IMP

I/S INTERCORPORATE MEASUREMENT PROGRAM

SPECIAL REPORT

MANAGING SYSTEMS DEVELOPMENT

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and

Center for Research on Information Technology and Organizations (CRITO)

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MANAGING SYSTEMS DEVELOPMENT

INTRODUCTION

One of the most frequently asked questions by chief information officers in corporations today is: "How should we be managing the systems development function?" The frequency with which this question is asked has increased with the wave of restructuring that has swept corporate America and is now sweeping corporations in both Europe and the Asia-Pacific. The successful management of systems development continues to be a critical success factor for the I/S function in corporations, but is one which eludes many, especially in the face of current 'right-sizing' efforts.

Although there are few definitive answers to the question of how to effectively manage systems development, there are several ways firms approach the question.

Some approach the question by trying *organizational solutions*. These include decentralizing the development function to bring it closer to the business units, or centralizing the development function to bring about greater coordination, standardization, and rationalization of the development process. Many firms decentralize systems development activities to the business units, but retain a "corporate" development unit as well. Firms developing global information systems are centralizing the development of corporation-wide systems while allowing local development of country or regional systems.

Others approach the question by conducting *R&D in new technologies and applications*. Successful R&D usually leads to test-bed implementation so corporate clients can get a first hand understanding of the "look and feel" and operational implications of the new system. This results in redesign as needed, implementation of the final system, and then roll-out of the new system. This approach works extremely well for radical new technologies and systems that will be placed in many sites.

Still others attempt to achieve greater effectiveness in systems development by the *creation of advanced development environments and the use of advanced development practices*. Development environments refer to advanced function workstations, development software, and networks to support rapid, easy communication between mixed development teams working in one or more sites. Advanced development practices include development methods, procedures, tools and techniques.

We take the latter approach in this report. The use of advanced development practices is achieving greater popularity because it does not require large organizational changes. Although capital investment is required for development environments and tools,

these investments have been found to be relatively cost-effective.

Methods and Data

Our general approach is to look at management practices for system development over the past four years to discern important trends. We then focus on advanced development practices and assess the relationship between these practices and the efficiency and effectiveness of systems development.

We define efficiency as the ratio of staff to hardware spending for I/S, or the labor-capital ratio. We define effectiveness as the proportion of total development projects completed within budget, on time, and meeting functional requirements.

The analysis is based upon data collected from a sample of approximately 40 corporations. These firms were chosen as part of the Intercorporate Measurement Program (IMP)[1] from corporations that are at the leading-edge of I/S practice.

Exhibits A1-A6 in the Appendix show how our 40 IMP corporations compare with a larger sample of over 400 corporations[2] on six key features:

- Percent I/S budget of total revenues
- Percent I/S employees of total staff
- Total I/S expenses
- Total I/S staff
- Total I/S penetration
- Corporate productivity

Comparison of the patterns in these exhibits indicates two significant features of the two samples. The 40 IMP corporations are consistently higher on most values than the larger sample -- "The 400 Firms." This is consistent with the IMP firms being at the leading-edge of I/S practice. However, the "patterns" in the exhibits are similar which indicates that the IMP sample can be generalized to the larger sample.

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[1]The Intercorporate Measurement Program is a sponsored research program conducted by CSC Consulting and the Center for Research on Information Technology and Organizations at the University of California, Irvine. The work is also supported by a grant from the CISE Division of the U.S. National Science Foundation.

The aim is to further the state of the art of I/S performance measurement and to improve I/S performance in practice. IMP conducts annual surveys of management practice and I/S performance in corporations. It feeds back the knowledge gained to survey participants, to IMP sponsors, and to CSC Consulting members through publications, workshops and client programs.

[2]The larger sample of over 400 corporations was created by combining those reported in the *Computerworld Premier 100* and the *Information Week 500* from 1988-1992.

MANAGING SYSTEMS DEVELOPMENT

The effective management of systems development is complex and challenging, involving many interrelated aspects. This survey focused on five aspects:

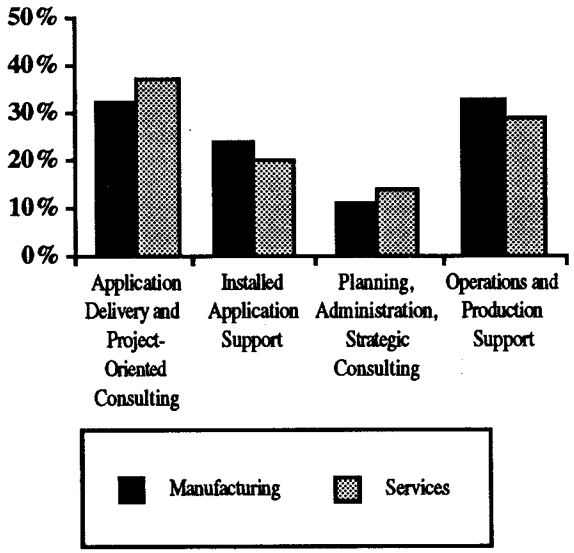
- Allocation of staff resources
- Investment in staff productivity
- Use of standard development methods
- Use of modern development tools and techniques
- Effects of development tools and techniques on I/S performance.

Allocation of Staff Resources

The allocation of development resources is a key success factor because it determines the character of the application portfolio in a firm and therefore the business value derived from IT investments. It is frequently asserted in the business and computer press that maintenance of existing systems consumes the bulk of development resources, leaving little for the building of new systems or for major redesign of old systems where greater value might be achieved. However, this is not the case among the 40 IMP firms.

These firms allocate more staff resources for development of new applications than for maintenance of installed applications. In addition, service firms allocate relatively more for development whereas manufacturing firms allocate relatively more for maintenance (Exhibit 1).

Exhibit 1. Distribution of I/S Personnel Staff Dollars by I/S Activity, 1992

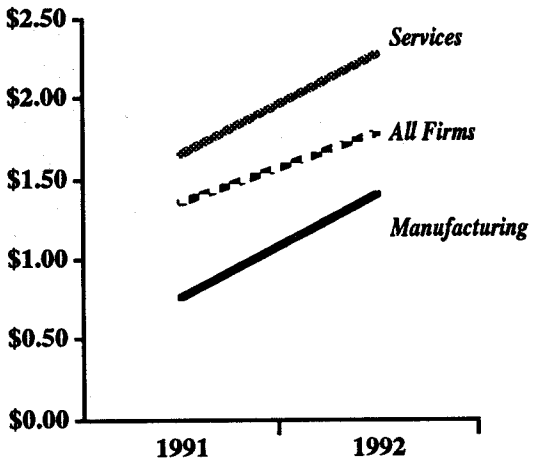


Of total staff spending for I/S in corporations, *systems development** represents 56%, computer operations and technical support represents 32%, and management represents 12%. This distribution has not significantly changed over the five years of the survey.

Of the 56% spent on systems development, 34% is for *new development* and 22% for *maintenance* (Installed Application Support). However, service firms spend more on new development than manufacturing firms. Service firms on average spend 65% of total development dollars on new development whereas manufacturing firms spend on average 55%. In absolute dollars, service firms spend nearly twice as much as manufacturing firms on new development (Exhibit 2).

* Includes "Application Delivery and Project-Oriented Consulting" plus "Installed Application Support" in Exhibit 1.

Exhibit 2. Dollars Spent for New Application Development for Each Dollar Spent on Maintenance of Applications, 1991-1992



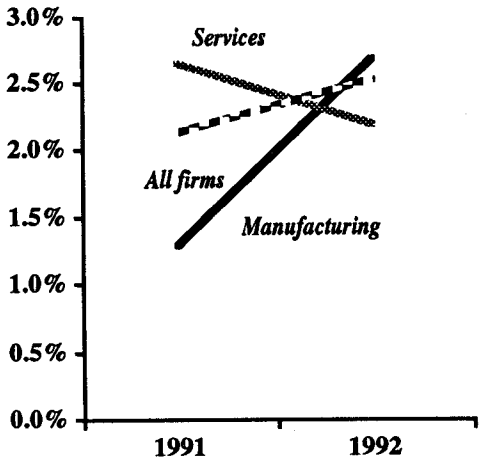
The average spending for new development over the past two years is about $22 million in service firms and $10 million in manufacturing. The average spending for maintenance is $8.5 million in service firms and $6.5 million in manufacturing (data not shown).

Investment in Staff Productivity

Assuming a good mix of development and maintenance resources, staff resources can be enhanced by investments in staff productivity. But, do firms make the required investments?

Firms are investing in tools, techniques and hardware aimed at increasing staff productivity (Exhibit 3). About 2.3% of the total I/S budget is spent for productivity aids, averaged over the past two years. This is about $1.6 million dollars per year. There is no significant difference between manufacturing and service firms, although manufacturing does appear to be increasing its proportion of the I/S budget spent for productivity aids.

Exhibit 3. Percent of I/S Budget Spent For Tools, Techniques and Hardware for Enhancing Staff Productivity, 1991-1992



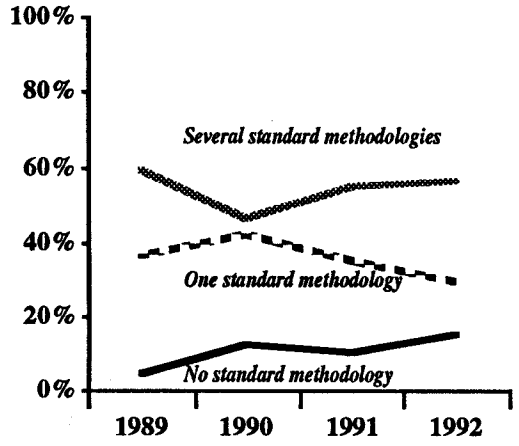
Studies of software development show that productivity might be increased by standardization of development methods and procedures, by use of development tools, and by use of development techniques.

Use of Standard Development Methods

Most of the I/S units continue to use several development methodologies rather than a single standard (Exhibit 4). Over half (56%) of the I/S units use several methodologies. They are applied to fit different development situations (e.g., large or small projects, simple or complex projects), and the project leader

is free to choose the most appropriate from among the several methodologies adopted by the firm. However, about 30% of the I/S units have adopted a single standard which project leaders are expected to follow. In 15% of the I/S units, there is no standard development methodology for applications. Each project leader decides what method to use.

Exhibit 4. System Development Methods, 1989-1992



Use of Modern Development Tools and Techniques

While the use of one standardized development procedure has declined, the use of development tools has increased somewhat over the past four years. Exhibit 5 shows that most of the increase has come in the use of CASE tools, particularly Upper CASE tools. Over 60% of the I/S units use Upper CASE, whereas about 45% use Lower CASE, and 25% use Integrated CASE. Only 20% or less use CATI, reusable software modules, reverse engineering tools, business process simulation tools, or object-oriented techniques. Exhibit 6 shows that Upper CASE tools are used by a greater proportion of service firms than manufacturing firms, and the difference is significant. There are no other significant differences in the use of the other specific tools between manufacturing and service firms. However, as shown by the index which combines all tool use in Exhibit 7, *service firms tend to use all forms of development tools somewhat more than manufacturing firms.* The difference is statistically significant.

Exhibit 5. Use of Developmental Tools, 1989-1992

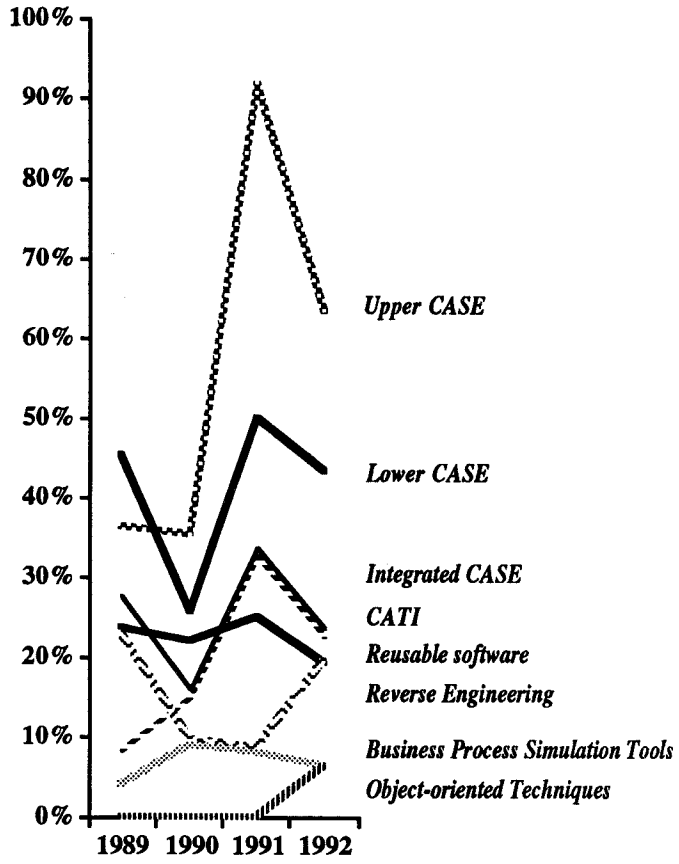


Exhibit 6. Use of Upper CASE, 1989-1992

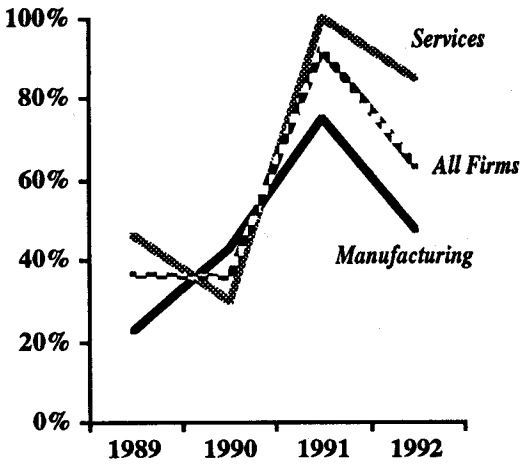
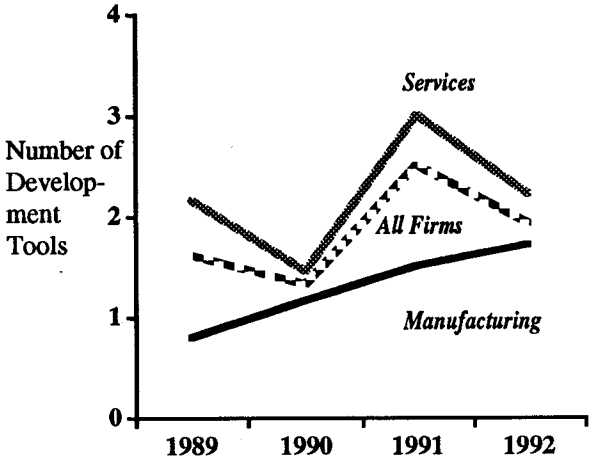
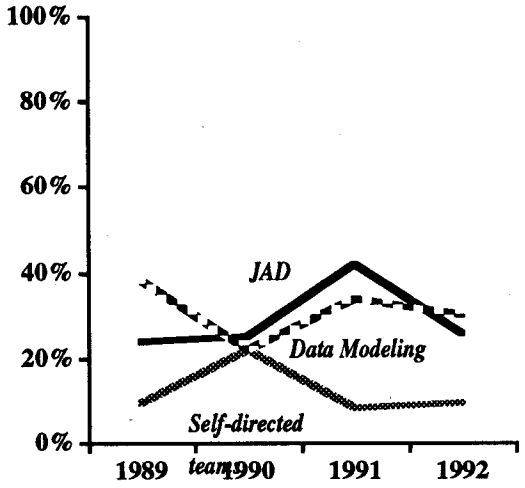


Exhibit 7. Index of Development Tool Advancement, 1989 - 1992



The use of development techniques has essentially remained the same between 1989 and 1992, and is relatively low. About 30% of the I/S units use data modeling, 26% use Joint Application Development (JAD), and 10% use self-directed teams (Exhibit 8). There is no difference between manufacturing and service firms.

Exhibit 8. Use of Development Techniques: 1989-1992



Effects of Development Tools and Techniques on I/S Performance

Previous IMP reports showed that the use of development tools and techniques improves the performance of I/S units in systems development, including both efficiency and effectiveness. This pattern continues to be seen with the firms participating in the 1992 survey.

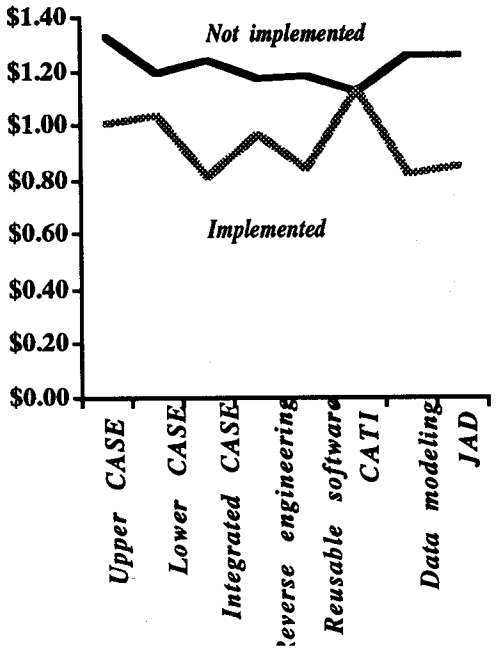
Efficiency is defined as the ratio of labor (personnel spending) to capital (hardware spending) for I/S. Effectiveness is defined by the proportion of total development projects completed within budget, on time, and meeting functional requirements.

Comparison of performance between I/S units which have widely implemented development tools and techniques and those which have not, indicates that both development tools and techniques affect efficiency, whereas only development tools are likely to affect effectiveness.

Efficiency of Systems Development. *Firms which have widely implemented systems development tools and techniques appear to be more efficient in their total development activities than those which have not* when efficiency is measured by the labor-capital ratio (Exhibit 9). For example, those firms which have widely implemented Integrated CASE tools spent on average $.81 on development staff salaries for every dollar spent on hardware. Firms without Integrated CASE which spent $1.24. All of the other software development tools and techniques surveyed except CATI showed this difference, with the gap as high as $.45 and low as $.15.

It is noted in Exhibit 7 that service firms tend to use all forms of development tools more than manufacturing firms. Service firms also appear to be more efficient in their total development activities than manufacturing firms when measured by labor-capital ratios. The labor-capital ratio used here is defined as the total staff salaries for new development and maintenance divided by total hardware dollars. The ratio for manufacturing is 1.4:1 whereas the ratio for services is 1.1:1.

Exhibit 9. I/S Efficiency (Labor-Capital Ratio) and Use of Advanced Technologies and Techniques, 1992

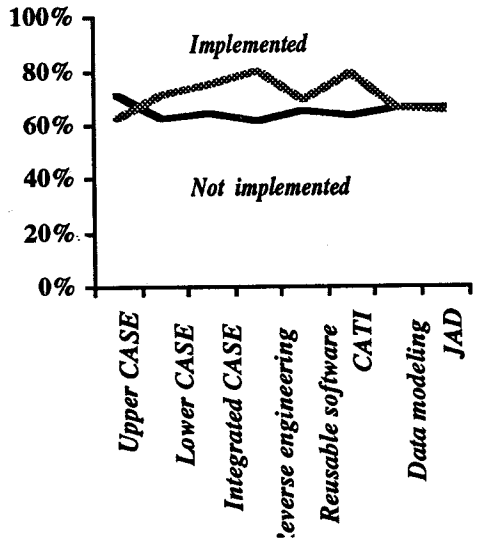


There are several differences between the development units in manufacturing and service firms which might explain the differences in efficiency. First, there are fewer systems development units in service firms. Second, there are fewer development and maintenance staff in those units.

It appears that manufacturing firms are attempting to increase their productivity. Spending for productivity tools has increased in manufacturing whereas it has remained steady in services. However, in manufacturing firms greater staff consolidation and reduction probably will be required for further gains in efficiency.

Effectiveness of Systems Development. *Firms which have widely implemented development tools and techniques appear to be more effective in their development activities than those who have not when measured by the percent of delivered projects which were completed on time, within budget and meeting all functional requirements* (Exhibit 10). While the differences are not large and indeed in terms of Upper CASE tools show a reversal, the consistent pattern is noteworthy.

Exhibit 10. I/S Effectiveness (Percent "Successful" Projects) by Use of Advanced Technologies and Techniques



DISCUSSION

The I/S literature and previous studies suggest that substitution of hardware, productivity tools, and management techniques for labor in systems development could bring about productivity gains for the I/S function. This report indicates that substitution of capital for labor does result in greater productivity. Moreover, it is achieved primarily through the use of productivity tools and techniques that reduce labor costs. However, use of these tools requires high investments in hardware and software platforms to support the tools.

Examples of these tools include CASE tools, relational database systems, program generators, program debuggers and the like. Our previous report indicates that such investments reap a return on investment of approximately 2:1. That is, every dollar invested in productivity hardware and software returns two dollars in staff productivity. This considerable improvement in labor productivity suggests that greater adoption of such tools would be sound management practice.

CONCLUSION

Given that I/S budgets are level, and that the I/S department's share of total corporate spending on computing appears to be stable at best, it is clear that corporate and I/S management must examine the I/S function carefully. For the present at least, many firms can no longer expect corporate "growth" to provide the basis for achieving efficiency in production of information services. Efficiency will have to be achieved by organizational and managerial changes within the I/S function itself.

Moving development and maintenance of applications into the business units and user departments will be important. Such staff deployment is a means of both developing more user-oriented systems and attaining the business value of the systems produced.

The use of productivity aids in systems development will be needed to enhance both efficiency and effectiveness. These include *hardware* such as advanced workstations, *methods* such as joint application development teams and rapid application development, *techniques* such as software reuse, and *software tools* such as CASE and information engineering. The use of project planning and management techniques will be important to delivering functionality on time and within budgets, and improving the overall effectiveness of systems development.

Corporate executives and CIOs need to examine their current investments in I/S productivity. Previous studies have shown that many U.S. corporations currently are underinvesting in these areas. Yet, our own and others' studies have shown that such investments can produce a return of 2:1 or greater.

Exhibit A.1 Percent I/S Budget of Total Revenues, 1989-1992

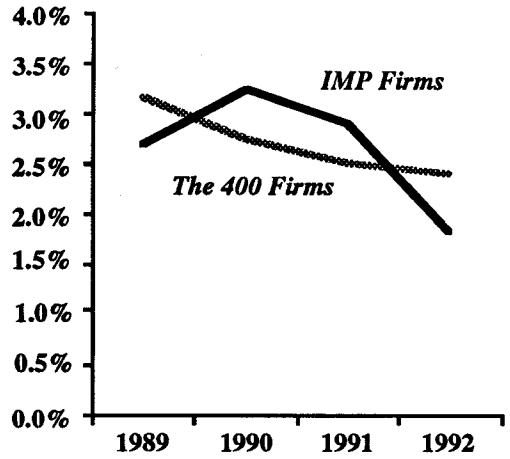


Exhibit A.2 Percent I/S Employees of Total Employees in Corporation, 1989-1992

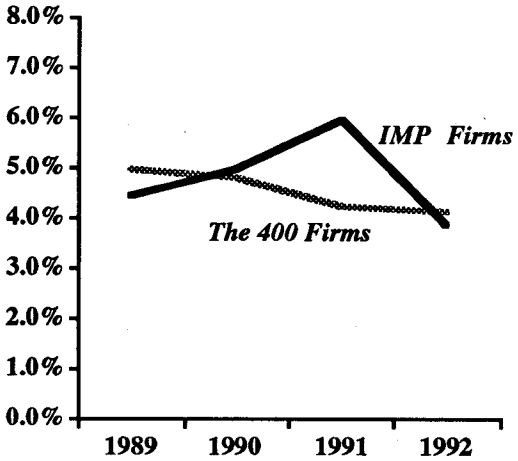


Exhibit A.3 Corporate I/S Expenses (in millions), 1989-1992

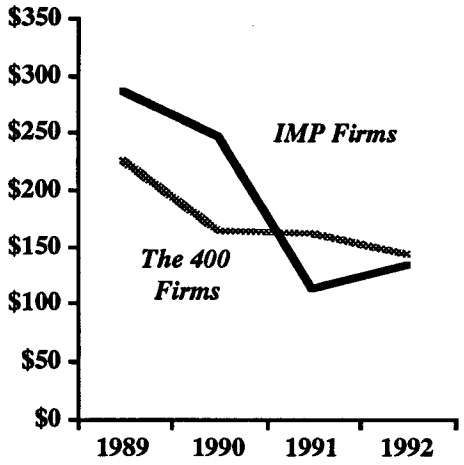


Exhibit A.4 Total I/S Staff in Corporation, 1989-1992

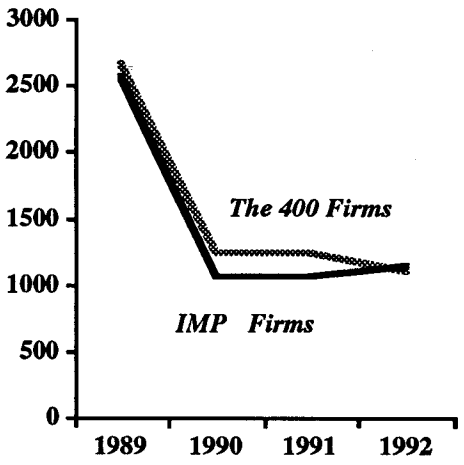


Exhibit A.5 Number of PCs/CRTs per Corporation Employee, 1989-1992

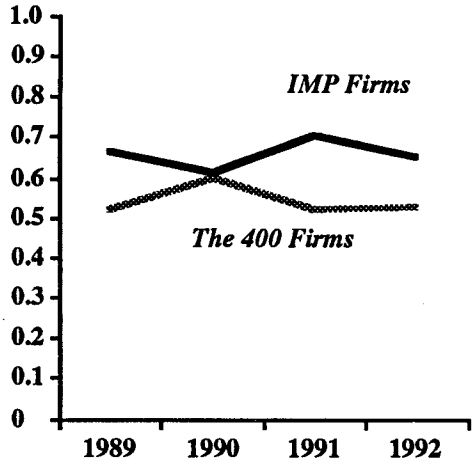
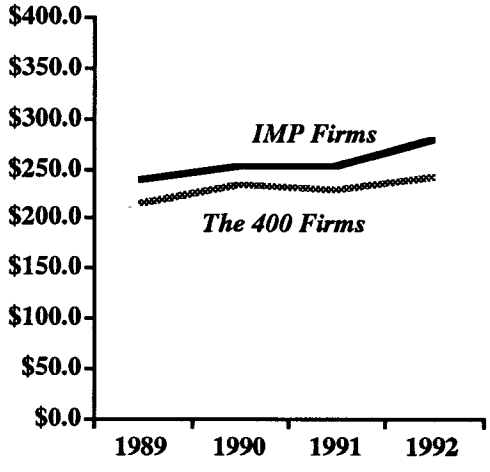


Exhibit A.6 Corporate Revenue per Employee (in thousands), 1989-1992



List of IMP Participating Corporations

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Aetna Life and Casualty
Aid Association for Lutherans
Airborne Freight Corp.
Amdahl Corporation
American Airlines, Inc.
American Cyanamid Co.
American Electric Power Service Corporation
American President Cos
Ameritech Services
Amoco Corporation
Apple Computer
Ashland Oil, Inc.
Automobile Club of Southern California
Barnett Banks, Inc.
Battelle Memorial Institute
Bell Atlantic
BellSouth Telecommunications
Blue Cross Blue Shield of Michigan
Boeing
Borden, Inc.
British Columbia Telephone
Brooklyn Union Gas
Burroughs Wellcome Co.
Campbell Soup Company
The Church of Jesus Christ of Latter-Day Saints
Ciba-Geigy Corporation
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Colgate-Palmolive Company
Colonial Life & Accident Insurance Company
Conoco
Consolidated Edison Company of N.Y.
Consolidated Freightways, Inc.
Consumers Power Company
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Del Monte Foods
Duke Power Company
Eastman Kodak Company
El Paso Natural Gas Co.
Elf Atochem North America
Engelhard Corporation
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Federal Express Corporation
Florida Power & Light Co.
Ford Motor Company
Furr's Inc.
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General Electric Company
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Pacific Bell Directory
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Transamerica Insurance Group
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Union Camp Corporation
Uniroyal Chemical Co.
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The Upjohn Company
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Xerox Corporation

About this Report

This special report is from "Performance Benchmarks for Information Systems in Corporations," the full report of the 1993 survey of I/S. Corporations interested in obtaining a copy of the report, participating in the next survey, or joining the select group of corporations that are Sponsors of IMP are invited to contact:

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Corporations having questions or comments on this report and/or are interested in becoming a Corporate Partner of CRITO are invited to contact:

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About IMP

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