

7-1986

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Elise G. Jancura

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Recommended Citation

Jancura, Elise G. (1986) "Widespread Computerization and Automation of Business Operations: Part I: New Developments in Computer Technology, the Business Community and the Profession," *Woman C.P.A.*: Vol. 48 : Iss. 3 , Article 5.

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Widespread Computerization and Automation of Business Operations

Part I: New Developments in Computer Technology, the Business Community and the Profession

Edited by Elise G. Jancura

One of the issues raised by the Future Issues Committee of the AICPA in its 1984 report, "Major Issues for the CPA Profession and the AICPA," was the following:

The widespread use of computers is changing the traditional client-CPA relationship, expanding the scope of services, fostering competition, and creating changes in the operating structure of CPA firms and businesses generally. Within the next two decades, the increasingly rapid growth in computer and information technology is expected to revolutionize business practice in all areas and create a host of new products and services.

The EDP Technology Research Subcommittee was asked by the Chairman of the Board of Directors of the AICPA to address this issue. The committee met over the next year and prepared a report submitted to the Board of Directors in September 1985. Members of the EDP Technology Research Subcommittee who prepared this report were:

John Lehman, Chairman (Touche Ross & Co.)
John G. Baab (Ernst & Whinney)
Robert D. Gilges (Peat, Marwick, Mitchell & Co.)

Elise G. Jancura (Cleveland State University)
James C. Kinard (The Ohio State University)
John T. Overbey (Western Carolina University)
Richard S. Robins (MONY—Mutual Life of N.Y.)
Trevor R. Stewart (Deloitte Haskins & Sells)
Arnold Wasserman (Coopers & Lybrand)

Two major sections of the report addressed the following topics: (1) the new developments in computer technology, the business community, and the profession; (2) the impact of these new developments on the profession. This article reproduces the first section of that report.

Introduction

The era we live in is being called the "information age." In the next few years, the computer will become a universal machine much as the calculator is today. Journals in fields outside of business and computers, as well as those inside these fields, speak of the information explosion, the information revolution, information as a resource, etc. Organizations have information

centers and chief information officers. Millions of people are using personal computers and terminals and mainframes in their daily work at their desk. In 1980, Aetna Life and Casualty had one terminal for every six employees, but by 1985, they had one terminal every two employees. IBM estimates that there are 20 million terminals in use today and that by 1990, the numbers will approximate 50 million. The principal users of these terminals are professionals and managers, clerical personnel.

The computer has moved from just being in the data processing shop to being in the office, the store, the school and the home as well. With that forward move, a drastic change has occurred in the nature of information processing and communicating equipment. For centuries, the processes of numeric calculation, test preparation, storage information, communication and illustration had all required separate pieces of equipment.

Today, with the integration of personal computers, electronic mail, voice input/output, word processing, graphics, etc., one unit performs all of these tasks. In 1983, there were 2.4 million personal computers sold in the United States. It is estimated that 10 million will be sold in 1990. If that is true and the increase is constant per year, there will be 52 million personal computers in use in the United States by 1990. Further, there is every likelihood that many of them will become part of interconnected networks.

The computer's ever increasing power, coupled with declining costs of technology, have made it possible for even the smallest company to now have computer power that was not in existence 30 years ago. To demonstrate this explosive growth of the technologies, consider that in 1972 an IBM System 370 Model 168 CPU sold for more than \$4 million. In 1982, there were a number of minicomputers that offered the same computing power for approximately \$15,000. This represents a 300 to 1 reduction in cost in only ten years. In 1985, this cost, for what is called a micro-computer, has declined further to only a few thousand dollars.

Today, in some manufacturing plants new computerized systems make it possible for a design engineer using computer aided design and manufacturing software (CAD/CAM) to

develop a new product, test it, make a blueprint, generate a program for computerized, numerically controlled machine tools to build tooling and enter a bill of material and route sheet into a database with only minimal human intervention. Further, automated retrieval storage systems have significantly reduced the need for material handlers. Similar improvements in white collar productivity are on the horizon and will impact the way CPAs see new business opportunities and manage their practice. The sub-committee has looked at current trends of emerging technologies in order to discuss what is foreseen to be the impact of computer technology on the accounting profession.

The implications of the information technology explosion are especially critical to the public accounting profession. Increasing competition within the profession and from outside the profession creates an essential need to operate more efficiently, to control the costs of services provided in the traditional audit and tax practices, and to expand the scope of services offered. This is especially true in those areas where clients are developing the ability to takeover, at a reasonable cost, some of the activities for which they previously relied on the public accounting firm—i.e., availability of economically feasible tax and financial analysis packages. In the tax area alone, inexpensive personal computers, tax software, and the public-utility database services (i.e., PHINET, LEXIS) make many clients more independent and/or cost conscious. This trend may be greatly accelerated as "expert systems" move into place, effectively profiling an alternative for professional services and expertise.

Information Processing Environments

Data processing encompasses a great variety of processing environments, equipment configurations and

Virtually all clients will have computerized functions requiring universal computer literacy.

software systems. Usually, large mainframe systems exist in organizations of sufficient size and scale of operations to justify a separate data processing department performing some degree of centralized processing. However, it must be remembered that mainframe installations can vary in size and scale from relatively small operations with very small DP staffs (sometimes no programmers) to very large organizations with large multiple operations geographically scattered and large specialized staffs, including programmers, analysts, database administrators, data communications specialists and computer operators.

The enormous growth in the use and availability of personal computers has significant implications for both the processes of organizational computing and of personal computing. Personal computers have also provided the tool for individual or personal computing tasks. The availability of the hardware and software (spread sheets, word processors, graphics, communication packages) systems, for personal computers at sufficiently low costs, make it economically feasible to use these systems for individual workstations. Thus, analysis requiring multiple iterations or multi-dimensional comparisons can be performed more rapidly and on a much larger scale than previously possible. Documents can be prepared, revised and illustrated with effective graphics much more rapidly and effectively.

Another impact of the growth in personal computers has been the significant reduction in the scale of operations for which in-house computerization of the accounting and management information systems is not only feasible but advantageous. This means that virtually all clients—large and small—will have computerized functions requiring universal computer literacy within the profession.

Micro-Mainframe Interface

Until the advent of micro-computers and low cost fixed storage devices, data stored on mini-computer or mainframe hosts was relatively safe and not easily transportable. Access to a tape drive was necessary, and communications capabilities were severely limited. Today, this is no longer true. Whole files of several megabytes can be transmitted between microcomputers and large machines in a matter of

Approximately 2,000 public databases are in existence today.

minutes. Thus, micro-mainframe interface technology has significant potential for expansion of information networks and increased effectiveness in these networks. This connection provides increased efficiencies for the movement of data in both directions between data sources and organizational databases.

Another important characteristic of the micro-mainframe interface is the ability to provide individual users effective access to organizational data for timely analysis and flexible reporting needs. The advantage of micros as a powerful individual tool for analysis, simulation and report generation is often limited by the availability of data, where the data are available, or the practical problem of entering very large volumes of data. A micro or personal computer connected to a larger computer can provide users independent access to this existing data. Once the information has been accessed or down loaded, the user can perform analysis and generate individually tailored reports.

The micro is an extremely powerful and flexible tool for an information network. It can make data capture feasible at its source, can facilitate editing and processing of data close to the source for local use even as the data are being transmitted to central files or being distributed to a network. A network using micros can use them as terminals or can allow them to be used independently as local processing facilities. While this design philosophy is not unique to micros, the small scale at which micros are feasible allows great latitude in designing networks.

Micro-mainframe interface technology has several implications for public accounting. It can enhance testing procedures and audit independence by giving auditors using micros direct access to client data. However, it increases the complexity of the system being evaluated and thus increases

the technical competence required by the auditor.

New Software Tools

As the amount of technical expertise required by users of information technology has been reduced, thus encouraging its widespread use, the technology itself has become much more complex. User friendly software may make these systems "user transparent," but they encompass more sophisticated software and hardware components and much more complex system architecture. The advances in computer technology have resulted in computer users being able to access data stored throughout an organization's computer resources and format and tailor it to their own needs.

The new software tools make it possible for users without technical training in computer design or in programming techniques to effectively use the computer and thus benefit from the speed and flexibility it can provide. The computer has become a utility whose use is beneficial, even though the user does not fully understand how it works. Software tools can also be used to improve the productivity of technically qualified personnel in the application and systems development process.

Some software can be used to improve the efficiency of application development, while other kinds of software requiring no great expertise are being made available to users for reporting or analytical needs. A new organizational unit, called the information center, is evolving in which the EDP professional provides the basic data structure, and end users are performing the access and reporting functions. Thus, the productivity of an information system can be significantly enhanced by making information

more available to a greater range of users and allowing developmental costs of a system to be better matched to the needs of the users. The implications for control of such an environment raise the need for an expanded set of access and processing controls. In this environment, inexperienced users can successfully access and use organizational data. This eliminates a former protection previously available when lack of technical expertise provided an inherent protective barrier around the information system.

Availability of Public Databases

Data has always been the raw material from which decisions are made, and today's management decisions are becoming increasingly complex and time dependent and require a wide range of data to be available on short notice. To meet this need, a new type of service has developed—the public database. A public database is a data source that can be accessed by means of a personal computer and a telephone.

There are approximately 2,000 public databases in existence today covering a wide range of topics. Examples of the types of information available include financial data and reports, periodical references and abstracts covering most professional fields, credit reports, sports news and airline schedules. In other words, almost any type of information can be obtained from one of these sources. There are also service organizations which subscribe to hundreds of databases and perform research for a fee. Directories of these public databases are also available.

Improved Telecommunications in Local Area Networks

Faster and more versatile voice and data communications will be available for firms and their clients to use. The present inability to transfer data between computers will be eliminated either by computerized network interface protocol emulators or industry standardization. There will be an acceleration of integration occurring in businesses as they deal with the convergence of data, voice, image and word processing technologies in the office environment.

CPAs and their clients will have integrated office networks without duplicate equipment and communication circuits.

Improved local area networks for personal computers, which allow them to share resources and access other computers in an organization or outside databases, are starting to appear. As organizations add more computers, there will be a need to link them so that data can be shared throughout the enterprise. The growth of local area networks and front-end communications devices will enable individually developed applications and data to be made available to other departments within a company or firm. Local area networks will accommodate both voice and data, enabling them to be switched throughout the computer-controlled local area and voice communication networks.

Local area networks are beginning to appear in "smart" buildings in Los Angeles, California (Grand Financial Plaza), Chicago, Illinois (One Financial Place), Arlington, Virginia (Crystal Gateway III), and Hartford, Connecticut (City Place). Others are under construction. In these smart buildings, desktop terminals or mini-computers are linked to centralized mainframe computers which offer access to public data bases and are available to perform other computing functions for the tenants. Because these LANs are interfaced with the telephone system, access could be allowed from any remote location.

For CPAs, this means they will be able to access their own or client databases without regard to present day equipment compatibility limitations. The merging of voice and data communication will reduce the need for redundant voice and data circuits as well as allow communication of simultaneous voice-over-data transmission. This will allow CPAs and their clients to have integrated office networks without duplicate equipment and communication circuits.

Faster and more versatile voice and data communications will be available for use.

Artificial Intelligence

Hardly a day passes without articles and meetings about the potential impact of artificial intelligence (AI) and expert systems on the job market. While these systems are, for the most part, still in the research and development phase, their development is occurring at an increasing rate.

International Data Corporation (IDC) provides a fairly good working definition of artificial intelligence: "the programming tools and techniques used in modeling human intelligence, as well as the commercial products evolving from these tools and techniques." Defined as such, one can view AI, not as a revolution, but as a part of an evolution towards more powerful and sophisticated computer systems.

Now that the first 20 years of research to develop computer systems which can emulate human thought are completed, movement is into a second stage of an emerging commercial market for AI-based products. The commercial market for AI software in 1984 was probably only \$15 million, but by 1990 it is expected to grow to \$700 million, with another \$350 million to be spent on work stations and development hardware. A.D. Little believes we can expect an \$11 billion market as ever increasing chip densities will allow additional AI applications to be made available. In fact, micro-processor and memory storage circuitry is becoming so complex that one of the first applications of AI is in the design of these new circuits. Three areas of AI are more advanced in terms of existing and potential commercial applications: natural language, expert systems and robotics. The first two of these will be of relevance to the profession as they offer the potential of allowing CPAs and their staffs to manage and process information more efficiently.

Natural language programs, for example, are used to improve the man-machine interface by analyzing a question posed by a person in his or her natural language and then converting it to a format a computer can understand. Expert systems seek to emulate what the most knowledgeable persons in a particular area of knowledge know and transfer that knowledge via an AI program into a list of rules that can be recalled in order

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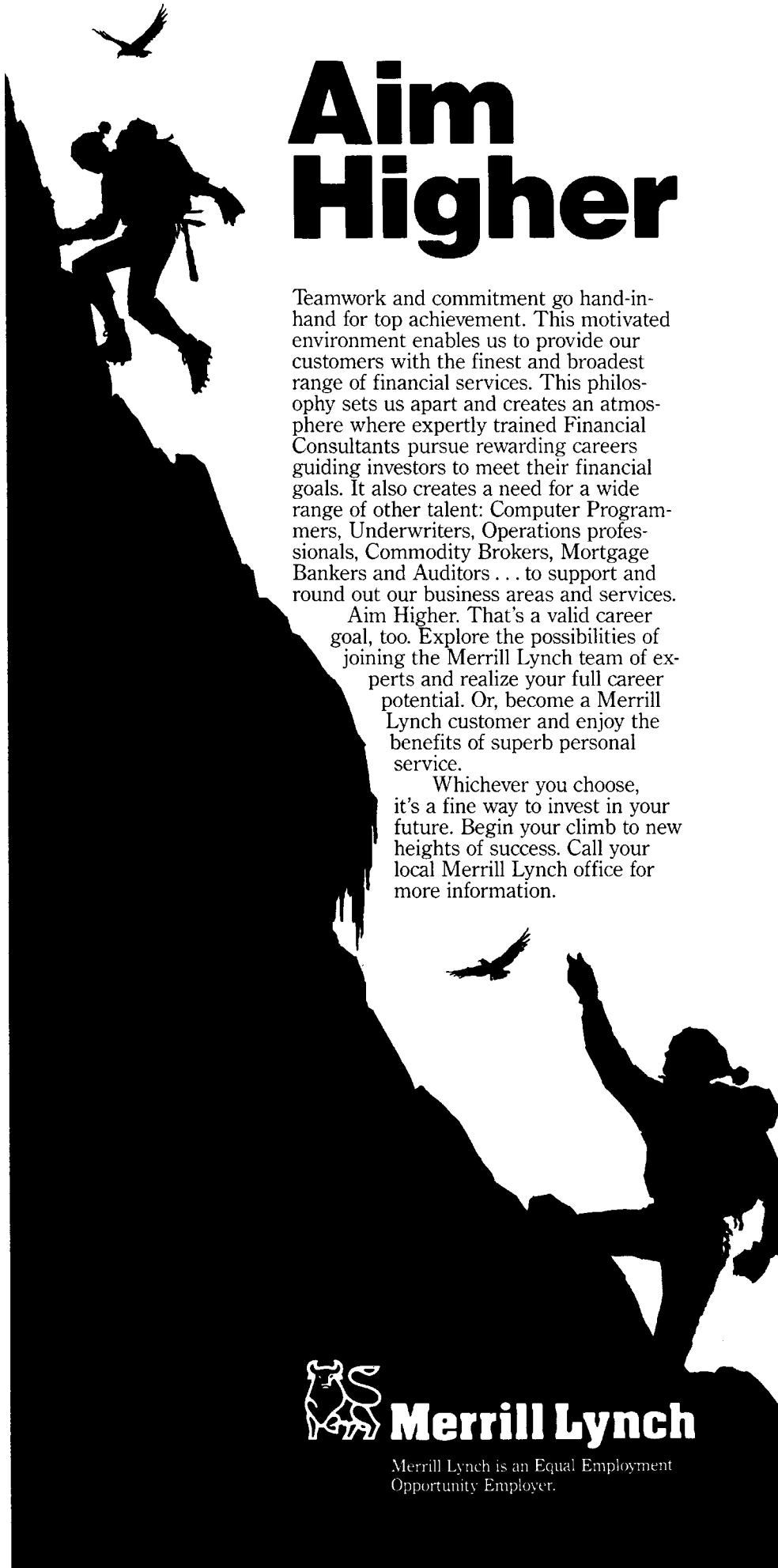


Image processing permits the entry of data into the processing system, without keyboarding, through the use of scanners.

to replicate an expert's decision.

Although significant developmental efforts are ahead, the basic tools of AI are in the marketplace, enabling businesses to invest and fund further research and development. The profit potential is so great that it will encourage development by any organizations who have the capital and whose chief resources are people and information. One of the areas of early impact of AI will be in software engineering. Particularly in the systems design stage of software development, tools are available which generate applications. Also, there are others which, by use of logic-based programming, render systems analysis so efficient that separate specifications and programs are not needed. Every tool and advantage that new information technologies can offer us to expedite, clarify and reliably engineer software will have a major impact on our MAS, tax and computer audit practices. The CPA will need to be on top of all these tools and technologies in order to deal with them appropriately when we encounter them in the client environment.

This leads to one of the most promising applications of AI—Intelligent Computer-Aided Instruction (ICAI). It is more effective than conventional instruction. It could be an important aid to meeting our increased requirements for professional and technical knowledge.

Voice recognition technology is one of the difficult problem areas in AI research. Currently, progress is being reported from a variety of organizations. But the bottom line is that economics are currently prohibitive for anything near full language capabilities. (Now a system which can recognize 1,000 words costs \$3,000 purchased in large quantities.) Although limited-function voice

recognition is in its second generation development stage, only a speaker-dependent capability with limited vocabulary is now available. However, the same dramatic cost reductions that have occurred in other areas of technology can be expected in voice recognition.

Image Processing

Digitized image processing is the technology for transforming text and images from a paper document into binary data, understood by a computer. The main appeal of this technology is the potential for eliminating many of the millions of paper documents produced by U.S. businesses each day. Image processing could offer significant economies to professional firms by permitting the entry of client data into the tax or financial processing system without any keyboarding through the use of low cost scanners that can recognize text. Further, a permanent file will be created at the same time.

By the end of the decade, optical laser disk storage systems will be a reality. These stable, low-cost devices, coupled with increased data address capacity and the capabilities of 32-bit micro-processors with improved graphics processing should allow for



Elise G. Jancura, Ph.D., CPA, CISA, is chairperson of the Accounting and Business Law Departments of Cleveland State University. She has served on the Computer Services Executive Committee with the AICPA and as chairperson of the Computer Education Committee. She is a member of the Ohio Society of CPAs, the Association for Computing Machinery, AWSCPA, ASWA, and AAA.

the integration of text (office) and normal data processing files. Whole documents will be able to be stored digitally, as well as be available for subsequent manipulation by programs. New methods of data entry will be practical and will eliminate much of the present transformation, i.e., re-keying of data. New software will be developed to enable selection of text in the computerized databases. Fiber optic links, capable of transmitting digitally encoded documents at speeds of millions of bits per second (compared to existing computer networks which typically run at 9,600 bits per second), will be subject to continued price performance improvements. The recent introduction of low-cost laser printers and scanners, coupled with improved read-write media, should enable CPAs to witness these developments in their clients' offices within the next few years and in their own CPA's office by the end of the decade.

Summary

The subcommittee believes that many of the technological trends that will impact the profession are now well established. The views that the subcommittee has expressed in its report are based on the personal and professional observations of its members, all of whom are actively involved in EDP and information technology within their respective firms or universities.

A compelling case for a significant response by the profession to changes in information technology can be made if one accepts one or more of the following propositions:

- a. The rate of technological change, particularly the cost/benefit characteristics of such change, is currently high and will increase.
- b. The changing technology has potential business and competitive implications which will impact some areas of current practice and the structure and economics of future practice.
- c. Since the mid-1950s, the profession has been in a reactive, catch-up posture with the result that some professional mechanisms are badly in need of a major overhaul, not simply a minor tune-up. Consequently, many CPAs are now members of technology-based associations and the CPA exam no longer reflects what a CPA will encounter in practice.

Part II, covering the impact of these new developments on the profession will appear in the October issue. Ω