

: *What is the information technology productivity paradox?*

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Starry-eyed salespeople proclaimed that information technology would revolutionize organizations, create paperless offices, reduce costs, and lead to greater wealth and prosperity for us all even with fewer workers needed due to IT-based automation. That may be the ultimate outcome, but implementing information technology and transforming organizations has proven challenging and fraught with planning and execution problems exacerbated by social and cultural barriers. This article explores the consequences of past overpromising and naive purchasing of Information Technologies.

During the 1970s, 80s and 90s, there was rapid adoption of Information Technologies including the personal computer (PC), but according to Brynjolfsson (1993) productivity growth slowed down. Solow (1987) quipped, "You can see the computer age everywhere but in the productivity statistics." The IT productivity paradox is a perceived "discrepancy between measures of investment in information technology and measures of output at the national level." Harris (1994) reported an analysis where there was a 12 percent annual increase in data processing budgets for U.S. corporations that yielded annual productivity gains of less than 2 percent. Increased investments in Information Technology did seem related to increases in the number of white-collar employees, especially managers.

According to Wachter (2015), the history of technology tells us that it is the "financial, environmental, and organizational factors, rather than the digital wizardry itself, that determine the success and impact of new IT tools." (p. 242)." Investing in Information Technology does not seem to directly increase productivity in a specific firm or in the broader economy. Wachter further explains in a chapter titled "The Productivity Paradox", that "The key to unlocking information technology's productivity gains, it says, is not in the technology itself, but in the emergence of 'complementary innovations'"(p. 245). He further notes "Today as ever, changing the way that work is done often determines whether an organization will get its money's worth from its IT investment."

A causal model suggested by these results and analyses identifies Information Technology spending as an independent variable and productivity as the dependent variable. IT spending increases Productivity with moderating factors of innovations and adaptations in work processes and other organizational factors, environmental factors like actions of competitors, and financial factors like resource availability. The productivity paradox may be reflected in a macro analysis, but perhaps not in a firm-level analysis. Some managers and firms may adapt better and faster than others. In some firms increased IT spending may result more directly in effectiveness and productivity.

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Jones et al. (2012) explored three possible explanations for the IT productivity paradox: measurement, mismanagement, and poor usability. There are measurement difficulties in that IT expenditures are easier to measure than productivity gains and the lag between expenditures and results can be difficult to assess. The paradox may be an artifact of the estimation of productivity gains (Yorukoglu, 1998). Mismanagement is likely a problem in some organizations. Working with new and novel IT can be challenging. Finally, the quality and usability of systems that are developed and installed does vary. Better systems are more likely with user experience testing. A focus on users is a relatively new concern in the development of computerized systems. Brynjolfsson (1993) explored similar causes including measurement of outputs and inputs, lags due to learning and adjustment, redistribution and dissipation of profits, and mismanagement of information and technology. He noted the measurement problem is becoming more severe.

Wachter (2015) explained the productivity problem for healthcare in the Preface to **The Digital Doctor**, "The wiring of healthcare has proven to be the Mother of All Adaptive Problems. Yet we've mistakenly treated it as a technical problem: simply buy the computer system, went the conventional wisdom, take off the shrinkwrap, and flip the switch. We were so oblivious to the need for adaptive change that when we were faced with failed installations, mangled work flows, and computer-generated mistakes, we usually misdiagnosed the problem; sometimes we even blamed the victims, both clinicians and patients (preface, p. xiii)".

In a Harvard Business Review article, Heifetz and Linsky (2002) discuss how people can lead in situations that require adaptive change. Organizational digital transformation requires adaptive change. People in the transforming organization must change and adapt and learn new knowledge, skills and behaviors. Organizational members must individually and collectively seek solutions. Adaptive change is very different than "technical change". The problem definition, solution, and implementation for automation, machine learning, and the Internet of Things (IoT) is generally structured and in some situations well understood. Hence, the technical change associated with information technology is much easier in many situations than the associated adaptive change that is required. Change and transformation of attitudes and behaviors is especially challenging. Heifetz and Linsky argue the single biggest failure of leadership is to treat adaptive challenges like technical problems.

Brynjolfsson and Hitt wrote in 1998 that "Organizational factors that unlock the value of IT are costly and time consuming." They noted "For every dollar of IT there are several dollars of organizational investment that, when combined, generate the large rise in measured firm productivity and value.' This means that an organization's capacity to avoid treating its IT implementation as a 'one and done,' and to keep investing and evolving, is what ultimately determines the outcome."

Information technologies are disrupting many traditional industries. For example, automation, the

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Internet and Information Technologies have led to employment declines. 24/7 Wall St. reviewed annual employment data from the Bureau of Labor Statistics for the time frame 2008 to 2017 to identify the fastest dying industries. Industries on this list had employment declines of at least 37% in the last decade. Eight industries lost over half of their workers during that time. Due to automation, outsourcing, and the changing technological landscape, many of the industries that lost the most jobs over the past decade are expected to continue to struggle, cf. Suneson, 2018.

Information technology has an increasing role in improving production processes and automation seems to be a major reason for the decline in employment in some industries. Some industries where labor is being replaced due to automation include: Automobile and truck manufacturing, Port and harbor operations, Textile and fabric finishing mills, and Tobacco manufacturing. Increasing use of digital communication and digital media has also led to major changes and disruptions in industries like book and periodical merchant wholesalers, book stores and news dealers, directory and mailing list publishers, newspaper publishing, office supplies, and stationery product manufacturing. For example, the following declines seem directly attributable to Information Technology:

Book stores and news dealers --> Employment change 2008-17: -43.3%

Newspaper publishers --> Employment change 2008-17: -50.3%

Directory and mailing list publishers --> Employment change 2008-17: -56.0%

Table 1 based on U.S. Bureau of Labor Statistics data

According to a report by McKinsey Global Institute (2017), "While about half of all work activities globally have the technical potential to be automated by adapting currently demonstrated technologies, the proportion of work actually displaced by 2030 will likely be lower, because of technical, economic, and social factors that affect adoption." In a 2014 McKinsey panel discussion, Laura Tyson said "What's happening with the technology, which is skill biased and labor saving, is that it's eliminating middle-income jobs but is complementary to high skills. The jobs are high-income jobs because some smart people have to work with the technology. But there's a very large number of people who are being pushed down into lower-income jobs."

There is still a productivity problem. Irwin (2016) reported that data released showed that "gross domestic product in the first quarter was up 1.9 percent over the previous year. Despite constant

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advances in software, equipment and management practices to try to make corporate America more efficient, actual economic output is merely moving in lock step with the number of hours people put in, rather than rising as it has throughout modern history." Information Technology was not positively impacting productivity.

The productivity paradox is a business process phenomenon. As more investment is made in information technology, worker productivity may go down instead of up and information technology may lead to digital disruption and the death of industries. Adopting "new" Information Technology does not necessarily increase productivity and it does not insure the survival of a business or industry. Brynjolfsson (1993) commented that "The fact that firms continue to invest large sums in the technology suggests that the individuals within the firm that make investment decisions are getting some benefit or at least believe they are getting some benefit from IT."

So perhaps you can save money by spending it on Information Technology, but there are no guarantees. A paradox can be thought provoking, which is a good result.

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Note: To identify America's 25 dying industries, 24/7 Wall St. reviewed employment change from 2008 through 2017 for U.S. industries in the fourth level of detail in the North American Industry Classification System by the Office of Management and Budget. All data, including the number of establishments within each industry and average weekly and annual wages, was retrieved from the U.S. Bureau of Labor Statistics' Quarterly Census of Employment and Wages.

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