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INHIBITORS TO COMPUTER USAGE IN CIVIL ENGINEERING: THE FEDERAL GOVERNMENT PERSPECTIVE

Ronald L. King, C.P.A.[1] 5/13/81

My comments today will give the Federal Government perspective from the viewpoint of the General Accounting Office. As a legislative agency tasked with the responsibility of evaluating the efficiency, economy, effectiveness, and legality with which Federal agencies carry out their financial, management, and program responsibilities, GAO's views are often in conflict with those of executive branch agencies. Consequently, what I say should not be construed as representing a consensus of opinions among Federal construction agencies, but only GAO's viewpoint based on our work concerning the use of computers in the construction industry over the past six years.

Our initial report on the use of computers in the construction industry was our 1978 staff study on computer-aided building design. In that study we looked at the state-of-the-art of computer-aided design discussing the benefits which could be derived from computer use and identifying those factors which seemed to inhibit the further development and use of computer-aided methods. We felt then, and we continue to believe that computer technology offers a tremendous productivity-improving potential to the construction industry. It is our perception, and that of many others, that the industry's absorption of computer technology advances is far below that of other industries.

Construction is a unique industry. It is the only industry which separates the design and production functions. To date, most of GAO's work has been on the design side of the industry and it is our belief that in design the industry has fallen well behind others in developing computer aids. In spite of the vast

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[1]Senior GAO Evaluator, Procurement, Logistics, and Readiness Division, U. S. General Accounting Office, Washington, D. C.

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advances in computer technology over the past 30 years, building designers have remained reluctant to aggressively develop the full potential of the computer. While some notable savings and increases in efficiency and productivity have been achieved, computers are still far from being effectively used, in relation to their full potential, by building design professionals or the industry as a whole.

In our view, greater use of computers is possible with todays computer technology. Most of the factors we identified during our prior study as inhibiting further development of computer aids are primarily management problems; not technical problems. For example, some of the inhibitors we found were:

--Inadequate communications and professional interactions,

--Uncontrolled proliferation of computer programs,

--Lack of agreement among researchers and system developers on the requirements for computer-aided design systems,

--Difficulty in defining design problems,

--Inadequately defined designer needs,

--Lack of appropriate standards,

--Software problems which limit technology transfer,

--Varying interests or reasons for wanting computer aids used,

--Deficiencies in the educational process, and

--Lack of strong construction-oriented focal points in the United States.

Of these factors, one is probably more significant than the others and probably contributes to several of the other inhibitors identified. Given the organizational structure of the building industry, good communications and professional interaction are essential to the development of cost-effective integrated computer-aided design systems.

For many years inadequate communications has been recognized as a major problem for the industry. The lack of effective communications causes expensive duplications of effort. For example, practitioners face many problems when they seek to acquire a new program. Finding out about the existence or availability of a program is a major obstacle, however, even when availability is known, problems still exist. The cost of acquiring existing software can be prohibitive to many small firms. If the source of the software is a Federal agency, firms frequently face problems such as the timeliness of the agency's response to the request, release of the program by the agency, and the price the agency assigns to the program. Once a software package is located and acquired, there are still communication-type problems such as limited documentation and computer hardware transferability problems. As long as potential users are not aware of and cannot conveniently find out what software is available or are unsure of its quality, they will continue to produce their own software at unnecessary expense. Thus, the wheel is reinvented, again and again.

Another significant inhibitor to further advances in computer use is the academic curricula. All universities now include in either their mathematics or general engineering programs, courses in the rudiments of programming in the common higher-level languages such as FORTRAN or BASIC. However, the available software and hardware are often badly out of date. It costs money to acquire and keep current computer programs, to buy modern, up-to-date computer equipment and to acquire knowledgeable faculty. Most schools do not have this money readily available or are unable to make the long-term commitments required.

There are notable exceptions, but the general situation is that the educational system is not turning out students equipped with the tools needed to carry on their profession with modern technology and new methods. Few schools, if any, attempt to teach their students how to apply the computer as a professional

tool. More hands-on training is needed to familiarize students with the computer and its capabilities. In general, our study confirmed that undergraduate exposure to computer oriented instruction is mixed, with the universities lagging behind most of industry in general computer utilization.

In summary, I would say that both the communications and curricula problems deserve the attention of this and other professional groups. Inadequate or ineffective communications is a perennial problem which needs constant attention to keep it under control. It is a problem often discussed at conferences such as this, so I will not dwell on the point further.

As for the curricula problem, the educational process is a long drawn out one; it takes years for the effects of education to impact on practice. Consequently, the sooner students are given adequate education in the capabilities of computers in design and their application, the sooner that the potential of computer techniques can be realized. It is apparent that changes in the educational curricula for architectural and engineering students are necessary if future graduates are to possess the knowledge and capabilities they will need to carry on their profession with modern technology and new methods.

Exactly how the educational process should be changed is a matter to be resolved by the academic community and the professional societies working jointly on the problem. We believe the needs of practice should be reflected more in the curricula than is the present case. An underlying problem here seems to be that a large majority of those filling faculty positions have little or no experience in practice and consequently do not have a good understanding or personal knowledge of the needs of those in practice.

Thank you.