e-mail.

EPEACHTREE

EPEACHTREE, the online offering from Peachtree (www.peachtree.com/), is more robust than QuickBooks for the Web. It can import a Peachtree Office Accounting file, although some features from the desktop version have been altered or dropped. For example, customized reports are not imported, but you can export reports and forms to Excel, Word, Rich Text, or Crystal Reports format. A wireless service lets you check inventory as well as customer and vendor information from various Web-enabled cell phones or from a Palm.

Advice and Caveats

A recent survey published by Financial Executives International (FEI)(www.fei.org) revealed that outsourcing would continue to be a solution for areas where management does not believe that in-house efforts can be cost-effective. The same survey also revealed that financial executives' satisfaction levels with shared services are as high as 90%. Web-based accounting packages enable small businesses to outsource their accounting function at an affordable price, and web-based inventory control software allows small businesses to track their inventories in real time. Web-based software has the added bonus of always being up to date, because providers continuously provide incremental upgrades and new features.

To embrace web-based software, a small business must first develop a technology plan. This plan should be based on a thorough review of the company's existing computing resources, and focus on what the business plans to do with technology. The plan should state the goals clearly, prioritize them, and tie them to a budget and a timetable. The firm must complete this prioritizing process before making any purchase decisions.

Once the company completes the technology plan, the second step is to match software products to the company's goals and objectives. The business should be flexible with the technologies and should consider all available products in the market. At this point, the company can either handle the process with its own staff or use consultants to expedite the process.

Purchasing equipment can be overwhelming when facing all the choices in the market. Categorizing the available products can simplify this process. When evaluating competing services, the value-added features, such as unlimited free nationwide dial-up, robust web-based e-mail, and hosting web content, can be extremely beneficial. For example, outsourcing the tasks of maintaining

a web server, managing the associated traffic, and maintaining the continuous server uptime may result in savings of $2,000 to $3,000 per year.

EXTENSIBLE BUSINESS REPORTING LANGUAGE (XBRL)

There exist too many data formats on the Internet preventing users from analyzing financial information without many labor intensive conversions. Excessive time is devoted to extracting useful information from available accounting and financial data. Further, time is wasted re-keying the same information into a spreadsheet. For example, data in the Securities and Exchange Commission's (SEC) database referred to as Electronic Data Gathering, Analysis, and Retrieval System (EDGAR) cannot be imported directly into spreadsheets. EDGAR performs automated collection, validation, indexing, acceptance, and forwarding of submissions by companies and others who are required by law to file forms with the SEC. The comparison of numbers and ratios requires significant effort and very time consuming re-keying.

Extensible Business Reporting Language (XBRL) makes available financial information in an "easy to use" format on the Internet. Formerly code named XFRML, a freely available electronic language for financial reporting, it is an XML-based framework that provides the financial community a standards-based method to prepare, publish in a variety of formats, reliably extract and automatically exchange financial statements of publicly held companies and the information they contain. XBRL is not about establishing new accounting standards but enhancing the usability of the ones that we have through the digital language of business. XBRL will not require additional disclosure from companies to outside audiences. This new language allows the financial community to communicate in a universal language.

How Companies Create XBRL Statements

Accounting software vendors will put XBRL tags in their accounting systems to allow users to cross-reference their accounts to this framework enabling a more efficient reporting process and a more meaningful experience for the users of financial information. Some of the most popular accounting software companies have al ready announced their plans to provide XBRL output in the financial statements. The list includes SAP, Oracle, Great Plains, and ACCPAC. There are more than 50 companies in the U.S. and about 150 companies globally involved in the development and adoption of XBRL. On March. 5, 2002, Microsoft became the first major corporation to publish its financial statements on the Internet using the XBRL framework.

Applications of XBRL

There are many accounting, financial, and business applications of XBRL including:

1. Automating business reporting.
2. Financial statement preparation and analysis. For example, XBRL financial statements on a company's web site can go directly into Microsoft Excel so re-keying is not required.
3. Auditing of financial statements.
4. Managing and distributing accounting data.
5. Consolidating and reporting data to regulatory bodies.
6. Collecting and updating financial data on borrowers such as by accessing the borrower's Web page.
7. Assessing credit risk.
8. Integrating investment information.

9. Communicating financial performance to users of financial statements.
10. Internal management reporting such as cost control and analysis.

CHAPTER 2
THE USE OF COMPUTER SOFTWARE IN MANAGERIAL ACCOUNTING

Learning Objectives:

After studying this chapter you will be able to:

1. Classify cost accounting systems.
2. Explain the function of Activity-Based Costing (ABC) systems.
3. Utilize cash flow forecasting software.
4. Select statistical software.
5. Identify budgeting and planning software.
6. Explain project planning and evaluating.
7. Develop a capital budget.
8. Conduct an appraisal of inventory.
9. Discuss a variety of executive management games.
10. Understand *linear programming*.
11. Illustrate flowcharting.
12. Implement a system for risk analysis.

Computer software is available for most areas of managerial accounting, including cost systems, activity-based costing (ABC), forecasting, budgeting and planning, inventory evaluation, material requirement appraisal, project management, capital budgeting, risk analysis, linear programming, and flow-charting. There are stand-alone packages, templates, and spreadsheet add-ins. The purpose of this chapter is to alert you to software useful in managerial accounting, including their features, applications, and suitability to meet a particular company's needs.

COST ACCOUNTING SYSTEMS

Maxwell Business Systems' *Job Cost Accounting and Management Information System* (JAMIS) is a job costing system. The software keeps track of employee hours worked, distributes (allocates) labor cost to the responsible unit, keeps track of department or product costs, distinguishes between direct labor and indirect labor, and manages inventory. Job costs are broken down into 100 different transactions. Since the software tracks all costs, it can also perform activity-based accounting because the jobs can be expressed in terms of activities or tasks. The activities can further be divided into sub-activities or subtasks. Costs may be broken down by operation or function (e.g., buying materials). Costs may also be identified by division or department. JAMIS can also be used to budget by cost type (e.g., labor, materials and supplies). Costs may be tracked by project or contract for multiple years. It has time-based budgeting. It makes automated retroactive rate adjustments. The system supports contract types, cost classes, and job budgeting.

SouthWare Innovations' *Excellence Series* has features for job costing, contract management, service management and wholesale distribution.

Manufacturing Management Systems' *Quite-A-Profit* performs competitive pricing,

target costing, and earnings appraisal by product or service.

Peachtree Accounting has a module for *Job Costing* to track and report the revenue, cost, and profit for individual jobs and projects.

Macola Software's *Progression Series Accounting and Distribution Software* has modules for job costing, inventory management, and shop floor control. It prepares many management reports, including those analyzing inventory and manufacturing operations.

Lawson Software's *Activity Manager* performs activity-based management and costing. It performs multi-dimensional data analysis, offers "what if' scenarios, does cost allocations, performs inventory control, and aids in warehousing.

Abacus Data Systems' *ADAMS 4GL* aids in warehousing, shop-floor control, inventory control and management, work-order management, and customer analysis.

Prosoft's Inc.'s *Contractor Cost Accounting Package* offers speed and flexibility. The system is fully integrated and each module interacts with others. It offers modules for General Ledger, Accounts Payable, Job Costing, Payroll, Accounts Receivable, and Purchase Orders. Accounts are user-defined and can be referenced and accessed by name or by number. You can customize the program and its reports to suit your needs.

3C Software's *Impact* allows you to set up the system to use any cost accounting method—ABC, Traditional, Machine Based, Job, Direct, Japanese, JIT, or your own hybrid—so you can control how costs are calculated. It allows you to define the methodology, calculations, variables, products, processes, and reports. *Impact* contains an integrated, full-featured query and report writer, which allows reports to be generated quickly and easily. Typical reports include: Product Cost Sheets, Product Pricing Sheets, Variance Reports, Inventory Valuations, Budgets and Forecasts, Profitability Reports, and other customized reports to meet cost reporting requirements.

ACTIVITY-BASED COSTING (ABC) SOFTWARE

An Activity-Based Costing (ABC) system accumulates costs on the basis of production or service activities at a firm. Basically it assigns costs by activity and links them to specific products. It is argued that the resulting cost data is much more realistic and precise as compared to the data obtained from a traditional costing system. ABC helps in determining what a product or process should cost, areas of possible cost reduction, and value-added vs. nonvalue-added aspects. Activity-based costing is beneficial in appraising value-chain functions. Further, costs are a function of their consumption factors such as number of employees, units produced, labor hours, etc.

Aided by computer software designed for ABC, the management accountant can more easily and accurately accumulate cost information and perform "what-if' testing. With this data, management is in a better position to evaluate and make decisions regarding its operations and products. There is a good deal of software that the management accountant can use to aid in accumulating cost data. Some software are actually spreadsheet applications; others are modules of mainframe packages.

The Journal of Cost Management reviewed nine cost management software packages. All these packages are for use on a personal computer and most were designed for activity-based costing or activity-based management. Figure 8 separates these packages into two categories: Those developed by independent vendors, and those supported or developed by a big-six CPA

firm. It should be noted that some products include consulting support as part of the overall package.

PricewaterhouseCoopers' ACTIVA is a comprehensive activity-based costing (ABC), profitability, and performance management software tool. Its features and capabilities include budgeting and planning, product costing and pricing, cost management and analysis, decision support, process improvement, activity-based management, and variance determination and evaluation. Developed using state-of-the art client/server technology, its additional features include capital investment analysis, production sourcing, distribution logistics, and foreign currency appraisal. ACTIVA aids in measuring the profitability by customer, product, service, market, process, and distribution channel. ACTIVA can support many users conducting diverse applications in multiple locations worldwide. The software contains sophisticated security features.

Lead Software's Activity Analyzer assigns activities to cost objects and calculates by activity costs and profitability. Profitability may be determined by product, service, customer, and territory. Armstrong Laing's Hyper ABC is a multidimensional, multi-period activity-based management system. Sapling Software's Net Prophet combines activity-based costing and management, process view analysis, budgeting, capacity planning, and constraint checking.

FIGURE 8
ABC SOFTWARE

ABM Tools and ABC Management Budget
Decimal Technologies
www.decimal.ca

Acorn System Cost Analyzer
Acorn Systems, Inc.
www.acornsys.com

Activity Analyzer
Lead Software, Inc.
www.leadsoftware.com

CMS-PC
ICMS, Inc.
www.icms.com

Prodacapo ABC/M
Prodacapo
www.prodacapo.com

SAS
SAS Institute
www.sas.com

CASH FLOW FORECASTING SOFTWARE

Computer software allows for day-to-day cash forecasting and management, determining cash balances, planning and analyzing cash flows, finding cash shortages, investing cash surpluses, accounting for cash transactions, automating accounts receivable and payable, and dial-up banking. Computerization improves availability, accuracy, timeliness, and monitoring of cash information at minimal cost. Daily cash information aids in planning how to use cash balances. It enables the integration of different kinds of related cash information such as collections on customer accounts and cash balances, and the effect of cash payments on cash balances.

Spreadsheet program software such as *Lotus 1-2-3*, *Microsoft's Excel*, and *Quattro Pro* can assist you in developing cash budgets and answering a variety of "what-if" questions. For example, you can see the effect on cash flow from different scenarios (e.g., the purchase and sale of different product lines).

There are computer software packages specially designed for cash forecasting and management. These packages generally contain automatically prepared spreadsheets for profit/loss forecasts, cash flow budgets, projected balance sheet, payroll analysis, term loan amortization schedule, sales/cost of sales by product, ratio analysis, and graphs. You input data into different categories such as sales, cost of sales, general and administrative expenses, long-term debt, other cash receipts, inventory build-up/reduction, capital expenditures (acquisition of long-term assets such as store furniture), and income tax. The program allows changes in assumptions and scenarios providing a complete array of reports.

Three popular ones are briefly described below.

1. Quicken (**quicken.intuit.com/?src=www.quicken.com**)

This program is a fast, easy to use, inexpensive accounting program that can help a small business manage its cash flow. Bills can be recorded as postdated transactions when they arrive; the program's *Billminder* feature automatically reminds the payer when bills are due. Then, checks can be printed for due bills with a few mouse and/or keystrokes. Similarly, he/she can record invoices and track aged receivables. Together, these features help maximize cash on hand.

2. Up Your Cash Flow XT (**www.cashplan.com/**)

Up Your Cash Flow XT creates financial forecasts for small to mid-size businesses with many features. This program automatically prepared spreadsheets for profit/loss forecasts, cash flow budgets, projected balance sheet, payroll analysis, term loan amortization schedule, sales/cost of sales by product, ratio analysis, and graphs. Accountants and consultants can use this software to provide management advice, secure financing, assist troubled businesses and offer other valuable services. CFOs, Controllers and financial managers use Up Your Cash Flow XT to make fast company budgets, manage cash flow and reach desired levels of profitability. Over 30 reports show the impact of Sales, Expenses, Cost of Sales, Financing, Payroll, Inventory and more. You can run "what-if" scenarios to see how changes in business activity affect the bottom line and

compare plan to actual data to measure how close you've come to your goals and be able to predict any cash shortfalls before they happen.

3. Cashflow Plan - Cashflow Forecast Software (**www.planware.org/cashshareware.htm**?)
Cashflow Plan is a range of powerful, easy-to-use software packages for preparing comprehensive monthly cashflow projections for 12 months ahead. You can use it for cashflow planning, budgets, business planning, fund raising etc. for young & established businesses of all sizes and types. It incorporates a roll-forward facility to help you to speedily update the projections every month. More powerful versions also include a tool for consolidating projections. Cashflow Plan will help plan your business's cash requirements, improve control over cash flows and conserve cash resources. It will be especially useful if you need to forecast cash flows in the context of:

- Tight cash/profit margins
- Limited financial resources
- Planning for growth or radical change
- Compiling cash budgets
- Preparing business improvement plans

Cashflow Plan is pre-formatted to handle the very wide range of the variables and functions normally encountered when preparing cashflow and financial projections. Based on your assumptions, it compiles detailed, fully-integrated financial projections for the coming year on a monthly basis, and for the initial three months on a weekly basis. It automatically produces 20+ pro-forma financial and management reports together with numerous graphs for key variables.

FORECASTING AND STATISTICAL SOFTWARE

There are numerous computer software used for forecasting purposes. They are broadly divided into two major categories: forecasting software and general purpose statistical software. Some programs are templates, while others are spreadsheet add-ins. Still others are stand-alone. A brief summary of these three types of software follows.

Templates

A template is a worksheet or computer program that includes the relevant formulas for a particular application but not the data. It is a blank worksheet that we save and fill in the data as needed for a future forecasting and budgeting application. Most templates are spreadsheet templates used in *Lotus 1-2-3, Excel, or Quattro Pro* that produces sales and financial forecasts, even for new products with limited historical data. They offer a variety of forecasting methods (such as moving averages, exponential smoothing, trend analysis, decomposition of time series, regressions, etc.) for accurate forecasts. You can use the built-in macros to enter data into your forecast automatically. For example, enter values for the first and last months of a 12 month forecast. The compounded-growth-rate macro will automatically compute and enter values for the other ten months.

Add-ins

There are many add-ins that feature the following:

- Uses a variety of forecasting techniques and includes both automatic and manual modes
- Eliminates the need to export or reenter data

You can use it in either automatic or manual mode. In automatic mode, just highlight the historical data in your spreadsheet, such as sales, expenses, or net income; then the program tests several exponential-smoothing models and picks the one that best fits your data.

Forecast results can be transferred to your spreadsheet with upper and lower confidence limits. They generate a line graph showing the original data, the forecasted values, and confidence limits.

You can vary the type of trend (constant, linear, or dampened), as well as the seasonality (nonseasonal, additive, or multiplicative).

Stand-Alone Programs

There are an abundance of stand-alone packages that are much more powerful than templates or add-ins. Some business software use artificial intelligence. A built-in expert system examines your data. Then it guides you to exponential smoothing, Box-Jenkins, or regression - whichever method suits the data best. In addition to allowing the usage of all major forecasting methods, packages permit analysis of the data, suggests available forecasting methods, compares results, and provides several accuracy measures in such a way that it is easier for the user to select an appropriate method and forecast data under different economic and environmental conditions

1. Forecast Pro

Forecast Pro, stand-*alone* forecasting software, is the business software that uses artificial intelligence. A built-in expert system examines your data. Then it guides you to state-of-the-art forecasting techniques (exponential smoothing, Box-Jenkins, dynamic regression, Croston's model, event models, and multiple level models) - whichever method suits the data best.

Business Forecast Systems, Inc.
68 Leonard Street
Belmont, MA 02478
Tel: (617) 484-5050
Fax: (617) 484-9219
www.forecast/

2. Easy Forecaster Plus I and II

Easy Forecaster Plus I and II is a *stand-alone* forecasting software, developed by the Institute of Business Forecasting. The software's features include the following models: naïve, moving averages, exponential smoothing (single, double, and Holt's), linear trend line, and multiple regression. The program selects optimal model automatically and prepares monthly/quarterly forecasts using seasonal indices.

Institute of Business Forecasting

P. O. Box 670159, Station C
Flushing, NY 11367-9086
Tel: (718) 463-3914
Fax: (718) 544-9086
www.ibf.org

3. Autobox 5.0 for Windows 9X,ME,NT,2000 and XP
This is the software utilizing Box-Jenkins forecasting methodology.

Automatic Forecasting Systems
PO Box 563
Hatboro, Pennsylvania 19040
Tel: (215) 675-0652
Fax: (215) 672-2534
www.autobox.com

4. LifeCast Pro
LifeCast Pro is *stand-alone* new product forecasting software. It quickly allows the integration of different marketing assumptions, prices, market research, competitive intelligence, historical similarities, and expert judgment all within a graphically based product life cycle framework. Using LifeCast Pro will help you "sell" your forecasts as believable because it merges statistical diffusion theory with your own assumptions in a way easy to explain to management. Feature include:

- Data availability options (high/medium/ or none)
- Incorporation of price scenarios and elasticities
- Jackknife stability analysis
- Automatic search for best saturation
- Search area analysis and precision estimates
- Life cycle analysis for mature products
- Statistical forecasting equations
- Easy to use.

LifeCast Pro
6516 Wedgewood Way
Tucker, GA 30084

5. DS FM (Demand Solutions Forecast Management)
This system delivers detailed information to front-line inventory managers, as well as top-level sales forecasts to front-office executives. It is the forecasting engine and data warehouse of choice for effective supply chain management. Key benefits include:

- Forecast at any level of data - item, item/customer, item/country/customer, or however you need it
- Quantify market intelligence, promotions and other variables
- Create production and purchase plans
- Meet your inventory and sales objectives. Continuously analyze a comprehensive and accurate view of your inventory and production
- Features the new Service Level Optimizer

- Microsoft SQL Server ODBC-compliant

Demand Management, Inc.
165 North Meramec Ave.,
Suite 300
St. Louis, MO 63105-3772 USA
Tel: (314) 727-4448
www.demandsolutions.com

6. ForecastX Wizard
The ForecastX Wizard software provides:

- Full integration with Excel to eliminate the learning curve
- One Click business forecasting to pick the best method and generate award winning results
- Forecast one item or thousands of items with unlimited batch sales forecasting
- Clear, concise customizable reports to present results and collaborate with others
- Ad-Hoc planning and analysis with "what-if" scenarios
- Compelling charts and graphs that allow drag and drop adjustments
- Determine the effectiveness and timing of promotions with best/worst case analysis

John Galt Solutions, Inc.
125 South Clark Street, Suite 1950
Chicago, IL. 60603
Tel: (312)701-9026
Fax: (312) 701-9033
www.forecastxperttoolkit.com

7. Demandworks DP
The critical element in any supply chain plan is the demand forecast. Demand Works DP™ is a full-featured demand management solution that improves the entire business planning function by maximizing forecast accuracy. It leverages demand history, current sales orders, promotions, events, and user judgment to arrive at an optimal estimate of future demand and required safety stocks. Demand Works DP combines best-in-class forecasting, a powerful and highly flexible design, and a 100% web architecture for better deployment and enhanced teamwork.

Demand Works Co.
16 W. Market Street
West Chester, PA 19382
Tel:: (610) 701-9873
Fax: (610) 701-9875
www.demandworks.com/

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8. Roadmap Geneva Forecasting

Roadmap Geneva Forecasting uses advanced statistical techniques to forecast sales of new and established products and predict the effects of advertising, promotion, new products, pricing changes or competitive actions. Geneva Forecasting includes:

- Powerful statistical modeling.
- Collaborative planning between headquarters and field sales.
- Advanced data mining tools to uncover exceptions and trends.
- Support for remote and mobile users.
- Interfaces to SAP and Retail POS databases.
- Specialized modules for promotion analysis, sales planning and customer forecasting.

Roadmap Technologies
900 Cummings Center
Beverly, MA 01915
Tel: (978) 232-8901
Fax: (978) 232-8903
www.managingautomation.com

9. SmartForecasts

SmartForecasts Enterprise combines automatic forecasting with rapid batch processing to accurately forecast thousands or tens of thousands of items quickly and easily—more than 100,000 items per hour. Manufacturers, distributors, and retailers can easily create accurate demand forecasts for each product item in inventory, along with item-specific estimates of safety stock requirements that significantly reduce inventory costs. The Enterprise edition provides direct connectivity and easy integration with your corporate database (including major client/server systems such as Oracle, IBM DB2 and SQL Server), as well as ERP, DRP, Supply Chain and other planning systems.

Automatic Statistical Forecasting provides fast, accurate forecasts for hundreds or thousands of product items—at the click of your mouse.

SmartForecasts' expert system selects the best forecasting method for your data and handles all the math, easily incorporating trends, seasonal patterns and the effects of promotions and other special events. Interactive (Eyeball) Adjustments let you adjust your forecast results directly on-screen based on your business knowledge, for more realistic forecasts and informed planning decisions.

Multilevel (Multiseries) Forecasting makes it easy to obtain top-down and bottom-up forecasts, by product group/item or item/region, for large groups containing hundreds or thousands of items.

Smart Software, Inc.
Four Hill Road
Belmont, MA 02478
Tel: (617) 489-2743 or 1 (800) SMART-99
Fax: (617) 489-2748
www.smartcorp.com

10. EViews 5 for Windows 98, Me, NT 4.0, 2000, and XP

EViews 5 is a *stand-alone* software that provides the tools most frequently used in practical econometric and forecasting work. It covers Estimation, forecasting, statistical analysis, graphics, simulation, data management, all in a powerful, graphical object-oriented interface.

Quantitative Micro Software
4521 Campus Drive, Suite 336
Irvine, CA 92715
Tel: (949) 856-3368
Fax: (949) 856-2044
www.eviews.com

11. SIBYL/RUNNER
Sibyl/Runner is an interactive, *stand-alone* forecasting system. In addition to allowing the usage of all major forecasting methods, the package permits analysis of the data, suggests available forecasting methods, compares results, and provides several accuracy measures in such a way that it is easier for the user to select an appropriate method and forecast needed data under different economic and environmental conditions.

BUDGETING AND PLANNING SOFTWARE

In recent years, the focus has been on moving away from spreadsheets to enterprise budgeting applications in order to make the planning and budgeting process more efficient and the data more reliable. However the underlying process remains fundamentally unchanged; it is still about capturing and consolidating line item expenses. Several popular ones are described briefly.

Adaytum Planning
Adaytum Planning by Adaytum Software (www.adaytum.com**)** (1-800-262-4445) is a multi-user budgeting, planning, and forecasting system. It gives you the flexibility to:

- Update hierarchies directly from General Ledger (G/L).
- Combine top-down planning with bottom-up budgeting
- Make last minute changes to model structure
- Empower end-users to do ad hoc modeling without information system (IS) support.

Budget Maestro v5.8
Centage's Budget Maestro (www.centage.com) is probably the best answer to distributed budgeting, strategic planning and financial control. Budget Maestro shortens your budgeting cycle and puts you into control of the process. Its information-driven environment guides you through budgeting, planning, modeling, forecasting, resource management, consolidation, analysis, and reporting. CFOs and budget managers can plan, analyze and manage, in ways never before possible. Look at a user's screen and make changes directly without ever being there. Deliver budget models and deploy reconfigured software updates to many users at once. Plus manage budgetary information, even enterprise wide information systems, with a single consistent interface. Budget Maestro is designed to put CFOs and financial managers in control of all aspects of managing budgets, creating financial models and building and deploying financial plans. Budget Maestro

allows business managers unparalleled flexibility in analyzing cash flow and business performance throughout the enterprise. Budget Maestro significantly shortens your budgeting and planning cycles. It eliminates rekeying and formatting of data. It increases your data accuracy and integrity. It allows your time to manage and analyze your business. It is an excellent tool that provides you the ability to perform:

- Budgeting
- Forecasting; rolling forecasts
- Planning
- What-if scenario building
- Payroll and Benefits Management
- Headcount Planning
- Capital Asset Planning
- Debt Management
- Automatic data consolidation
- Management Reports
- Extensive drill-down Reporting
- Income Statement, Balance Sheet & Statement of Cash Flows

As an alternative to spreadsheets, Budget Maestro automates many of the complex and repetitive tasks in the budgeting process while eliminating the need for creating complicated formulas and manual consolidation of multiple worksheets.

Budget Maestro offers three editions:

Desktop Edition - A single user license that is ideal for the CEO, CFO or Controller of small to mid-sized organizations that have a centralized budgeting and planning process.
Small Business Edition - This edition supports up to 3 users operating in a collaborative environment to generate budgets, forecasts and financial reports.
Enterprise Edition - An enterprise-wide application for use by finance executives and departmental/line managers to foster a more collaborative and participatory planning environment.

Microsoft Business Solutions for Analytics—Forecaster

This is Web-based budgeting and planning solution from FRx Software (www.frxsoftware.com/). Many organizations find it difficult to perform the ongoing budgeting and planning processes necessary to keep business performance on target. Financial "surprises" are met with panic, and more often than not, companies are forced to make sacrifices in places they cannot afford. The result is a direct, negative impact on their strategic objectives. But it's not for lack of trying. Finance departments simply don't have the time it takes to combine multiple spreadsheets submitted from across the company (Let alone the resources to make sure all line managers understand the importance of the budgeting and planning process, and of submitting well-planned information on time!). *Forecaster* puts the systems and processes in place to help you immediately realize the benefits of an effective budgeting and planning process, and make it an ongoing part of your business strategy.

Host Budget V3.2

(www.hostanalytics.com) HOST BUDGET is an integrated budgeting and planning software that provides streamlined budgeting, forecasting, reporting, and analysis. Modules are used to automatically manage, consolidate, and change information for planning and replanning. These budgeting, forecasting, and planning modules include:

- Integration with Host's Performance Measurement Scorecard
- SG&A Budget module
- Human Resources Budget module
- Sales and Operation Planning (S&OP) module
- Sales Forecasting module
- Capital Expenditure Budget module and others

HOST BUDGET is architected for the Web so that the individuals involved in budgeting and planning can use all of the features. All that is needed by the user is a web browser to access and update the application. Microsoft Excel spreadsheets can be used "on-line" or "live" to the database for queries and updates. Or, if the user prefers to work disconnected from the central database the user can work "off-line" and easily upload the Excel file later or submit via email.

Because of the streamlined effects of HOST BUDGET on an organization's budgeting process, budgets and forecasts can be refined on an ongoing basis. Managers can consider what has happened so far and can regularly look into the future aided by actual versus budgeted information along with current forecast projections in their effort to meet financial goals.

Executive Managers can create top down budgets and "push down" the budget to lower levels of the organization. Line managers and department heads can create budgets from the bottom up and submit budgets for approval.

Continuous rolling forecasts can easily be created with HOST FORECASTER and bi-directional data integration allows the detailed budgets to be loaded to or from other applications.

Based on best practices, HOST FORECASTER provides a rich set of tools to facilitate sales forecasting using standard methods including:

- Statistical forecasting.
- Top down forecasting allocated to the SKU level based on prior year history, current estimate, last two years average sales, and other basis.
- Bottom up forecasting for product introductions and discontinued products.
- Ability to smooth forecasts to eliminate the impact of infrequent sales events.

SRC Systems

SRC Budgeting

Balancing flexibility and control, sophistication and ease-of-use, SRC Budgeting (www.srcsoftware.com) provides the tools you need to create and execute detailed budgets—transforming strategic goals into operational plans. SRC Budgeting not only simplifies the budgeting process, but also streamlines the sharing of data with key managers. The result is: Greater accuracy, enhanced accountability, and increased ownership by business units—all while dramatically reducing the time required for the planning process.

The benefits are:

- Increase collaboration while streamlining the budget process.
- Model budgets to fit your business.
- Align budgets with strategic plans and forecasts.
- Create flexible and sophisticated budgets.

SRC Sales Planning

With SRC Sales Planning, all deals can be tracked—not just the hot ones—and sales managers can adjust focus, training, and incentives to increase sales. Greater visibility into how leads play out at

various points in the sales pipeline improves management decision-making ability. Understand which leads are working and which ones are not. Understand which products and services are in demand, identify and investigate changes and fluctuations, and take appropriate action—whether it means realigning the salesforce or adjusting production and distribution.
The benefits are:

- Create a robust sales forecast.
- Make more accurate and timely planning decisions.
- Align sales, supply chain, and operations.

SRC Forecasting
This system allows you to create timely, high-level, dimensionally independent rolling forecasts—driven by the strategic plan—and translated into operational targets. SRC Forecasting streamlines and speeds the forecasting cycle, leverages a sophisticated and customizable modeling process, and helps ensure organizational alignment.
The benefits are:

- Streamline financial forecasting
- Customize and model forecasts for accurate planning
- Align forecasts with detailed budgets.

THE LATEST GENERATION OF BUDGETING AND PLANNING (B&P) SOFTWARE
The new budgeting and planning (B&P) software represents a giant step forward for accountants. Finance managers can use these robust, Web-enabled programs to scan a wide range of data, radically speed up the planning process, and identify managers who have failed to submit budgets. More often known as *active financial planning software*, this software includes applications and the new level of functionality that combine budgeting, forecasting analytics, business intelligence, and collaboration. Figure 9 lists popular B&P software.

FIGURE 9
ACTIVE FINANCIAL PLANNING SOFTWARE—
NEXT GENERATION BUDGETING AND PLANNING (B & P) SOFTWARE

Companies	*Websites*	*Software*

ABC Technologies	www.abctech.com	**Oros**
ActiveStrategy	www.activestrategy.com	**ActiveStrategy Enterprise**
Actuate	www.actuate.com	**e.Reporting Suite**
Adaytum Software	www.adaytum.com	**e.Planning**
Applix	www.applix.com	**iPlanning, iTM1**
Brio Technology	www.brio.com	**Brio.ONE, Brio.Impact, Brio.Inform**
Business Objects	www.businessobjects.com	**e-BI, BusinessObjects Auditor, BusinessObjects BW Connect, WebIntelligence**
Cartesis	www.cartesis.com	**Cartesis Budget Planning, Cartesis Carat, Cartesis Magnitude**
Closedloop Solutions	www.closedloopsolutions.com	**CBizPlan Manager, SpendCapManager, TopLine Manager**
Cognos	www.cognos.com	**Cognos Finance, Cognos Visualizer, Cognos Enterprise, Business Intelligence**
Comshare	www.comshare.com	**Management Planning and Control (MPC) Application, Comshare Decision**
CorVu	www.corvu.com	**CorManage, CorVu Rapid Scorecard, CorBusiness, CorPortfolio**
E.Intelligence	www.eintelligence-inc.com	**e.Intelligence Suite**
Epicor	www.epicor.com	**Epicor eIntelligence Suite**
Geac	www.geac.com	**Geac Smartstream Financials, Enterprise Solutions Expert Series, FRx**
Great Plains Software	www.greatplains.com	**eEnterprise, FRx Budget Controller, Dynamics**
Hyperion	www.hyperion.com	**Hyperion Financial Management, Hyperion Planning, Hyperion Essbase**
J.D. Edwards	www.jdedwards.com	**J.D. Edwards Financial Planning and Budgeting, Business Intelligence, OneWorld Xe**
Lawson Software	www.lawson.com	**Enterprise Budgeting SEA Applications – including E-Scorecard; Analytic Extensions**
Longview Solutions	www.longview.com	**Khalix**
MIS-AG	www.misag.com	**MIS Alea Decisionware, MIS DelaMiner, Collaborative Analytic Processing**
NextStrat	www.nextstrat.com	**NextStrat Strategic Implementation Portal (NextSIP)**
Oracle	www.oracle.com	**Oracle Strategic Enterprise Management (SEM)**
OutlookSoft	www.outlooksoft.com	**OutlookSoft Financial Planning and Analysis (FPA), OutlookSoft Enterprise Analytic Portal**
PeopleSoft	www.peoplesoft.com	**Enterprise Performance Management (EPM), PeopleSoft Balanced Scorecard, PeopleSoft Enterprise Warehouse, PeopleSoft eBusiness Analytics, PeopleSoft Activity-Based Management**
SAP	www.sap.com	**SAP Strategic Enterprise Management (SEM), SAP Financial Analyzer Business Intelligence with mySAP.com**
SAS Institute	www.sas.com	**SAS Total Financial Management, Strategic Vision, SAS/Warehouse Administrator, SAS Enabling Technology (OLAP)**
Silvon	www.silvon.com	**Stratum**
SRC Software	www.srcsoftware.com	**Budget Advisor, Payroll Planner, Information Advisor**

PROJECT PLANNING AND EVALUATION

Most project management applications today use computers extensively. The management of projects is enhanced by tools such as *Gantt* charting, Fish-bone diagram, the *Program Evaluation and Review Technique (PERT)*, and *Critical Path Method (CPM)*. These tools are easily computerized and indeed there are dozens of commercial packages on the market. The user inputs activity time estimates and procedure information, program output slack for each activity, duration and variance for critical paths, and other useful project management information. Many project management software packages, such as Microsoft project, let planners enter defined activities, events, and times only once, and then present either a Gantt or a PERT chart-or both-on the computer's monitor. The project manager can then see how changing parameters will alter the charts and completion times. Some managers prefer using Gantt charts, some prefer PERT charts, and others use both, for the same projects. The preference depends on the personality of the manager and on presentation needs, rather than on the nature of the project.

The types of project management software are described below.

1. Project- and Resource-Tracking Software. With these applications, you enter each task and subtask of the project as well as each subproject, then define resources, such as employees and contractors, and assign them. Most of these tools let you define priorities and set the order in which subprojects or individual parts of the project must be done. Many good specialized project-tracking tools are available, but remember, spreadsheets and even text editors can do the job in a pinch. The quality of your project management depends more on your skill and attentiveness than on the tools you choose to use.
2. Time-Tracking Software. These applications let you track in detail the amount of time it takes to implement your project. Keeping abreast of this information over time will help you improve your estimating skills.
3. Bug-Tracking and Source-Code Version-Control Software. These applications are not just for software-development projects. You can use these products to control changes to documentation, keep on top of the versions of vendor software that are in your standard desktop image and track problems with every portion of your project.

Below is a list of project management software.

Artemis International Solutions Corporation
http://www.artemisintl.com
Artemis Views 5

Computer Associates International
http://www.cai.com
AllFusion Process Management Suite

Integrated Strategic Information Systems Pvt.Ltd.
http://www.iPlanEnterprise.com
iPlan Enterprise 4.3; iPlan Web 1.3

Microsoft Corp.

http://www.microsoft.com
Microsoft Project 2000
Microsoft Visio Standard 2002

Pacific Edge Software
http://www.pacificedge.com
The Edge Solution w/Portfolio Edge & Project Office

PlanView
http://www.myplanview.com
PlanView

Primavera Systems
http://www.primavera.com
Primavera TeamPlay

Welcom
http://www.welcom.com
Cobra 3.5
Open Plan 2.6
WelcomHome 2.5

CAPITAL BUDGETING

There are many software packages such as ready-to-use Excel worksheets, called templates. The following are samples of such software.

1. Investment-Calc PRO (www.mlnsoft.com/software/most_popular/index.php)
With Investment-Calc PRO Version 5.0 you can create and manipulate ready to use cash flow Excel worksheets to analyze business, capital, share, lease purchase cash flow forecasts for internal use, for acquisitions, and for calculating best valuation for sale. The program calculates Net Present Values, Internal Rate of Return, Accounting Rate of Return, Share Valuation & Economic Valuations over any forecast period to 15, 20, 30 or 50 years. Investment-Calc incorporates self generating tables, that calculate yearly asset depreciation values for any yearly capital purchase program, prepares tax calculations, calculates annual lease and loan finance costs and repayments, compounds money values and transfers all values automatically into user's spreadsheets to help save time.

2. Budget-Calc (www.mlnsoft.com/software/most_popular/index.php)
Budget-Calc PRO provides ten budgeting templates plus dynamic (self-adjusting) Excel tables for depreciation and loan amortization for preparing investment forecasts, profit/loss budgets, cash flow forecasts, capital budgets, sales, 91 day AP/AR forecasts and annual employee productivity plans quickly and accurately. (FASB 141 & 142 goodwill & intangible variable depreciation tables included).

APPRAISAL OF INVENTORY

SQL Financials International's *Purchasing Control* is used to control the purchasing processes. It provides information about purchase orders, items, vendors, receipts, invoices, and payments.

Computer Associates' *ACCPAC* is a financial management software including order entry, inventory control, and job costing.

Lawson Software's *Insight Business Management System* includes supply chain and procurement, materials distribution, and audit controls.

Inventory Analyst is a template for computing economic order quantity, reorder point, and optimal inventory levels. Inventory history is depicted as a basis to predict future trends. It incorporates such forecasting techniques as moving average, exponential smoothing, and time series. Seasonal factors are incorporated.

Computron Software's *Computron Financials* does inventory stock control and time recording.

Dun & Bradstreet's *Smart Stream* does inventory stock control, warehousing, accounting for manufacturing processes, production scheduling and routing, and materials requirements planning.

Syspro Impact Software's *Impact Encore* does materials and resource planning to aid in cutting costs and improving delivery and quality. It has a purchase order system and can handle activity-based costing. It aids in tracking items through the production process.

Open Systems' *Accounting Software* inventory module features alternative costing and pricing methods including matrix pricing for customers. It can perform physical and cycle counts based on specified criteria. It also determines the level of inventory requiring a reorder. The package also has sales order functions.

Fourth Shift Corporation's *Manufacturing Software System* keeps track of inventory and manufacturing.

Best Ware's *MYOB* software's inventory module provides a listing of items, restocking information, and backorder listing.

EXECUTIVE MANAGEMENT GAMES

Computerized management games provide an excellent learning tool in making financial and managerial decisions so as to develop analytical and strategic abilities. The management game is a type of mathematical model and simulation. Simulation is designed to simulate a system and to generate a series of quantitative and financial results regarding system operations. In management games, participants make decisions at various stages in an attempt to better comprehend the external simulated environment. The games allow for a better understanding of the interrelationships of the various functions within the business and how such interactions affect overall performance. Some good management games are *PERT-SIM* for project planning and control, *Westinghouse Simulation Exercise* for distribution and logistics, *IBM Production Manpower Decision Model* for production and manpower scheduling, *MARKSIM* for marketing decision making, *X-Otol* for distribution analysis, Green and Sisson's *Materials Inventory Management Game* for inventory planning, and *FINASIM* for financial management simulation. Other executive management games are Harvard University's *Harvard Business Game,* K. Goosen's *Management Accounting Game,* R. Schrieber's *Top Management Decision Game,* Carnegie Mellon's *COGITATE,* and R. Barton's *IMAGINIT Management Game.*

LINEAR PROGRAMMING

Linear programming is the allocation of limited capital and human resources to maximize gain or minimize cost. *Linear Interactive and Discrete Optimization* (LINDO) can be used to obtain optimal solutions.

What's Best! is a linear programming software aiding in determining the optimal allocation of limited capital, human, and financial resources. It considers time constraints and is ideal for management decision making. The objective of the software is to maximize revenue or minimize cost.

FLOWCHARTING

Flowcharts are diagrams that use standardized symbols, interconnected with flow lines, to visually represent complex procedures and data flow. People generally understand pictures better than words, and visual representation of data can often enhance understanding. Accountants can use flowcharts to document and understand the processing of information through the accounting system. Flowcharting software allows users to illustrate policies, processes, and procedures with diagrams. Typical flowcharting packages allow users to create diagrams for process and data flows, hierarchy charts, fishbone diagrams, structure charts, cause and effect diagrams, and organizational charts. Most packages contain templates or specialized libraries for symbols typically used by accountants and other professionals. It is also possible to create a custom library composed of frequently used shapes.

Micrografx Inc.'s *ABC FlowCharter* is a powerful and easy-to-use package. You can "drag and drop" hundreds of shapes from its extensive template library.

HavenTree Software Ltd.'s *EasyFlow* is a specialized drawing program. It uses the "drag and drop" approach to flowcharting. The user selects shapes from a palette and drops them into the appropriate place in the work area. *EasyFlow* comes with excellent documentation and tutorials.

Clear Software's *allCLEAR* takes a unique approach to flowcharting. To create a flowchart in *allCLEAR*, you write a script in the form of an outline. The punctuation in the script determines how the flowchart will look. The script approach makes it easy to create and modify even complicated flowcharts. However, the script approach greatly restricts the user's ability to customize flowcharts.

Patton & Patton Software Corp's *Flow Charting* is a good choice for the flowcharting beginner. It is a specialized drawing program and utilizes the drag and drop approach to flow charting. It comes with an excellent tutorial.

Aldus Corp.'s *IntelliDraw* is a powerful diagramming and illustration package. It is not exclusively a flowcharting package. *lntelliDraw* is ideal if you work with many types of drawings, and flowcharting is just one of your many needs.

Micrografx Inc.'s *ABC Snap Graphics* is a general-purpose drawing and illustration package. It offers an easy-to-use interface and makes extensive use of drag and drop capabilities. It is ideal for an individual that prefers ease of use to esoteric features.

Shapeware Corp's *Visio* offers users a choice of drag and drop or script approach. Drawing flowcharts with *Visio* is very similar to manually drawing flowcharts. *Visio* works with computerized versions of plastic stencils that include cutouts for various symbols.

RISK ANALYSIS

Corporate risk may be analyzed using the spreadsheet add-in *@Risk*. How will a new competitor affect your market share? @RISK calculates the likelihood of changes and events that affect your bottom line. First use @RISK's familiar @ functions to define the risk in your worksheet. Then let @RISK run thousands of what-if tests using Monte Carlo simulation. You get a clear, colorful graph that tells you the likelihood of every possible bottom-line value. @RISK lets you view your model's results from hundreds or even thousands of what-if scenarios. You get answers to questions like, "what's the chance of a negative result?", "What's the chance of a result over one million?" At a glance you'll know if your risk is acceptable, or if you need to make a contingency plan.

Business Foundations' *Internal Operations Risk Analysis* appraises a company's areas of risk. It is an expert system developed around more than *150* interview questions. Based on the answers to the questions, the software prepares analytical and management reports summarizing the strengths and weaknesses in the company's operations. A risk rating (high, medium, low) is assigned to risk categories. It recommends corrective steps for problem areas. There is an upgrade for industry-specific situations.

CHAPTER 3
INFORMATION SECURITY AND DATA PROTECTION

Learning Objectives:

After studying this chapter you will be able to:

1. Evaluate computer system failures.
2. Establish a security policy.
3. Maintain a preventive care system.
4. Institute safety alarm systems.
5. Develop hardware and software security.
6. Examine an audit trail.
7. Initiate network and password security.
8. Develop and implement a process for contingency planning.
9. Understand the legal issues.

Security concerns have heightened in recent years including computer-related data errors, thefts, burglaries, fires, and sabotage. The increased use of networked computers, including the Internet, intranets, and the extranets, has had a profound effect on computer security. The nature of the computing environment has changed significantly. The greatest advantage of remote access via networks is convenience. This convenience, however, makes the system more vulnerable to loss. As the number of points from which the computer can be accessed increases, so does the threat of attack. More caution is clearly needed to counter such threats.

The first step in managing computer security is to identify the resources that need to be protected. For example, the resource to be protected might be CPU cycles or computer time. This is unlikely to be the objective of most attackers or hackers. Frequently, hackers are interested in obtaining access to private or confidential information. Sometimes, the organization may not even consider the information to be “valuable” to anyone else and may not be willing to take security precautions. This is a serious mistake. Hackers often steal or destroy data or information simply because it is there! Other hackers may delete or destroy files in an attempt to cover their illegal activity. This leads to just one conclusion. A casual attitude towards computer security is never justified.

The second step in managing computer security is to determine against whom you want to protect your system. The security needs of a military computer system are likely to be significantly different from the security needs of a corporation. Are you trying to protect your computer system from teenagers “playing around” or corporate spies or industrial espionage?

The third step in managing computer security is balancing the costs and benefits of various security safeguards. In other words, how much are you willing to spend on security? Clearly, it is prudent to spend more on protecting resources that are of greater value to the organization. The cost of security safeguards include not only the direct cost of the safeguards, such as equipment and installation costs, but also indirect costs such as employee morale and

productivity. It is important to recognize that increasing security typically results in reduced convenience. Employees for example, may resent the inconvenience that results from implementing security safeguards. Too much security can be just as detrimental as too little security; a balance must be maintained.

The last step in managing computer security is contingency planning. Assuming that security is violated, how do you recover? What are the data backup policies? What are the legal consequences? What will be the financial impact? A risk analysis should be performed in planning computer security policies and financial support. Computer security risks fall into one of three major categories: destruction, modification, and disclosure. Each of these may be further classified into intentional, unintentional and environmental attacks. The threat comes from computer criminals and disgruntled employees who intend to defraud, sabotage, and "hack." It also comes from computer users who are careless or negligent. Lastly, the threat comes from the environment; an organization must protect itself from disasters such as fire, flood, and earthquakes. An effective security plan must consider all three types of threats: intentional attacks, unintentional attacks, and environmental attacks. What is the company's degree of risk exposure? Insurance policies should be taken out to cover such risks as theft, fraud, intentional destruction, and forgery. Business interruption insurance covers lost profits during downtime.

COMPUTER SYSTEM FAILURES

A computer system can fail for several reasons, including:

- Operator mistakes
- User mistakes
- Malicious acts
- Hardware malfunction
- Software bugs
- Environmental factors, such as lightning, fire, earthquake, or power outage

When discussing computer reliability, it is useful to distinguish between *errors, failures* and *faults* in a computer system. An error occurs when there is a deviation from expectations. Some errors are acceptable because they can be overcome, others are not. An unacceptable error is a failure. If the failure can have serious consequences, it is considered a critical failure. A fault is a condition that results in a failure.

System reliability is distinct from system security. Security is designed to protect against intentional misuse and does not consider malfunction. Improving one factor often enhances the other factor. Both factors need to be considered in managing risk.

ESTABLISHING A SECURITY POLICY

Every organization should have a security policy that defines the limits of acceptable behavior and the organization's response to violations of such behavior. Its purpose is to assign accountability and delegate authority across the organization. The security policy will naturally differ from organization to organization, based on its own unique needs. For example:

- There may be an edict barring the playing of computer games on corporate computers.
- There may be a policy against visiting adult web sites on the Internet using corporate Internet accounts or computers.
- Some organizations may wish to restrict the use of a specific protocol because it cannot be administered securely.
- Employees may be prohibited from taking copies of certain corporate data out of office premises.
- There may be a policy prohibiting use of pirated software.

The security policy should not only define acceptable behavior, but it should also contain the organization's response to violations. How will the violators be reprimanded? Will the organization reprimand violators inside the organization differently from violators outside the organization? What type of civil or criminal actions might be taken against violators?

The security policy should be a broad statement that guides individuals and departments in achieving certain goals. The specific actions needed to realize the goals are contained in supporting standards rather than in the policy document. The security policy should be concise and to the point, generally not exceeding ten pages. It should be easy to understand. Its focus should be on emphasizing the role of individuals and departments in achieving the objectives. It is not the purpose of the security policy to educate or train individuals. Such an objective is better served through training seminars.

The background for developing a security policy should be discussed. It should explain the purpose of security, including why data integrity must be maintained. The importance of maintaining confidentiality and privacy of information resources should be emphasized. The continuous availability of information is important for the organization and any interruption can have serious financial consequences.

Employees should understand computer security is everyone's responsibility. The scope of the computer security policy should encompass all locations of the company and all of its subsidiaries. Security is only as strong as its weakest link and therefore the same set of standards should be used throughout the organization. This means that the standards should be flexible enough so they can be used in a wide variety of circumstances and conditions, yet they should provide consistency and quality across the organization.

The security policies apply to all computer facilities and the data they contain, including stand-alone computers, Internet and intranet sites, local area networks (LANS), and wide area networks (WANS). All forms of electronic communication, including email and fax and data transmissions are covered by the security policy. Other printed material, such as documentation and technical specifications, should be included in the security policy.

Computer security should be viewed as a means to an end and not an end itself. Computer security is an integral component of an organization's overall risk management strategy. The

responsibilities of various departments and individuals should be identified in the security policy. The policy established should be evaluated on a periodic basis to incorporate changes in technology or circumstances. The authority for issuing and amending the security policy should rest with a committee such as the Information Technology Management Committee. This committee should be responsible for determining when circumstances justify departure from the policy; all exemptions and exceptions should be approved by the committee.

Active participation by individuals and departments is needed for a security policy to succeed. It is well established that individuals are more likely to accept the security policy if they have had input during its creation. The real benefit of participation is that employees or departments will make a positive contribution to the policy by imparting their knowledge. Senior management's support and cooperation is critical in implementing the policy.

The relationship between the computer security policy and other corporate policies should be described. For example, the computer security policy should be used in conjunction with the firm's policies for:

- the internal control structure
- contingency plans, including business resumption planning
- privacy and confidentiality
- compliance with local and federal laws and regulations

A process should be in place to ensure compliance with laws and regulations. Privacy and confidentiality issues have a serious effect on computer security. Increased governmental regulation should be expected in the future. The legal department should assist department heads in complying with laws and regulations.

The Information Systems department's and its security personnel's responsibilities should be defined in the security policy document. These responsibilities include:

- ensuring that security personnel have the training and skill needed to perform duties required by the security policy.
- provide computer security assistance to other departments. Be responsible for all computer networks and communications.
- providing systems development methodology for security needs. Be responsible for all cryptographic methods and keys.
- provide and manage virus detection software for networked and stand-alone computers.
- be responsible for acquiring hardware or operating systems that are not currently part of the organization's architecture.
- authorizing the use of the network, including the Internet and Intranet.
- review, evaluate and approve all contracts with third parties concerning information systems.

For personal computer systems, additional precautions are needed and should be addressed in the security policy. Some points to consider include:

- all original data should be backed up on a periodic basis.
- personal computers connected to a network may be a source of viruses; virus detection software should always be used, especially before copying data or programs on to the network.
- confidentiality and privacy of data may be compromised.
- certain types of confidential or important data should never be stored on a local hard drive; instead such data should be stored on the network, or on floppy or compact disks or removable hard drive so that it may be removed and stored in a secure place.
- standards should be established for remote access.
- personal computers should not be directly connected to the Internet since the Internet is a source of virus infections and hackers may be able to gain access through it; Internet access should be only through the company's Internet server which is capable of protecting itself.

PHYSICAL SECURITY AND DATA SECURITY

Physical and data security considerations are equally important. An effective security system should prevent a security breach. However, if in spite of proper protection, a system is successfully attacked, the system should create an audit trail to allow prompt investigation.

Unauthorized access to the computer facilities should be restricted and sensing and surveillance devices should be installed. Computer environment, including heating, cooling, dehumidifying, ventilating, lighting, and power should be protected. Appropriate care must be taken to protect the plant from harm and accidents and disasters such as fire and floods. Adequate emergency lighting should be available for safe evacuation in case of fire or other disaster. Consideration must be given to loss or damage to computer equipment and peripherals. Media, such as disks, tapes, and output should be protected. User manuals for equipment and software must be protected to maintain continuity of proper operations. Surge protectors should be used to protect the computer system against power line disturbances. Of course, the organization must consider loss of or injury to its personnel.

The layout of computer facilities is important in planning for computer security as well as achieving cost savings. As computers become smaller, they can be housed in smaller areas and this changes the way facilities are designed and planned. For example, it is no longer necessary to have raised floors in the computer room. If wiring is a concern, cables can generally be along the walls. If flooding is a concern, aluminum channels or I-beams can be used to raise components and cabinets. Cabling costs can be saved by placing the network equipment inside, next to the processing equipment. Smaller components may be stacked vertically to conserve floor space and reduce cable costs.

The computer facilities should be housed in a building's core area near wire distribution

centers. Care should be taken to avoid a location where water or steam pipes cross either vertically or horizontally. The room should be sealed to keep out smoke and dust.

Only one door should be used for access into a secured area. The door should be self-closing and it should not have a hold-open feature. A combination or programmable lock may be sufficient. An alarm system should be installed. There should not be any direct access from public places.

WIRES AND CABLES

With the increase in distributed computing, it is even more essential to protect the wiring system. Wires and cables are generally made of either copper or optical fiber. Fiber optics offer significant performance and security advantages. However, they cost more to install. Still, if considerable data needs to be transferred, the cost disadvantage of fiber optics rapidly diminishes.

Cables and wires are fragile. They can be easily damaged. It is not possible to repair damaged wires; they must be replaced. The electrical properties of cables may also be affected and the data may become unreliable. Alternate paths should be provided for cables linking important or critical paths.

Fiber optics offer better security protection. It is relatively easy for someone to wire tap copper lines if they can obtain access anywhere along its length. Such wiretaps are very difficult to detect. In contrast, it is difficult and expensive to wire tap fiber optics. Moreover, normal operations are disturbed in a fiber optics tap and can therefore be detected more easily. Even with fiber optics, it is possible that a skilled individual with proper equipment can tap the system undetected. Fiber optics provide a deterrent, but should not be viewed as being perfectly secure. Of course, the best way to protect sensitive data is to use some type of encryption.

Fiber optics are not affected by electrical or magnetic interference. Copper wires have to be shielded with cabling and grounded metal conduits have to be provided.

The ends of all fiber optic cables must be microscopically smooth. They have to be exactly aligned and positioned. This requires the use of expensive special equipment and highly trained personnel.

Data wiring should be certified by a knowledgeable and experienced individual. Such an individual should

- Perform a visual inspection.
- Check that each cable is connected correctly.
- Check that there are no crossed pairs.
- Use a reflectometer to detect if there are any constrictions, bad terminations, or external interference.

Purchase orders for any wiring should specify:

- Who will certify the wiring.
- What equipment will be used to test the wiring.

- What standards will be followed.

DESTROYING DATA

Once data is no longer needed, it must be properly destroyed. Information on magnetic media is typically "destroyed" by over-writing on it. While the information appears to have been destroyed, there are many subtleties to consider. For example, if the new file is shorter than the old file, information may remain on the magnetic media beyond the new file's end-of-file marker. Any information beyond the end-of-file can be easily retrieved. A safe method is to overwrite the entire media. However, overwriting the entire media is time consuming and other methods, such as degaussing should be used. Degaussers are essentially bulk erasure devices that when used within their specification provide adequate protection.

Formatting a disk does not safely destroy all information. It is important to note that magnet media may retain a latent image of the preceding bit value after the write insertion of a new bit value. This occurs due to the inability to completely saturate the magnetization. While normal read/write operations are not affected by this limitation, it does pose a security threat and anyone with sophisticated equipment could exploit it.

For papers and other soft materials, such as microfiche and floppy disks, it is possible to shred them. Some shredders cut in straight lines or strips. Others offer cross-cutting and particle producing. Some shredders disintegrate by repeatedly cutting and passing the material through a fine screen. Shredders may also grind the material and make pulp out of it.

Burning is still another way to destroy sensitive data that is no longer needed. As with shredding, burning means that the storage media can no longer be reused. Even when burning, one needs to exercise caution. It is possible, for example, to retrieve printed information using special techniques from intact paper ashes, even though the information may no longer be visible to the human eye.

ENVIRONMENTAL CONSIDERATIONS

Computer facilities are susceptible to damage from environmental factors. Fire security is especially important and is discussed in detail in a separate section. Other important factors include heat, water, humidity, dust, and power failure.

- *Heat* and high temperature can cause electronic components to fail. Air conditioning is generally essential for reliable operation. Simple precautions should be taken to ensure that air vents are not blocked and that the air is allowed to circulate freely. Backup power should be available for air conditioning if the computer system will be used even if the primary power fails.
- *Water* is an obvious enemy of computer hardware. Hoods, rain, sprinkler system, burst pipes, etc. could do significant damage. Attention should be given to the design of routing water pipes and the location of the computer facilities. Instead of a traditional sprinkler system, consider using an alternate fire-extinguishing agent that will not damage the hardware.
- *Humidity* at either extreme is harmful to the hardware. High humidity is likely to lead to condensation which can corrode metal contacts or cause electrical shorts. Low humidity is

likely to permit the buildup of static electricity. Computer facilities should either be housed on bare floors or floors covered with anti-static carpeting. Humidity should be continuously monitored and kept at acceptable levels.

- *Dust,* dirt, and other foreign particles can ruin computer hardware. For example, dust can interfere with proper reading and writing on magnetic media. Personnel should not be permitted to eat or drink near the computer facilities. Air should be filtered and filters replaced at appropriate intervals.
- *Power failure* can render all equipment useless. Brownouts and blackouts are the most visible sign of power failure. However, voltage spikes are much more common and can cause serious damage. Spikes may be produced by lightening and such spikes may either damage equipment or randomly alter or destroy the data. A drop in line voltage can also lead to malfunction of computer equipment and peripherals. Voltage regulators and line conditioners should be used if electrical fluctuations occur. Use of uninterruptible power supplies should be considered.

MAINTENANCE AND PREVENTIVE CARE

Facilities should be protected against adverse effects of the weather and other environmental factors. Regular maintenance can help prevent unexpected downtime. Diagnostic programs should be run as part of regular maintenance. Maintenance logs should be kept. Recurring problems can be quickly identified by scanning the logs. The maintenance log should include, at a minimum, the following information:

- Description of equipment serviced.
- Company Identification number of equipment serviced.
- Date of service.
- Services performed, including the results of diagnostic tests.
- A note indicating whether the service was scheduled or unexpected.

Computer areas should be properly cleaned and dusted. Eating, drinking, and smoking should be prohibited in computer areas. Personnel should be trained in proper handling of computer equipment and peripherals. Personnel should be trained in proper handling of magnetic media and CD-ROMs. For example, magnetic media should not be placed on top of or near telephones, radios, and other electric equipment. Labels should be prepared prior to placing them on disk; many untrained personnel will affix the label to the disk and then write on the label using a ball point pen.

Computers and peripheral equipment should be cleaned on a regular basis using cleaning products recommended by the manufacturer. Electrical equipment should never be sprayed directly with cleaning liquids. Keyboard surfaces should be cleaned with a damp cloth and vacuumed using special computer vacuums.

Magnetic media devices, especially the read/write heads and transport rollers, should be cleaned using commercially available cleaning products for such purpose. Dust, smoke, finger prints, and grease can build up on recording surfaces and lead to crashes or permanent damage to the equipment and magnetic media. Printers may need to be cleaned to remove fibers, dust

particles and lint.

Simple precautions, such as using static-resistant dust covers protect the computer equipment and peripherals. Such covers should only be used when the equipment is not in use. Otherwise, the equipment may overheat and be damaged.

WATER ALERT SYSTEMS

Water alert systems should be installed in locations where water might damage computer equipment. Generally, water alert systems should be installed in the basement or in floors above the computer systems. Water sensing systems are especially useful in protecting electrical cables under the floor. Water sensors should be installed within suspended ceilings and inside water cooled computer cabinets and process cooling equipment. The water sensors should activate an alarm as well as some type of a drainage pump.

STATIC ELECTRICITY

Static electricity results from an excess or deficiency of electrons. An individual could easily become charged to several thousands of volts. While the current from electrostatic discharges is too low to harm humans, electronic equipment could easily be damaged. Protective measures against electrostatic discharges include grounding, shielding, filtering and limiting voltage. Vinyl flooring is generally better than carpeting to avoid a build up of static electricity. Simple precautions can minimize the dangers from static electricity; these include:

- Using anti-static spray.
- Grounding computer equipment.
- Using anti-static floor and table mats.
- Maintaining the proper level of humidity.

HUMIDITY CONTROL

Humidity should be tightly controlled and maintained at an optimal level. When the air is too dry, static electricity is generated. When humidity is too high, generally at levels above 80% relative humidity, there may be problems with electric connections, as a process similar to electroplating starts to occur. Silver particles start to migrate from connectors on to copper circuits, thus destroying electrical efficiency. A similar process affects the gold particles used to bond chips to circuit boards. Generally, an optimal relative humidity level is about 40 to 60 percent.

FIRE PROTECTION

According to insurance companies, fire is the most frequent cause of damage to computer centers. No combustible material should be allowed in the computer room. This means special care should be taken in selecting office furniture. Waste receptacles should not be in the computer room. Instead, waste receptacles should be located nearby, just outside the computer room.

Fire detectors should be installed in appropriate locations and connected to an automatic fire alarm system. Fire detectors sense either changes in temperature or thermal combustion and its byproducts. Fire detectors may be activated by smoke, heat, or flame.

Smoke activated devices provide early warning for slowly developing fires. Smoke detectors should be installed in air conditioning and ventilating systems. Smoke detectors typically rely upon either *photoelectric* devices or *radioactive* devices.

- *Photoelectric Smoke Detectors:* Variations in the intensity of light cause changes in electric current in the photoelectric cell. Photoelectric smoke detectors are generally of three types:

- *Area-sampling* photoelectric devices draw in air from the area to be protected, and if smoke is present in the sampled air, the light reflections on the photoelectric cell will trigger the alarm.

- *Beam* photoelectric devices focus a beam of light on to a photoelectric cell from across the protected area. The smoke causes an obstruction in the light and activates the alarm.
- *Spot* photoelectric devices, unlike beam photoelectric devices, contain the light source and the receiver in one unit. Light is not projected across the protected area. Instead, smoke entering the detector causes the light to reflect onto the photoelectric cell hence activating the alarm.

- *Radioactive Smoke Detectors:* These smoke detectors contain a minute amount of radioactive material in a special housing. Smoke interacts with the radioactive material and changes its ionization which activates the alarm. Radioactive detectors are most commonly the *spot* type. The response time for radioactive smoke detectors is affected by several variables, including the stratification of air currents and the nature of products of combustion. Generally, the heavier the particles resulting from combustion, the longer it takes for them to reach the ceiling where the smoke detectors are usually attached and the longer the response time of the unit. Incidentally, the danger from radiation from such detectors is minimal and all detectors must meet or exceed government standards.

Heat activated detectors can be of two types. The first type will activate the alarm when the temperature reaches a fixed predetermined value. The second type of detector senses the rate of change in temperature. Typically when the rate of rise in temperature exceeds 150 to 200 F, the alarm is activated.

For highly combustible areas, the rate of rise temperature detectors are recommended due to their faster response time. However, fixed temperature detectors tend to be more reliable and are not as prone to false alarms. Some heat activated detectors contain both types of sensors.
Heat activated detectors are available in *line* or *spot* coverage styles. Line type detectors usually rely upon heat sensitive cables or a pneumatic tube. Spot type detectors are placed at fixed intervals in each zone.

Flame activated detectors are of two types: Flame-Radiation-Frequency and Flame-Energy. Radiation-frequency detectors sense the flame related flicker caused by combustion. These sensors tend to be expensive and are therefore suitable under limited circumstances. Flame-energy detectors sense the infrared energy of the flame. These are also expensive and tend to be suitable for protecting expensive equipment. The principal advantage of flame-energy detectors is their super-fast detection of infrared energy of flame. These detectors are also capable of producing enough voltage to trigger the release of an extinguishing agent.

Different types of fires require different types of extinguishing agents. Using the wrong extinguishing agent can do more harm than good.

- Fires involving ordinary *combustible materials,* such as wood, paper, plastics, and fabric can be safely extinguished using water or tri-class (ABC) dry chemical.
- Fires involving *flammable liquids and gases,* such as oil, grease, gasoline, and paint can generally be safely extinguished using tri-class (ABC) and dry chemical, Halon, FM-200, and carbon dioxide.
- Fires involving live electrical equipment should be extinguished using a non-conducting extinguishing agent, such as tri-class (ABC), regular dry chemical, Halon, or carbon dioxide.

Most computer room fires will be electrical, caused by overheating of wire insulation or other components. Smoke from an electrical fire may be toxic and it should be avoided in even small quantities. Generally electrical fires cannot be extinguished till the heat source is eliminated.

A power panel with circuit breakers for the major pieces of equipment should be placed at an easily accessible location, preferably inside the computer room. The circuits should be clearly labeled so equipment can be shut down quickly in an emergency. Redundant devices should be on separate circuits. There should be one emergency switch to shut down everything in the event of a fire.

In the event of a major fire or explosion, the only concern should be the safety of human life. Computer equipment and wiring is likely to be destroyed by the intense heat. Backup copies of disks and data should always be kept at off-site locations. Not only will this help when attempting to recover from a fire, but it can also help during the fire since the personnel will not attempt to save backup data by risking their lives.

Halon has the potential of depleting the ozone layer. While Halon is still in use, an international agreement was reached to stop its manufacture as of January 1, 1994. FM-200 is now available as a Halon substitute. Both Halon and FM-200 systems tend to be expensive and governmental approval is often required. These systems are also not very effective against electrical fires. In an electrical fire, it is essential that the power be shut off because a fire extinguishing system will only suppress the fire till power is stopped.

Water sprinkler systems are simple and a relatively inexpensive protection against fire. Most new buildings are required by code to have a sprinkler system. Accidental activation of the

sprinkler system can cause substantial damage and it may take a long time before normal operations are resumed. In an electrical fire, water may even intensify the fire and cause greater damage. Sensors should be installed to cut off electrical power before sprinklers are turned on. It should be possible to activate sprinkler heads individually to prevent damage to a wide area. There should be a shutoff valve inside the computer room so that water can be shut off when it is no longer needed. This will minimize damage in the event of accidental activation.

Carbon dioxide, Halon, and FM-200 extinguishers do not require any clean-up after discharge. However, carbon dioxide discharge can suffocate humans. Foam or dry chemicals can be hard to remove. Hand-held fire extinguishers should be mounted on walls. Self-contained breathing apparatus should also be mounted on the wall.

Quick removal of smoke should be a priority. Special fans and blowers should automatically be activated by the smoke or fire alarm.

If computer equipment starts smoking, the first step should be to cut off the equipment's electrical power. This is frequently sufficient and the fire will probably extinguish by itself. If there are visible signs of fire, or if you can feel the heat, an appropriate fire extinguisher should be used. Carbon dioxide extinguishers are often recommended for microcomputer related fires. When using a carbon dioxide extinguisher, do not spray the extinguishing agent directly onto the glass surface of the CRT, since it will lead to a sudden drop in temperature and shatter the glass.

Personnel should be trained for fire emergency. Company policy should state exactly what action should be taken in the event of a fire or smoke alarm. Personnel should be strictly forbidden from risking injury or loss of life to protect data or equipment. The following steps can reduce the damage caused by fire, and in the process, reduce insurance premiums:

- Safes for storage of documents should have a minimum four-hour fire rating.
- Walls, floors, and ceilings of computer facilities should have a minimum two-hour fire rating.
- Fire alarm should ring simultaneously at the computer facility and the nearest fire department. In addition, fire alarm signals should be located where prompt response is assured.
- Vaults used for storing backup tapes and records should be located in a separate building at a sufficient distance.
- Smoke and ionization detection systems should be installed throughout the ceiling of the computer facilities. Water detection systems should be installed under the floor of computer facilities.
- Halon, FM-200, or a similar fire extinguishing system should be installed throughout the computer facilities. Automatic sprinkler systems can be used in the supply and support areas. In case of destruction, there should be a disaster recovery plan.
- Building code and fire marshal regulations must be adhered to strictly.

Access controls guard against improper use of equipment, data files, and software. The oldest method of restricting physical access is by using some type of lock. Locks may be classified into two types: preset locks and programmable locks.

With preset locks, it is not possible to change the access requirements short of physically modifying the locking mechanism. Programmable locks may be either mechanical or electronic. The combination on the programmable locks can be more easily changed, as security needs change. A basic problem with such locks is that the entry codes are frequently easy to obtain by an observer. Some types of electronic locks overcome this problem by using a touch screen that randomly varies the digit locations for each user and by restricting directional visibility to basically perpendicular angle.

Security guards and security dogs are another way to restrict access in a wide variety of situations. The physical presence of guards and dogs serve as a deterrent. In the event of a problem, the guard is able to respond appropriately. Preemployment screening and bonding are essential when hiring security guards. Certain states, such as New York, have mandatory training requirements for guards.

Limitations with such methods are well known. Guards can become easily bored with the routine work and may not fulfill their duties as expected. It is easy for someone to forge identification and be let in by a guard. Another limitation of guards is that they may not be informed and through procedural error allow unauthorized individuals access to restricted areas.

Guard dogs are also very useful and act as deterrents. Dogs have excellent hearing and a keen sense of smell. Guard dogs can be trained to “hold” intruders till security personnel arrive. One disadvantage of security dogs is that additional liability insurance must be purchased. Training and maintaining dogs is expensive. Finally, guard dogs generally cannot differentiate between authorized and unauthorized visitors.

Still, security is enhanced if guards and/or dogs patrol the facilities frequently and at random intervals. The use of guards and dogs contribute to psychological deterrence. It lets a potential attacker or intruder know that he might be caught. A determined attacker, of course, is unlikely to be deterred by psychological deterrents and security should always be supplemented through other means.

Something as simple as lights greatly enhances security. Lights improve the ability of security personnel to carry out surveillance. Lights also deter intruders from entering the facilities. Lights may be left on all the time, on timer control, on ambient control, activated by motion detectors, or manually operated.

Computer and terminal access controls include:

- *Automatic Shut-Off* The system signs off the user if the user fails to sign off after the transmission is completed.
- *Call Back:* A phone call is made to the terminal site to verify the user’s identity before access is granted to the system.
- *Time Lock:* Access is denied to the system during specified hours, such as after normal business hours.

Within the plant, areas containing sensitive data should be accessible only to authorized

personnel. These areas, including the computer room should have only a single entry door which can be operated by an appropriate encoded magnetic-strip ID card. Physical controls include having a librarian keeping a log. A lockout should occur with repeated errors. Logs should automatically be kept of the ID number, time of access, and function performed. Further, data dictionary software provides an automated log of access to software and file information. Intrusion detection devices such as cameras and motion detectors should be used to monitor sensitive and high-risk areas against unauthorized individuals.

Are controls being diligently followed over processing, maintaining records, and file or software modification? Each individual function (e.g., accounts receivable, payroll) may have its own password so that users have access to limited areas of their authorization. The computer can keep an internal record of the date and time each file was last updated. This internal record should be compared against the log. The hours to access "key" microcomputer files should be limited. This prevents unauthorized access after normal working hours. Files should be expressed in terms of different levels of confidentiality and security such as top secret, confidential, internal use only, and unrestricted. Confidential information should not be displayed on the screen. To control access to sensitive data, there should be a mapping of access requirements to the system components. Access rights should be based on job function, and there should exist an appropriate segregation of duties. Temporary employees should be restricted to a specific project, activity, system, and time period.

HARDWARE SECURITY

Computer hardware has improved in reliability and speed tremendously. These technological advances have not always had a beneficial impact on computer security and data integrity. Most integrated circuit chips on hardware equipment appear to be inscrutable to a lay person. There are hundreds of thousands of transistors on a small semi-conductor. Still, it is possible for a bug to be planted into electronic equipment and it may be very difficult to detect. Several techniques may be used to seal the hardware against tampering.

Records should always be kept of hardware failure and computer down times. Regular maintenance should be performed on periodic intervals and records should be maintained. If computer equipment frequently requires servicing, personnel might be tempted to bypass controls and take shortcuts. The possibility of human errors therefore increases considerably. Records should be analyzed to determine if an unfavorable trend is observed for the downtime or if the equipment frequently requires unscheduled service.

Records should be kept of all computer equipment and peripherals. The hardware inventory logs should contain at least the following information:

- a description of the hardware
- manufacturer's name
- model number
- serial number
- company identification number
- date of purchase

- name, address and phone number of stores from where the item was purchased
- date warranty expires
- the department or location where the hardware equipment will be used
- the name and title of responsible individual
- the department name
- the signature of the responsible individual or department head
- if the equipment is taken off premises, the date and time the equipment is checked out, and the date and time the equipment is returned along with the signature of the authorized individual

The hardware inventory logs should be stored in a secure location. A copy of the logs should also be stored in an off-site location. All hardware equipment should be etched or engraved with the company name, address, telephone number, manufacturer's serial number, and company's identification number. To prevent theft, locking devices should be used to secure computer equipment and peripherals to desktops, etc.

SOFTWARE SECURITY

Segregation of duties is essential in protecting computer programs during the development and modification stages. When software is developed and maintained internally, changes are frequently made to meet changing requirements. The source code is generally stored in the source library, while the compiled and executable version of the program is stored in the production library. The source library is under the control of the programmer, whereas the production library should be under the control of computer operations or a similar entity that does not have programming responsibilities.

All programs and data files should have date and time stamps, including both production and test versions. Date and time stamps make it possible to determine the current version of the program in the event of an error or malfunction.

The transfer from test status to production status of programs should be accompanied by authorization by management. The quality assurance department should do a formal review before releasing the final production version.

Whenever modification to a program is required, the reasons and requirement must be documented to prevent fraudulent modification. Requests for modification should include at least the following information:

- description of change
- why is the change needed
- how will the change benefit the department or organization
- name, title, and department of individual requesting the change
- approval of department head or another authorized individual
- date of request
- date of desired completion (time by which modifications should be made)

Once the Information Systems department receives the request to modify a program, it should determine:

- the priority of modification and the estimated date of completion
- the cost to make the modifications and the charge to the user department

The user department should be notified of the budgeted cost and the estimated completion time. The user department should approve the estimated completion time and budgeted cost.

A control sequence number should be assigned to the modification. Change requests should be tracked from the time they are initially submitted to the time the changes are completed. A programmer or analyst should be assigned the primary responsibility for making the changes. A determination should be made as to how the modified program will be tested. This generally requires the cooperation of the user department.

Small changes or emergency modifications should be possible without going through the full formal control procedure. Such changes should be carefully monitored. At a minimum, the following information about the modification should be documented:

- description of modification
- approval of the user department
- review of source code changes by a supervisor

PASSWORD SECURITY

Passwords are subject to attack using several techniques. One technique, which relies on brute force, was frequently used in the past. All possible combinations were tried till the attacker was successful. To prevent such unauthorized access, the number of unsuccessful tries should be limited. Moreover, unsuccessful login attempts should be audited.

A hacker is often able to guess the correct password because many individuals select words or strings of characters that have a logical association with the individual under attack. For example, individuals often select the following easily guessable words:

- spouse’s or girlfriend’s/boyfriend’s name
- children’s name
- pet’s name
- social security number
- phone number
- own birthday, or a loved one’s birthday
- words like “password” or “code”

It is best to select a password that does not appear in a dictionary. It is also a good idea to include numbers or characters, such as a question mark or a percentage or a dollar sign in the password.

It is sometimes possible for a hacker to edit the password file and insert bogus user names and passwords. To protect against such an attack, the password file should be properly protected against unauthorized writing.

The passwords should always be kept in an encrypted format. Otherwise, it is easy for someone to scan for commands that are followed by passwords such as logins to capture passwords either from storage, or as they are being typed or routed in transit.

A serious design flaw can sometimes result in the creation of a "universal password." Such a password satisfies the requirements of the login program without the hacker actually knowing the true and correct password. In one case, for example, a hacker could enter an overly long password. The overly long password would end up overwriting the actual password, thus allowing the hacker unauthorized access.

AUDIT TRAIL

Audit trails contain adequate information regarding any additions, deletions or modifications to the system. They provide evidence concerning transactions. An effective audit trail allows the data to be retrieved and certified. Audit trails will give information regarding the date and time of the transaction, who processed it, and at which terminal.

Computer-related risks affect the company's internal control structure and thereby affect the company's auditability. Electronic Data Interchange (EDI) systems are on-line systems where computers automatically perform transactions such as order processing and generating invoices. Although this can reduce costs, it can adversely affect a company's auditability because of the lessened audit trail.

The AICPA has issued control techniques to ensure the integrity of an EDI system. The AICPA recommends controls over accuracy and completeness at the application level of an EDI system to include: checks on performance to determine compliance with industry standards, checks on sequence numbering for transactions, reporting irregularities on a timely basis, verifying adequacy of audit trails, and checking of embedded headers and trailers at interchange, functional group, and transaction set level. Control techniques at the environmental level include: review quality assurance of vendor software, segregation of duties, ensuring that software is virus-free, procuring an audit report from the vendor's auditors, and evidence of testing. To ensure that all the EDT transactions are authorized, the AICPA provides these authorization controls: operator identification code, operator profile, trading partner identifier, maintenance of user access variables, and regular changing of passwords.

NETWORK SECURITY

Computer networks play a dominant role in transmitting information within and between firms. A network is simply a set of computers (or terminals) interconnected by transmission paths. These paths usually take the form of telephone lines; however, other media, such as wireless and infrared transmission, radio waves, and satellite are possible. The network serves one purpose:

exchange of data between the computers and/or terminals. The considerations in selecting a network medium are:

- Technical reliability
- Type of business involved
- The number of individuals who will need to access or update accounting data simultaneously
- Physical layout of existing equipment
- The frequency of updating
- Number of micros involved
- Compatibility
- Cost
- Geographic dispersion
- Type of network operating software available and support
- Availability of application software
- Expandability in adding additional workstations
- Restriction to PCs (or can cheaper terminals be used?)
- Ease of access in sharing equipment and data
- Need to access disparate equipment like other networks and main frames
- Processing needs
- Speed
- Data storage ability
- Maintenance
- Noise
- Connectivity mechanism
- Capability of network to conduct tasks without corrupting data moving through it

Backup capability is an especially important feature of networks. For instance, if one computer fails, another computer in the network can take over the load. This might be critical in certain industries such as financial institutions.

Data flows between computers in a network use one of three methods.

- Simplex transmission is in one direction only. An example of simplex transmission is radio or television transmission. Simplex transmission is rare in computer networks due to the one-way nature of data transmission.
- Half-duplex transmission is found in many systems. In a half-duplex system, information can flow in both directions. However, it is not possible for the information to flow in both directions simultaneously. In other words, once a query is transmitted from one device, it must wait for a response to come back.
- A full-duplex system can transmit information in both directions simultaneously; it does not have the intervening stop-and-wait aspect of half-duplex systems. For high throughput and fast response time, full-duplex transmission is frequently used in computer applications.

Data switching equipment is used to route data through the network to its final destinations. For instance, data switching equipment is used to route data around failed or busy devices or channels.

THE SECURITY ADMINISTRATOR

The size and needs of the company will dictate the size of the security administration department. This department is responsible for the planning and execution of a computer security system. They make sure that the information system's data is reliable and accurate. The security administrator should possess a high level of computer technical knowledge as well as having management skills and a general understanding of the organization's internal control structure.

A security administrator should interact with other departments to learn of the organization's changing needs and be able to maintain and update the security system efficiently. The security administrator is responsible for enacting and customizing policies and standards for the organization based on specific needs. Checks on performance and monitoring of staff should be done to ensure that these policies and standards are being complied with. In developing these policies and procedures, as well as the overall information computer security system, the security administrator must perform a risk assessment.

CONTINGENCY PLANNING

Many man-made and natural disasters can strike a company. A disaster may be defined as anything that will create a significant disruption in an organization's ongoing activities for a considerable period of time. Proper contingency planning can help minimize the loss of human life, data, and capital. Preparedness is the key to recovering from disaster.

The primary focus of computer security should always be to take preventive action, not corrective action. Nonetheless, it is impossible to prevent every security breach. It is virtually impossible to anticipate every problem and even if a problem can be anticipated, the cost/benefit criterion may not justify taking any preventive action. Sometimes the precautionary measures may prove to be ineffective because of human or other error. Productivity and efficiency may also be sacrificed if precautionary measures are taken too far.

Emergency procedures should be established for each type of disaster that may occur. For each type of disaster, a determination should be made about the effect of the disaster on data processing and business operations. In other words, how long will the service be interrupted and at what level would the company be able to operate.

LEGAL ISSUES

Legal issues are important in considering computer security. Substantial liability may be incurred by a company for violating legal requirements. Sometimes management may even be held personally liable.

Privacy and other personal rights may be violated due to lack of computer security. The

public is very concerned about privacy and this is reflected in the ever increasing legal requirements and regulations.

The general rule at the federal level is that all government files are open to the public unless there is a specific reason, enacted by the legislature, to keep the information secret. The Freedom of Information Act makes it possible for citizens and organizations to obtain access to most government records.

The federal government has passed legislation to protect private information. The Financial Privacy Act of 1978 was one step in this direction. The 1987 Computer Security Act showed further commitment toward computer security. This act states that, "improving the security and privacy of sensitive information in the federal computer systems is in the public interest." This by no means should be limited to the federal government. The private sector also has to play their part in ensuring that private information is kept private. The public is very concerned about information getting into the wrong hands, and is concerned when asked to provide sensitive information.

With the 1987 Computer Security Act, the *National Institute Of Standards and Technology* (NIST) was assigned the responsibility to develop cost-effective standards and guidelines to protect sensitive information in the federal databases. The Act also created a twelve-member panel to help NIST in performing their role. The private sector and the corporate world as a whole should not rely entirely on the government to take the steps towards improving security. To ensure that the individual privacy is protected, the following needs to be considered.

- Classification of Information
- Accuracy
- Protection of Sensitive Information

Once the information is determined to be sensitive, it should be verified for accuracy before being put into a database. Such information should be afforded the necessary protection to keep it confidential and adequately protected.

The Federal Privacy Act applies to records maintained by certain branches of the federal government. When contracting with agencies subject to the Federal Privacy Act, the act applies to the contract. The contractor and its employees are subject to the same requirements. Agency and criminal penalties may result from failure to comply.

Most states have Public Records Acts similar to the federal Freedom of Information Act. Several states have also enacted Fair Information Practices Acts which regulate the information state agencies, and those contracting with the state agencies, may maintain about individuals.

At the international level, especially in Europe, there are laws covering both governmental and private records. Computerized data banks must be licensed and certain laws apply only to them. Rules concerning disclosure are generally strict. There are frequently prohibitions against transferring information across national boundaries.

Email communications may be a source of claims of privacy violations. The organization should have a clearly stated policy about using computer systems for personal communications. For example, the organization may want to clearly state that the organization has the right to read all email communications. Courts have generally held that the employer has the right to view employee email; still it is prudent to have a written policy on this issue.

The Computer Fraud and Abuse Act is a federal law making it a crime for any unauthorized use (copying, damaging, obtaining database information, etc.) of computer hardware or software across state lines. Offenders can be sentenced to up to 20 years in prison and fined up to $100,000.

The Foreign Corrupt Practices Act (FCPA) of 1977 applies to all companies whose securities are registered or filed under the Securities Exchange Act of 1934. This Act requires the companies to keep accurate accounting records and to maintain a system of internal control. In other words, this Act mandates that these companies maintain appropriate computer security of its accounting records. Criminal prosecution can result from willful violations.

Computer security related legal liability may be incurred in a variety of situations, ranging from programming errors to civil or criminal violations. A company is expected to exercise due care and violation of the due care standard could result in liability. Consider a computer program that was originally designed properly, bug-free and operating effectively. However, due to lack of appropriate security, an attacker is able to place a logic bomb that causes the system to crash at a specified time in the future. The organization and its senior management may be held personally liable for any damages arising from the crash of the program. Such damages may include, for example, loss in market price of stock shares. Human life might also be affected if the program that crashed performed critical functions, such as a medical diagnosis system.

Consider another scenario where the attacker is able to modify the database of a construction company. Assume the database contains information about the strength of various types of steel that will be used to construct an office building. Engineers may rely upon the modified database and use steel that is not strong enough. The building eventually collapses and human life is lost. The liability that may result in such circumstances is likely to be astronomical, especially if it is proven that appropriate security could have prevented modification of the database.

The National Institute of Standards and Technology (NIST) has published several national standards in the area of computer security. Some of the standards include:

- password usage
- physical security and risk management
- data encryption standards
- user authentication techniques
- contingency planning
- electrical power for computer facilities
- key management
- automated password generators

- digital signature standard

The Department of Defense (DOD) also publishes booklets known as the Rainbow Series to help developers, evaluators and users of trusted systems. It includes information on networks, databases, and other problems with distributed computer systems. Similar guidelines are issued by other countries. The governments of Britain, Netherlands, France, and Germany have jointly issued detailed Information Technology Security Evaluation Criteria (ITSEC).

It is prudent to consider using these standards in managing computer security. In a lawsuit alleging breach of security, failure to follow these standards may be used by plaintiffs to prove negligence, even if your organization was not required to follow these standards.

CHAPTER 4
THE ACCOUNTANT AND DATABASE MANAGEMENT SYSTEMS

Learning Objectives:

After studying this chapter you will be able to:

1. Establish data classifications.
2. Design a distributed database management system.
3. Utilize data warehousing.
4. Plan and design a data model.
5. Conduct link analysis and appraisals.
6. Define the concept of knowledge discovery.
7. Implement a system of memory-based reasoning (MBR).
8. Use data mining to identify trends and make decisions.
9. Explain the function of neural networks.
10. Initiate online analytical processing (OLAP).
11. Utilize online transmission processing (ULTP).
12. Illustrate decision trees.
13. Define the use of personal information agents.

The accountant needs to access a database because it includes accumulated interrelated records of different types and files. The stored information is used by the accountant to have enough data to make an informed decision. Use should be made of clustering the database in which there is a logical order to the stored information. For example, revenue and cost data may be kept and retrieved in sequential order in department and division order. In database concurrency, there is simultaneous accessing of the database by more than one financial person or application. In looking at the database file, the accountant sees an accumulation of related records explaining a subject by using a field set.

A database management system (DBMS) involves an integrated set of computer programs that create the database, maintain the elements, safeguard the data from loss or destruction, and make the data available to application programs and inquires. In a database system, the data and programs are maintained separately except during processing. The DBMS constraints a description of the logical and physical structure of the database called the schema. The schema is the description of the structure of organization of the database using data description (definition) language. A primary goal of a DBMS is to minimize data redundancy, and user interface is enhanced through increased accessibility and flexibility. The system is administered by a database administration who is a person with overall responsibility for developing and maintaining the database.

A database management system refers to software managing and controlling the database. Typically, the database is on a server. Accountants can define, create, modify, and maintain the database. The standard query language (SQL) is usually used to create and maintain the relational databases including its accessing and updating.

A system catalog lists the data contained in a database. The data may be kept in a text file or dictionary-like document. The accountant should be concerned with administering financial information such as managing information resources, developing, designing, planning, keeping standards, and maintaining policies and procedures.

A network database model is one comprised of interrelated records and data items. The database should furnish a wide range of data to users. It should range from easy questioning to report writing based on different desired specifications to very complex solutions related to decision support systems. A network database model fosters many relationships such as the association between a vendor's database and the stocking of particular merchandise. The merchandise may be bought from different vendors, and each vendor can sell many different types of merchandise.

The accountant should schedule in sequential order database functions or transactions to accomplish a task in the most efficient way. In sequential access, the accountant selects all records of a particular type.

In a leap file, financial records are in the identical order of insertion. Database files may be subdivided (fragmented) over a number of documents. In replication, there is a duplicating of key elements of the database in different locations and assuring that copies of the information are updated simultaneously.

In a computer-aided manufacturing database we store manufacturing-related data for example, as data for the production of goods such as appliances.

We can use sensitivity analysis to determine how output is affected by inputs. Input variables may be modified at the same time to see the impact on outcome. Sensitivity analysis allows us to determine the relative importance of the various inputs. A model may be constructed to forecast multiple variables. An experimentation with different combinations of input variables may lead to better overall results. Further, the accountant should rank variables in the order of importance.

It is possible that data on a particular topic of interest is obtained from different sources. In such cases, the controller should be careful that erroneous conclusions are not drawn when the various sources present similar data in different manners. If data is missing, the controller must be careful if he or she decides to guess at the data left out or use mean, median, or common value figures.

Data conversion tool software extracts information from heterogeneous sources and transfers the source information to target data and then derives the programming codes to process it. Data must be carefully checked for consistency to ensure successful processing.

The accountant should split the database into segments of similar financial records. An example is sales territories having a particular range of sales. In segmentation, the accountant may want to break down a larger project into smaller ones for analysis purposes.

In hypothesis testing, the accountant attempts to prove or disprove an assumption. The hypothesis is proven or not by evaluating information via observation and testing.

This chapter discusses database security, classification of data, object databases, distributed databases, hierarchical databases, multidimensional databases, multimedia databases, meta-data, data warehousing, data marts, data modeling, link analysis, knowledge-based systems, market basket analysis, memory-based reasoning, data mining, fuzzy searches, neural networks, online analytical processing, online transaction processing, genetic algorithms, decision trees, and personal information assistants.

DATABASE SECURITY

Kerberos is one centralized server having secured user names and passwords for all information and resources on the network. Kerberos servers have such security features as login database access and authorization codes. The Kerberos server identifies and validates a user.

It may be advisable to have a secure single login in which users log into the network rather than each specific server or application. Access is permitted only to authorized resources.

Security of the database may be aided by referential integrity checks, which compare data among tables for appropriateness and logical relationship order. For security, we should match the database to the transaction log file. A transaction log is a listing of database transactions including updates for managing and control purposes.

The security analyzer tool for analyzing networks (SATAN) reviews the network to spot security weak points. System fault tolerance are networking aspects that safeguard the network from faults. An analytical report is prepared indicating problem areas and possible solutions.

The accountant should hide sensitive financial information in the database so it is not revealed to unauthorized individuals. To access a database, proper identification such as a password is required. In a database lock, database data cannot be accessed or altered until a transaction has been finalized. A shared lock is a database lock that allows users to read data but not update it.

A time bomb is a virus activated at a particular date or time. Antivirus software must be used.

To assure staff are familiar with the security procedures and policies to be adhered to in a database management system, a control plan should exist. Control related statements should provide detailed directions to conduct procedures and explain the needs of the security system. Any policy statements should not be subject to short-term modifications. The control plan should be distributed and consistent throughout the company. The plan should have some flexibility so it may be successfully adopted to different parts of the entity that may differ to some degree from one another. The control plan should be periodically reviewed to ensure that any changes in the company's circumstances or improvements in technologies are responded to.

Databases containing sensitive information must be restricted only to authorized individuals. Database access should be assigned different levels of confidentiality and security such as generally

accessible data (unrestricted), internal use only, and top secret. Confidential information should not be displayed on computer screens without the appropriate access codes. Employee compliance should be periodically reviewed to ensure that individuals are honoring the controls that have been established. Each database function (e.g., payroll) should require its own password so that employees only have access to the areas that they have been approved and authorized for. Segregation of duties should also exist. For example, a programmer who modifies or patches a program should not have access to the computer database area or library to assure the prevention of data manipulation. Thus, segregation of duties should exist between programmers, installation librarians, operators, data processing personnel, users, and control employees.

The Information Technology Internal Auditor should be concerned with the following areas when reviewing the company's database system:

- Monitoring and appraising the company's computer policy and security standards applying to the database and network.
- Supporting internal auditing functions during operational and compliance audits.

In auditing a typical database system, the IT auditor will review and analyze the following areas of the company's information system:

- Personnel practices applying to the installation.
- Contingency planning and disaster recovery.
- Data center structure.
- Backup controls of the data center.
- Effectiveness and efficiency of operating and administrative procedures.
- Standards of developing the installation.
- Specific control practices.
- Control procedures of the database information library.

The Information Technology auditor is responsible to assure that the company's database system controls are in place and properly functioning. To achieve this, the following specific control functions should be watched and appraised by the IT auditor.

- Errors and omissions are identified and corrected. However, the emphasis should be on preventing these problems in the first place.
- Assurance that jobs are performed in a timely manner.
- Transactions are properly approved and authorized by the appropriate level of management.
- Transactions are correctly processed.
- Functions should be reviewed periodically and incompatible activities should be segregated.

Transaction trails should exist for additions, deletions, or modifications of data processed by the database. Audit trails should be created or made available to provide the IT auditor information regarding (1) the date and time of the transactions, (2) who processed the transactions, and (3) where the transaction was initiated (e.g., terminal). Most database software has the ability to track database transactions.

CLASSIFICATION

Data may be classified from the population in similar groups. The classification may be based on a training model. The classes of information are periodically appraised and updated. For example, we can classify potential clients as low, medium, or high risk. In some cases, the accountant may start with a training set and build a predictor model on the grouping of new records. For example, credit card customers may be segmented into predefined classes to ascertain whom to send promotional mailings.

OBJECT DATABASES

In an object database management system, objects are stored in a multi-user client/server form. We can have concurrent access to objects. Objects can be protected from threats and transactions can be safeguarded. The object database management system adds to the traditional database management system the functions of questioning, concurrency, locking, and protection.

DISTRIBUTED DATABASE MANAGEMENT SYSTEMS

A distributed database is a collection of tables spread over at least two servers in the company at different locations. With distributed transactions, one transaction gives a sequence of database requests to different remote database servers. This allows for database update on various servers.

A transaction consists of SQL statements, each allowing for the access of data at different locations. In distributed transactions processing, transactions are processed over multiple distributed linked computers in multiple geographically situated locations.

HIERARCHICAL DATABASES

In a hierarchical database, there is a family tree of related record types. Lower-level records are subordinate to higher-level ones.

MULTIMEDIA DATABASES

In a multimedia database, we have abstract unstructured data such as audio, graphics, video, animation, hypertext, and hypermedia.

MULTIDIMENSIONAL DATABASES

With multidimensional databases, we handle multiple dimensions that include product, service, geographic locality, customer, client, guest, order, salesperson, and time period. A multidimensional database for a company's products may include time, territory, sales volume, customer, price, vendor, store, and total sales. Data may be appraised using alternative dimensions.

DATA WAREHOUSING

A data warehouse enhances productivity within the controller's department. It provides timely and accurate financial information. The data warehouse organizes and classifies information.

In data warehousing, there is a voluminous database of summarized and detailed interrelated information that may be extracted and analyzed in making financial management decisions. Detailed information may relate to sales, purchases, payables, and receivables. There is a vast accumulation of past and current data. It is updated continuously because data is reliable for a specified time period. This updating may be via planned batch processing to foster comparative analysis. (However, in some cases, a data warehouse may not be designed to update data immediately and repetitively.) The database is subject-oriented and timely. Complex, analytical, and investigative questioning of the data warehouse may solve financial problems.

Data warehousing includes data regarding payroll, accounting, finance, marketing, and management. Information stored is usually classified by type such as by product/service line, department, division, sales territory, marketing survey data, suppliers, customers, orders, transactions, physical resources, personnel, or financial resources. A major purpose of data warehousing is to question a database spread over a multinational company.

The data warehouse allows the company to integrate its cumulative operational information into an accessible means so that forecasts, trends, and strategic decisions may be derived.

The financial data of all departments of the company is put into a database that can be managed, controlled and evaluated.

In data warehousing, there should be integration of extraction, retrieval, cleansing, questioning, and summarizing. For this purpose, meta-data integration software is available.

Data transformation from these data sources to the data warehouse should be well documented. Data going into the data warehouse are from numerous operational databases inside and outside the company. Thus, information is accumulated from sources in different locations. The accountant should be abreast of where information came from and how it was modified and transformed. Merged information should be put into a standardized and consistent format to enhance decision making and support. Therefore, there should be a derived commonality in data definition, structure, and relationships. Errors and inconsistencies in the data must be rectified to assure information quality. A data warehouse may be used for training purposes.

Data warehousing may be used in internal audits by providing information and analysis to appraise corporate activities and control operations. It fosters the examination of the company's efficiency. Inefficiencies may be indicated by comparing estimated to actual amounts. Areas of fraud, irregularities, and errors may readily be identified. Areas of sensitivity are highlighted.

Marketers may use a customer or guest database to profile individuals who are apt to respond to special incentives. Further, the company may accumulate information regarding buying patterns of their major customers to stimulate purchases by them.

Problems with the quality of goods may be identified by looking at the trend in product returns or allowances due to defective merchandise. An analysis may also be made of buying schedules to ascertain the appropriate times to buy merchandise to take advantage of lower prices and quantity discounts.

Data warehousing can be used by insurance companies to ascertain prospective policy holders who may be underwriting risks.

Divisions doing poorly may be identified. Then either corrective action may be taken or those divisions may be liquidated or sold.

Applications of data warehousing include:

- Measuring the impact of changing prices on product demand
- Detailing credit standing of a new customer
- Pricing based on inventory patterns and demand
- Detecting insurance and warranty claims fraud

Meta-data describes data included in the data warehouse including where it came from, content, and importance. Information flow in and out of the data warehouse is indicated. Therefore, the history of any data may be reconstructed. Meta-data reveals what data are available in the system and its location. As such, meta-data enable accountants to comprehend the logical data model of the data warehouse. Meta-data enables us to track the data components of the data warehouse, data content, integration and transformation of data, and from where the data was derived. Meta-data involves a review and analysis of where information was extracted, indexing process, statistical analysis, data aggregations, and patterns. For control purposes, meta-data should be well defined, updated, secured, integrated, comprehendible, and documented. Retrieval policies should be specified.

DATA MARTS

A data mart is a data file consisting of logical records. It is an element of a data warehouse furnishing summarized information that can be used in decision making by a department or division manager. The data mart may be either tied to or separated from the entity's centralized data warehouse. Because data marts have much less data than a data warehouse, a data mart is simpler to understand and utilize.

Data marts service the data requirements of particular departments within the organization. Data marts are of benefit and use to specific departments. A data mart is a subset of a data warehouse that accumulates the information required by a particular department or other responsibility unit such as a product or service line. Also, a given data mart might be used solely by two or more departments on a shared basis for common requirements.

Information for the data mart is directly obtained from the data warehouse of the overall company. (However, it is possible to construct a data mart as an independent unit with departmental information accumulated just for it.) With a data mart, information may be available more quickly because of substantially less transaction volume. Further, the information may be better customized to meet the department's needs. Another benefit of a data mart is that its cost is much lower than that data of a data warehouse.

Data marts may be transportable personal warehouses on a laptop to be used by internal auditing staff with auditing branches.

DATA MODELING

A data model involves designing and planning a database. In an entity's data model there is shown important financial information, key relationships between financial data, and the impact of the information on the firm. The accountant should make use of the data model in explaining information, its interrelations, and limitations. The accountant wants to fully understand accountants' database. Noted are cases in which data is shared.

In modeling, an output(s) is derived from inputs. In a *time series model*, we see the effect of a factor over time such as the market price of the company's stock base based on various changes associated with the company's financial health. In a *clustering model*, financial records are grouped in terms of similarity. An example is finding what similar financial characteristics divisions of the company have in common. In a *classification model*, we classify a record based on some predetermined criteria. New classifications may emerge in addition to old classifications. A *prediction model* forecasts future results based on past and current information. The correctness of the model as a predictor should be assessed by comparing what is expected to what actually happens. What is the degree of deviation? The model should be tested over time. Any changes should be incorporated as needed.

LINK ANALYSIS

The financial manager should engage in link analysis looking at the relationship between fields such as relating departmental profit to departmental assets. In link appraisal, the financial manager looks at how financial records are related to see what patterns exist. For example, the financial manager may want to know the likelihood that merchandise or services will be purchased together. Also, how are vendors associated and what effect will that have on the company if there is a shortage of raw materials? What is the link between customers, lenders, and employee unions?

In link analysis, the accountant may find new characteristics associated with financial data. However, the controller should note that link analysis is not as reliable with large data sets as with smaller ones.

KNOWLEDGE DISCOVERY

Knowledge discovery does not involve prior assumptions. The financial manager searches database information so as to draw new views or management conclusions. A knowledge base is a set of information to answer queries and solve business problems. What patterns are evident?

There is an emphasis on finding meaningful information. Data is chosen, refined, and put into a useful form. The data is then evaluated to see what should be investigated further. Based on the results, management will undertake steps to control a problem situation or eliminate a problem. For example, is there a way to attract additional business? Special attention should be given to unusual associations. However, when files are marked, "secure," they may not be transferred.

Knowledge discovery helps us determine who is apt to purchase certain kinds of merchandise.

MARKET BASED ANALYSIS

The market based analysis (MBA) method classifies item groupings that take place together in a transaction. MBA is particularly appropriate for numeric and categorical data. The accountant should examine the likelihood of different goods or services being brought together in some logical order. Thus, we can use MBA to examine multiple buys by a customer or a sales catalog of numerous types of merchandise. Guidelines for this process should be enumerated. Why do customers purchase certain products? Which customers buy multiple products simultaneously and why? MBA also aids in establishing a good advertising and promotion plan.

With MBA, we can better compare sales derived from different geographic areas like urban versus suburban. Seasonal differences may be taken into account.

If there is an unexpected combination of insurance claims over a short time period, it may point to fraud.

MEMORY-BASED REASONING

Under memory-based reasoning (MBR), we use cases of known events or occurrences to predict unknown events or instances. We look at similar events (neighbors) in prior years to predict what will happen now. The number of neighbors to use for analysis depends on information distribution and the nature of the problem being evaluated. What was an insurance company's historical experiences with the types of claims being submitted now? Did fraud occur in prior years? Were the claims legitimate and immediately paid? MBR can also be used to predict how customers will react to a particular advertisement.

The degree of similarity or dissimilarity between the historical records and current records must be ascertained. What is the distance between the two? The less distance, the more reliable will be the conclusions drawn.

The training set is the historical records that enable us to find the nearest neighbors to an unknown (current) record. For useful results to occur, an adequate amount of records by category is necessary. The more the neighbors used, the more accurate will be the conclusions.

The training set should include a sufficient number of occurrences for all possible classifications. We should also include for analytical purposes rare instances such as fraud so we have a good balance of usual and unusual occurrences for all categories. Better results are achieved when the training set is voluminous and representative.

DATA MINING

Data mining involves software examining a database to identify patterns, relationships, and trends to assist in financial management decision making. We extract past and current information from a voluminous database for analysis. Are there any problem areas requiring corrective action? To be effective, data mining relies on the source data to be accurate, consistent, and integrated. Data mining looks both to confirm anticipated patterns and to uncover new patterns. Anything unusual, hidden, or unexpected should be investigated.

Data mining allows accountants to evaluate integrated consistent information for future strategic decisions. However, over time, data mining results may change due to, say, changing economic and political factors. Data mining results should be reviewed by the controller for common sense and reasonableness. The controller may be able to come up with new ideas, guidelines, yardsticks, and rules. Data mining assists in improving corporate operations and the resulting bottom line.

A data warehouse stores data while data mining extracts, cleanses, and appraises the information for management decision making. Data mining provides intelligence to a database.

In deciding on the appropriate data mining method suitable in a given situation, the accountant should take into account the circumstances, tasks to be performed, nature of input in terms of quality and amount, reliability required, type of output, importance, training desired, available software and data, scalability, and accuracy and understandability of the model.

In data mining, we go through large databases to search for useful patterns, relationships, and trends. Some of the ensuing results will be expected, others will be unexpected. The accountant will continually question the database until a complete financial picture emerges. Any unanticipated patterns should be verified through repeated questioning and evaluation. The controller can refine his or her search by only extracting key information. In actuality, data mining is most advantageous when there is a vast amount of sophisticated and complex information.

We may use artificial intelligence or statistical methods when searching and evaluating the data warehouse or data marts. Data mining involves clusters, segmentation, grouping, linking, predicting, explaining, and highlighting variances between expected and actual financial figures.

Managerial and financial applications for which data mining may be applied include determining whether a bank should grant a loan to a particular borrower (and, if so, how much), spotting insurance fraud, noting fraudulent warranty claims and credit card fraud, creating advertising and promotional efforts to maximize sales (including gauging how prospective customers will react best to a specified promotion, or which products or services are most favored by customers in a particular geographic area), evaluating and selecting vendors, financial statement analysis, including the appraisal of profitability and liquidity, customer profiling based on such factors as buying behavior, selection of stocks and bonds in portfolio management, establishing a credit rating for a loan applicant or customer, pricing of products and/or services, ascertaining risk level for a new project or proposal, predicting sales, inventory control, production management, detecting questionable patterns of internal funds transfers, ascertaining the degree of customer confidence and commitment, customer service, determining which products or services to cross-sell, marketing research and planning, and finding the reasons why products or services sell better in certain markets or to certain customer types.

Other applications include appraising seasonality issues, deciding on which products to push and when, arranging merchandise in a branch store or sales catalog to generate the most orders, deciding how to best package merchandise, profiling clients and hotel guests, uncovering forgeries in documents, quality control including identifying defective goods bought from a supplier, determining products a particular class of customer is likely to buy (e.g., young people are more apt to buy sporting merchandise than older individuals), predicting future prices in commodities, forecasting foreign currency exchange rates, direct marketing, predicting employee theft, deriving optimal selling techniques, credit approval, employee or customer development and retention, deciding on whether to offer discounts for certain products to promote sales, planning store layout to promote business, assessing the possibility of a product or service line failing, new product or service, forecasting expected profit from a new customer, predicting trading patterns of securities, estimating which hotel guests are likely to return, grouping and classifying customers, picking the best location for a new store, improving product design, determining customer retention, appraising suppliers, deciding which customers should receive incentives so they do not switch to competitors, efficiently allocating resources, deciding on advertising approaches to maximize orders, determining the best piggyback products, risk reduction, and demographic analysis.

Numeric variables are good for data mining purposes because they may be totaled and sorted in mathematical computations. An example is costs.

There are many considerations to take into account when selecting data mining software. These include how many data records exist, database access, reporting aspects and requirements, network functioning, simplicity, documentation, graphic support, operating systems, data compatibility, scalability in product and users, technical support, interfaces supported, and organizational fit.

FUZZY SEARCH

In a fuzzy search, user direction is absent or minimal. If-then rules may also be derived. The controller may in fact not know before hand what he or she is looking for. As far as the search process is concerned, in market basket analysis, the controller tries to identify patterns where the occurrence of something implies something else will happen. In a sequential search, there is a chronological time order to events or patterns. In a search clutter, the controller looks to classify items in homogenous groupings.

NEURAL NETWORKS

In Neural networks (NN), the financial manager must identify inputs and output factors. A range from 0 to 1 must exist after inputs and outputs have been modified. It is crucial to select the "right" input data and the appropriate examples. Multiple inputs should be used. The neural network can be used to derive outputs for unknown inputs.

A training set is the basis to teach the NN. Based on the findings of the examples in a training set, learning occurs. NNs imitate the human mind. NNs uncover patterns in information and express the extent of a relationship between two variables. Combinations of variables are considered. Actual results are compared to expectations. The training process has been completed once the training set has gone through a maximum number of times or there is no or minimal change in the weights. At the time, the NN is the working model.

The training set should have a full assortment of all the factors the network will experience. The training variables must be representative. The neural network learns from past patterns. It must be updated for current developments.

Prediction is enhanced through the use of training examples. Training examples should exist for each weight in the network. Each weight should have about 20 training examples. Internal weights are improved to aid prediction. However, the number of training examples per output should be approximately the same. Both good and bad examples should be used. After all, you want the NN to identify problem situations. For example, if we are trying to spot a rare occurrence (e.g., credit card fraud), the training set should have a sufficient number of instances of the rare occurrences.

Once the neural network has learned from the training set, a new set of examples should be used. How well has the neural network been instructed? Is further training required?

The time required to train the NN partly depends on the number of inputs involved. The more variables, the longer time period to train. Further, if the number of input factors grows too large, less reliable solutions may be forthcoming. The discarding of unimportant variables will improve prediction accuracy.

In feed-forward networks, the accountant should take into account activation (how units react and merge), topology, (how units are connected), and back propagation (how the network learns to recognize patterns).

Two advantages of the NN are that many different types of problem areas are solved and canned software is available. A disadvantage of NNs is the inability to explain results.

ONLINE ANALYTICAL PROCESSING

Online analytical processing (OLAP) assists financial executives in gaining a clear and consistent perspective on financial information so as to facilitate decision making. OLAP enables controllers to gain perception on information quickly and consistently in an interactive way. What patterns and trends are evident in the financial data?

Information can be modified depending on need. The controller may use OLAP for data reporting purposes.

OLAP techniques are used in accessing voluminous databases. It includes data stored in a centralized data warehouse, operational system, or virtual distributed warehouse. OLAP extracts information from a data warehouse, operational system, or virtual distributed warehouse. OLAP extracts information from a data warehouse that is relevant, understandable, important, correct, and timely. Many OLAP tools have drill-down capabilities into the initial database. The controller is able to get interactive access to a large variety of data views.

OLAP is an approach to original and condensed historical multidimensional data to assist accountants in better understanding the information and reaching sound decisions. As the financial environment changes, an updating of the information will be necessary. The result will be comprehensive, current, and reliable data.

In OLAP, why and what-if questions can be asked and answered to improve financial decision making. For instance, the financial manager may wish to find out how the entity's new products have affected its sales over the past three years by a major geographic region. There are significant analytical attributes. Data may be evaluated by some predetermined criteria. Further, OLAP gives the financial manager the opportunity to probe and appraise corporate data in bits and pieces.

OLAP is mostly a decision support technique with such beneficial characteristics as links, dimensions, and formulas. The specifics of each feature are evaluated. With OLAP, the controller is provided with the records answering his queries as well as with scenario settings.

There are several factors that need to be considered in choosing a suitable OLAP tool for a given application. Factors include type of software used, conformity to the company's environment, future needs, scalability, questioning capabilities and evaluative techniques, operations to be conducted, performance, and ability to add, delete, or modify data.

In OLAP, we have multidimensional aggregate data providing fast access to key financial information so it can be properly appraised by the accountant. In most cases, accountants examine financial information by product or service line, scenario, geographic area, and time. It is essential that the financial executive can appraise data by dimension, function, or aggregation level. Multidimensional online analytical processing is suitable for financial applications where

detailed computations are needed for different products, services, business segments, responsibility units, divisions, and departments of the company. With multidimensional information, financial executives may obtain budgeted compared to actual amounts as well as summarized financial data by product/service line, time, and organization. Sales may be noted by time, product, service, sales price, geographic area, distribution channel, and customer. A typical query in OLAP is "What are the sales by product, service, customer, quarter, and store?" OLAP can go across various domains-for example, presenting sales in stores and credit card charges.

Financial applications of OLAP include financial forecasting (e.g., sales), retrieval of relevant financial information for decision making from large data sets, budgeting, operating performance analysis, financial modeling, and activity-based costing. In production, OLAP assists in manufacturing planning and uncovering assembly line problem areas. In marketing, OLAP assists with marketing research, market segmentation, customer appraisals, and advertising and promotion.

In evaluating the company compared to competitors, OLAP can be helpful to accountants by looking at the percentage growth in accounts such as revenue, costs, and assets. We can model complex and sophisticated relationships.

Advantages of OLAP include fast computation and response time, flexibility, interactivity and easy application. Also, it considers multidimensional data, supplies timely information, and is sound in analyzing time series. Unfortunately, continuous variables are not handled well.

ONLINE TRANSACTION PROCESSING

With online transaction processing (OLTP), transactions are immediately entered. Information has to be accurate and consistent. The nature of processing is repetitive with continual updates. Database integrity should have proper controls. Numerous applications exist such as inventory control, management control, and collections. OLTP is mostly structured for transactional, repetitive processing instead of unstructured investigative processing. By using OLTP, the financial manager can optimize his or her transaction processing capability associated with such applications as manufacturing, accounting, marketing, and sales. OLTP is application and event driven. Data in OLTP is changing and volatile.

In OLTP, the nature of questioning involves day-to-day operations such as the updating of inventory for buys and sells. At a certain inventory level, a reorder occurs.

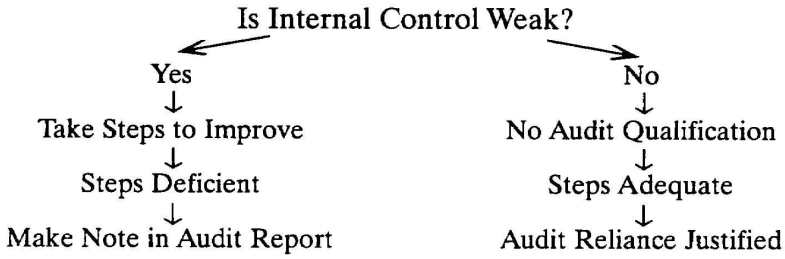
GENETIC ALGORITHMS

Genetic algorithms (GAs) may be used in scheduling physical and human resources subject to limitations (e.g., budget). There is an allocation of limited resources taking into account relationships among resources and users.

GAs can help find optimal values such as the best selling price, optimal number of units to produce, and correct number of staff to service customer/client needs. Disadvantages of GAs involve encoding and high cost.

DECISION TREES

A decision tree breaks down records into subsets. They are easy to understand because the flow of the financial decision process is shown such as:



A decision tree asks questions in sequential order. This method is feasible when you can derive comprehendible and explainable rules.

PERSONAL INFORMATION AGENTS

Personal information agents are mobile applications on data warehouses to perform questioning or uncover data patterns. Many agents are rule-based such as "if A occurs, do Y." Agents should be able to note unexpected occurrences or events within a data warehouse. The typical personal information agent can specify the particular subject or event based on a specified time frame. Any changes in the subject area are updated.

CHAPTER 5
THE ACCOUNTANT AND THE CLIENT/SERVER ENVIRONMENT

Learning Objectives:

After studying this chapter you will be able to:

1. Develop a familiarity with client/server environments.
2. Appraise network traffic with the network analyzer.
3. Develop an executive information system (EIS) for decision-making.
4. Address security concerns with protective steps.

The accountant should have some basic familiarity with the client/server environment. There should be a list of authorized users with specified identifications to access certain equipment or information files. Different layers of authorization should exist depending on the activities to be performed.

A network should be designed to meet corporate goals and purposes. In a client/server arrangement, computers are connected by a network in which some computers (clients) process applications while other computers (servers) provide services (e.g., Internet hosting, file storage) to the clients. In client-server environments, change control must also ensure synchronization of programs across the network so that each client and each server run the same versions of the programs. In mainframe environments, only one copy of the production system may be executed, and synchronization of programs is not required.

A client-server system divides processing of an application between a client machine on a network and a file server. This division depends on which tasks each is best suited to perform. However, user interaction is ordinarily restricted to the client part of the application. This portion normally consists of the user interface, data entry, queries, and receipt of reports. The file server customarily manages peripheral hardware and controls access to shared databases. Thus, a client-server application must be designed as separate software components that run on different machines but appear to be one application. Client-server systems do not necessarily use relational databases.

In a client/server environment, the accountant is primarily concerned with issues of functioning, decision-making, and security.

FUNCTIONING

Does transparency exist, and if so, to what extent? Transparency is the ability of distributed processing systems to merge clients and servers to different operating systems and protocols into a logical framework that processes distributed applications. Also called *network transparency*, it is a condition in which an operating system or other service allows the user access to a remote resource through a network without needing to know if the resource is remote or local.

Middleware is the software layer enabling the communication and accessing of information between servers and clients. If differences or irregularities are found, they should be reconciled.

Network traffic may be appraised with a network analyzer. An example is the decoding of data packets. A work flow manager facilitates and monitors multistep data movement through the network. Transaction processing (TP) monitors and polices client/server traffic. It manages transaction from the initiation point, typically on the client, across servers, and then back to the initiating client. TP monitors can run transactions, route and execute transactions, and restart them after failure. If a network management issue needs to be resolved, point products software may be written.

On a periodic basis, equipment and software should be checked as to their proper functioning including making comparisons to norms. To safeguard the system, one server should substitute for another one that has malfunctioned.

The accountant may want to make use of a remote procedure call allowing software running on the client to use the services of a program running on the server.

A network management platform (framework) enables integration between a shared database and modules to which alerts and warnings are stored.

There should be global services in which the global network operating system can locate a particular user, resource, or server regardless of location.

With a peer-to-peer network any computer on a network can act as a server. Local area networks (LANs) accommodate network activities for departments and divisions. To access shared network services and resources, use LAN resource management software.

Point-to-point protocol clients are remote clients that are linked to servers operating in different network operating systems.

Financial managers should make use of groupware so staff can communicate and work together in electronic form so as to enhance productivity regardless of location or time.

For the distribution of code and data across clients and servers we use mobile agents.

DECISION MAKING

An executive information system (EIS) furnishes data on how the entity is presently conducting its financial and operating functions. It gives management up-to-date information to make better decisions.

The accountant should be aware of performance metrics, which compare actual performance to established standards. A significant variance is examined for corrective action.

The accountant should engage in what-if analysis, which is a simulation approach predicting the outcome of changing inputs relative to alternative network scenarios. What-if analysis is undertaken to derive optimal solutions. To look at what-if possibilities associated with the network we can use network simulation and modeling software. Decision support system software allows managers to derive better decisions based on available information. Customization of reports occurs.

In packetizing, we add management information to raw data so it is properly delivered.

Personal information agents represent mobile applications on the data warehouse. Questions are asked to uncover patterns and unexpected events. Agents are usually rule-based. Agents warn if something unusual occurs. An accountant may use personal information management software to maximize his or her productivity.

SECURITY CONCERNS

Security is more difficult to achieve in a client-server system than in a mainframe environment. The system has numerous access points, and users have many chances to alter data. Thus, application controls must be combined with general access controls to protect the system.

The financial manager should be assured that protective steps have been taken to protect the computer system such as financial database files. We can restrict access to information on the network by having a nonprivileged mode.

Encryption equipment can be used to assure proper security during transmission. Encryption safeguards a message so it cannot be comprehended except if the receiver has a "key" to decipher it. A private key is a shared confidential key used to encrypt or decrypt a message or transmission. In encryption, we begin with an initial unencoded message and scramble the plain text with an algorithm that has a key to derive unintelligible ciphertext. Further, checksums should be used to provide confidence that data has not been improperly changed while being processed over the network.

There should be a security server keeping security data such as names and passwords. A password authentication protocol repeatedly transmits user identifications and passwords for authentication reasons. A digital signature (electronic identification) assures the author's authenticity and the integrity of the communication or message. A digital signature is attached to documents being transferred electronically for security to guarantee that a sender is actually who he or she purports to be. This signature gives assurance that the document has not been changed improperly. Digital signature encryption is public key encryption in reverse. Further, security can be enhanced by using network auditing tools that highlight which users accessed which network files.

Before a server acts on an important client request, the server should substantiate the appropriateness of the request.

There is network-filtering software that examines source and destination addresses to determine access. Internal firewalls are filters on the network to ascertain if corporate transmissions on the internal network are authorized. Filter tables list those individuals authorized to proceed through the firewall server into the entity's network. Filter tables may have different levels of access to different file types. With application-level filters, there is additional security by evaluating the whole data request rather than just the source and destination addresses.

There should be workstation-based security software. To monitor suspicious behavior of employees and outside users we can use intrusion detection software. The financial manager should make use of performance monitoring software in which limits are set for which an overage over such limits indicate a problem to be appraised and corrected for. There is usually an audit trail.

The financial manager should note the proper values applicable to various data fields. We may use and allow decoy files to be infected so as to identify, monitor, and control viruses. In pre-emptive monitoring, there is a problem test set run on a recurring basis to diagnostically test network traffic to alert the financial manager if a malfunction is detected. We must be on guard against polymorphic viruses, which are viruses that change their appearance each time infected software is run to make detection more difficult. A Trojan horse is a virus hidden in a legitimate program. We can identify unknown viruses via running an emulation program. Antivirus software must be used to safeguard data files and programs.

Any out-of-the-ordinary occurrences should be investigated. We can use event detection software to identify and filter data for such unexpected events.

Security penetration/vulnerability analysis should be conducted periodically to uncover any possible problems. Penetration tools, such as the Security Analysis Tool for Auditing Networks (SATAN), should be used to try to break into a system to uncover weaknesses in the firewall and router configurations. Automated tools exist to audit the computer system and report potential security weaknesses. Vulnerabilities are identified such as poor passwords or failure to update software with security patches. Vulnerability testing tools search for potential weaknesses that may allow an attacker to gain unauthorized access.

Vulnerability test may audit the system or launch a mock attack. Vulnerability testing programs may be classified according to scope. Their focus may be narrow and they may examine just a single vulnerability or their emphasis may be broad and they may appraise the whole system.

Access controls should exist to use a specific terminal or application. Data and time constraints along with file usage should be enumerated. Unauthorized use should deactivate or lock a terminal.

Communication security over the network may be in the form of:

- **Access control**. Guards against improper use of the network. For example, KEYBEROS is a commercial authentication software that is added to an existing security system to verify a user's existence to assure the person is not an imposter. KEYBEROS accomplishes this by encrypting passwords transmitted around networks. Password control and user authentication

devices such as Security Dynamics' Secur ID (800-SECURID). Review all dial-up terminal users.

- **Data confidentiality**. There is in place protection of confidential information during transmission.
- **Routing control**. Inhibits data flow to insecure network elements such as identified unsecured relays, links, or sub-networks.
- **Identification.** Identifies the origin of a communication within the network by digital signals or notarization.
- **Authentication**. Substantiates the identity of an originating user or user entity within the network. Examples of security controls are time stamping, passwords, synchronized checks, non-repudiation, and multiple-way handshakes. Biometric authentication methods measure body characteristics with the use of equipment attached to the workstation. Keystroke dynamics is another form of identification.
- **Digital signature.** Messages are signed with a private key.
- **Traffic padding**. A traffic analysis of data for reasonableness.
- **Data integrity**. Steps exist to guard against unauthorized charges of information at the receiving and sending points.

Security should exist in different layers. Security needs to be provided over networking facilities and telecommunication elements. Controls must be placed over both host computers and sub-networks.

Network traffic may be over many sub-networks, each having their own security levels, depending on confidentiality and importance. Hence, different security controls may be needed.

A firewall is used to control access between two networks. Its objective is to restrict unauthorized traffic. A firewall performs the following two functions:

- Restricts or blocks certain traffic.
- Permits certain traffic.

Firewalls provide logging and auditing functions for security purposes. Firewalls work by blocking unwanted and unauthorized people from viewing company databases. For example, security data may be gathered about the number of login attempts and password failures.

Digital signatures can be used when the content of the message is not secret, but the sender wants to authenticate his or her identity and confirm that he or she wrote the message.

CHAPTER 6
THE ACCOUNTANT AND ARTIFICIAL INTELLIGENCE APPLICATIONS

Learning Objectives:

After studying this chapter you will be able to:

1. Describe the six key elements of expert systems.
2. Explain the functions of expert systems.
3. Classify the uses of neural networks.
4. Identify applications of neural networks.

Artificial intelligence (AI) and its subfield, expert systems (ES), have been identified by the AICPA Future Issues Committee as one of the major issues the accounting profession will face in the future. Expert systems attempt to permit a computer to think and make decisions in a human way. An expert system is an interactive system that asks a series of questions and uses knowledge gained from a human expert to analyze answers and come to a decision, that is, to exercise judgment. They were originally developed to make decisions in areas that did not have enough human experts for decision making. Some of the earliest expert systems were used by doctors to diagnose diseases. Experimental work is being done with expert systems in taxation, financial accounting, managerial accounting, and auditing.

The purpose of artificial intelligence (AI) is to replicate human reasoning and brain activity. AI aids in distributing expertise to nonexpert staff. A "shell" is a collection of software packages and tools used to design, develop, implement, and maintain AI expert systems for a company.

EXPERT SYSTEMS

An expert system is a set of computer programs conducting a task at the level of a human expert. A good candidate for an expert system is an application requiring the use of expert knowledge, judgment, and experience. Expert systems can explain the reasoning behind a conclusion and this capability is critical in validating the results. In fact, the expert system can ultimately become more knowledgeable over time. The expert system keeps learning and applies that knowledge to formulate better decisions.

Expert systems allow even small companies to perform activities and provide services previously only available from larger firms. The use of expert systems has helped to improve the quality of customer service in applications such as maintenance and scheduling by automating them and making them easy to perform.

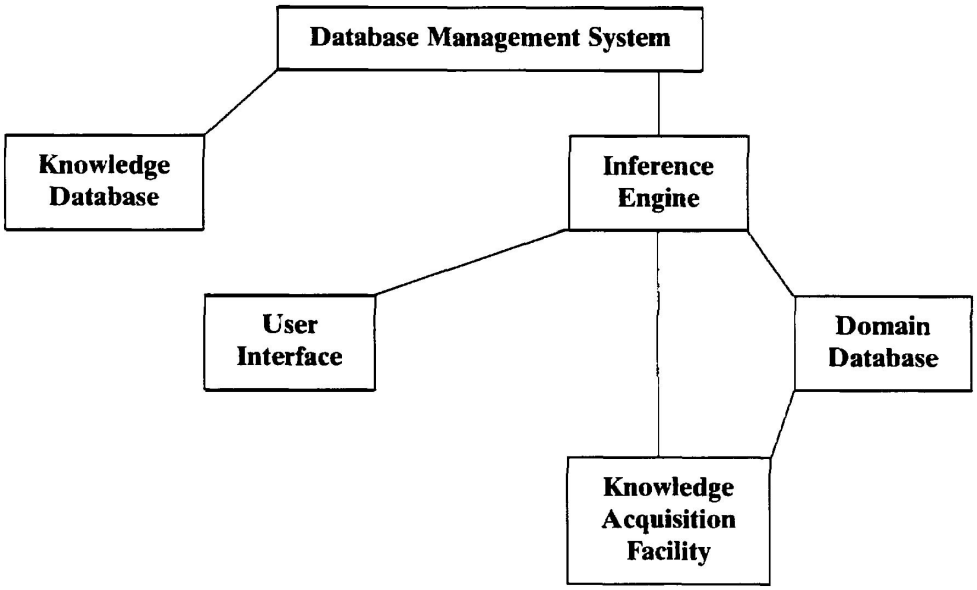
A series of logical sequential questions are asked to the user by the expert system. Follow-up questions are based on the answer to the prior questions. After all questions have been asked and answered, conclusions are drawn by the expert system

There are six key elements in an expert system comprised of:

- Knowledge database of rules, cases, and criteria in making decisions.
- Domain database of suitable information in the particular area of interest.
- Database management system to control the input and management of the above two databases.
- Inference engine (processing system) consisting of the interface strategies and controls used by experts in using and manipulating the first two databases. It acts as the brain of the expert system. It receives the request from the user interface and carries out reasoning in the knowledge base. The inference engine assists in problem solving such as by processing and scheduling rules. It asks for further data from the user, makes assumptions about the information, and formulates conclusions and recommendations. The inference engine may also determine the degree to which a recommendation is qualified and in the case of multiple solutions rank them.
- User interfaces are the explanatory features, online assistance, and debugging tools assisting the user in comprehending and properly using the expert system.
- Knowledge acquisition facility enabling interactive processing between the user and the system. It allows the system to obtain appropriate knowledge and experience of the human.

Figure 10 represents expert system relationships.

FIGURE 10
EXPERT SYSTEM RELATIONSHIP



The knowledge is comprised of two kinds of knowledge representations: rule based and case based. The rule base of an expert system contains a set of production rules. Each rule has an "if then" clause. Expert system users furnish facts or statements so that production rules are triggered and conclusions forthcoming. In a case-based expert system, an inductive method is used to perform expert system reasoning. A case base is used comprised of many "historical" cases having different results. Cases consist of information regarding a situation, the solution, results of using that solution, and major attributes. The expert inference engine searches through the case base and finds the appropriate historical case, which matches the facts of the present problem to be resolved. After there is a match, the solution of the marched historical case will be modified and used as the new suggestions for the current problem.

Knowledge-based (expert) systems contain a knowledge base for a limited domain of human expertise and inference procedures for the solution of problems. They use symbolic processing based on heuristics rather than algorithms. A heuristic procedure is an exploratory problem-solving technique that uses self-education methods, e.g., the evaluation of feedback, to improve performance. These systems are often very interactive and provide explanations of their problem-solving behavior.

Expert systems provide decision models for planning and control. Applications of expert systems include:

- Financial analysis
- Preparing and conducting audits
- Preparation of accounts and reports
- Evaluate credit worthiness of customers
- Planning to reduce costs
- Planning to enhance productivity and quality of products and services
- Appraisal of internal controls
- Claim authorization and processing
- Competitive analysis
- Manufacturing and capacity planning and scheduling
- Analysis of revenue (by price, volume, and product/service mix)
- Cost analysis (by category and type)
- Inventory analysis
- Resource planning
- Preparation of budgets and forecasts
- Credit authorization
- Appraisal of risk
- Bankruptcy prediction
- Ascertaining sufficiency of expense provisions and revenue sources
- Appraisal of mergers and acquisitions
- Compliance reporting
- Aging of accounts (e.g., customers)
- Deciding whether to refinance debt
- Improve productivity

In auditing, an expert system can reduce the cost and time in making audit decisions and in improving the audit plan and substantive testing. Expert systems can choose or develop an audit program, perform and analytical review, appraise source information and evidence, select a sample and test data, compute and analyze error rate, plan and watch over the audit engagement, identify relationships between accounts that do not make sense, appraise assets and liabilities, evaluate internal control and risk level, and ascertain disclosure compliance.

Business Foundations' Internal Operations Risk Analysis software appraises a company's areas of risk and internal control structure. It highlights strengths and weaknesses in business operations. A risk rating is assigned to risk categories. It recommends corrective steps for problem areas.

In managerial accounting, expert systems assist in capital budgeting decision-making such as buying the "right" asset, having the most advantageous product and service mix, keeping or selling a business segment, and buying or leasing. Expert systems aid in optimally allocating resources based on factors as cost, time, availability, risk, and demand patterns. *Financial Advisor* developed at MIT's Sloan School of Management evaluates capital investments in property, plant and equipment. It also provides advice on projects, products, and acquisitions. Arthur D. Little's expert system conducts variance analysis and explains the reasons for significant variances.

In taxation, expert systems are used in tax preparation and planning, and facilitating compliance with tax rules and procedures.

The expert system can decide if a loan should be made and if so, the amount of credit to be given. It takes into account profitability, risk, economic factors, and management's policy. The expert system can approve the loan based on predetermined criteria and subject to specified restrictions and limitations. The expert system may decide on the appropriate interest rate, credit line, collateral requirements, and repayment schedule. Questionable loans are highlighted for careful attention.

In investment analysis, expert systems can recommend suitable investments taking into account such considerations as return/risk preferences, tax rate, dividend yield, portfolio mix, liquidity, and economic conditions. Expert systems aid in the best timing of purchases and sales of stocks because it integrates and considers real time multiple internal/external data sources. Watchdog Investment Monitoring System is used in investment analysis and management including financial statement analysis and financial forecasting.

A "rule generator" expert system notes information patterns and formulates trading recommendations. A "critic" expert system evaluates and reviews system suggested trades coupled with the explanation of doing so. An expert system can provide 24 hour trading programs so as to optimally take advantage of domestic and international market conditions such as changes in foreign exchange rates. Expert systems can identify and evaluate arbitrage opportunities and trigger transactions.

An insurance company may use expert systems to appraise and process claims including those of a questionable nature. *Escape* is used for claim authorization and processing.

The knowledge base of the expert system for marketing purposes includes market structure, customer characteristics, and competition. Expert systems may be used in market planning, marketing decision making, product/service introduction, new product development and enhancement, product features and options, marketing mix decisions, price formulation, return policy, warranty service planning, appraisal of product quality, discount formulation policy, setting credit terms, and advertising and promotion.

Applied Expert Systems' *Plan Power* is a financial planning expert system that takes into account a financial situation, then matches needs with the most suitable financial products and services. Additionally, the system will run scenario spreadsheets showing the income tax situation, cash flows, net worth, and other key factors based on alternative decisions.

FUZZY LOGIC

Fuzzy logic is a superset of conventional (Boolean) logic that has been extended to handle the concept of partial truth. Because they use nonspecific terms (membership functions) characterized by well-defined imprecision, fuzzy logic systems can create rules to address problems with many solutions. Fuzzy logic can be used when values are approximate or subject and data are incomplete or ambiguous. These systems have been applied successfully to applications such as ventilating expressway tunnels, backing a tractor-trailer into a parking space, reducing power usage in an air conditioner, selecting companies for business combinations, or detecting fraud in medical insurance claims.

NEURAL NETWORKS

Neural network software simulates human intelligence and learns from experience. For example, each time neural network software makes the correct decision (predetermined by a human expert) on recognizing sequential patterns of information, the programmer reinforces the program with a stored confirmation message. However, if there is an incorrect decision a negative message is reinforced. Hence, over time experimental knowledge is built in a subject.

Financial managers may use neural network to aid in decision making to provide early warning signs of problems, and to confirm assessments. In developing a neural network, the network should be furnished with sufficient information to recognize a pattern. It needs to be trained. The neural network should be part of other software to have a user interface. The companies regularly retrain the network and update the software at all locations. Finally, companies conduct follow-up and monitor the performance of the neural network. In planning the neural network, there should be a clear and precise definition of what the network should achieve, when the network should accomplish the task, and how the results are to be communicated.

A neural network may be used in portfolio management and investment selection. Neural network software may be used to predict changes in stock and bond prices, movements in currency exchange rates, and to spot undervalued securities.

Training the neural networks can be done in one of two ways—a massive set (all securities in a class or market segment) or a simplified set (a representative sample of securities within a class or market segment). With regard to the massive set, the neural network requires significantly more time to train because training involves examining the information hundreds of thousands of times. Thus, if the number of observations is large (tens of thousands or millions) the training iterations becomes millions of billions. The risk associated with smaller training sets revolves on the possibility that the neural network will memorize the actual training data and then be unable to make predictions about other securities in the market segment with tracking the broader data set. In any event, part of the training includes a holdout sample to test the trained network. This test gives assurance concerning the ability of the neural network to reliably predict the behavior of securities in the market segment appraised.

After the neural network is trained, the trained network can be integrated with other decision support systems to monitor movements in various capital markets. The neural network then recommends whether to buy, sell, or hold securities. By tracking changes in the market place, the neural network can predict upswings and downswings in the market, signaling buy and sell decisions.

Over time conditions change and the patterns of various securities and markets also change. With additional experience, the neural network can be retrained by adding new experience to the training set. The neural network can be retained on a monthly or quarterly basis to incorporate the most current changes in conditions. Some accountants, however, may opt to delete the oldest data set and replace it with the newest experience. The drawback of doing this is that the accountant loses experience gained before using the neural network.

Accountants using neural networks should try to ascertain how well the neural networks predict the behavior of individual securities and the overall market. If neural network is retrained annually or semiannually, and the sleeved securities fluctuate differently from predictions of the neural network during any month or quarter, the follow-up should indicate that retraining should take place immediately.

Neural networks can be used to select those securities that optimize the position of the investment portfolio. Neural networks can be used to identify specific securities from among a set that yield the highest return. The neural network highlights those securities that will best achieve the objectives of the portfolio.

The planning and design of the neural network depends on the accountant's objectives. If the monitoring applies to particular securities or specific markets or market segments, the software may involve a series of neural networks, one for each security. The accountant may need some up-front processing of information to accumulate and consolidate market or market segment data before running a series of neural networks, one for each market or market segment. Further, software to communicate the results of the neural network prediction to the accountant on a real-time basis must link to the neural networks. Most accountants embed neural networks in their on-line or e-commerce software that accounts for marketable securities.

The accountant locates data sources to provide the information necessary to achieve the objectives of buying and selling decisions for marketable securities in the company's portfolio. The data sources vary depending on the company, but usually, is a combination of databases from subscription services, internal databases, and direct feed from various stock exchanges. The plan should identify the needed result of the neural network and what information is to be gathered. If the financial manager is evaluating individual securities, outcomes of prior assessments furnish the best way to train the neural network to ascertain if particular stocks should be purchased or sold in the future.

An accountant may also use neural networks to identify potential customers who may be poor credit risks. Further, neural network software can be used to identify credit card fraud by recognizing suspicious activity based on the pattern of charges.

An accountant may use neural networks in the control and valuation of inventory. Neural networks provide inventory control by recognizing patterns indicating processing inefficiencies, cover-up of inventory theft, and fraudulent reporting. Neural networks furnish an efficient method to predict changes in inventory prices and inventory movement to aid in determining inventory obsolescence and identifying items for consideration of lower of cost or market adjustments. The neural network watches over inventory transactions to spot potential errors and frauds in the transactions that take place in the automated inventory system.

The information used by the firm to develop neural networks may include a number of observations including prior transactions for a given inventory item, size of each transaction, frequency of transactions, customer characteristics (for inventory sales transactions), supplier characteristics (for purchase transactions), and employee activity data. The accountant should retain information from individual inventory accounts that have been subjected to fraud or errors with similar information for good transactions. Companies use as much data as possible for this type of neural network, usually two to five years of history.

A neural network may be developed to monitor employee expense reimbursement claims to uncover potential fraudulent claims and provide the company an opportunity to cease authorization of payment or flag those claims requiring further investigation. The claim data from false claims usually has some pattern. The database for the neural network may include prior employee reimbursement expense claims for a particular activity, size of each claim transaction, frequency of reimbursement claim transactions, and employee characteristics. The company should use information from expense accounts that have been fraudulently submitted with similar valid employee reimbursement claims data. Two to five years of information should be collected.

Neural networks aid the accountant in detecting excess hedging in the budgetary process so realistic budget figure may be used. Neural networks can provide on-line pre-screening of accounts and details for various budgetary units.

Neural networks assist in assessing internal control, making potential fraud assessments, gathering evidence, and providing support for audits. Neural networks can recognize patterns of internal control and make a recommendation on the establishment of control risk to be used in audit

planning. Neural networks can identify the control risk level associated with different levels of internal control components.

Neural networks may also be used in operational auditing. Neural networks can identify clusters of operations with high or low potential for improvements in either effectiveness or efficiency. Some operational auditors use neural networks successfully to provide rapid identification of the best opportunities for improvement from a large group of operations.

NEURAL NETWORK APPLICATIONS IN BUSINESS

1. At Signet Bank, neural networks read and automatically process student loan applications and canceled checks.
2. A neural network helps manage the Fidelity Disciplined Equity Fund, a fund that has consistently beat the Standard & Poor's 500 Stock Index.
3. Neuroscope is a neural network diagnostic tool that provides early warning of failure in industrial machinery.
4. Foster Ousley Conley uses a neural network-based system for residential real estate appraisal. The system performs better than humans because it can review data from hundreds of houses and analyze the data in many different ways.
5. At Mellon Bank's Visa and Mastercard operations, neural networks outperform expert systems—and the experts themselves—in detecting credit card fraud. Since the neural network can learn by experience, it can find incidences of fraud *not anticipated by an expert.*
6. Neural networks can be used to forecast a client's earnings. By comparing this forecast to actual results, the auditor can make a judgment as to the reasonableness of the actual results. The forecasted earnings can also indicate to the auditor if the client is likely to continue as a going concern.
7. A cost accountant/consultant can use a neural network to determine optimal resource allocation and production schedules. The manipulation of the hundreds of variables and constraints has traditionally been undertaken using operations research models.
8. The IRS in Taiwan is using a neural network to determine the likelihood of tax evasion and the necessity of further investigation.

Other applications of neural networks include:

- Appraising spending patterns.
- Predicting bankruptcy.
- Evaluating customer behavior patterns.
- Working capital management.

The following is a list of popular neural network software.

NeuroSolutions
NeuroDomension, Inc.
www.neurosolutions.com

NeuroXL Predictor

FRANZ AG
www.neuroxl.com

NeuralWorks Predict
NeuralWare
www.neuralware.com

CHAPTER 7
INFORMATION SYSTEMS AND ECONOMIC FEASIBILITY STUDY

Learning Objectives:

After studying this chapter you will be able to:

1. Describe types and special features of capital budget decisions.
2. Recognize the time value of money.
3. Explain and utilize several capital budgeting techniques.
4. Discuss the effect of Modified Accelerated Cost Recovery Systems (MACRS) on capital budgeting decisions.
5. Determine the cost of capital.
6. Make lease-purchase decisions.
7. Conduct economic feasibility studies for new information systems.

Capital budgeting is the process of making long-term planning decisions for alternative investment opportunities. There are many investment decisions that the company may have to make in order to grow. Examples of capital budgeting applications are installation of a new information system (IS), lease or purchase, new product development, product line selection, keep or sell a business segment, and which asset to invest in. A careful cost-benefit analysis must be performed to determine a project's economic feasibility of a capital expenditure project.

WHAT ARE THE TYPES OF INVESTMENT PROJECTS?

There are typically two types of long-term capital expenditure decisions:

1. *Selection decisions* in terms of obtaining new facilities or expanding existing ones: Examples include:
    a. Investments in property, plant, and equipment as well as other types of assets.
    b. Resource commitments in the form of new product development, market research, introduction of an IS system, refunding of long-term debt, and so on.
    c. Mergers and acquisitions in the form of buying another company to add a new product line.
2. *Replacement decisions* in terms of replacing existing facilities with new ones. Examples include replacing an old machine with a high-tech machine.

WHAT ARE THE FEATURES OF INVESTMENT PROJECTS?

Long-term investments have three important features:

1. They typically involve a large amount of initial cash outlays which tend to have a long-term impact on the firm's future profitability. Therefore, this initial cash outlay needs to be justified on a cost-benefit basis.

2. There are expected recurring cash inflows (for example, increased revenues, savings in cash operating expenses, etc.) over the life of the investment project. This frequently requires considering the *time value of money*.
3. Income taxes could make a difference in the accept or reject decision. Therefore, income tax factors must be taken into account in every capital budgeting decision.

UNDERSTANDING THE CONCEPT OF TIME VALUE OF MONEY

A dollar now is worth more than a dollar to be received later. This statement sums up an important principle: money has a time value. The truth of this principle is not that inflation might make the dollar received at a later time worth less in buying power. The reason is that you could invest the dollar now and have more than a dollar at the specified later date.

Time value of money is a critical consideration in financial and investment decisions. For example, compound interest calculations are needed to determine future sums of money resulting from an investment. Discounting, or the calculation of present value, is inversely related to compounding, is used to evaluate the future cash flow associated with capital budgeting projects. There are plenty of applications of time value of money in accounting and finance.

How Do You Calculate Future Values - How Money Grows?
A dollar in hand today is worth more than a dollar to be received tomorrow because of the interest it could earn from putting it in a savings account or placing it in an investment account. Compounding interest means that interest earns interest. For the discussion of the concepts of compounding and time value, let us define:

F_n = future value: the amount of money at the end of year n
P = principal
i = annual interest rate
n = number of years

Then,

F_1 = the amount of money at the end of year 1
= principal and interest = $P + iP = P(1+i)$

F_2 = the amount of money at the end of year 2
= $F_1(1+i) = P(1+i)(1+i) = P(1+i)^2$

The future value of an investment compounded annually at rate i for n years is

$$F_n = P(1+i)^n = P \cdot T1(i,n)$$

where T1(i,n) is the compound amount of $1 and can be found in Table 1.

EXAMPLE 1
You place $1,000 in a savings account earning 8 percent interest compounded annually. How much money will you have in the account at the end of 4 years?

$$F_n = P(1+i)^n$$

$F_4 = \$1{,}000\ (1 + 0.08)^4 = \$1{,}000\ T1(8\%,4\ \text{years})$

From Table 1, the T1 for 4 years at 8 percent is 1.361.

Therefore, $F_4 = \$1{,}000\ (1.361) = \$1{,}361.$

EXAMPLE 2

You invested a large sum of money in the stock of Delta Corporation. The company paid a $3 dividend per share. The dividend is expected to increase by 20 percent per year for the next 3 years. You wish to project the dividends for years 1 through 3.

$$F_n = P(1+i)^n$$

$F_1 = \$3(1+0.2)^1 = \$3\ T1(20\%,1) = \$3\ (1.200) = \$3.60$

$F_2 = \$3(1+0.2)^2 = \$3\ T1(20\%,2) = \$3\ (1.440) = \$4.32$

$F_3 = \$3(1+0.2)^3 = \$3\ T1(20\%,3) = \$3\ (1.728) = \$5.18$

Future Value of an Annuity

An annuity is defined as a series of payments (or receipts) of a fixed amount for a specified number of periods. Each payment is assumed to occur at the end of the period. The future value of an annuity is a compound annuity which involves depositing or investing an equal sum of money at the end of each year for a certain number of years and allowing it to grow.

Let S_n = the future value on an n-year annuity
A = the amount of an annuity

Then we can write

$$S_n = A(1+i)^{n-1} + A(1+i)^{n-2} + \ldots + A(1+i)^0$$

$$= A[(1+i)^{n-1}+(1+i)^{n-2}+ \ldots + (1+i)^0]$$

$$= A \cdot \sum_{t=0}^{n-1} (1+i)^t = A \bullet \frac{(1+i)^n - 1}{i} = A \cdot T2(i,n)$$

where T2(i,n) represents the future value of an annuity of $1 for n years compounded at i percent and can be found in Table 2.

EXAMPLE 3

You wish to determine the sum of money you will have in a savings account at the end of 6 years by depositing $1,000 at the end of each year for the next 6 years. The annual interest rate is 8 percent. The T2(8%,6 years) is given in Table 2 as 7.336. Therefore,

S_6 = $1,000 T2(8%,6) = $1,000 (7.336) = $7,336

EXAMPLE 4
You deposit $30,000 semiannually into a fund for ten years. The annual interest rate is 8 percent. The amount accumulated at the end of the tenth year is calculated as follows:

$$S_n = A.\ T2(i, n)$$

where A = $30,000
i = 8%/2 = 4%
n = 10 x 2 = 20

Therefore,

S_n = $30,000 T2(4%, 20)
= $30,000 (29.778) = $893,340

What Is Present Value - How Much Money Is Worth Now?
Present value is the present worth of future sums of money. The process of calculating present values, or discounting, is actually the opposite of finding the compounded future value. In connection with present value calculations, the interest rate i is called the *discount rate*. The discount rate we use is more commonly called the *cost of capital*, which is the minimum rate of return required by the investor.

Recall that $F_n = P(1+i)^n$

Therefore,

$$P = \frac{F_n}{(1+i)^n} = F_n \bullet \left(\frac{1}{(1+i)^n} \right) = F_n \bullet T3(i, n)$$

Where T3(i,n) represents the present value of $1 and is given in Table 3.

EXAMPLE 5
You have been given an opportunity to receive $20,000 6 years from now. If you can earn 10 percent on your investments, what is the most you should pay for this opportunity? To answer this question, you must compute the present value of $20,000 to be received 6 years from now at a 10 percent rate of discount. F_6 is $20,000, I is 10 percent, and n is 6 years. T3(10%,6) from Table 3 is 0.565.

$$P = \$20{,}000\left[\frac{\quad}{(1+0.1)^6}\right] = \$20{,}000\ T3(10\%,6) = \$20{,}000(0.564) = \$11{,}280$$

This means that you can earn 10 percent on your investment, and you would be indifferent to receiving $11,280 now, or $20,000 6 years from today since the amounts are time equivalent. In other words, you could invest $11,300 today at 10 percent and have $20,000 in 6 years.

Present Value of Mixed Streams of Cash Flows

The present value of a series of mixed payments (or receipts) is the sum of the present value of each individual payment. We know that the present value of each individual payment is the payment times the appropriate T3 value.

EXAMPLE 6

You are thinking of starting a new product line that initially costs $32,000. Your annual projected cash inflows are:

1	$10,000
2	$20,000
3	$5,000

If you must earn a minimum of 10 percent on your investment, should you undertake this new product line?

The present value of this series of mixed streams of cash inflows is calculated as follows:

Year	*Cash inflows*	*x T3(10%, n)*	*Present Value*
1	$10,000	0.909	$9,090
2	$20,000	0.826	$16,520
3	$5,000	0.751	$3,755
			$29,365

Since the present value of your projected cash inflows is less than the initial investment, you should not undertake this project.

Present Value of an Annuity

Interest received from bonds, pension funds, and insurance obligations involve annuities. To compare these financial instruments, we need to know the present value of each. The present value of an annuity (P_n) can be found by using the following equation:

$$P_n = A \bullet \frac{1}{(1+i)^1} + A \bullet \frac{1}{(1+i)^2} + \ldots + A \bullet \frac{1}{(1+i)^n}$$

$$= A \bullet \left(\frac{1}{(1+i)^1} + \frac{1}{(1+i)^2} + \ldots + \frac{1}{(1+i)^n} \right)$$

$$P_n = A \bullet \sum_{t=0}^{n} \frac{1}{(1+i)^t} = A \bullet \left[\frac{1}{i} \left(1 - \frac{1}{(1+i)} \right) \right] = A \bullet T4(i,n)$$

where T4(i,n) represents the present value of an annuity of $1 discounted at i percent for n years and is found in Table 4.

EXAMPLE 7
Assume that the cash inflows in Example 6 form an annuity of $10,000 for 3 years. Then the present value is

$$P_n = A \,.\, T4(i,n)$$

$$P_3 = \$10{,}000\ T4(10\%, 3\ \text{years}) = \$10{,}000\ (2.487) = \$24{,}870$$

Table 1 Future Value of $1 = T1(i,n)

Periods	4%	6%	8%	10%	12%	14%	20%
1	1.040	1.060	1.080	1.100	1.120	1.140	1.200
2	1.082	1.124	1.166	1.210	1.254	1.300	1.440
3	1.125	1.191	1.260	1.331	1.405	1.482	1.728
4	1.170	1.263	1.361	1.464	1.574	1.689	2.074
5	1.217	1.338	1.469	1.611	1.762	1.925	2.488
6	1.265	1.419	1.587	1.772	1.974	2.195	2.986
7	1.316	1.504	1.714	1.949	2.211	2.502	3.583
8	1.369	1.594	1.851	2.144	2.476	2.853	4.300
9	1.423	1.690	1.999	2.359	2.773	3.252	5.160
10	1.480	1.791	2.159	2.594	3.106	3.707	6.192
11	1.540	1.898	2.332	2.853	3.479	4.226	7.430
12	1.601	2.012	2.518	3.139	3.896	4.818	8.916
13	1.665	2.133	2.720	3.452	4.364	5.492	10.699
14	1.732	2.261	2.937	3.798	4.887	6.261	12.839
15	1.801	2.397	3.172	4.177	5.474	7.138	15.407
16	1.873	2.540	3.426	4.595	6.130	8.137	18.488
17	1.948	2.693	3.700	5.055	6.866	9.277	22.186
18	2.026	2.854	3.996	5.560	7.690	10.575	26.623
19	2.107	3.026	4.316	6.116	8.613	12.056	31.948
20	2.191	3.207	4.661	5.728	9.646	13.743	38.338
30	3.243	5.744	10.063	17.450	29.960	50.950	237.380
40	4.801	10.286	21.725	45.260	93.051	188.880	1469.800

Table 2 Future Value of an Annuity of $1 = T2(i,n)

Periods	4%	6%	8%	10%	12%	14%	20%
1	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2	2.040	2.060	2.080	2.100	2.120	2.140	2.200
3	3.122	3.184	3.246	3.310	3.374	3.440	3.640
4	4.247	4.375	4.506	4.641	4.779	4.921	5.368
5	5.416	5.637	5.867	6.105	6.353	6.610	7.442
6	6.633	6.975	7.336	7.716	8.115	8.536	9.930
7	7.898	8.394	8.923	9.487	10.089	10.730	12.916
8	9.214	9.898	10.637	11.436	12.300	13.233	16.499
9	10.583	11.491	12.488	13.580	14.776	16.085	20.799
10	12.006	13.181	14.487	15.938	17.549	19.337	25.959
11	13.486	14.972	16.646	18.531	20.655	23.045	32.150
12	15.026	16.870	18.977	21.385	24.133	37.271	39.580
13	16.627	18.882	21.495	24.523	28.029	32.089	48.497
14	18.292	21.015	24.215	27.976	32.393	37.581	59.196
15	20.024	23.276	27.152	31.773	37.280	43.842	72.035
16	21.825	25.673	30.324	35.950	42.753	50.980	87.442
17	23.698	28.213	33.750	40.546	48.884	59.118	105.930
18	25.645	30.906	37.450	45.600	55.750	68.394	128.120
19	27.671	33.760	41.446	51.160	63.440	78.969	154.740
20	29.778	36.778	45.762	57.276	75.052	91.025	186.690
30	56.085	79.058	113.283	164.496	241.330	356.790	1181.900
40	95.026	154.762	259.057	442.597	767.090	1342.000	7343.900

*Payments (or receipts) at the *end* of each period.

Table 3 Present Value of $1 = T3(i,n)

PERIODS	3%	4%	5%	6%	7%	8%	10%	12%	14%	16%	18%	20%	22%	24%	25%	26%	28%	30%	40%
1	.9709	.9615	.9524	.9434	.9346	.9259	.9091	.8929	.8772	.8621	.8475	.8333	.8197	.8065	.8000	.7937	.7813	.7692	.7143
2	.9426	.9246	.9070	.8900	.8734	.8573	.8264	.7972	.7695	.7432	.7182	.6944	.6719	.6504	.6400	.6299	.6104	.5917	.5102
3	.9151	.8890	.8638	.8396	.8163	.7938	.7513	.7118	.6750	.6407	.6086	.5787	.5507	.5245	.5120	.4999	.4768	.4552	.3644
4	.8885	.8548	.8227	.7921	.7629	.7350	.6830	.6355	.5921	.5523	.5158	.4823	.4514	.4230	.4096	.3968	.3725	.3501	.2603
5	.8626	.8219	.7835	.7473	.7130	.6806	.6209	.5674	.5194	.4761	.4371	.4019	.3700	.3411	.3277	.3149	.2910	.2693	.1859
6	.8375	.7903	.7462	.7050	.6663	.6302	.5645	.5066	.4556	.4104	.3704	.3349	.3033	.2751	.2621	.2499	.2274	.2072	.1328
7	.8131	.7599	.7107	.6651	.6227	.5835	.5132	.4523	.3996	.3538	.3139	.2791	.2486	.2218	.2097	.1983	.1776	.1594	.0949
8	.7894	.7307	.6768	.6274	.5820	.5403	.4665	.4039	.3506	.3050	.2660	.2326	.2038	.1789	.1678	.1574	.1388	.1226	.0678
9	.7664	.7026	.6446	.5919	.5439	.5002	.4241	.3606	.3075	.2630	.2255	.1938	.1670	.1443	.1342	.1249	.1084	.0943	.0484
10	.7441	.6756	.6139	.5584	.5083	.4632	.3855	.3220	.2697	.2267	.1911	.1615	.1369	.1164	.1074	.0992	.0847	.0725	.0346
11	.7224	.6496	.5847	.5268	.4751	.4289	.3505	.2875	.2366	.1954	.1619	.1346	.1122	.0938	.0859	.0787	.0662	.0558	.0247
12	.7014	.6246	.5568	.4970	.4440	.3971	.3186	.2567	.2076	.1685	.1372	.1122	.0920	.0757	.0687	.0625	.0517	.0429	.0176
13	.6810	.6006	.5303	.4688	.4150	.3677	.2897	.2292	.1821	.1452	.1163	.0935	.0754	.0610	.0550	.0496	.0404	.0330	.0126
14	.6611	.5775	.5051	.4423	.3878	.3405	.2633	.2046	.1597	.1252	.0985	.0779	.0618	.0492	.0440	.0393	.0316	.0254	.0090
15	.6419	.5553	.4810	.4173	.3624	.3152	.2394	.1827	.1401	.1079	.0835	.0649	.0507	.0397	.0352	.0312	.0247	.0195	.0064
16	.6232	.5339	.4581	.3936	.3387	.2919	.2176	.1631	.1229	.0930	.0708	.0541	.0415	.0320	.0281	.0248	.0193	.0150	.0046
17	.6050	.5134	.4363	.3714	.3166	.2703	.1978	.1456	.1078	.0802	.0600	.0451	.0340	.0258	.0225	.0197	.0150	.0116	.0033
18	.5874	.4936	.4155	.3503	.2959	.2502	.1799	.1300	.0946	.0691	.0508	.0376	.0279	.0208	.0180	.0156	.0118	.0089	.0023
19	.5703	.4746	.3957	.3305	.2765	.2317	.1635	.1161	.0829	.0596	.0431	.0313	.0229	.0168	.0144	.0124	.0092	.0068	.0017
20	.5537	.4564	.3769	.3118	.2584	.2145	.1486	.1037	.0728	.0514	.0365	.0261	.0187	.0135	.0115	.0098	.0072	.0053	.0012
21	.5375	.4388	.3589	.2942	.2415	.1987	.1351	.0926	.0638	.0443	.0309	.0217	.0154	.0109	.0092	.0078	.0056	.0040	.0009
22	.5219	.4220	.3418	.2775	.2257	.1839	.1228	.0826	.0560	.0382	.0262	.0181	.0126	.0088	.0074	.0062	.0044	.0031	.0006
23	.5067	.4057	.3256	.2618	.2109	.1703	.1117	.0738	.0491	.0329	.0222	.0151	.0103	.0071	.0059	.0049	.0034	.0024	.0004
24	.4919	.3901	.3101	.2470	.1971	.1577	.1015	.0659	.0431	.0284	.0188	.0126	.0085	.0057	.0047	.0039	.0027	.0018	.0003
25	.4776	.3751	.2953	.2330	.1842	.1460	.0923	.0588	.0378	.0245	.0160	.0105	.0069	.0046	.0038	.0031	.0021	.0014	.0002
26	.4637	.3607	.2812	.2198	.1722	.1352	.0839	.0525	.0331	.0211	.0135	.0087	.0057	.0037	.0030	.0025	.0016	.0011	.0002
27	.4502	.3468	.2678	.2074	.1609	.1252	.0763	.0469	.0291	.0182	.0115	.0073	.0047	.0030	.0024	.0019	.0013	.0008	.0001
28	.4371	.3335	.2551	.1956	.1504	.1159	.0693	.0419	.0255	.0157	.0097	.0061	.0038	.0024	.0019	.0015	.0010	.0006	.0001
29	.4243	.3207	.2429	.1846	.1406	.1073	.0630	.0374	.0224	.0135	.0082	.0051	.0031	.0020	.0015	.0012	.0008	.0005	.0001
30	.4120	.3083	.2314	.1741	.1314	.0994	.0573	.0334	.0196	.0116	.0070	.0042	.0026	.0016	.0012	.0010	.0006	.0004	.0000
40	.3066	.2083	.1420	.0972	.0668	.0460	.0221	.0107	.0053	.0026	.0013	.0007	.0004	.0002	.0001	.0001	.0001	.0000	.0000

Table 4 Present Value of an Annuity of $1 = T4(i,n)

Periods	3%	4%	5%	6%	7%	8%	10%	12%	14%	16%	18%	20%	22%	24%
1	.9709	.9615	.9524	.9434	.9346	.9259	.9091	.8929	.8772	.8621	.8475	.8333	.8197	.8065
2	1.9135	1.8861	1.8594	1.8334	1.8080	1.7833	1.7355	1.6901	1.6467	1.6052	1.5656	1.5278	1.4915	1.4568
3	2.8286	2.7751	2.7232	2.6730	2.6243	2.5771	2.4869	2.4018	2.3216	2.2459	2.1743	2.1065	2.0422	1.9813
4	3.7171	3.6299	3.5460	3.4651	3.3872	3.3121	3.1699	3.0373	2.9137	2.7982	2.6901	2.5887	2.4936	2.4043
5	4.5797	4.4518	4.3295	4.2124	4.1002	3.9927	3.7908	3.6048	3.4331	3.2743	3.1272	2.9906	2.8636	2.7454
6	5.4172	5.2421	5.0757	4.9173	4.7665	4.6229	4.3553	4.1114	3.8887	3.6847	3.4976	3.3255	3.1669	3.0205
7	6.2303	6.0021	5.7864	5.5824	5.3893	5.2064	4.8684	4.5638	4.2883	4.0386	3.8115	3.6046	3.4155	3.2423
8	7.0197	6.7327	6.4632	6.2098	5.9713	5.7466	5.3349	4.9676	4.6389	4.3436	4.0776	3.8372	3.6193	3.4212
9	7.7861	7.4353	7.1078	6.8017	6.5152	6.2469	5.7590	5.3282	4.9464	4.6065	4.3030	4.0310	3.7863	3.5655
10	8.5302	8.1109	7.7217	7.3601	7.0236	6.7101	6.1446	5.6502	5.2161	4.8332	4.4941	4.1925	3.9232	3.6819
11	9.2526	8.7605	8.3064	7.8869	7.4987	7.1390	6.4951	5.9377	5.4527	5.0286	4.6560	4.3271	4.0354	3.7757
12	9.9540	9.3851	8.8633	8.3838	7.9427	7.5361	6.8137	6.1944	5.6603	5.1971	4.7932	4.4392	4.1274	3.8514
13	10.6350	9.9856	9.3936	8.8527	8.3577	7.9038	7.1034	6.4235	5.8424	5.3423	4.9095	4.5327	4.2028	3.9124
14	11.2961	10.5631	9.8986	9.2950	8.7455	8.2442	7.3667	6.6282	6.0021	5.4675	5.0081	4.6106	4.2646	3.9616
15	11.9379	11.1184	10.3797	9.7122	9.1079	8.5595	7.6061	6.8109	6.1422	5.5755	5.0916	4.6755	4.3152	4.0013
16	12.5611	11.6523	10.8378	10.1059	9.4466	8.8514	7.8237	6.9740	6.2651	5.6685	5.1624	4.7296	4.3567	4.0333
17	13.1661	12.1657	11.2741	10.4773	9.7632	9.1216	8.0216	7.1196	6.3729	5.7487	5.2223	4.7746	4.3908	4.0591
18	13.7535	12.6593	11.6896	10.8276	10.0591	9.3719	8.2014	7.2497	6.4674	5.8178	5.2732	4.8122	4.4187	4.0799
19	14.3238	13.1339	12.0853	11.1581	10.3356	9.6036	8.3649	7.3658	6.5504	5.8775	5.3162	4.8435	4.4415	4.0967
20	14.8775	13.5903	12.4622	11.4699	10.5940	9.8181	8.5136	7.4694	6.6231	5.9288	5.3527	4.8696	4.4603	4.1103
21	15.4150	14.0292	12.8212	11.7641	10.8355	10.0168	8.6487	7.5620	6.6870	5.9731	5.3837	4.8913	4.4756	4.1212
22	15.9369	14.4511	13.1630	12.0416	11.0612	10.2007	8.7715	7.6446	6.7429	6.0113	5.4099	4.9094	4.4882	4.1300
23	16.4436	14.8568	13.4886	12.3034	11.2722	10.3711	8.8832	7.7184	6.7921	6.0442	5.4321	4.9245	4.4985	4.1371
24	16.9355	15.2470	13.7986	12.5504	11.4693	10.5288	8.9847	7.7843	6.8351	6.0726	5.4509	4.9371	4.5070	4.1428
25	17.4131	15.6221	14.0939	12.7834	11.6536	10.6748	9.0770	7.8431	6.8729	6.0971	5.4669	4.9476	4.5139	4.1474
26	17.8768	15.9828	14.3752	13.0032	11.8258	10.8100	9.1609	7.8957	6.9061	6.1182	5.4804	4.9563	4.5196	4.1511
27	18.3270	16.3296	14.6430	13.2105	11.9867	10.9352	9.2372	7.9426	6.9352	6.1364	5.4919	4.9636	4.5243	4.1542
28	18.7641	16.6631	14.8981	13.4062	12.1371	11.0511	9.3066	7.9844	6.9607	6.1520	5.5016	4.9697	4.5281	4.1566
29	19.1885	16.9837	15.1411	13.5907	12.2777	11.1584	9.3696	8.0218	6.9830	6.1656	5.5098	4.9747	4.5312	4.1585
30	19.6004	17.2920	15.3725	13.7648	12.4090	11.2578	9.4269	8.0552	7.0027	6.1772	5.5168	4.9789	4.5338	4.1601
40	23.1148	19.7928	17.1591	15.0463	13.3317	11.9246	9.7791	8.2438	7.1050	6.2335	5.5482	4.9966	4.5439	4.1659

Use of Financial Calculators and Spreadsheet Programs
There are many financial calculators that contain pre-programmed formulas to perform many present value and future applications. They include *Hewlett-Packard 10B*, *Sharpe EL733*, and *Texas Instrument BA35*. Furthermore, spreadsheet software such as *Excel* has built-in financial functions to perform many such applications.

HOW DO YOU MEASURE INVESTMENT WORTH?

Several methods of evaluating investment projects are as follows:

1. Payback period
2. Net present value (NPV)
3. Internal rate of return (IRR)

The NPV method and the IRR method are called *discounted cash flow (DCF) methods.* Each of these methods is discussed below.

1. Payback Period

The payback period measures the length of time required to recover the amount of initial investment. It is computed by dividing the initial investment by the cash inflows through increased revenues or cost savings.

EXAMPLE 8

Assume:

Cost of investment	$18,000
Annual after-tax cash savings	$3,000

Then, the payback period is:

$$\text{Payback period} = \frac{\text{Initial investment}}{\text{Cost savings}} = \frac{\$18{,}000}{\$3{,}000} = 6 \text{ years}$$

Decision rule: Choose the project with the shorter payback period. The rationale behind this choice is: The shorter the payback period, the less risky the project, and the greater the liquidity.

EXAMPLE 9

Consider the two projects whose after-tax cash inflows are not even. Assume each project costs $1,000.

CASH INFLOW

Year	*A($)*	*B($)*
1	100	500
2	200	400
3	300	300
4	400	100

5	500
6	600

When cash inflows are not even, the payback period has to be found by trial and error. The payback period of project A is ($1,000= $100 + $200 + $300 + $400) 4 years. The payback period of project B is $1,000 = $500 + $400 + $100):

$$2 \text{ years} + \frac{\$100}{\$300} = 2\ 1/3 \text{ years}$$

Project B is the project of choice in this case, since it has the shorter payback period.

The advantages of using the payback period method of evaluating an investment project are that (1) it is simple to compute and easy to understand, and (2) it handles investment risk effectively.

The shortcomings of this method are that (1) it does not recognize the time value of money, and (2) it ignores the impact of cash inflows received after the payback period; essentially, cash flows after the payback period determine profitability of an investment.

2. Net Present Value

Net present value (NPV) is the excess of the present value (PV)of cash inflows generated by the project over the amount of the initial investment (I):

$$NPV = PV - I$$

The present value of future cash flows is computed using the so-called cost of capital (or minimum required rate of return) as the discount rate. When cash inflows are uniform, the present value would be

$$PV = A \,.\, T4\,(i, n)$$

where A is the amount of the annuity. The value of T4 is found in Table 4.

Decision rule: If NPV is positive, accept the project. Otherwise reject it.

EXAMPLE 10

Consider the following investment:

Initial investment	$12,950
Estimated life	10 years
Annual cash inflows	$3,000
Cost of capital (minimum required rate of return)	12%

Present value of the cash inflows is:

PV = A.T4(i,n)	
= \$3,000. T4(12%,10 years)	
= \$3,000 (5.650)	\$16,950
Initial investment (I)	12,950
Net present value (NPV = PV - I)	\$4,000

Since the NPV of the investment is positive, the investment should be accepted.

The advantages of the NPV method are that it obviously recognizes the time value of money and it is easy to compute whether the cash flows form an annuity or vary from period to period.

3. Internal Rate of Return

Internal rate of return (IRR), also called *time adjusted rate of return*, is defined as the rate of interest that equates I with the PV of future cash inflows.

In other words,

at IRR I = PV or NPV = 0

Decision rule: Accept the project if the IRR exceeds the cost of capital. Otherwise, reject it.

EXAMPLE 11

Assume the same data given in Example 10, and set the following equality (I = PV):

\$12,950 = \$3,000 . T4(i,10 years)

$$\text{T4(i,10 years)} = \frac{\$12,950}{\$3,000} = 4.317$$

which stands somewhere between 18 percent and 20 percent in the 10-year line of Table 4. The interpolation follows:

	PV of An Annuity of \$1 Factor T4(i,10 years)	
18%	4.494	4.494
IRR	4.317	
20%		4.192
Difference	0.177	0.302

Therefore,

0.177

$$IRR = 18\% + \frac{}{0.302}(20\% - 18\%)$$

$$= 18\% + 0.586(2\%) = 18\% + 1.17\% = 19.17\%$$

Since the IRR of the investment is greater than the cost of capital (12 percent), accept the project.

The advantage of using the IRR method is that it does consider the time value of money.

The shortcomings of this method are that (1) it is time-consuming to compute, especially when the cash inflows are not even, although most financial calculators and PCs have a key to calculate IRR, and (2) it fails to recognize the varying sizes of investment in competing projects.

Can A Computer Help?

Spreadsheet programs can be used in making IRR calculations. For example, *Excel* has a function IRR(values, guess). Excel considers negative numbers as cash outflows such as the initial investment, and positive numbers as cash inflows. Many financial calculators have similar features. As in Example 13, suppose you want to calculate the IRR of a $12,950 investment (the value --12950 entered in year 0 that is followed by 10 monthly cash inflows of $3,000). Using a guess of 12% (the value of 0.12), which is in effect the cost of capital, your formula would be @IRR(values, 0.12) and Excel would return 19.15%, as shown below.

Year 0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
$ (12,950)	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
IRR =	19.15%									
NPV =	$4,000.67									

Note: The *Excel* formula for NPV is NPV (discount rate, cash inflow values) + I, where I is given as a negative number.

Note: For IT investments, an increasing number of companies started using a new metric, known as: *return on infrastructure employed (ROIE).* ROIE is a retrospective comparison of net earnings with yearly IT operating expenses — the networks, systems, and applications that underpin the business — expressed as a ratio, with a higher number being better than a lower one.

HOW DO INCOME TAXES AFFECT INVESTMENT DECISIONS?

Income taxes make a difference in many capital budgeting decisions. The project which is attractive on a before-tax basis may have to be rejected on an after-tax basis and vice versa. Income taxes typically affect both the amount and the timing of cash flows. Since net income, not cash inflows, is subject to tax, after-tax cash inflows are not usually the same as after-tax net income.

How To Calculate After-Tax Cash Flows

Let us define:

S = Sales
E = Cash operating expenses
d = Depreciation
t = Tax rate

Then, before-tax cash inflows (or cash savings) = S - E and net income = S - E - d

By definition,

After-tax cash inflows = Before-tax cash inflows - Taxes = (S - E) - (S - E - d) (t)

Rearranging gives the short-cut formula:

After-tax cash inflows = (S - E) (1 - t) + (d)(t) or
= (S - E - d) (1 - t) + d

The deductibility of depreciation from sales in arriving at taxable net income reduces income tax payments and thus serves as a *tax shield*.

Tax shield = Tax savings on depreciation = (d)(t)

EXAMPLE 12
Assume:

S = $12,000
E = $10,000
d = $500 per year using the straight line method
t = 30%

Then,

After-tax cash inflow = ($12,000 - $10,000) (1 - .3) + ($500)(.3)
= ($2,000)(.7) + ($500)(.3)
= $1,400 + $150 = $1,550

Note that a tax shield = tax savings on depreciation = (d)(t)
= ($500)(.3) = $150

Since the tax shield is dt, the higher the depreciation deduction, the higher the tax savings on depreciation. Therefore, an accelerated depreciation method (such as double-declining balance) produces higher tax savings than the straight-line method. Accelerated methods produce higher present values for the tax savings which may make a given investment more attractive.

EXAMPLE 13

The Navistar Company estimates that it can save $2,500 a year in cash operating costs for the next ten years if it buys a special-purpose machine at a cost of $10,000. No residual value is expected. Depreciation is by straight-line. Assume that the income tax rate is 30%, and the after-tax cost of capital (minimum required rate of return) is 10%. After-tax cash savings can be calculated as follows:

Depreciation by straight-line is $10,000/10 = $1,000 per year. Thus,

$$\text{After-tax cash savings} = (S - E)(1 - t) + (d)(t)$$
$$= \$2,500(1 - .3) + \$1,000(.3)$$
$$= \$1,750 + \$300 = \$2,050$$

To see if this machine should be purchased, the net present value can be calculated.

$$PV = \$2,050\ T4(10\%, 10 \text{ years}) = \$2,050\ (6.145) = \$12,597.25$$

Thus, $NPV = PV - I = \$12,597.25 - \$10,000 = \$2,597.25$

Since NPV is positive, the machine should be bought.

EXAMPLE 14

Shalimar Corporation has provided its revenues and cash operating costs (excluding depreciation) for the old and the new machine as follows:

	Revenue	*Annual Cash Operating Costs*	*Net Profit before Depreciation and Taxes*
Old machine	$150,000	$70,000	$80,000
New machine	$180,000	$60,000	$120,000

Assume that the annual depreciation of the old machine and the new machine will be $30,000 and $50,000, respectively. Assume further that the tax rate is 46%.

To arrive at net profit after taxes, we first have to deduct depreciation expense from the net profit before depreciation and taxes, as follows:

	Net Profits after Taxes	*Add Depreciation*	*After-Tax Cash Inflows*
Old machine	($80,000-$30,000)(1-0.46)=$27,000	$30,000	$57,000
New machine	($120,000-$50,000)(1-0.46)=$37,800	$50,000	$87,800

Subtracting the after-tax cash inflows of the old machine from the cash inflows of the new machine results in the relevant, or incremental, cash inflows for each year.

Therefore, in this example, the relevant or incremental cash inflows for each year are $87,800 - $57,000 = $30,800.

Alternatively, the incremental cash inflows after taxes can be computed, using the following simple formula:

After-tax incremental cash inflows = (increase in revenues)(1-tax rate)
- (increase in cash charges)(1-tax rate)
+ (increase in depreciation expenses)(tax rate)

EXAMPLE 15
Using the data in Example 14, after-tax incremental cash inflows for each year are:

Increase in revenue x (1-tax rate):	
($180,000-$150,000)(1-0.46)	$16,200
- Increase in cash charges x (1-tax rate):	
($60,000-$70,000)(1-0.46)	-(-5,400)
+ Increase in depreciation expense x	
tax rate: ($50,000-$30,000)(0.46)	9,200
	$30,800

HOW DOES MACRS AFFECT INVESTMENT DECISIONS?

Although the traditional depreciation methods can be used for computing depreciation for book purposes, 1981 saw a new way of computing depreciation deductions for tax purposes. The current rule is called the *Modified Accelerated Cost Recovery System* (MACRS) rule, as enacted by Congress in 1981 and then modified somewhat in 1986 under the Tax Reform Act of 1986. This rule is characterized as follows:

1. It abandons the concept of useful life and accelerates depreciation deductions by placing all depreciable assets into one of eight age property classes. It calculates deductions, based on an allowable percentage of the asset's original cost (See Tables 5 and 6).

With a shorter asset tax life than useful life, the company would be able to deduct depreciation more quickly and save more in income taxes in the earlier years, thereby making an investment more attractive. The rationale behind the system is that this way the government encourages the company to invest in facilities and increase its productive capacity and efficiency. (Remember that the higher d, the larger the tax shield (d)(t)).

2. Since the allowable percentages in Table 5 add up to 100%, there is no need to consider the salvage value of an asset in computing depreciation.

3. The company may elect the straight line method. The straight-line convention must follow what is called the *half-year convention*. This means that the company can deduct only half of the regular straight-line depreciation amount in the first year.

The reason for electing to use the MACRS optional straight-line method is that some firms may prefer to stretch out depreciation deductions using the straight-line method rather than to accelerate them. Those firms are the ones that just start out or have little or no income and wish to show more income on their income statements.

EXAMPLE 16

Assume that a machine falls under a 3-year property class and costs $3,000 initially. The straight line option under MACRS differs from the traditional straight line method in that under this method the company would deduct only $500 depreciation in the first year and the fourth year ($3,000/3 years =$1,000; $1,000/2=$500). The table below compares the straight line with half-year convention with the MACRS.

Year	*Straight line* ***(half-year)*** ***Depreciation***	*Cost*		*MACRS %*	***MACRS*** ***Deduction***
1	$ 500	$3,000	x	33.3%	$ 999
2	1,000	3,000	x	44.5	1,335
3	1,000	3,000	x	14.8	444
4	500	3,000	x	7.4	222
	$3,000				$3,000

EXAMPLE 17

A machine costs $10,000. Annual cash inflows are expected to be $5,000. The machine will be depreciated using the MACRS rule and will fall under the 3-year property class. The cost of capital after taxes is 10%. The estimated life of the machine is 5 years. The salvage value of the machine at the end of the fifth year is expected to be $1,200. The tax rate is 30%. Should you buy the machine? Use the NPV method.

The formula for computation of after-tax cash inflows (S - E)(1 - t)+ (d)(t) needs to be computed separately. The NPV analysis can be performed as follows:

					Present value Factor @ 10%	***Present*** *Value*
(S-E)(1 -t):						
	$5,000 For 5 years	$5,000 (1 - .3) = **$3,500** for **5** years		**$3.500**	3.791(a)	$13,268.50
(d)(t):						
Year	*Cost*	*MACRS %*	*d*	*(d)(t)*		
1	$10,000 x	33.3%	$3,330	**$999**	.909(b)	908.09
2	$10,000 x	44.5	4,450	**1,335**	.826(b)	1,102.71

	3	$10,000 x	14.8	1,480	**444**	.751(b)	333.44
	4	$10,000 x	7.4	740	**222**	. 683(b)	151.63
Salvage value:							
		$1,200 in year 5:	$1,200(1-.3) = **$840**(c) in year **5**		**$840**	.621(b)	521.64
			Present value (PV)				$16,286.01

(a) T4 (10%, 4 years) = 3.170 (from Table 4).
(b) T3 values (year 1, 2, 3, 4, 5) obtained from Table 3.
(c) Any salvage value received under the MACRS rules is a *taxable gain* (the excess of the selling price over book value, $1,200 in this example), since the book value will be zero at the end of the life of the machine.

Since NPV = PV - I = $16,286.01 - $10,000 = $6,286.01 is positive, the machine should be bought.

TABLE 5
MODIFIED ACCELERATED COST RECOVERY SYSTEM
CLASSIFICATION OF ASSETS

Property class

Year	*3-year*	*5-year*	*7-year*	*10-year*	*15-year*	*20-year*
1	33.3%	20.0%	14.3%	10.0%	5.0%	3.8%
2	44.5	32.0	24.5	18.0	9.5	7.2
3	14.8a	19.2	17.5	14.4	8.6	6.7
4	7.4	11.5a	12.5	11.5	7.7	6.2
5		11.5	8.9a	9.2	6.9	5.7
6		5.8	8.9	7.4	6.2	5.3
7			8.9	6.6a	5.9a	4.9
8			4.5	6.6	5.9	4.5a
9				6.5	5.9	4.5
10				6.5	5.9	4.5
11				3.3	5.9	4.5
12					5.9	4.5
13					5.9	4.5
14					5.9	4.5
15					5.9	4.5
16					3.0	4.4
17						4.4
18						4.4
19						4.4
20						4.4
21						2.2
Total	100%	100%	100%	100%	100%	100%

a. Denotes the year of changeover to straight-line depreciation.

TABLE 6
MACRS TABLES BY PROPERTY CLASS

MACRS Property Class & Depreciation Method	*Useful Life (ADR Midpoint Life) "a"*	*Examples of Assets*
3-year property 200% declining balance	4 years or less	Most small tools are included; the law specifically excludes autos and light trucks from this property class.
5-year property 200% computers, declining balance	More than 4 years to Less than 10 years	Autos and light trucks, typewriters, copiers, duplicating equipment, heavy general- purpose trucks, and research and experimentation equipment are included.
7-year property 200% and declining balance	10 years or more to less than 16 years	Office furniture and fixtures most items of machinery and equipment used in production are included
10-year property 200% declining balance	16 years or more to less than 20 years	Various machinery and equipment, such as that used in petroleum distilling and refining and in the milling of grain, are included.
15-year property 150% declining balance	20 years or more to less than 25 years	Sewage treatment plants telephone and electrical distribution facilities, and land improvements are included.
20-year property 150% declining balance	25 years or more	Service stations and other real property with an ADR midpoint life of less than 27.5 years are included.
27.5-year property Straight-line	Not applicable	All residential rental property is included

31.5-year property Straight-line	Not applicable	All nonresidential property is included.

"a" The term ADR midpoint life means the "useful life" of an asset in a business sense; the appropriate ADR midpoint lives for assets are designated in the tax Regulations.

WHAT TO KNOW ABOUT THE COST OF CAPITAL

The cost of capital is defined as the rate of return that is necessary to maintain the market value of the firm (or price of the firm's stock). Project managers must know the cost of capital, often called the *minimum required rate of return*, used either as a discount rate under the NPV method or as a hurdle rate under the IRR method. The cost of capital is computed as a weighted average of the various capital components, which are items on the right-hand side of the balance sheet such as debt, preferred stock, common stock, and retained earnings.

Cost of Debt

The cost of debt is stated on an after-tax basis, since the interest on the debt is tax deductible. However, the cost of preferred stock is the stated annual dividend rate. This rate is not adjusted for income taxes because the preferred dividend, unlike debt interest, is not a deductible expense in computing corporate income taxes.

EXAMPLE 17

Assume that the Hume Company issues a $1,000, 8 percent, 20-year bond whose net proceeds are $940. The tax rate is 40 percent. Then, the after-tax cost of debt is:

$$8.00\% (1-0.4) = 4.8\%$$

EXAMPLE 18

Suppose that the Hume company has preferred stock that pays a $12 dividend per share and sells for $100 per share in the market. Then the cost of preferred stock is:

$$\frac{\text{Dividend per share}}{\text{Price per share}} = \frac{\$12}{\$100} = 12\%$$

Cost of Common Stock

The cost of common stock is generally viewed as the rate of return investors require on a firm's common stock. One way to measure the cost of common stock is to use the *Gordon's growth model.* The model is

$$P_o = \frac{D_1}{r - g}$$

where P_o = value (or market price) of common stock

D_1 = dividend to be received in 1 year
r = investor's required rate of return
g = rate of growth (assumed to be constant over time)

Solving the model for r results in the formula for the cost of common stock:

$$r = \frac{D_1}{P_o} + g$$

EXAMPLE 19
Assume that the market price of the Hume Company's stock is $40. The dividend to be paid at the end of the coming year is $4 per share and is expected to grow at a constant annual rate of 6 percent. Then the cost of this common stock is:

$$\frac{D_1}{P_o} + g = \frac{\$4}{\$40} + 6\% = 16\%$$

Cost of Retained Earnings
The cost of retained earnings is closely related to the cost of existing common stock, since the cost of equity obtained by retained earnings is the same as the rate of return investors require on the firm's common stock.

Measuring the Overall Cost of Capital
The firm's overall cost of capital is the weighted average of the individual capital costs, with the weights being the proportions of each type of capital used.

$\sum$ (Percentage of the total capital structure supplied by each source of capital x cost of capital for each source)

The computation of overall cost of capital is illustrated in the following example.

EXAMPLE 20
Assume that the capital structure at the latest statement date is indicative of the proportions of financing that the company intends to use over time:

		Cost
Mortgage bonds ($1,000 par)	$20,000,000	4.80% (from Example 17)
Preferred stock ($100 par)	5,000,000	12.00 (from Example 18)
Common stock ($40 par)	20,000,000	16.00 (from Example 19)
Retained earnings	5,000,000	16.00
Total	$50,000,000	

These proportions would be applied to the assumed individual explicit after-tax costs below:

Source	Weights	Cost	Weighted Cost
Debt	40%(a)	4.80%	1.92%(b)

Preferred stock	10	12.00%	1.20
Common stock	40	16.00%	6.40
Retained earnings	10	16.00%	1.60
	100%		11.12%

(a) $20,000,000/$50,000,000 = .40 = 40%
(b) 4.80% x 40% = 1.92%

Overall cost of capital is 11.12%

By computing a company's cost of capital, we can determine its minimum rate of return, which is used as the discount rate in present value calculations. A company's cost of capital is also an indicator of risk. For example, if your company's cost of financing increases, it is being viewed as more risky by investors and creditors, who are demanding higher return on their investments in the form of higher dividend and interest rates.

LEASE-PURCHASE DECISION

The lease-purchase decision is one commonly confronting firms considering the acquisition of new assets. It is a hybrid capital budgeting decision which forces a company to compare the leasing and financing (purchasing) alternatives.

There are tax benefits of leasing equipment rather than financing it with a term loan. Depending upon your needs and the nature of your business, the entire lease payment may be fully deductible as a business expense, thereby reducing your taxable income. With a loan, only the interest and depreciation can be used for deductions. Another benefit a lease offers is 100% financing plus an additional 10% of the equipment's costs to cover "soft costs," such as taxes, shipping and installation. Some term loans offer 100% financing but, typically, they cover the cost of equipment only.

A lease can help you manage your cash flow. The payments are usually lower than for a term loan. Since a lease payment requires no down payment or deposit, you can get the equipment you need without depleting your reserve capital. The types of business that most often lease equipment to generate revenue are manufacturing, transportation, printing, and professional corporations, such as medical, law, or accounting firms. Leasing works well for such companies since they can keep their equipment current without having to dip into capital to do it. Since the business' capital is not being used for equipment, they can use it for business development and expansion.

A loan is your best choice, however, if you wish to keep the equipment and build equity quickly. Loans can be structured so you can own the equipment outright at the end of the term *Not*e: If you are sure you want to retain your equipment beyond the lease term and prefer to know the full cost of the financing up front, you may choose a Lease Purchase option. As its name implies, this option requires no additional payment to own the equipment at the end of the lease.

To make an intelligent financial decision on a lease-purchase, an after-tax, cash outflow, *present value* comparison is needed. There are special steps to take when making this comparison. When considering a lease, take the following steps:

1. Find the annual lease payment. Since the annual lease payment is typically made in advance, the formula used is:

$$\text{Amount of lease} = A + A.T4(i,n-1) \text{ or } A = \frac{\text{Amount of lease}}{1 + T4\,(i,n-1)}$$

Notice we use n-1 rather than n.

2. Find the after-tax cash outflows.
3. Find the present value of the after-tax cash outflows.

When considering a purchase, take the following steps:

1. Find the annual loan amortization by using:

$$A = \frac{\text{Amount of loan for the purchase}}{T4\,(i,n-1)}$$

The step may not be necessary since this amount is usually available.

2. Calculate the interest. The interest is segregated from the principal in each of the annual loan payments because only the interest is tax-deductible.
3. Find the cash outflows by adding interest and depreciation (plus any maintenance costs), and then compute the after-tax outflows.
4. Find the present value of the after-tax cash outflows, using Table 3.

EXAMPLE 21

A firm has decided to acquire a computer system costing $100,000 that has an expected life of 5 years, after which the system is not expected to have any residual value. The system can be purchased by borrowing or it can be leased. If leasing is used, the lessor requires a 12 percent return. As is customary, lease payments are made in advance, that is, at the end of the year prior to each of the 10 years. The tax rate is 50 percent and the firm's cost of capital, or after-tax cost of borrowing, is 8 percent.

First compute the present value of the after-tax cash outflows associated with the leasing alternative.

1. Find the annual lease payment:

$$A = \frac{\text{Amount of lease}}{1 + T4\,(i,n-1)}$$

$$= \frac{\$100,000}{1 + T4\,(12\%,4\text{ years})} = \frac{\$100,000}{1 + 3.3073} = \frac{\$100,000}{4.3073} = \$23,216 \text{ (rounded)}$$

Steps 2 and 3 can be done in the same schedule, as follows:

Year	(1) Lease Payment($)	(2) Tax Savings($)	(3)=(1)-(2) After-Tax Cash Outflow($)	(4) PV at 8%	(5)=(3) x (4) PV of Cash Out-flow($,Rounded)
0	23,216		23,216	1.000	23,216
1-4	23,216	11,608 a	11,608	3.3121 b	38,447
5		11,608	(11,608)	0.6806 a	(7,900)
					53,763

a $23,216 X 50%
b From Table 4.
c From Table 3.

If the asset is purchased, the firm is assumed to finance it entirely with a 10 percent unsecured term loan. Straight-line depreciation is used with no salvage value. Therefore, the annual depreciation is $20,000 ($100,000/5 years). In this alternative, first find the annual loan payment by using:

$$A = \frac{\text{Amount of loan}}{T4\,(i,n)}$$

$$A = \frac{\$100,000}{T4(10\%,5\text{ years})} = \frac{\$100,000}{3.7906} = \$26,381 \text{ (rounded)}$$

2. Calculate the interest by setting up a loan amortization schedule.

Yr	(1) Loan Payment($)	(2) Beginning-of-Yr Principal($)	(3)=(2)(10%) Interest($)	(4)=(1)-(3) Principal($)	(5)=(2)-(4) End-of-Yr Principal
1	26,381	100,000	10,000	16,381	83,619
2	26,381	83,619	8,362	18,019	65,600
3	26,381	65,600	6,560	19,821	45,779
4	26,381	45,779	4,578	21,803	23,976
5	26,381	23,976a	2,398	23,983a	

a Because of rounding errors, there is a slight difference between (2) and (4)

Steps 3 (cash outflows) and 4 (present values of those outflows) can be done as shown in Table 7.

The sum of the present values of the cash outflows for leasing and purchasing by borrowing shows that purchasing is preferable because the PV of borrowing is less than the PV of leasing ($52,008 versus $53,763). The incremental savings is $1,675.

TABLE 7
LEASE VERSUS PURCHASE EVALUATION REPORT

	Leasing		Purchase/Borrow						
Year	Lease Payments	Net After-Tax Cash Flow	Loan Payments	Interest Expense	Depreciation Expense	Net After-Tax Cash Flow	Present Value Factor	Discounted Cash Flow Leasing	Discounted Cash Flow Purchase
0	$ 23,216	$ 23,216					1	$ 23,216	
1	23,216	11,608	$ 26,381	$ 10,000	$ 20,000	$ 11,381	0.9259	10,748	10,538
2	23,216	11,608	26,381	8,362	20,000	12,200	0.8573	9,952	10,459
3	23,216	11,608	26,381	6,560	20,000	13,101	0.7938	9,214	10,400
4	23,216	11,608	26,381	4,578	20,000	14,092	0.735	8,532	10,358
5		(11,608)	26,381	2,398	20,000	15,182	0.6806	(7,900)	10,333
	$ 92,864	$ 58,040	$ 131,905	$ 31,898	$ 100,000	$ 65,956		$ 53,761	$ 52,087

	Lease Proposal	Purchase Proposal
Cost of machine	$ 100,000	$ 100,000
Terms of payment	5 years	5 years
Interest rate	12%	10%
Downpayment		
Monthly lease payment at the end of the year	$ 23,216	
Monthly loan payment		$ 26,381
Depreciation		Straight line
Residual purchase price	0%	0
Corporate tax bracket	50%	50%
After-tax cost of capital	8%	8%

ECONOMIC FEASIBILITY STUDY FOR A NEW INFORMATION SYSTEM

Determining economic feasibility requires a careful investigation of the costs and benefits of a proposed information system. The basic framework for feasibility analysis is the *capital budgeting* model in which cost savings and other benefits, as well as initial outlay costs, operating costs, and other cash outflows, are translated into dollar estimates.

The estimated benefits are compared with the costs to determine whether the system is cost beneficial. Where possible, benefits and costs that are not easily quantifiable should be estimated and included in the feasibility analysis. If they cannot be accurately estimated, they should be listed and the likelihood of their occurring and the expected impact on the organization evaluated. Some of the tangible and intangible benefits a company might obtain from a new system are cost savings: improved customer service, productivity, decision making, and data processing: better management control; and increased job satisfaction and employee morale.

Equipment costs are an initial outlay cost if the system is purchased and an operating cost if rented or leased. Equipment costs vary from a few thousands for microcomputer systems to millions of dollars for enormous mainframes. Equipment costs are usually less than the cost of acquiring software and maintaining, supporting, and operating the system. Software acquisition costs include the purchase price of software as well as the time and effort required to design, program, test, and document software. The personnel costs associated with hiring, training, and relocating staff can be substantial. Site preparation costs may be incurred for large computer systems. There are costs involved in installing the new system and converting files to the appropriate format and storage media.

The primary operating cost is maintaining the system. There may be significant annual cash outflows for equipment replacement and expansion and software updates. Human resource costs include the salaries of systems analysts, programmers, operators, data entry operators, and management. Costs are also incurred for supplies, overhead, and other operating costs. Initial cash outlay and operating costs are summarized in Table 8.

TABLE 8
INITIAL CASH OUTLAY AND OPERATING COSTS

Hardware
- Central processing unit
- Peripherals
- Special input/output devices
- Communications hardware
- Upgrade and expansion costs

Software
- Application, system, general-purpose, utility, and communications software
- Updated versions of software
- Application software design, programming, modification, and testing

Installation
- Freight and delivery charges
- Setup and connection fees
- Conversion
- Systems testing
- File and data conversions
- Parallel operations

Documentation
- Systems documentation
- Training program documentation
- Operating standards and procedures

Site preparation
- Air-conditioning, humidity, and dust controls
- Physical security (access)
- Fire and water protection
- Cabling, wiring, and outlets

Furnishing and fixtures
Staff
Supervisors
Analysts and programmers
Computer operators
Input (data conversion) personnel
Recruitment and staff training
Maintenance/backup
Hardware/software maintenance
Backup and recovery operations
Power supply protection
Supplies and overhead
Preprinted forms
Data storage devices
Supplies (paper, ribbons, toner)
Utilities and power
Others
Legal and consulting fees
Insurance

During systems design, several alternative approaches to meeting system requirements are developed. Various feasibility measures such as technical, operational, legal, and scheduling feasibility are then used to narrow the list of alternatives. Economic feasibility and capital budgeting techniques, which were discussed earlier, are used to evaluate the benefit-cost aspects of the alternatives.

EXAMPLE 22
Sophie, an information systems (IS) project manager for the HYY chain of discount stores, is contemplating installation of a new IS system that is flexible, efficient, timely, and responsive to user and customer needs. The new system aims at improving the company's business processes. After the analysis Sophie's IS project team decided they wanted the corporate office to gather daily sales data from each store. Analyzing the prior day's sales will help the company adapt quickly to customer needs. Providing sales data to suppliers will help avoid stockouts and overstocking.

Coordinating buying at the corporate office will help HYY to minimize inventory levels and negotiate lower wholesale prices. Stores will send orders electronically the day they are prepared. Based on store orders, the previous day's sales figures, and warehouse inventory, HYY will send purchase orders to suppliers. Suppliers will process orders and ship goods to regional warehouses or directly to the stores the day orders are received. Each store will have the flexibility to respond to local sales trends and conditions by placing local orders. Accounts payable will be centralized so the firm can make payments electronically.

Sophie's team conducted an economic feasibility study and determined that the project makes excellent use of funds. As shown in Table 9, they estimated that initial outlay costs for the system are $4.32 million (initial systems design and new hardware $1.8 million each, software $375,000. and training, site preparation, and conversion $250,000 each).

The team estimated what it would cost to operate the system for its estimated six-year life, as well as, what the system would save the company. The following recurring costs were identified: hardware expansion, additional software and software updates, systems maintenance, added personnel to operate the system, communication charges, and overhead. The system will also save the company money by eliminating clerical jobs, generating working capital savings, increasing sales and profits, and decreasing warehouse costs. The costs and savings for years 1 through 6, which are expected to rise from year to year, are shown in Table 9.

Sophie calculated the annual savings minus the recurring additional costs and then calculated the annual after-tax cash savings under the MACRS tax rule. The $4.66 million system can be depreciated over the six-year period. For example, the depreciation in year 1 of $932,000 reduces net income by that amount. Since the company does not have to pay taxes on the $1 million, at their tax rate of 34% they end up saving an additional $316,880 in year 1. Finally, Sophie calculated the net savings for each year.

Sophie used HYY's cost of capital of 10% to calculate the net present value (NPV) of the investment, which is over $3 million. The internal rate of return (IRR) is a respectable 26%. Sophie realized how advantageous it would, be for the company' to borrow the money (at 10% interest rates) in order to produce a 26% return on that borrowed money. In addition, payback (the point at which the initial cost is recovered) occurs in the fourth year. NPV and 1RR are calculated as shown in Table 9.

Sophie presented the system and its cost-benefit calculations to top management. Challenges to her estimates (various "what-if" scenarios) were plugged into the Excel model so that management could see the effect of the changed assumptions. This spreadsheet analysis was intended to ensure a positive return of the new system under future uncertainty.

TABLE 9
ECONOMIC FEASIBILITY STUDY FOR A NEW INFORMATION SYSTEM

	Initial Outlay	Years					
	0	1	2	3	4	5	6
itial outlay costs (I)							
Initial system design	$ 1,800,000						
Hardware	1,800,000						
Software	375,000						
Training	185,000						
Site preparation	250,000						
Conversion	250,000						
Total	$ 4,660,000						
ecurring costs							
Hardware expansion			$ 250,000	$ 290,000	$ 330,000	$ 370,000	$ 390,000
Software			160,000	210,000	230,000	245,000	260,000
Systems maintenance		$ 70,000	120,000	130,000	140,000	150,000	160,000
Personnel costs		485,000	800,000	900,000	1,000,000	1,100,000	1,300,000
Communication charges		99,000	160,000	180,000	200,000	220,000	250,000
Overhead		310,000	420,000	490,000	560,000	600,000	640,000
Total		$ 964,000	$ 1,910,000	$ 2,200,000	$ 2,460,000	$ 2,685,000	$ 3,000,000
ash savings							
Clerical cost savings		$ 500,000	$ 1,110,000	$ 1,350,000	$ 1,500,000	1,700,000	1,950,000
Working capital savings		1,000,000	1,200,000	1,500,000	1,500,000	1,500,000	1,500,000
Increased sales and profits			500,000	900,000	1,200,000	1,500,000	1,800,000
Reduced warehouse costs			400,000	800,000	1,200,000	1,600,000	2,000,000
Total		$ 1,500,000	$ 3,210,000	$ 4,550,000	$ 5,400,000	$ 6,300,000	$ 7,250,000
ash savings minus recurring costs		536,000	1,300,000	2,350,000	2,940,000	3,615,000	4,250,000
Less income taxes (34%)	34%	(182,240)	(442,000)	(799,000)	(999,600)	(1,229,100)	(1,445,000
ash savings (net of tax)		$ 353,760	$ 858,000	$ 1,551,000	$ 1,940,400	$ 2,385,900	$ 2,805,000
Tax shield from depreciation		316,880	507,008	304,205	182,206	182,206	91,895
et cash inflows (net savings)							
after taxes	$ (4,660,000)	$ 670,640	$ 1,365,008	$ 1,855,205	$ 2,122,606	$ 2,568,106	$ 2,896,895

Tax savings from depreciation deduction

Year	*MACRS*	*Depreciation*	*Tax savings*
1	20.00%	$ 932,000	$ 316,880
2	32.00%	1,491,200	507,008
3	19.20%	894,720	304,205
4	11.50%	535,900	182,206
5	11.50%	535,900	182,206
6	5.80%	270,280	91,895

Net present value calculations @ a cost of capital of 10%

Year	*Net savings*	*PV factor*	*PV*
0	$ (4,660,000)	1.0000	$ (4,660,000)
1	670,640	0.9091	609,679
2	1,365,008	0.8265	1,128,179
3	1,855,205	0.7513	1,393,815
4	2,122,606	0.6830	1,449,740
5	2,568,106	0.6209	1,594,537
6	2,896,895	0.5645	1,635,297
		NPV	$ 3,151,248
		IRR	26.26%

SUMMARY

We have examined the process of evaluating capital expenditure projects. We have also discussed several commonly used criteria for evaluating capital budgeting projects, including the NPV and IRR methods. Since income taxes could make a difference in the accept or reject decision, tax factors must be taken into account in every decision. Although the traditional depreciation methods still can be used for computing depreciation for book purposes, 1986 saw a new way of computing depreciation deductions for tax purposes. The rule is called the modified accelerated cost recovery system (MACRS). Lease-purchase decisions were also treated on an after-tax basis. Also presented is an example of economic feasibility study for a new information system.

GLOSSARY

ACTIVE FINANCIAL PLANNING SOFTWARE new-breed, Web-enabled software that includes applications and the new level of functionality that combine budgeting, forecasting analytics, business intelligence, and collaboration.

ACTIVITY-BASED COSTING (ABC) system that accumulates costs on the basis of production or service activities at a firm. Basically it assigns costs by activity and links them to specific products.

APPLICATION SERVER server running application programs. It is a network server performing applications requested by a client.

APPLICATION SOFTWARE has two prime subcategories comprising of resource management software (provides access to shared network resources and services) and productivity software (aids user productivity).

ARTIFICIAL INTELLIGENCE (AI) application of human reasoning techniques to machines. Artificial intelligence systems use sophisticated computer hardware and software to simulate the functions of the human mind including that of reasoning, sensation, perception, learning, and communicating. It gives computers the ability to think and solve complex business problems. Computers are made to act intelligently. Artificial intelligence applications include forecasting stock market prices via sequence prediction plannings. Plans describe many alternative sequences of actions with specification of conditions based on what different sequences were followed. In planning we can use program-like structures such as fuzzy algorithms to represent plans. Pattern recognition applications also exist. Further, applications are aided by long chains of "if-then" rules.

AUTHENTICATION mechanism used to ascertain if a user is who he or she purports to be.
CAPITAL BUDGET a budget or plan of proposed acquisitions and replacements of long-term assets and their financing. A capital budget is developed using a variety of capital budgeting techniques such as the discount cash flow method.

CLIENT/SERVER NETWORK OPERATING SYSTEMS supports voluminous users and enables interaction with other network operating systems through gateways. Client/server networks are much more complex and costly than peer-to-peer network operating systems.

CLIENT/SERVER sharing and interaction of data between server and client computers connected by a network.

CLIENT-SERVER SYSTEM computers connected by a network in which some computers (clients) process applications while other computers (servers) provide services (e.g., file storage, Internet hosting) to the clients.

COMMON GATEWAY INTERFACE (CGI) means of programming Web sites. Script programs are run on the server. (This is different from Java which runs on the client). CGI is

primarily used to handle online forms. CGI allows Web applications to be written and executed on multiple different Web servers.

COMPUTER-AIDED DESIGN (CAD) DATABASE stores information applicable to engineering or mechanical design such as for buildings, ships, and aircraft.

COMPUTER-AIDED MANUFACTURING (CAM) DATABASE stores production-related information such as for manufacturing products (e.g., automobiles, trucks, equipment).

COMPUTER-AIDED SOFTWARE ENGINEERING (CASE) DATABASE stores information associated with software development including planning, designing, analyzing, testing, implementing, and maintaining.

CONCEPTUAL DATABASE DESIGN building a data model for the company irrespective of any physical aspect.

COOKIES information stored in the client on behalf of a server for a specified time period. Servers usually use cookies to store user identifications, user habits, and buying tastes. The cookie is sent back to the server in later requests from the client. Cookies are, by default, communicated only to the server that created them.

COOKIES small text files residing on the Web client. An example of a cookie is a virtual shopping client.

CORPORATE DATA MODEL presents key data, relationships between that data, and how it effects and is used by different areas of the entity. Areas of data sharing are indicated.

DATA ADMINISTRATION managing data resources including planning, designing, developing, and maintaining standards, procedures and policies.

DATA DEFINITION LANGUAGE (DDL) language allowing users to define the database as well as specify data types and nature along with constraints associated with the database. The DDL allows users to describe the entities needed for the application and their interrelated relationships.

DATA DICTIONARY (CATALOG) description and explanation of all data objects stored and managed by the system. The information can be stored in a dictionary-like document or a text file.

DATA FILE file of logical records.

DATA MARTS mobile personal warehouses on a laptop used on the road such as by salespeople and real estate brokers.

DATA MARTS subset of a data warehouse providing business information, usually in summarized fashion, to a specific department or division within the company. The data mart can

be independent or linked to the company's centralized data warehouse (containing large amounts of detailed information). Since data marts contain less information relative to the data warehouse it is more readily comprehendible and easier to use.

DATA MINING process of going through voluminous databases to find meaningful trends, relationships, correlations, and patterns. We accumulate and analyze significant information stored in data warehouses or data marts by using artificial intelligence, and mathematical and statistical tools. Data mining is used to make business decisions. The major activities related to data mining are prediction, segmentation, linking, and identifying deviations. Examples of data mining applications are to determine whether to give a loan to an applicant based on his/her application, uncovering fraud, advertising approaches to maximize orders, analyzing liquidity or solvency, earnings quality, portfolio selection, profiling customers, and appraising suppliers. Data mining looks at data trends and patterns based on a stipulated model of classification and/or clustering.

DATA WAREHOUSING subject-oriented, timely integrated database providing important information to management in making business decisions.

DATABASE ADMINISTRATOR (DBA) individual in-charge of managing and monitoring all database activities including design, implementation, security, and maintenance of operations.

DATABASE collection of interrelated records of different types, and may be consisting of a collection of interrelated files. The stored information is used to satisfy the requirements of multiple users within the company and/or other companies accessing it.

DATABASE FILE collection of related records describing a subject by using a set of fields.

DATABASE MANAGEMENT SYSTEM (DBMS) generalized software used to manage databases. The software system allows users to define, create, alter, and maintain the database and provides controlled access to the database. The DBMS is the software enabling interaction of the user's application programs and the database. Information is organized in a specified way so that accurate, reliable, and timely data can be retrieved.

DATABASE MANAGEMENT SYSTEM software which manages the database. Most client/server systems use a database management system running on a server. The database management system typically creates and maintains relational databases using the SQL language to access and update the database.

DATABASE organized collection of information.

DECISION SUPPORT SYSTEM (DSS) computer-based software that assists decision makers by providing data and models. It conducts primarily semistructured tasks. DSS do not make decisions but merely attempt to improve and enhance decisions by providing indirect support without automating the entire decision process.

DISTRIBUTED DATABASE MANAGEMENT SYSTEM (DDBMS) software allowing for managing the distributed database to users. The DDBMS is comprised of one logical database split into fragments. Each site can independently process user requests where local data (local applications) may be accessed and the site can also process data stored on other computers (global applications) in the network. The sites are linked by a communications network where interrelated data is shared.

ECONOMIC FEASIBILITY requires a careful investigation of the costs and benefits of a proposed information technology (IT) system. The basic framework for feasibility analysis is the *capital budgeting* model in which cost savings and other benefits, as well as initial outlay costs, operating costs, and other cash outflows, are translated into dollar estimates.

ENCRYPTION data coding making one unable to read the information without having the decryption key.

EXECUTIVE INFORMATION SYSTEM (EIS) provides information on how the company is currently performing in its operating and financial activities. The EIS provides detailed information as needed to bring management up-to-date in executive decision making.

EXECUTIVE MANAGEMENT GAME a type of mathematical model and simulation. Simulation is designed to simulate a system and to generate a series of quantitative and financial results regarding system operations.

EXPERT SYSTEM (ES) reasoning, inference, logical, or if-then functions to solve a business problem such as how to reduce a specific cost and/or and improve productivity. The expert system is a program that functions as an expert in solving problems via a body of knowledge. The expert system not only assists in decision making but also provides the user with the logic it used to reach its decision.

EXPERT SYSTEM DATABASE stores knowledge and rule bases for artificial intelligence applications.

EXTENSIBLE BUSINESS REPORTING LANGUAGE (XBRL) formerly code named XFRML, a freely available electronic language for financial reporting. It is an XML-based framework that provides the financial community a standards-based method to prepare, publish in a variety of formats, reliably extract and automatically exchange financial statements of publicly held companies and the information they contain.

EXTRANET intranet partly accessible at different levels by authorized parties dealing with a company such as suppliers and customers.

EXTRANET network using Internet technology to link a company to outside related parties such as suppliers and customers.

FILE collection of records of a similar type.

FILE SERVER server holding the files needed for the DBMS and applications.

FILE TRANSFER PROTOCOL (FTP) protocol allowing for transferring data files and software over the Internet.

FILE TRANSFER PROTOCOL TCP/IP protocol allowing users to download data to their client PC.

FIREWALL system to prevent unauthorized access to or from a private network. A firewall examines the propriety of messages and blocks those that violate security criteria.

FUZZY SYSTEMS a kind of expert system because they also store knowledge as rules in the form of fuzzy rules or patches. Expert systems work with logic or symbols. Fuzzy systems work with fuzzy sets and have a numerical or math basis facilitating math analysis and simple chip design.

GOPHER menu-based client/server structure having search engines obtaining requested data from information servers. Gopher client software is usually on a client PC interacting with software on a specified Gopher server. This Gopher server searches many FTP sites to find the needed data to send to the Gopher client.

GROUPWARE type of client/server software facilitating collaborative work. It enables individuals to communicate and accomplish activities together electronically.

GROUPWARE SERVERS manages data such as text, image, mail, and work flow. This client/server has people interacting with each other.

HOTLINKING linking between two applications such that changes in one affect the other. For example, some desktop publishing systems let you establish hot links between documents and databases or spreadsheets. When data in the spreadsheet changes, the corresponding charts and graphs in the document change accordingly.

HYPERTEXT MARKUP LANGUAGE (HTML) presentation language to format data for WWW browsers. It is a protocol allowing one to embed formatting information in a Web document.

HYPERTEXT TRANSFER PROTOCOL (HTTP) client/server protocol on the WWW. HTTP is a request/response model for messages between client and server. Web servers run software supporting HTTP to service the multiple Web client requests for Web pages. It is the protocol to transmit HTML documents over the Internet.

INTERNAL RATE OF RETURN (IRR) the rate of interest that equates the initial investment with the present value of future cash inflows.

INTERNET international network of networks. It is a wide area network linking vast amounts of host computers.

INTRANET local area Web which is a single network within the company. It is a private network of a company accessible only internally by staff and employees, or others having authorization.

LEASE-PURCHASE DECISION a decision commonly confronting firms considering the acquisition of new assets. It is a hybrid capital budgeting decision which forces a company to compare the leasing and financing (purchasing) alternatives.

LOCAL AREA NETWORK (LAN) serves as the infrastructure for client/server applications. The LAN relays service requests from the client to server and carries the resulting information back to the client. LAN is a computer network situated near each other such as in the same building.

NET PRESENT VALUE (NPV) the difference between the present value of cash inflows generated by the project and the amount of the initial investment.

NETWORK connection of computers to share files, data, hardware, and software. There is architecture switching and transmission equipment.

NEURAL NETWORKS software programs that simulate human intelligence. Neural networks make the computer a "thinking problem solver." They are designed to learn from experience.

ON-LINE ANALYTICAL PROCESSING (OLAP) creation and summarization of historical, multidimensional data to aid users in decision making. OLAP database servers use multi-dimensional structures in data storage and relationships. OLAP is concerned with extracting information from a DATA WAREHOUSE that is useful, relevant, comprehendible, timely, and accurate.

OUTSOURCING retaining outside experts to handle network issues.

PEER-TO-PEER NETWORK any computer on the network can act as a server. An example is Windows for Workgroups.

PEER-TO-PEER two sides of a communication link use the identical protocol interface to carryout the network transmission.

QUERY LANGUAGE an English-like language that allows database users to specify what information they want to retrieve or examine.

REAL-TIME 1. conferencing in which individuals work together using real-time technologies.

RELATIONAL DATABASE data is represented in two-dimensional tables comprising of rows and columns. The tables are referred to as "relations". The relational database relates or connects data in different files through the use of a key field, or common data elements.

RISK ANALYSIS analyzing questions like, “what’s the chance of a negative result?”, “What’s the chance of a result over one million?” At a glance you'll know if your risk is acceptable, or if you need to make a contingency plan.

SERVER network computer sharing resources and information with network users. A dedicated server is only used to provide service for network users. A nondedicated server may be used as a client as well.

SMART CARDS smart identifications which may have a numeric keypad. It is used in token authentication systems.

STRUCTURED QUERY LANGUAGE (SQL) standard language used in a relational database management system to create, retrieve, modify, and secure data. With SQL, a database user can insert and delete information held in relations, and enforce relational integrity rules. SQL has a high level interface to a relational system. SQL provides a description of information to be retrieved via a command. SQL carries out questioning of the database to obtain relevant information from it. SQL is a trnasform-oriented language structured to use relations to transform inputs into required outputs. It is a declarative language not a procedural one.

TEMPLATE a worksheet or computer program that includes the relevant formulas for a particular application but not the data.

TROJAN HORSE virus is hidden in a legitimate program. It infects the network or system as intended unless identified and corrected for.

UNIFORM RESOURCE LOCATOR (URL) address of a Web site. Web pages may be indexed and linked. In other words, URL is a name used to identify and access a file on the Internet regardless of its format or the protocol needed for retrieval.

WEB-BASED ACCOUNTING makes the data easily accessible to multiple remote users at one time, and of course it offers the usual benefits of Web-based software: server-side upgrades, maintenance, and backups.

WEB CONFERENCING software supporting video, audio, document, and data conferencing on the World Wide Web. It’s used in business applications.

WEB SERVER provides services and information to Web clients asking for Web pages. It is a server (hardware) equipped with software allowing it to run Web applications. It is a server storing HTML documents accessible on the Web.

WEB SITE information posted on the Internet to attract user interest.

WIDE AREA NETWORK links two or more LANs. The connected LANs to derive a WAN may be in the same building, or different buildings near each other or distantly apart. WANs are essential in the client/server environment because the applications in client/server usually apply to accessing data stored in separate locations.

WORLD WIDE WEB browsing of information on the Internet using hyperlinks. Data on the Web is in the form of Web pages appearing as text, graphics, sound, video, and pictures. The network of computers on the Web consists of servers (providing information) and clients (receiving information). Data on the Web is stored in documents using Hyper Text Markup Language (HTML). HTML is the document formatting language in designing Web pages. Browsers must comprehend and interpret HTML to display the documents.

XBRL *see* EXTENSIBLE BUSINESS REPORTING LANGUAGE (XBRL)