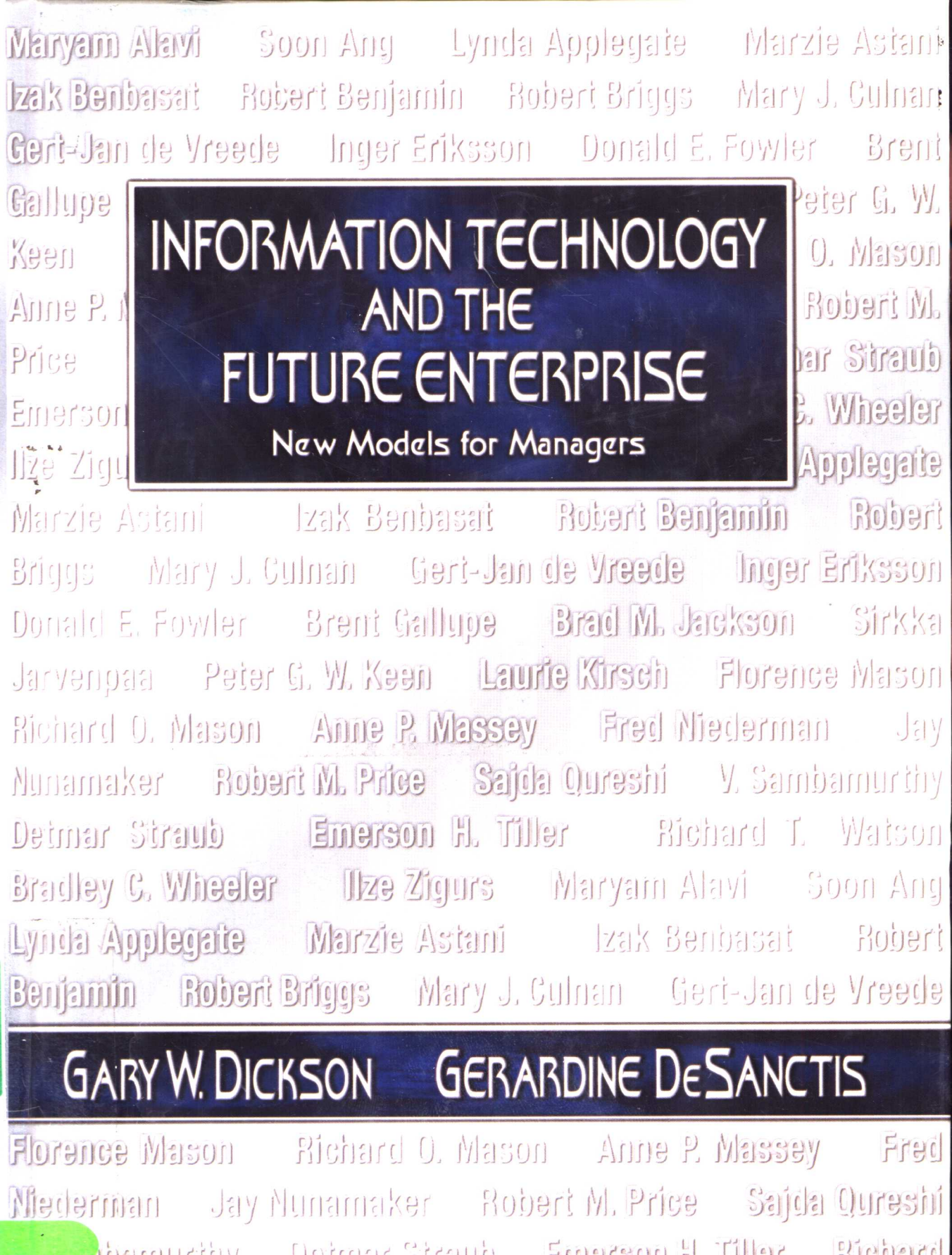
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AND THE
FUTURE ENTERPRISE
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Information Technology and the Future Enterprise

New Models for Managers

Gary W. Dickson
North Carolina State University

Gerardine DeSanctis
Duke University

and Associates

Prentice Hall

Upper Saddle River, New Jersey

Dickson, Gary W.
Information technology and the future enterprise : new models for managers / Gary W. Dickson, Gerardine DeSanctis.
p. cm.
ISBN 0-13-017854-3
1. Information technology—Management. I. DeSanctis, Gerardine II. Title.

T58.64.D53 2000
658—dc21

00-04413

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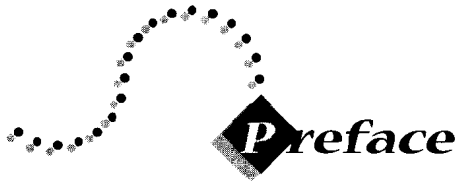
10 9 8 7 6 5 4 3 2
ISBN 0-13-017854-3



A key theme of this book is that information technology, at its best, helps in the management of relationships. We are fortunate that our interest in information technology management has led us to many wonderful collegial relationships over the years. In December of 1999, as we anticipated the dawn of a new century, we brought together a fine group of colleagues to discuss the future of IT management, to share our thoughts, and, most of all, to share our mutual friendship. The result was the chapters in this text. This book is dedicated to the many colleagues we have been fortunate to know over the years—those who have contributed to this text and those who have not. We salute all of you.

—*Gerry DeSanctis* and *Gary Dickson*

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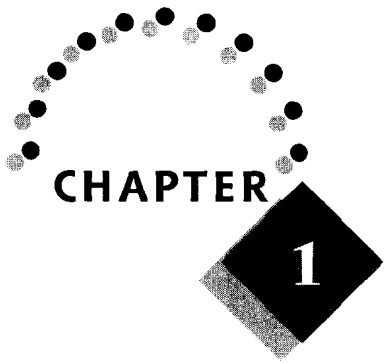

Information Technology Management

Perspective, Focus, and Change in the Twenty-First Century

Gerardine DeSanctis, Duke University
Gary Dickson, North Carolina State University
Robert Price, Duke University

Provocations:

1. Advances in information technology continually bring about new eras of IT management that challenge technologists and managers alike.
2. The models for managing IT strategy, the IT function, and IT projects are changing in the twenty-first century. The models of the past are inadequate.

◆ INTRODUCTION

As we all know, information technology (IT) has undergone rapid and fundamental change since it was first introduced in organizations nearly 50 years ago. As the technology has changed, so too have the applications of technology changed, and organizational methods for managing IT have changed as well. This introductory chapter provides a backdrop for this book by looking at changes in IT application and management as we begin the twenty-first century. We start with an overview of the history of IT use in organizations to show how the attributes of technology have influenced its application and management in the past. Next, we look to the future and how the current models for IT application and management are moving to new models for (1) using IT for competitive advantage, (2) managing IT within the enterprise, and (3) developing IT projects.

◆ IT APPLICATION AND MANAGEMENT: PAST, PRESENT, AND FUTURE

The first commercial computer was installed in the United States in a General Electric Plant in Lexington, Kentucky, in 1954. Not long before that time, the first computers were delivered to the U.S. government for use in managing the national census and for use in nuclear weapons research. Thus, we have nearly a half century of applying and managing IT in our organizations. For convenience, we have broken this history into five eras that are distinguished by the nature of the technology and, consequently, how it has been applied and managed.[1] We put dates on these eras to give the reader an idea of approximately when major shifts occurred. However, the reader should consider the dates only as guides, because changes in technology as well as changes in technology application and management can lag behind each other and take place over several years in moving from era to era. Table 1.1 highlights key aspects of each era.

FIRST ERA: PIONEERS, PENETRATION, AND CHAOS (1954–1963)

The 1950s and 1960s were part of the Cold War era in the United States. The early adopters of computers tended to be aerospace and electronics firms. Other pioneers in using computers were what one might think of as Fortune 100–sized organizations. Computers of this era were very specialized. Some machines were designed for the numerical applications found in science and engineering, intended primarily for the scientific computation market. Other machines were designed for business data processing, focusing on character manipulation. Scientific applications, fueled by the Cold War environment, were dominant. Remington Rand's Univac I machine was a leader in the marketplace and was used in business as well as scientific calculations; Engineering Research Associates' (ERA) model 1101 was an early entrant in this arena, and the ERA 1103 (by then ERA had become a part of Remington Rand as well) and IBM's 701 model were not far behind. Although what we commonly refer to as business applications and business-oriented machines were being introduced, scientific applications and machines to support them were primary.

Programming languages in this era were machine specific and very technical in nature. One of the challenges of the early adopting firms was to find people with the programming skills needed to write applications for these early computers. Most large firms, for example, Boeing, did in-house training for scientific programmers. In fact, one of the authors of this chapter spent two

TABLE 1.1 Each Era of Computing Has Brought New Applications, Management Approaches, and Organizational Concerns

	Computing	*Applications*	*Management*	*Organization*	*Key Issues*
First Era (1954–1963)	Isolated machines	Scientific and engineering; machine-specific programs	In-house training of technical staff	Unplanned, chaotic	Few concerns; computing is a mystery, scattered and hidden from top management view.
Second Era (1964–1976)	Distributed access to mainframes; compatible product lines (IBM 360 architecture)	Accounting, inventory, and business transactions	Standardized programming languages, early database technology	Consolidation of control within the data processing function	Rising costs, unmet user expectations
Third Era (1977–1984)	Midrange computers, easy-to-use interfaces	Commercial and user-developed applications complement internal systems development efforts.	Systems development life cycle procedures; distributed IT development	Greater business unit control of IT	Coordination of centralized and business-unit IT efforts
Fourth Era (1985–1996)	Personal computers, local area networks, Internets and Extranets	User-friendly applications, desktop systems (spreadsheets, word processing) followed by groupware and workflow systems	User-driven systems management: everyone is an IT manager; project control techniques.	Federated or free market approach to IT, including centralized, decentralized, and outsourced IT operations	Incompatible systems, integration difficulties, Y2K
Fifth Era (1997 onward)	Personal digital assistants, mobile technology, Internet as primary platform	Electronic commerce systems	Professionalism and team skills are paramount; flexibility is added to project control.	Downsizing of corporate IT, integration of business and IT operations	Embracing both old (fourth era) and new models of IT management

years teaching programming languages to engineers and scientists hired by Boeing to be scientific programmers. In the early 1960s, computer programming was not something that very many colleges and universities provided, and when they did, it was likely to be for a language other than that needed by the employer. It was not until the middle of this era (late 1950s) that the FORTRAN programming language was available for use by scientific programmers. And it was late in the era (early 1960s) before the COBOL business-oriented language became widely available. Even these languages

were machine specific at this time, so highly specialized knowledge was needed for programmers to do their task.

The computing technology was extremely primitive by any of today's standards. The machines were physically large, based on vacuum-tube technology, and input was by punched card or magnetic tape. Most machines used magnetic tape for data storage, and telecommunications spanned only from the computer to a card reader or printer located in the computer room. Believe it or not, in the early part of this era the U.S. government was reputed to have forecast the worldwide demand for computing machines to someday be as many as six or seven. No one could foresee the explosive interest in computing yet to come.

IT was not used for strategic purposes in this early era of computing. The value of the computer was that it could do things more quickly—run models, make calculations, compile character information, and determine numeric results. The business applications developed for the early computers were, for the most part, accounting oriented. For this reason, in many early adopting firms, the data processing department was located in the accounting function and frequently reported to a vice president of finance. Scientific and engineering applications appeared in defense, electronics, and aerospace businesses but otherwise were rarely evident in business settings. Over time, of course, businesses of all sorts became increasingly interested in computing.

It would be misleading to say that the organizational use of computers was really managed during this era. Again, let's consider Boeing as an example. In the early 1960s, Boeing had several pockets of computing located in its two major divisions, aerospace and commercial aircraft. Some of these computers and associated technical staff were found in accounting and finance departments. But scientific computers were located wherever there were pioneers with budgets that allowed them to acquire a computer and a staff to program it. Management of IT in most businesses during this era would best be characterized as unplanned and chaotic.

By the early 1960s, larger firms were beginning to spend a significant amount of money on computers, and the technology was starting to get the attention (though not the understanding) of senior management. At Boeing, a time-consuming job assignment of the time was trying to find out where in the company computers were located, what they were being used for, and how much money was being spent on them. This new technology called computing had come to the attention of management largely owing to the fact that computers were expensive and subject to little or no control. Management directed that inventories be conducted to find out what was going on.

Changes in the computer industry and in the nature of the supporting technology were soon to bring dramatic consolidation of organizational computing resources.

SECOND ERA: GAINING CONTROL—CENTRALIZATION AND A TECHNICAL MONOPOLY (1964–1976)

Just prior to the beginning of this era, a number of things were happening in technology development and in the computer industry that made significant changes possible regarding IT use and application. Technical and computer industry advances facilitated what management was seeking—gaining control of computing resources. On the technology side, an important development was the new availability of direct-access storage devices (DASD)—hard disks that would replace magnetic tape as the most popular secondary storage devices used by computers. In addition, telecommunication technology advanced to the point where data transmission could extend outside the computer room. This meant that input and output from the computer could be on peripheral devices, such as terminals located throughout a company's office building, or even across a campus of office buildings. The computer terminals, of course, were "dumb" in the sense that they consisted only of a keyboard for input and a screen for output.[2] They were incapable of the powerful computation we take for granted today.

Taking advantage of DASD and telecommunication advances, researchers at the Massachusetts Institute of Technology (MIT) developed a process called Multiple Access Computing in which a mainframe computer's resources (particularly the memory and the processor) could be shared so that multiple users could be connected and working at the same time. By this time, transistors had replaced vacuum tubes, and computer memories were made of magnetic core, which added the capacity and speed (still primitive by today's standards) necessary for multiple users to share a central computer from remote locations. This approach to computing stands in contrast to input on punched cards and tape, output only on paper, and computers devoted to processing one job at a time.

Meanwhile, within the computer industry, IBM made a significant announcement in 1963. The company had developed a new computer architecture for a family of compatible machines that would be a compromise in design between business data processing and scientific computation. The System 360 series of computers was intended to allow a firm to purchase lower-capability models (mainly for business data processing) and move up to

more sophisticated and expensive models as its needs grew. Meanwhile, huge scientific and engineering firms (such as Boeing) could obtain very expensive mainframes at the high end of the line for their advanced scientific computational needs, yet these same machines could also support business applications. The first IBM System 360 computers were delivered in 1964, and although some promises in the announcement were not met, this family of systems ultimately led to IBM's dominance in the computer industry (holding 60 percent or more of the market at its peak level). The so-called BUNCH companies (Burroughs, Univac, NCR, Control Data, and Honeywell) grew to compete intensely with IBM, but smaller competitors with many technical advantages over IBM, such as Control Data, suffered when competing against IBM's marketing expertise and ability to support a large user base.

Throughout this era, computing technology advanced in capability and sophistication. In particular, in the later 1960s database technology arrived, solving a number of problems related to data being functionally tied to programs (and programmers). The computing cost/performance ratio rapidly improved, though total corporate costs for computing continued to rise. As in the prior era, the business value of IT was that it brought brute force to make calculations and transactions occur more rapidly. Computing was not yet being used for strategic purposes. But the increasing importance of computing across business functions was a harbinger of things to come. Business applications were no longer merely for accounting but also included inventory management and transactions processing systems. The banking and airline industries, in particular, benefited from online transaction processes as illustrated by checking account management systems and airline reservation systems. Federal and state governments expanded their involvement in data processing as well, developing applications for health and human services, tax collection, and Social Security.

Given the growth in computing applications, the compatibility of the IBM computer family, the ability of multiple users to share a centralized computer, and software standards such as COBOL and FORTRAN, it made good managerial sense to replace the structure of many incompatible computers located (with staff) around the organization into a more manageable centralized computer organization. In 1963, Boeing created Boeing Computer Services to support its entire operating base in the Seattle area. Computers and associated personnel were moved by many companies to special, designated locations, such as a wing of the corporate headquarters, a separate building, or a basement. For example, General Mills moved its data processing organization into what it called the East Wing: Minnesota Mining and Manufacturing designated a building on its corporate campus for computers and technical staff; and the Pillsbury Company took the basement approach.

Senior managers of this era were concerned about the growing cost of computing. The early 1970s brought the first major economic downturn since the dawn of computing, and as top managers looked inside their firms to control costs, computing came sharply into view. The general feeling was that computing was not being managed at all or certainly not as well as other major business functions. So the first step was to consolidate corporate computing in order to corral the problem to some extent. Once computing consolidated into one organizational unit, attention could turn to formalization and control.

Though some management discipline was imposed on the computing function of the enterprise, the 1960s and 1970s remained a period of domination by technicians for management of corporate computing. Throughout this era, the top IT manager (frequently called the head of data processing) was a monopolist. User-developed systems—that is, systems developed by the person or department with a specific computing need—were out of the question during this era, especially in those early years. The user manager wishing to have a computer application developed came hat in hand to the technologists of the data processing unit and pleaded to get a request into the applications development queue. (It helped if the user manager had money in his or her budget to pay for the program development.) The development process remained highly technical (requiring expertise in languages such as COBOL and FORTRAN), so the high priests and priestesses of technology in the data processing unit ruled.

Throughout this era, the following were some key constants:

- Management was increasingly concerned about the cost of corporate computing and its business impact.
- Nearly all computing systems were developed internally by the corporate programming staff. They took too long to develop and cost too much. Moreover, when completed, they often did not meet user needs and expectations. This was an outcome of several factors, including the technical challenges of the systems development process and the fact that user needs often changed over the lengthy course of the development process.

THIRD ERA: LETTING LOOSE—DISTRIBUTION AND DECENTRALIZATION (1977–1984)

By the last half of the 1970s, computing technology had evolved to the point where new processing options became available. Midrange computers arrived that could process some applications locally while still relying on the corporate mainframe for most core business applications. A major step taken by many

enterprises at this time was to attempt to better address user needs by involving users in systems development projects. Users began to help determine application requirements as well as monitor the deliverables of IT systems as development took place. Due to the rigid nature of software technology at this time (primarily COBOL based), there was considerable emphasis on processes and procedures for specifying system requirements. The systems development life cycle (SDLC), as it was known, became a regimented set of standards. There were even commercially available products and procedures to support the development of large applications, promising on-time, within-budget completion of projects with high user satisfaction.

This was a period in business when many enterprises were moving from the hierarchical form of organization to one that was more decentralized. A number of leading-edge firms went so far as to begin to distribute the IT development staff into user organizations. Frequently, some form of matrix management was employed for the IT personnel in which they reported to a business unit manger and also to a central IT manager.

By 1984, most IT organizations had added a strong management orientation to their traditionally technically-oriented approach to IT operations. As a result, users were becoming more satisfied with IT applications, and executives were more satisfied with the ability of IT to be managed. The trend to distribute IT staff to user organizations was having a positive impact in terms of improving user–IT relationships and meeting business needs with IT. Externally-developed software packages were becoming available, and some systems development by less technically sophisticated end users was now possible. Database software and associated higher-level programming languages (other than COBOL) were lowering development costs and increasing the speed at which new applications could be created and installed. External development of software applications was starting to replace internal systems development. Computing service firms—supporting applications development, operation, and maintenance—were on the rise, and many business applications were becoming standardized across firms. Software companies were starting to dominate hardware companies as central forces in the computer industry.

By the end of this era—at least in some organizations—users were taking full charge of IT projects, dealing with external vendors (both hardware and software) on their own to get applications built and installed. There was no corporate-level strategy for IT use, but individual functions or departments (such as marketing or manufacturing) were developing IT applications of critical importance to their particular areas. A mind shift in the role of centralized computing was starting to take place. The central IT organization was coming to be viewed more as an advisory resource for the service of customers rather than