3 Frank Boles, *Archival Appraisal* (New York, 1991).

David Bearman
Archives & Museum Informatics

Computer Systems Development: History, Organization and Implementation. ANDREW FRIEDMAN with DOMINIC S. CORNFORD. Toronto: John Wiley & Sons Ltd., 1989. ISBN 0 471 92399 0.

In appraising and describing electronic records, archivists must be aware of the context of computer development systems in the agencies which created them. Such information provides the archivist with insights into the ways in which electronic records have changed as computer systems have evolved. Friedman and Cornford's book is important in understanding the implementation of computer systems because it demonstrates that many of the transformations in computerization that have occurred since the 1950s resulted from a continual process of technological change generated largely from within the computing installations in user organizations.

The orientation of *Computer Systems Development* is of special interest to archivists because it focusses on the sites where the electronic records are created and where most people are occupied with computer systems development, that is, the user organizations, rather than either computer hardware manufacturers or independent software houses and service bureaus. Similarly, the authors are mainly interested in those occupations concerned with computer systems development such as systems analysts and programmers (whom they often describe collectively as computer systems developers) rather than those that usually comprise the computer systems industry such as computer operators, data preparation, and control staff or sales staff.

Their historical analytical approach to computer systems development provides an important contribution to the archivist's understanding of the past, current, and future developments. By linking the organization of computer systems development to a range of social, economic and technical factors, the significant differences between different installations can be better understood. As Friedman and Cornford explain, the standard explanation for observed differences in computer installations was simply their age, based on the idea that all such organizations go through an invariant set of stages in their development. While they believe that this evolutionary approach may be of limited use, it must be supplemented with an analysis of the interaction between computer installations and their environments.

They suggest that the myriad ways in which the work of computer systems developers has changed since the 1950s can be understood in terms of a succession of phases, each of which is marked by a particular critical factor, a particular constraint on the further development and penetration of computer-based systems. Efforts to overcome this critical factor stimulate changes in management strategies towards computer systems developers, changes in the position of systems development activities within organizations and even variations in the orientation of technological changes. Why is it that different critical factors have been the focus of attention during the history of computing? This can be explained by a combination of forces, including technological changes in hardware and software, changes in the competition faced by suppliers of computer systems and continual shortages of skilled and experienced computer systems developers.

In the first phase of computer systems development (early 1950s to late 1960s), the constraining factor was the hardware capabilities and costs of the computers themselves. Initially very expensive and possessing limited performance levels, energies were directed by the manufacturers to improve cost/performance ratios. Rapid technological progress was made in reducing the size and increasing the overall reliability of the computer's central processing unit (CPU) by switching from valves to transistors in the 1950s, and eventually to integrated circuits in the 1960s. The introduction of magnetic core in the late 1950s greatly improved computer memory and access time, which were significant in expanding its uses. The electro-mechanical basis of input/output processes (punch card, magnetic tape, paper tape readers, line printer) placed technical constraints on the efficient use of CPU and memory during this period.

During phase one, major developments in electronic components, both in terms of cost and capacity, greatly increased the overall utilization of CPU and memory, and the total "run-time" for programmes was reduced significantly. In addition, the rise of "systems software," of which the "operating system" is an example, allowed the power of the computer to be harnessed to make the overall system more efficient. However, the authors believe that the adoption of automated systems in private firms was more significantly influenced by the great reductions in the cost of computers than by their absolute performance levels.

When firms realized that potential savings could be achieved by computerizing parts of their administrative operations, they created computer departments with specialist staff to develop and maintain computer systems. Computers were introduced in those areas of the firm's information processing which conformed most to the computer's capabilities and where significant savings would result: high volume, routine clerical activities such as accounting, payroll, invoices, billing, stock control, etc.

While hardware costs were declining during most of this period, they represented a greater proportion of the expenditures on the implementation of computerization than computer personnel or applications programmes, and therefore became the primary consideration. Thus, while it was recognized that high-level computer languages enabled programming to be done much quicker than in a very basic assembler language, they ran much slower than their counterparts written directly in assembler language. Since in business applications the computer ran relatively few programmes or applications repeatedly, programmes written in a high-level language would pay the cost of inefficient machine use, over and over.

Due to the falling level of hardware cost/performance ratios and the absolute cost of the computer systems core (systems software and hardware), the next phase (from the early 1970s to the late 1970s) saw a rapid growth in the number of potential computer applications. Major advances in the computer systems core were made, sparked by continuing shortages of experienced systems developers. Computer hardware manufacturers — seeking for ways of either removing the need for some of the skill involved in programme development or of increasing the productivity of skilled personnel — included high-level languages, utilities, generators, and systems software such as database management systems and teleprocessing monitors with their systems. With fewer limitations on costs and the performance of hardware, more complex and grandiose schemes for computer systems could be attempted. During this period, the computer department, or data processing department, sought to extend the range of computerization within

the firm's oerpations, but encountered increasing difficulty translating "user" departments' requirements, which were imprecise and incomplete, into clear systems and programming specifications. These systems requirements, the authors stress, were likely to have been misunderstood by both the users and computing staff, and were limited in their effectiveness due to the combination of their increasing complexity and the relative inexperience of the systems development staff in the "mediation process." This led to late deliveries of systems, escalating costs and failed software projects which came to be known as the "software crisis."

Falling basic computer systems core costs had increased the visibility of the costs of software development, and the perception of a crisis in this area reflected the slower productivity growth of software compared with hardware. The software portion of computer department budgets overtook hardware costs during the early part of phase two. Furthermore, as the computer systems core infiltrated directly into user departments via personal computers (PCs), intelligent terminals via on-line systems, and more sophisticated end-user software, the monopoly position that computer departments held in user organizations deteriorated. Budget increases also reflected increasing staff costs, and by the end of phase two, on-line systems led to the rapid decline in specialist data preparation staff and computer operations in the computer departments. In contrast, analysts and programmers were growing to meet the rising maintenance loads on existing systems and the growth of user demands for new applications, while the division between applications and systems software specialists was becoming apparent and continued into the next phase.

During the third phase (early 1980s to late 1980s), the firm's user department's relations with computing departments became the primary constraint. User departments sought "end-user" computing systems or environments that could be directly tailored to their specific needs, and desired applications packages that not merely executed management decisions, but improved their quality through more sophisticated information processing and presentation. Just as developments towards the end of the previous phase had eroded the monopoly position of computer departments, the development of external markets for information systems services meant that user departments had alternatives independent of the firm's computer department available for their specific needs. As mentioned above, the computer department's task of meeting user requirements had not been satisfactorily addressed, and major efforts were made to rectify this situation, or at the very least, to oversee the implementation of "imported" systems solutions.

During this phase, computer departments in large firms were not only getting smaller because of decentralization, but were also down-sizing, as the computer systems core continued to spread in user departments. Their function increasingly shifted from systems and applications programme development to resource and technical support. In addition, many smaller firms were computerizing their organizations along the decentralized model, as the costs of purchased computer systems core, PCs, and "intelligent terminals" continued to decrease dramatically. They created computer resource centres within their organizations which provided technical resources and assistance.

As a result of the demands placed on computer departments and resource centres to effectively meet user needs, the traditional separation between systems analysts and programmers was increasingly breaking down in the 1980s. Staffing requirements stressed the desirability of employees with combined analyst/programmer skills, which signified

the growing importance of more user contact among ordinary development staff. Among incumbents within the computer departments, there was more pressure to face users and to develop knowledge of user functions, as well as general social and communication skills.

The authors identify a fourth phase, one that is only now beginning to become important, but that will likely become more significant in the future. In this fourth phase, the "organizational environment" is the major constraint on information systems development, and represents major changes occurring in the external environments of firms, as well as constraints in hardware and software. The growth of organizations managing proprietary databases and agencies dealing with inter-organizational transactions may presage a future where the prime computer systems core is no longer situated in each computer system user organization. Rather, each user organization would contain a satellite core. Around this satellite core there may be facilities for end-user computing and groups of systems developers providing small development jobs and supporting end users. Main development projects would be undertaken in specialist organizations. The authors see rising computer sophistication among higher-level managers, improved user interfaces, better support for end users, as well as improved selling techniques on the part of information systems specialists as resulting in a significant stimulation of demand for these systems.

However, the authors believe that this is merely one path of the future, and may require a degree of cooperation among organizations that may not be forthcoming. In order to deal with rapidly changing and potentially hostile environments, and to improve the organization's performances over other organizations, firms might opt for individualized real-time systems that would model the effects of specific external agents on the overall business environment and anticipate appropriate responses by the organization. These systems would require that the organization's internal structure be modelled, as well as the reactions of external agents, which the authors believe would mean software production constraints.

According to Friedman and Cornford, each phase examined in their book faced a characteristic constraint, and collectively these phases represent the general drift of change in computer systems development. Nevertheless, they emphasize that the problems of one phase are not solved with the progression to the next phase. They are alleviated and other problems have become exacerbated. "Earlier" chief problems no longer occupy centre stage, as the field increasingly devotes its energies to solving the "current" problem area, but work on alleviating constraints previously considered to be most important. Sub-communities continue to work on problems. In this way, the direction of technological progress in the field reflects the chief issues of the past, as well as current fashionable issues. For example, in phase three, efforts to address user relations constraints coexisted with work on improving hardware cost/performance ratios, on automating computer systems development, and on developing programming structures within the computer departments of the user organizations.

By examining the responses made by the computer departments within the user organizations to the perceived constraints affecting each phase of computer systems development, the authors help to counter the notion that such change is merely the result of the innovation and diffusion of a new invention, discovered by some agent outside the field. Rather, because a very significant portion of computer systems

development is endogenous, the authors refer to such change as the "autogeneration of new technology."

Archivists will also find Friedman and Cornford's analysis helpful, because it counters many of the other widely-held assumptions of computer development in the literature, such as studies of the social implications of the diffusion of computers and new forms of computer technology which, by definition, preclude the reverse direction of causality; or studies of the 'invention' of computers, which focus on the big breakthrough which the authors demonstrate has been increasingly less important for understanding what it is that has been diffusing under the label of computers — the cumulation of "minor" improvements to computer systems core.

By providing a historical framework for computer systems development that focuses on the activities within the user organizations, but also incorporates broader social and economic forces, Friedman and Cornford thus offer archivists valuable contextual information concerning the shaping of the electronic record. The appraisal and description of electronic records will be greatly enriched by taking such information into account.

David W. Horky
Archival Studies
University of Manitoba

Women's Archives Guide: Manuscript Sources for the History of Women. JOANNA DEAN and DAVID FRASER. Ottawa: National Archives of Canada/Archives nationales du Canada, 1991. 110 p. ISBN 0-662-58074-5.

In 1976 feminist historian and Renaissance scholar Joan Kelly described the dual restorative goal of women's history in which women were restored to history and history was restored to women. The restorative process not only contributed to historical knowledge, it significantly revitalized historical theory by questioning its conceptual foundations, constructing what Kelly called a "vantage point" from which to study women's experience. The implications for archivists in this revolution in scholarship were and likely continue to be felt most acutely at the reference desk, where the familiar question, "Do you have anything on women?" is first posed. Because early women's historical writing was vaguely hagiographic, focusing on the lives of individual great women, this question could be easily answered by providing the records either created by or directly reflecting these great individuals. Later the contributions of social history to women's history dictated the need for a broader range of primary sources on the experiences of the majority of invisible women undistinguished by individual records creation. Since the 1970s, the dual restorative process has exploded, encompassing questions about the social construction of sexuality and gender, the politics of reproduction, and the intersections of class, race, sex and ethnicity.

This widely publicized and explosive growth in the study of women's history since the 1970s should have disabused archivists of the notion that those questions "on women" could be easily answered by a single record type or form. In this more complex terrain of questions about women, any record, regardless of its creator and including those records in which women are conspicuous by their absence, could conceivably be regarded as relevant to women's history. This new context for questions about women's records sets