

12-31-1994

Information Technology Productivity Paradox: The Problem Facing IT Managers and Researchers

Mo Mahmood
University of Texas, El Paso

Erik Brynjolfsson
University of Minnesota

Follow this and additional works at: <http://aisel.aisnet.org/icis1994>

Recommended Citation

Mahmood, Mo and Brynjolfsson, Erik, "Information Technology Productivity Paradox: The Problem Facing IT Managers and Researchers" (1994). *ICIS 1994 Proceedings*. 38.
<http://aisel.aisnet.org/icis1994/38>

This material is brought to you by the International Conference on Information Systems (ICIS) at AIS Electronic Library (AISeL). It has been accepted for inclusion in ICIS 1994 Proceedings by an authorized administrator of AIS Electronic Library (AISeL). For more information, please contact elibrary@aisnet.org.

PANEL 7

INFORMATION TECHNOLOGY PRODUCTIVITY PARADOX: THE PROBLEM FACING IT MANAGERS AND RESEARCHERS

Panel Chair: Mo Adam Mahmood, University of Texas, El Paso

Panelists: Erik Brynjolfsson, Massachusetts Institute of Technology
Vijay Gurbaxani, University of California, Irvine
James D. McKeen, Queen's University
Stephen S. Roach, Morgan Stanley and Company

IS [information systems] have made a substantial and statistically significant contribution to the output of firms. [Brynjolfsson and Hitt 1993]

There is no relationship between spending for computers, profits and productivity. [Strassmann 1990]

There is a statistically significant negative relationship between productivity growth and the high-tech intensity of the capital. [Berndt and Morrison 1992]

Despite enormous investments in information technology (IT) and significant enhancements in the underlying technology there is still controversy as to whether these investments have made businesses, in aggregate, more productive. Although the information systems literature is replete with anecdotal evidence documenting spectacular successes obtained through IT investments (e.g., American Airlines, American Express, Citibank, Dun and Bradstreet, and Federal Express), there is a critical shortage of research documenting "hard" evidence linking IT investments to increased productivity. There are, however, a significant number of empirical studies that show little or no evidence relating IT to productivity, fueling further the notion of an IT productivity paradox.

The negative evidence includes Roach's (1991) widely cited research which focused on information worker productivity in the service sector. Based on data from the mid-1970s to the mid-1980s, Roach found that production worker productivity has increased by 16.9 percent while information worker productivity has decreased by 6.6 percent. During the same period, the investment in IT increased significantly. This lead Roach to conclude that IT investment in the service sector has been inefficient. In a survey of thirty firms also in the service sector, Strassmann (1990) also found no significant correlation between IT investment and return on investment. These conclusions are consistent with other studies showing low office productivity (Attewell 1991; Pentland 1989).

The negative evidence also extends to the manufacturing sector. Berndt and Morrison (1991) found that, since 1986, the marginal benefits of IT investments amounted to only about 80 percent of their value. In a survey of sixty manufacturing organizations, Loveman (1988) unearthed no significant correlation between IT investments and organizational productivity.

The positive and mixed evidence includes a number of research studies that span the service and manufacturing sectors. For example, Harris and Katz (1991) discovered that, overall, top performing life insurance firms had higher premium income growth and higher IT expense growth. They also had lower operating costs growth, and lower non-IT costs growth, lower IT cost efficiency growth. Weill (1991) found that transactional IT had a positive significant effect on firm performance, although he discovered no relationship between informational IT or strategic IT and firm productivity. Mahmood and Mann (1993) showed that individual IT measures (e.g., IT budget as a percentage of revenue and value of organizational IT as a percentage of revenue) are not effective in predicting firm productivity (e.g., return on investment and

and communicating mechanisms for players to conduct the affairs of the enterprises. Players form into companies and simulate business by generating and receiving business documents such as Quotations, Purchase Orders, Invoices, and Payments. These documents allow players to both compete and cooperate in the simulated multi-firm economy. Students gain hands-on experience and develop an understanding for the value of information in a competitive market; designing information systems around business protocols; building databases; having process controls; and providing user inquiries and decision support. Organization design, information systems design principles and trading partner relations develop naturally. The IOSGame has been used to simulate both domestic and international trade between student groups at McGill and Erasmus Universities.

EDI-IOS Lab: Curtin and Maribor Universities

Paula Swatnan and Joze Gricar will describe the EDI-IOS simulation, which sprang from an initiative discussed at the Sixth International EDI-IOS Conference held in Bled, Slovenia, in June 1993. This simulation was designed to investigate the feasibility of using EDI as an appropriate medium for teaching telecommunications in an international environment. Students at Curtin University, where the laboratory environment was developed, formed "companies" trading in a homewares manufacturing scenario and dealt with foreign suppliers (from the University of Maribor), as well as with local companies. The simulation features the use of different EDIFACT-compliant EDI software packages to provide technical realism, although the overall objectives of the laboratory are to investigate educational opportunities for EDI and electronic messaging.

After the panelists have presented their simulation games, the panel chair will moderate discussion among the panelists as to how and why simulation and gaming should be integrated into IS curricula around the following motivating ideas:

- Merits of using simulation and gaming: dynamics of real world inter-organizational coordination; balance between abstraction and realism; hands-on interactivity — learning by having fun.
- Business context: shift in unit of analysis from single organization to multiple organizations; business process view; business experience conveyed to participants by playing different roles; experience in the analysis of complex business scenarios.
- Technical context: doing business electronically; telecommunications; multi-media.
- Cross discipline integration: "selling" IS concepts to students from other disciplines; exposure to cross organizational factors including customers, suppliers, agents and other trading partners. Cross discipline experience gained from taking an enterprise level view of marketing, finance, accounting, production logistics, contracting, international and cultural aspects.

A significant amount of time will be allocated for interaction with the audience as the educational issues involved are important for MIS as a discipline. As higher bandwidth linkages become widely available, distributed simulations, involving multiple universities, multi-media and new business scenarios will add further realism to the teaching of inter-organizational systems. The audience is invited to contribute its ideas on these topics.

time, he and his associates have been able to conclude that many companies are indeed reaping financial benefits from their investment in IT. McKeen will discuss the "resource view" of IT and show how it can be used to measure IT productivity and, in the process, resolve the IT productivity paradox.

Stephen Roach is known for provocative research in the economics of IT area. He will argue that the IT productivity paradox still exists. Roach will provide evidence to that effect and insist that it can not be explained away.

References

Attewell, P. "Information Technology and the Productivity Paradox." Paper presented to the Markle Foundation/Social Science Research Council Conference on Social Aspects of Computing, Washington, D.C., September 1991.

Berndt, E. R., and Morrison, C. J. "High-tech Capital Formation and Economic Performance in U.S. Manufacturing Industries: An Exploratory Analysis." Massachusetts Institute of Technology, Sloan School of Management, Economics, Finance and Accounting Working Paper #3419, April 1992.

Brynjolfsson, E. "The Productivity Paradox of Information Technology: Review and Assessment." *Communications of the ACM*, Volume 35, Number 12, 1993, pp. 67-77.

Brynjolfsson, E., and Hitt, L. "Is Information Spending Productive? New Evidence and New Results." In J. I. DeGross, R. P. Bostrom, and D. Robey (Editors), *Proceedings of the Fourteenth International Conference on Information Systems*, Orlando, Florida, 1993, pp. 47-64.

Harris, S. E., and Katz, J. L. "Organizational Performance and Information Technology Intensity in the Insurance Industry." *Organization Science*, Volume 2, Number 3, 1991, pp. 263-295.

Loveman, G. "An Assessment of the Productivity Impact of Information Technologies." Massachusetts Institute of Technology, Sloan School of Management, Working Paper, Management in the 90s, 1988.

Mahmood, M. A., and Mann, G. J. "Measuring the Organizational Impact of Information Technology Investment: An Exploratory Study." *Journal of Management Information Systems*, Volume 10, Number 1, 1993, pp. 97-122.

McKeen, J. D., and Smith, H. A. "The Relationship Between Information Technology Use and Organizational Performance." In R. D. Banker, R. J. Kauffman, and M. A. Mahmood (Editors), *Strategic Information Technology Management: Perspectives on Organizational Growth and Competitive Advantage*. Harrisburg, Pennsylvania: Idea Group Publishing, 1993, pp. 405-444.

Pentland, B. T. "Use and Productivity in Personal Computing: An Empirical Test." In J. I. DeGross, J. C. Henderson, and B. R. Konsynski (Editors), *Proceedings of the Tenth International Conference on Information Systems*, Boston, Massachusetts, 1989, pp. 211-222.

Roach, S. S. "Services Under Seize: The Restructuring Imperative." *Harvard Business Review*, Volume 69, Number 5, 1991, pp. 82-91.

Strassmann, P. A. *The Business Value of Computers*. New Canaan, Connecticut: Information Economics Press, 1990.

Weill, P. "The Relationship Between Investment in Information Technology and Firm Performance: A Study of the Valve Manufacturing Sector." *Information Systems Research*, Volume 3, Number 4, 1992, pp. 307-333.

Wilson, D. D. "Assessing the Impact of Information Technology on Organizational Performance." In R. D. Banker, R. J. Kauffman, and M. A. Mahmood (Editors), *Strategic Information Technology Management: Perspectives on Organizational Growth and Competitive Advantage*. Harrisburg, Pennsylvania: Idea Group Publishing, 1993, pp. 405-444.

return on sales). When grouped together these measures, however, became significant predictors of firm productivity. In a sample of 71 service organizations, McKeen and Smith (1993) found that, on average, deflated business revenues for these companies had increased by 7.6 percent per year while the number of white collar employees had grown by 3.0 percent per year. This led the authors to conclude that “the white collar workers in these organizations are handling an ever increasing volume of business” (p. 427). In a recent study, Brynjolfsson and Hitt (1993) concluded that information technology has made a statistically significant contribution to the productivity of organizations. They went so far as to say that “Our findings suggest that if there ever was a ‘productivity paradox,’ it disappeared in the 1987-1991 period, at least for our sample of large firms” (p. 48).

Clearly, the mixed research findings generated so far suggest that the IT productivity paradox remains a major puzzle and it is imperative that further research and discussion are undertaken to explain it. Panel presentations will discuss key issues facing the IT productivity paradox but will be kept brief to facilitate audience participation. Specifically, the panelists will focus on:

- a. Whether there really is an IT productivity paradox.
- b. If the paradox exists, is it due to:
 - i. weak analytical tools that could not capture data and/or unreliable data (Brynjolfsson 1993, Wilson, 1993);
 - ii. time lags and productivity that show up after additional organizational learning and experience (Brynjolfsson 1993, Wilson 1993);
 - iii. redistributive effects that allow businesses to obtain private benefits that do not show up in industry aggregation (Brynjolfsson 1993);
 - iv. mismanagement on the part of the management since they may use poor justification for introducing IT and inadequate tracking of results (Brynjolfsson 1993);
 - v. management not being able to execute actions (such as clear justifications for an investment) needed to realize increased productivity (Wilson 1993);
 - vi. other reasons.

The panelists will address the aforementioned issues in the following manner:

Mo Adam Mahmood has done extensive research in the IT investment and business performance area. He has published in numerous journals and, recently, edited a book (with R. D. Banker and R. J. Kauffman) in the area. Mahmood will chair the panel and moderate the discussion. He will frame the key issues to be discussed and summarize approaches taken by different authors in resolving the IT productivity paradox.

Erik Brynjolfsson is also on the faculty of Harvard University. His research focuses on valuing IT investments and analyzing how the structures of markets and firms are being transformed by advances in computers and communications technology. He has written numerous articles in some of the academic and practitioner journals. Brynjolfsson will argue that recent evidence suggests that there may no longer be a productivity shortfall associated with IT. He will discuss how mismeasurement, time lags and redistribution, as well as mismanagement have helped fuel the productivity paradox.

Vijay Gurbaxani's primary research interests involve applying economic theory to management issues related to information systems. He is currently working on measuring the efficiency and effectiveness of the information systems function. He also studies the role of information technology in enhancing organizational effectiveness and its implications for the design and structure of organizations. To this end, he is conducting a longitudinal benchmarking study of information systems practice in Fortune 500 corporations. Gurbaxani will present the results of this research.

James McKeen has taken a “firm level” analysis using what he calls the “resource based” approach which considers the role of people and IT jointly to determine value. After analyzing a large number of companies over an extended period of