Nov 9th, 11:10 AM - 11:30 AM

Does an Information Technology Investment Contribute to Company Performance: A Further Examination of the Productivity Paradox

Marc Sollosy
Marshall University, sollosy@marshall.edu

Rick Weible
Marshall University, weible@marshall.edu

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Dr. Marc Sollosy, Associate Professor of Management/Strategy, Lewis College of Business, Marshall University

Dr. Rick Weible, Professor of MIS, Lewis College of Business, Marshall University

The role and impact of IT on firm performance

Why does this matter?

- Firms annually expend varying, often significant, amounts of resources on IT related activities
- The impact upon company performance is subject to much on-going debate.
- The dyadic nature of the performance debate has left the issues far from resolved (Bhatt & Grover, 2014; Ravinchandran & Lertwongsatien, 2005)

The role and impact of IT on firm performance

The measure of IT’s contribution to firm performance remains controversial.

- The “Productivity Paradox” (Brynjolfsson, 1993) posited why it is difficult to measure.
  - Mismeasurement of outputs and inputs
  - Lags due to learning and adjustment
  - Redistribution and dissipation of profits
  - Mismanagement of information and technology

The Productivity Paradox

Absence of good qualitative measures of value created by IT makes it difficult to assess.

- Carr’s HBR article ‘IT Doesn't Matter” (2003)
  - IT provides no significant advantage
  - THUS no competitive advantage
- Other researchers show that IT does contribute to organizational performance (Brynjolfsson & Hitt, 1996; Kohli & Devaraj, 2003).

The Productivity Paradox

The debate is a result of the breadth and extent of IT business contribution factors (Brynjolfsson, Hitt & Yang, 2002; Dewan & Kraemer, 2000):

- Type of IT
  - i.e., Network, CRM, AI, Data Analytics, etc.
- Management Practice
- Organization Structure

Numerous disciplines are involved; Information systems, economics, strategy, accounting, and operations research.

The Productivity Paradox

Is IT a necessary infrastructural expense providing no on-going competitive advantage for the firm or a source of differentiation and advantage?

- Viewed from the Resource Based View (RBV) perspective (Barney, 1986)
  - Scarcity not ubiquity is a necessary condition for supernormal rent generation

The Productivity Paradox

Viewed from the Resource Based View (RBV) perspective

Infrastructural & No Advantage	Provides a sources of differentiation & Advantage
Carr (2003)	Bhatt & Grover (2014); Mata et al. (1995); Santhanam & Hartono (2003)
• Ubiquitous	• Capabilities do create uniqueness
• Increasingly inexpensive	• Provide a competitive advantage
• Accessible to all firms	• Resource Configuration

The Productivity Paradox

- Viewed from the Resource Based View (RBV) perspective; Bhatt & Grover (2014); Mata et al. (1995); Santhanam & Hartono (2003)
  - IT related organizational capabilities tend to heterogeneously distributed among firms
  - Leading to differentiated business value
  - Improving organizational efficiencies, effectiveness, and uniqueness

The Productivity Paradox

- How IT resources are configured by management and how they are leveraged is the differential (Miller, 2017)
  - Entails the comprehensive process of structuring, bundling, and leveraging the organization’s resources with the **explicit** purpose of creating value and competitive advantage (Sirmon, Hitt, Ireland & Gilbert, 2010)
- The Chief Information Officer (CIO) becomes an integral member of the Top Management Team (TMT).
  - Serves to actively manage the integration and utilization of IT resources to aid in achieving strategic objectives.

The Productivity Paradox

- Beginning in the early 1980's considerable research focusing on the strategic impact of IT, it potential for creating firm competitive advantage (McFarlan, Jordan & Wurmfeld, 1984; Piccoli & Ives, 2005; Porter & Millar, 1985)
  - IT can lead to the creation of competitive advantage through efficiency and effectiveness improvements, differentiation, and channel domination (Sethi & King, 1994)
  - Firm moves dependent upon the use of IT designed to lead to sustained improvement in competitive position (Ross, Beath & Goodhue, 1996)

The Productivity Paradox

- Brandenburger & Stuart (1996) suggests that the totality of an activity system, depended upon IT at its core, supports the creation of economic value.
  - Utilized the lens of sustainable competitive advantage, RBV (Barney, 1986 & Wernerfelt, 1984) and dynamic capabilities (Eisenhardt & Martin, 2000; Zahra & Nielsen, 2002) to examine firm performance
  - Differences in the performance of activities chosen to perform serve as the basis of competitive advantage (Dehning & Stratopoulos, 2002)

The Productivity Paradox

We posit that;

- The Chief Information Officer (CIO) becomes an integral member of the Top Management Team (TMT).
  - Serves to actively manage the integration and utilization of IT resources to aid in achieving strategic objectives.
- While the impact of IT may differ between industry groups it DOES serve as an important differentiator within industry classes

The Productivity Paradox

- One measure of an organization’s significance of IT is the role of IT related management within the organization
  - We utilized the position of CIO as a proxy for evaluating the strategic import of IT within the organization.
    - Organizations with a CIO or equivalent will out perform their peers that do not identify or recognize such a role within their organization.

The CIO’s importance

- Organizational CIOs emerged in the early 1980’s (Synnott & Gruber, 1981)
  - Facilitate responding to rapidly changing technology
    - Changes requiring alteration of market orientation and competition requiring new delivery channels and services
  - The emergence of the ‘information economy’ (Benjamin, Charles & Rockart, 1985)

The CIO’s importance – Positioning

- Strategy-structure paradigm postulates organizations with CIOs will out perform those where the responsibility for IT is relegated to a lower level in the organization’s management hierarchy (Banker, Hu, Pavlou & Luftman, 2011).
  - CIOs reporting to the CEO perform at a higher level than those reporting to the CFO (Banker, et al., 2011)
  - The CIO reporting relationship is indicative of the criticality of IT to the organization’s culture and strategy (Benjamin et al., 1985; Jones, Taylor & Spencer, 1995)
- CIO’s reporting to the CEO indicate that IT is viewed as a strategic asset
- CIOs reporting the CFO or lower indicate an infrastructure or ‘plumbing’ view of IT.

The CIO's importance - Positioning

- Upper Echelon & Top Management Team (TMT) theories (Hambrick & Mason, 1984) postulate that an organization's TMT can effect performance.
  - The CIO has become increasingly more important as IT plays an increasingly central role in the organization's processes and strategy (Banker et el, 2011; Raghunathan & Raghunathan, 1989; Raghunathan & Raghunathan, 1993).
  - An organization's IT structure and reporting relationships can have a significant impact on performance (Csaszar & Clemons, 2006).
- The further from the TMT the CIO is positioned is further indication of the lack of importance placed on IT within the organization (Applegate & Elam, 1992: Luftman & Kempaiah, 2007).
  - The success and influence of IT is more likely if the CIO is closer to the CEO (Armstrong & Sambamurthy, 1999).

The CIO’s importance - Positioning

An organization’s CIO contribute to value creation by increasing the strategic foresight of the TMT.

- Karahanna & Chen (2006) and Preston & Karahanna (2009) found organizations with effective CIOs consistently out perform their industry competitors.
  - The CIOs reporting structure is reciprocal with the organization’s orientation towards IT.
    - In a strategic orientation, the CIO is a member of the TMT (Reich & Nelson, 2003)
    - In an operational orientation, the CIO is only responsible for leading the IT function, offering IT support and managing less risky, non-strategic projects (Ives & Olson, 1981).

The CIO's importance - Positioning

- The inclusion of a CIO in the TMT is an indication of an IT strategy.
  - Without a clear IT strategy, the actual contribution of IT to performance is most probably the result of serendipity (Galliers, 2011; Leider, Lo, & Preston, 2011)
  - Alignment of IT to the strategic alignment of the organization has focused on the degree IT is strategic and structural (Reich & Benbasat, 1996; Venkatraman, Henderson & Oldach, 1993) or even more recently, informationally (Chan, 2002), aligned with the organization.

The CIO's importance - Alignment

The alignment-fit view (Mintzberg, 1990)

- The importance of aligning the organization's IT strategy with the organization's strategic view and structure has been established (Govindarajan, 1989; Hambrick & Mason, 1984).
- Chen et al (2010) adopts Mintzberg's 5th definition – perspective – and defines IT strategy as the "Organizations perspective on the investment in, deployment, use, and management of information systems"(p.237).

The CIO's importance - Alignment

- The clearly articulated role of the CIO and the resulting integration of a shared view among the organization's TMT helps ensure that all members of the organization have a similar orientation (Tai & Phelps, 2000).
  - Leads to a general consensus among the TMT regarding the role of IT (Pyburn, 1983)
  - The conception and implementation whereby IT is inextricably incorporated in the organization's overall business strategy (Galliers, 2011; Leidner et al, 2011).

Postulate

The existence of a CIO or similar role within the organization will enhance organizational performance.

- The presence of a CIO exemplifies the significance of IT
  - By extension the existence of an IT strategy and IT’s impact on organizational level performance outcomes.
- Given the percentage of an organization’s capital expenditures
  - Presence of a CIO suggests the pursuing of activities and innovations supporting the businesses innovations.

Method

Standard & Poor's Capital I.Q. Database

- Dataset utilized 20,762 companies classified as Industrial capital goods broken out by sales volume
  - 19,846 had sales between $10 million and $100 million
  - 593 had sales between $101 million and $250 million
  - 156 had sales between $251 million and $500 million
  - 167 had sales great than $501 million

Method

Firms in the same or similar industries display significant heterogenicity in term of productivity

- To account for the effect of organizational size
  - Divided organizational total revenue by number of employees
  - Ratio served as a measure of success thus refining the performance measure
  - Served as a proxy for labor productivity
    - Mahmood & Mann (2009) – Canonical correlation

Findings

- Dependent Variable – Presence of a CIO or similar position
- Independent Variable – Organizational Performance
- One-way Analysis of Variance (ANOVA)

Size $(000,000)		Sum of Square	df	Mean Square	F	Sig.
$0 - $50	Between Group	53,179	8525	.0006	1.770	.000
	Within Group	36,391	10327	.004		
	Total	89,570	18852			
$51 - $100	Between Group	31,732	862	.037	1.804	.005
	Within Group	100	49	.020		
	Total	32,732	911			
$101 - $250	Between Group	39,748	525	.076	1.590	.158
	Within Group	667	14	.048		
	Total	40,415	539			
$251 - $500	Between Group	18,191	155	.117		
	Within Group	0.0	1	0.0		
	Total	18,191	156			
$500 +	Between Group	25,905	166	.156		
	Within Group	0.0	1	0.0		
	Total	25,905	167			

Findings

- Organizations with $50 million or less the presence of a CIO has a significant impact on performance
  - $F(90,, 18853) = 1.17$, $p=.000$
- The presence of a CIO was also significant for organizations with $50 million to $100 million
  - $F(49,, 1011) = 1.804$, $p=.005$
- At an annual sales volume of $101 million and more the presence or lack of a CIO has no significance on company performance.

Discussion

- The productivity paradox (Brynjolfsson, 1993) remain unresolved
- Carr’s (2003) argument still have credence
- However, when size is taken into account there does appear to be significance with smaller organizations

Discussion

- IT within larger organizations is in-grained in the organization thus becoming ubiquitous
  - IT resources and their management become disseminated throughout the vary DNA of the organization
  - The CIO, while remaining a part of the TMT, becomes more integrated into the entire organization
  - As a result, the impact becomes more difficult to measure
    - While an important member of the TMT, does not necessarily have a lead role in facilitating strategic orientation and operation

Discussion

- Smaller organizations have a tendency to isolate and focus on specific resources such as IT
- The CIO’s role and visibility is much greater
- These firms more frequently and aggressively reconfigure resources to adapt to changing environments
  - Dynamic capabilities (Eisenhardt & Martin, 2000; Teece, 2007)

Discussion

- The CIO in this process may well be analogues, if not the conductor of a symphony orchestra, the first seat in the string or woodwind section of the orchestra.

- In such a position, they play a significant role in the overall quality of the organization’s output.

Thank you