HACHIYA, Toyohiko
Graduate School of Commerce and Management
Hitotsubashi University

This research was partially supported by the Ministry of Education, Science, Sports and Culture, Grant-in-Aid for Scientific Research (A), 2043024, 2008-2010.

Introduction

Since late 1980s, many empirical studies examine the association between information technology (IT) and organizational performance. These studies document that
1) IT investments have an impact on productivity, cost reduction, and so on.
2) Complementary involving IT play an important role in the association.

Dehning & Richardson (2001), Returns on Investments in Information Technology: A Research Synthesis
Cronk & Fitzgerald (2002), Constructing a Theory of ‘IS Business Value’ from the Literature
Kohli & Devaraj (2003), Measuring information technology payoff: A meta-analysis of structural variables in firm-level empirical research
Wade & Hulland (2004), Review: The Resource-Based View and Information Systems Research
Melville, Kraemer & Gurbaxani (2004), Review: Information Technology and Organizational Performance: An Integrative Model of IT Business Value
Bray (2007), Literature Review – Enterprise Value of Information Systems
First Agenda

Research Framework
  > Development of framework
  > Recent research topics
  > Extended framework

Dehning & Richardson (2001) summarize the focus, performance measures, major findings of studies, and so on.

→ Many studies pay attention to the direct effect of IT on firm performance.


→ A principal finding is that IT is valuable, but the extent and dimensions are dependent upon internal and external factors, including complementary organizational resources of the firm and its trading partners, as well as the competitive and macro environment. [as exogenous variables]
Development of framework

Dehning & Richardson (2001)

**Information Technology**
- 1) Spending
- 2) Strategy
- 3) Management / Capacity

**Business Process**
- Efficiency, Quality, Inventory Turnover, Gross Margin

**Contextual Factors**
- Industry, Size, Financial Health

**Firm Performance**
- 1) Stock Market
- 2) Accounting
- 3) Sales, Market Share

Direct effect

Indirect effect

control

---

Toyohiko Hachiya (Hitotsubashi Univ.)

---

Melville et al. (2004)

**Macro Environment**

**Competitive Environment**

**Focal Firm**

**Value Generation Process**

- IT Resources
- Complementary Resources

**Internal Factors**

**External Factors**

- Industry Characteristics
- Trading Partner
- Country Characteristics

**Organization Performance**

Toyohiko Hachiya (Hitotsubashi Univ.)
**IT Resources**

**Technological IT resources (TIR)**
- Infrastructure: shared technology and technology services across the enterprise.
- Business applications: utilize the infrastructure, e.g., purchasing, sales, etc.

**Human IT resources (HIR)**
- Technical skills: programming, systems integration, database development, etc.
- Managerial skills: collaboration with business units and external organizations, project planning, etc.

**Complementary Organizational Resources**
Organizational resources complementary to IT, categories of which include non–IT physical resources, non–IT human resources, and organizational resources (Barney 1991), including organizational structure, policies and rules, workplace practices, culture, etc.

**Business Processes**
Activities underlying value generating processes (transforming inputs to outputs). Inbound logistics, manufacturing, sales, distribution, customer service, etc.

**Performance**

**Business process performance**
- Operational efficiency of specific business processes, measures of which include customer service, flexibility, information sharing, and inventory management.

**Organizational performance**
- Overall firm performance, including productivity, efficiency, profitability, market value, competitive advantage, etc.

---

Toyohiko Hachiya (Hitotsubashi Univ.) 7

---

**Recent Research Topics**

**1. Focus on Business Processes**

Previous studies use performance measures include gross margin, inventory turnover, Customer service, quality, efficiency, and turnover ratios as proxy of business process.

IT not only may improve individual processes, but also may enable process synthesis and integration across disparate physical and organizational boundaries (Basu and Blanning 2003).

Recent studies pay attention to the specific business process and extend it to outbound value-chain.

[recent studies]
- Prieto, Revilla, & Rodriguez(2007), Information Technology as Knowledge Management Enabler in Product Development.
- Menendez et al.(2008), Analysing the Information Technology Paradox in the Supply Chain.

Toyohiko Hachiya (Hitotsubashi Univ.) 8
2. Focus on strategy and organizational structure

Previous studies consider firm/business strategies and organizational structure as implicit assumption or given conditions. [as control variables]

Recent studies pay attention to diversification and/or global strategies, organizational design and structure, and so on as important factors influencing IT business value. [as key/endogenous variables]

[recent studies]
Dikolli & Vaysman (2005), Information technology, organizational design, and transfer pricing
Tanner (2006), Performance Effects of Information Technology Synergies in Multibusiness Firms
Rahman & Hussain (2008), The Impact of Information Technology on Performance Evaluation: Experience with Developing Countries
Chari, Devaraj, & David (2008), The Impact of Information Technology Investments and Diversification Strategies on Firm Performance

Extended Research Framework

Based on the above recent research trend, we extend the research framework.

Macro Environment

Competitive Environment

Focal Firm

Value Generation Process

IT Resources
Complementary Resources
Business Process
BP Performance
Organizational Performance

Extended BP
Supply Chain, Outsourcing, Marketing, Product Development

Firm / Business Strategy
Organizational Structure / Design

Toyohiko Hachiya (Hitotsubashi Univ.)
Second Agenda

IT does matter or not?
> Source of value
> Carr’s critique
> IT resource
> competitive advantage

Melville, Kraemer & Gurbaxani (2004)
• There is uncertainty and debate about what we know and don't know.
• Studies examining the association between IT and organizational performance are divergent in how they conceptualize key constructs and their interrelationships.

Carr (2003)
• It is no longer a source of advantage at the firm level

Bray (2007) review four perspectives of IT business value resource.

Transaction Cost Economics (TCE)

IT investments will allow a reduction in the unit costs of inter-organizational coordination, making markets more attractive.
IT provides enterprise value not only by influencing productivity or by profits, but also by expanding organizational design possibilities and structural transformations.

Agency Theory

IT can reduce external coordination costs, resulting in a firm’s increased use of markets for its value-chains. In addition, IT can reduce internal coordination costs, resulting in a firm’s ability to manage a large organization more effectively, ultimately resulting in increased firm size.
The Resource-based View (RBV) of the Firm

The resource-based view of the firm (RBV) emphasizes heterogeneous firm resource endowments as a basis for competitive advantage.

Sources of IT sustained competitive advantages include capital requirements, proprietary technology, technical skills, and managerial IT skills.

Organizational Enablers

Does the announcement of an IT investment affect the market value of the firm? >> IT investment signals firm’s private information?
>> IT contributes to a firm’s future performance potential?

What are the structural factors that affect IT business value?

IT does not matter.

Carr(2003) indicates that it is no longer a source of advantage at the firm level - it doesn't enable individual companies to distinguish themselves from their competitors in a meaningful way. Essential to competitiveness but inconsequential to strategic advantage: that's why IT is best viewed (and managed) as a commodity.

[controversial debates]

Whether IT should be considered as requirement condition of keeping competitive position or as differentiator of gaining strong competitive advantage.
**IT as a “Resource”**

Is IT resource endowment as a basis for competitive advantage?
Whether and how IT may be associated with competitive advantage?

**Resource:** something valuable, rare, difficult to imitate, and non-substitutable to lead to a long-term, sustainable advantage


<table>
<thead>
<tr>
<th>IT Resources</th>
<th>IT Capabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Infrastructure</strong></td>
<td>Competencies</td>
</tr>
<tr>
<td>foundation of shared IT services</td>
<td>IT skills, IT management quality</td>
</tr>
<tr>
<td><strong>Transactional</strong></td>
<td>Practices (routines)</td>
</tr>
<tr>
<td>automated/cut cost/increase volume</td>
<td>Culture of IT use, Digital transactions, Internet architecture</td>
</tr>
<tr>
<td><strong>Informational</strong></td>
<td></td>
</tr>
<tr>
<td>provide information</td>
<td></td>
</tr>
<tr>
<td><strong>Strategic</strong></td>
<td></td>
</tr>
<tr>
<td>new market/new product</td>
<td></td>
</tr>
</tbody>
</table>

Toyohiko Hachiya (Hitotsubashi Univ.)

---

**Competitive Advantage**

The formal conceptual definition [Hoffman (2000)]

An SCA (sustainable competitive advantage) is the prolonged benefit of implementing some unique value-creating strategy not simultaneously being implemented by any current or potential competitors along with the inability to duplicate the benefits of this strategy.

Barney (1991) Discusses four indicators of the potential of firm resources to generate SCA: value, rareness, inability to be imitated, and imperfect substitution.

**Productive use of firm resources**
> valuable
> rare
> appropriable

**Short term competitive advantage**

**Sustainable competitive advantage**
> limitability
> Substitutability
> mobility

Ex ante limits to competition

Ex post limits to competition

Toyohiko Hachiya (Hitotsubashi Univ.)
Our Empirical Analysis

We investigate the relation between intangibles (discretionary investments) and competitive advantage. In this study, we specify competitive advantage from three perspectives.

[Operationalizing competitive advantage]
0. FSP (firm-specific performance): individual firm’s performance – industry average performance measure: ROA (return on asset), Tobin’s Q
1. Level of FSP: average FSP over time
2. Reduction rate of FSP: slope of regression over time
3. Persistence of FSP: coefficient in the auto-regressive process (AR(1))

[Explanatory variables]
1. Discretionary investment: R&D intensity, ADV intensity, capital intensity
2. Industry adjusted discretionary investment

[sample]
Japanese listing company over 8 years from 1998 to 2005: about 2,500 firm-year

---

<table>
<thead>
<tr>
<th></th>
<th>ROA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>persistence</td>
</tr>
<tr>
<td>R&amp;D intensity</td>
<td>-0.0211</td>
</tr>
<tr>
<td>ADV intensity</td>
<td>-0.0112</td>
</tr>
<tr>
<td>capital intensity</td>
<td>-0.0219</td>
</tr>
<tr>
<td>ind-adj R&amp;D intensity</td>
<td>0.0235</td>
</tr>
<tr>
<td>ind-adj ADV intensity</td>
<td>0.0129</td>
</tr>
<tr>
<td>ind-adj capital intensity</td>
<td>0.0113</td>
</tr>
<tr>
<td>personnel expenses/employee</td>
<td>0.0013</td>
</tr>
<tr>
<td>sales growth</td>
<td>-0.0099</td>
</tr>
<tr>
<td>adjusted R^2</td>
<td>0.0877</td>
</tr>
<tr>
<td>Durbin-Watson</td>
<td>2.1063</td>
</tr>
<tr>
<td>F</td>
<td>2.8672 ***</td>
</tr>
<tr>
<td>n. of observations</td>
<td>2507</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Tobin’s Q</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>persistence</td>
</tr>
<tr>
<td>R&amp;D intensity</td>
<td>-0.0678 **</td>
</tr>
<tr>
<td>ADV intensity</td>
<td>-0.0312</td>
</tr>
<tr>
<td>capital intensity</td>
<td>0.0200</td>
</tr>
<tr>
<td>ind-adj R&amp;D intensity</td>
<td>-0.0058</td>
</tr>
<tr>
<td>ind-adj ADV intensity</td>
<td>-0.0333</td>
</tr>
<tr>
<td>ind-adj capital intensity</td>
<td>0.0096</td>
</tr>
<tr>
<td>personnel expenses/employee</td>
<td>0.0409</td>
</tr>
<tr>
<td>sales growth</td>
<td>-0.0145</td>
</tr>
<tr>
<td>adjusted R^2</td>
<td>0.0787</td>
</tr>
<tr>
<td>Durbin-Watson</td>
<td>2.0363</td>
</tr>
<tr>
<td>F</td>
<td>2.4073 ***</td>
</tr>
<tr>
<td>n. of observations</td>
<td>1910</td>
</tr>
</tbody>
</table>

IT business value also depend on the proxy of competitive advantage.

Toyohiko Hachiya (Hitotsubashi Univ.)
There is significant scholarly interest in understanding the relationship between IT investments and firm performance. However, findings to date remain mixed: while some studies find a positive relationship between IT investments and firm performance, others fail to find any significant relationships at all.

**Analytic approach**

*Melville, Kraemer & Gurbaxani (2004)* review analytic approach, and classify them into following three groups.

**Production Function approach**

The widely used production function approach relates production inputs such as labor, IT, and other capital to output via mathematical specifications derived from microeconomic theory.

**Process-oriented approach**

Weill (1992) focuses on the ability of firms to convert IT assets into organizational performance, identifying several conversion effectiveness factors that mediate the IT-performance relationship.

Soh and Markus (1995) develop a conceptual framework which posits that IT investment leads to IT assets (IT conversion process), IT assets to IT impacts (IT use process), and IT impacts to organizational performance (competitive process).
Production function and process-oriented models describe the relationship between IT investment and firm performance via an input-output perspective that sometimes includes intermediate factors such as managerial choices and organizational structure. However, the external environment of trading partners, industry characteristics, and socio-political conditions is also important, but rarely incorporated effectively.

**Complementary resources approach**

Other researchers focus on the attributes of IT and other organizational resources that together may confer a competitive advantage. Bharadwaj (2000) models three key IT resources and their relationship to a firm's capability to deploy IT for improved performance: IT infrastructure, human IT resources, and IT-enabled intangibles.

---

**Ongoing debate over IT value**

**1. Limitations of Cross-sectional Analysis**

- IT has the potential to provide important benefits within the same year the investment is made.
- The benefits of IT investment are realized only over longer periods of time.
- IT investment has cumulative effects on organizational performance.

the lagged effects of IT investment, the effects of cumulative IT investment, the comparison short-term and long-term effects

**2. Causality**

Correlations reflecting relationships between IT investment and organizational performance do not necessarily imply causation.

1) reverse causality  
2) endogenous determination
2-1 reverse causality
Due to considerations such as internal fund and fund raising, firm performance is at least as likely to affect investment to IT and/or complementary resource as IT investment is to affect performance.

2-2 endogenous determination by exogenous environment
Both IT investment and performance are endogenously determined by exogenous (and only partly observed) environment.

Granger causality
Instrumental variable method (Two or three-Stage Least Squares)