Asia Pacific Journal of Information Systems
Vol. 20, No. 3, September 2010

Analysis of the Relationship between Corporate IT Capability and Corporate Performance through Korea IT Success Cases: An Empirical Approach

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An IT system within a company play increasingly important role as a significant part of corporate assets. The IT system possesses an extraordinary ability to improve an organization's efficiency, effectiveness and productivity by providing competitive advantages and improving strategic business decision capabilities. Indeed, providing a more secure IT environment, improving employee productivity and enhancing business process and strategic decision capabilities are key areas to improve corporate performance. However, existing research on IT ROI of return on IT investments does not provide solid justification to stakeholders.

In this paper, we analyze the IT investment during the past 28 years from 1982 to 2009 and present the results in two dimensions. First, we show the IT solution implementation analysis by years and industries based on 1,240 IT success cases from 8 different sources such as major Korea IT newspaper, IT magazines, and IT vendors. Then, the paper presents the relationship between IT capability through IT success cases and corporate business performance among 32 industries.

Keywords : IS Management, IT Return of Investment, IT Success Case, IT Capability, Corporate Performance

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Ⅰ. Introduction

In the United States, corporate investment in IT surged from $3,500 in 1995 to $8,000 in 2005, according to the U.S. Bureau of Economic Analysis [McAfee and Brynjolfsson, 2008]. In the recent economic downturn, companies are reducing their IT spending by 7.1% [Ha, 2009] while the ratio of IT cost to existing system increased in Korea [Knowledge Research Group, 2007]. As the economy weakens, the pressure on IT increases to contribute more in lowering cost and increasing revenue.

Overall, an IT system within a company has played a significant role in supporting existing business strategies as well as shaping new ones [Henderson and Venkatraman, 1993]. Indeed, the IT system possesses an extraordinary ability to improve an organization's efficiency, effectiveness, and productivity by providing competitive advantages and improving strategic business decision capabilities. In fact, among the key areas to improve corporate performance are providing a more secure IT environment, improving employee productivity, and enhancing business process and strategic decision capabilities, and the IT has proven to be extremely useful to this end.

However, some companies are still skeptical about the benefit of IT investment due to lack of convincing research on the profitability of IT investments. In his famous book "Does IT Matter?," Nicholas Carr [Carr, 2004] commented that as the power and presence of IT had grown, its strategic relevance to the importance of business had actually decreased. Indeed, IT has been transformed from a source of advantage to a commoditized "cost of doing business." Also, not enough research on IT ROI (Return on Investment or Return of Investment) has been conducted to persuade IT decision makers of the true benefits of IT investments. Most research on IT ROI focuses on the short-term financial gains from specific projects such as network upgrades, mail system upgrades, and ERP (Enterprise Resource Planning) or CRM (Customer Relationship Management) implementation. Research on IT ROI framework for the evaluation of IT benefit has been done extensively with several financial techniques such as the NPV (Net Present Value), real option, and the economic justification method [Pisello and Strassman, 2003; Devaraj and Kohli, 2002].

However, IT decision makers need to know the answers to the following pivotal questions: Is an IT investment truly necessary?; Are IT systems helpful and critical to increase corporate competitiveness?; Will IT investments improve our business performance over a short-term or long-term period? The answers to these questions are not easy to find in the existing literature. Mainly due to the lack of information and ambiguity in measuring the performance of IT investment, long-term benefit analysis of IT investment has not delivered adequate answers to the field. Therefore, skepticism about IT investment has been much discussed in several IT-related magazines as a key hurdle to many IT decision makers in convincing companies of IT as a strategic weapon.

Therefore, the main goal of this paper is to investigate companies which have made continuous and successful IT investment as well as those with relatively less IT success. For this we use rea IT successful cases during the long stretch of 28 years from 1982 to 2009. Further-

more, this paper provides an analysis of the relationship between continuous and successful IT investment and corporate performance. This comparative analysis is conducted on selected primary and control groups.

The rest of the paper is organized as the following: Section 2 presents an overview of the previous research on the IT capability and the justification of IT investment. Section 3 presents the research model and methodology. Section 4 discusses the data collection method and preliminary analysis of the relationship between the IT capability and corporate performance of Korea's leading companies across 32 industries. Section 5 shows the statistical analysis of three different primary groups and the control group. In section 6 and 7, research implications, limitations, and suggestions for future studies are presented.

Ⅱ. Related Works

2.1 IT Capability

In order for a company to improve its corporate performance, it is important to providing a more secure IT environment and enhance business process and strategic decision capabilities as well as employee productivity. Recognizing the need to develop and sustain the IT capability to provide those benefits of IT solutions, corporations utilize their internal and external resources. Bharadwaj [Bharadwaj, 2000] defined a firm's IT capability as its ability to mobilize and deploy IT-based resources in combination or co-present with other resources and capabilities. In order to explain the IT capability, the resource-based view (RBV) has been widely used [Ross *et al*., 1996; Byrd and Turner, 2000; Bharadwaj, 2000; Tippins and Sohi, 2003; Bhatt and Grover, 2005; Ray *et al*., 2005]. The first capability of the RBV is the resource related to knowledge of IT people. Bharadwaj [2000] defined this resource as human IT resources including technical and managerial IT skills while Ray *et al*. [2005] defined this as technical IT skills needed to develop IT applications. The second capability is the resource related to external environment. Bharadwaj [2000] defined this as IT enabling intangibles including customer orientation, knowledge assets, and synergy while Bhatt and Grover [2005] described this resource as the dynamic capability to determine the level of response to environmental threats and leverage the opportunities. The last capability is the resource related with the technical IT infrastructure. Bhatt and Grover [2005] described this technical IT infrastructure as value capability. This RBV concept was used in several previous researches on the relationship between the IT capability and firm performance [Bharadwaj, 2000; Tippins and Sohi, 2003; Santhanam and Hartono, 2005; Ray, 2005; Stoel and Muhanna, 2009]. Other studies used the external rankings of IT leaders such as rankings of InformationWeek as an indicator of better IT capability [Bharadwaj, 2000; Santhanam and Hartono, 2005; Stoel and Muhanna, 2009] while it has been viewed that depending on external rankings is the one of limitations of previous research works.

2.2 Views on the Relationship between IT Capability and Corporate Performance

IT has been one of the key investment areas accounting for 1% or 2% in an ordinary corpo-

ration. Yet, research on IT ROI (Return on Investment) does not provide solid justification to stakeholders. Regarding the actual benefits of IT investment a notable dispute took place in 2003 between Nicholas Carr and several contenders who had opposite views. Carr stated in his Havard Business Review article [Carr, 2003] and his book, "Does IT matter?" [Carr, 2004] that IT had rapidly become a kind of commodity in the corporation, like electricity and water, with its value to gain competitive advantage against competitors eroding dramatically. Several contenders expressed their different views on IT investment [Stewart, 2003]. For example, Vijay mentioned in the debate that, "[T]he move to a common infrastructure is inevitable. However, it does not reduce the opportunities for competitive advantage. It increases them."

Before Carr, a similar discussion about the productivity paradox had already preceded [Hitt and Brynjolfsson, 1996]. Ever since the early stage of MIS research, providing a common framework to measure the value of IT investment has been one of the critical research topics among the members of the IT industry. Nonetheless, generating firm and consistent data on the benefit of IT investment has been a challenge because IT investment benefit is usually regarded as companies' internal information, carefully guarded against competitors [Brynjolfsson and Hitt, 1996]. Therefore, existing research on the relationship between IT investment and corporate performance has not been able to fully address the issue due to the lack of information access and the absence of key criteria of investment benefits.

With the information limitation, existing research ends up focusing on how to calculate IT ROI rather than how to get real benefit from IT investment. Currently available methods for calculating the future financial benefit of IT are usually derived from the NPV, Real-option, Economic Value Added (EVA), and statistical approach [Devaraj and Kohli, 2002]. While the NPV concept provides the information of financial benefits about the time value of the investment, the real option method can handle the future options of IT investments.

Usually, several IT vendors use their own IT ROI method such as Microsoft's REJ (Rapid Economic Justification) [Microsoft, 2000], Forrester's TEI (Total Economic Impact) [Forrester, 2010], and Alinean's Enterprise ROI framework from Alinean [Pisello and Strassmann, 2003]. For example, REJ is the qualifying method for the business value of IT developed by Microsoft. The REJ framework has an advantage over other methods by ensuring that IT investments are evaluated in terms of only significant business issues within the organization. This REJ framework is designed to evaluate individual IT investments including specific technologies or products. The method involves five steps to calculate the value of IT: assessing the business, defining the solution, estimating the benefits and costs, identifying the risks, and calculating the financial metrics. However, NPV and the real option-based methods have limitations in that they are valid for calculating only the financial benefits of each project.

Other approaches [Barua *et al*., 1995; Brynjolfsson and Hitt, 1996; Brynjolfsson and Hitt, 1998; Hitt and Brynjolfsson; 1996; Bharadwaj, 2000; Santhanam and Hartono, 2003; Tippins and Sohi, 2003; Ray *et al*., 2005; Stoel and Mu-

hanna, 2009] <Table 1>, validate the IT benefit by illustrating the relationship between IT investment and corporate performance or IT capability and corporate performance. In the mid 1990s, research was done using large databases such as SPI, IDG, and Compustat to measure the relationship between IT spending and the result of this spending. Some research showed positive output while some did not. Brynjolfsson and Hitt [1996, 1998] showed with several different sources of data that IT spending delivers a result proving wrong the "Productivity Paradox." Bharadwaj [2000] and Santhanam and Hartono [2003] showed the positive relationship between IT capability and firm performance using RBV for the IT capability, the company list by Information Week, and firm performance data from Compustat.

Adding the organizational learning component to IT capability and firm performance, Tip-

<Table 1> Previous Research on IT Investment and Corporate Performance

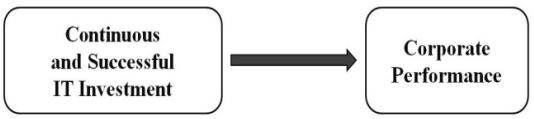
Author	IT investment	Firm Performance	Data Collection	Research Method	Conclusion
Barua *et al.* [1995]	IT Spending (IT Capital)	Capacity Utilization, Inventory Turn-over, Inferior quality, Relative Price, New Products	Empirical Data (SPI database)	2 Stage Analysis Regression Test	Mixed Benefit between IT spending and 5 metrics
Brynjolfsson and Hitt [1996]	IT Spending (Computer Capita and IS Labor)	Out of IT Spending	Empirical Data (IDG Data)	Linear Regression Analysis	Positive Result
Hitt and Brynjolfsson [1996]	IT Spending (IT Stock)	Productivity, Business Profitability, Consumer Surplus	Empirical Data (COMPUSTAT, IDG Survey, Council of Economic Advisors)	Computation Method	Somewhat Positive
Bharadwaj [2000]	Three IT Capability	Profit and cost related ratios.	Empirical Data (Information Week and Compustat database)	Two-matched Sample Test	Somewhat Positive
Tippins and Sohi [2003[	Three IT Competency, Organizational Learning	Customer Retention, Sales growth, Profitability, Return on Investment	Survey Data (4 Industries, 271 surveys)	Structured Equations Methodology	Significant relationship by organizational learning capability
Santhanam and Hartono [2003]	Resource-Based View	Profit and cost related ratios.	Empirical Data (Information Week and Compustat database)	Two-matched Sample Test	Strong and Partially Supported
Ray *et al.* [2005]	5 IT capability	Customer Service Process Performance	Survey Data (Life and Health Insurance Companies: 104 responses)	Three statistical Analysis	Mixed result
Stoel and Muhanna [2009]	Internal and external-focused IT Capability, External Conditions	Profit, Cost Ratios	Empirical Data (Information Week and Compustat database)	Statistical Analysis	Mixed Result

pins and Sohi [2003] showed that IT capability has a strong relationship with organizational learning capability while organizational capability is related with firm performance rather than having a direct relationship with firm performance. Recently, Stoel and Muhanna [2009] have shown the relationship between IT capabilities and firm performance through the same method of collecting primary and control companies as what Bharadwaj had used based on three environmental conditions: dynamism, munificence, and complexity.

However, previous research has several limitations. First, financial calculation methods adopted to assess the value of IT investment are only valid when applied to specific investments in specific projects for a short term. Thus, it is difficult to use those methods to analyze long-term benefits of IT investments. Second, in selecting companies from primary and control groups to study the relationship, some research used external rankings of IT leaders [Bharadwaj, 2000; Santhanam and Hartono, 2003; Stoel and Muhanna, 2009], and this solution cannot overcome the limitation due to inherent or potential biases despite several steps taken to minimize them. Third, in collecting performance data through the survey, a limitation may still come from the fact that the number of companies which responded to the survey was too small to validate the relationship.

Ⅲ. Research Model and Methodology

In this section, we provide the relationship analysis between IT capability driven by IT success cases and the corporate performance of Korea's leading companies from 32 industries. For this analysis, a hypothesis of the research model is presented and the methodology and sample selection process explained, followed by a statistical analysis and discussion.



<Figure 1> Relationship between IT Investment and Performance

In the previous section, the relationship between success investment and corporate business performance, as shown in <Figure 1>, has been the important research topic as IT is one of the main investment areas in corporations.

We propose the following hypothesis. A company which published more IT success cases or earlier than other companies during the past 28 year period has better IT capability and shows a better finance performance than other companies in the same industry which had fewer or no IT success cases in terms of profit: higher profits, higher revenue per employee and higher profit per employee. Due to the lack of internal information and a standard metrics for IT capability, the real IT capability of a corporation can't be accurately measured. As a result, comparing the IT capability of a company with other companies poses difficulties. As previously suggested, the media or IT vendors are among few available sources that reveal IT success cases in which we can find out which company in a specific industry invested certain solutions successfully. With such information from the IT success cases, other companies and industries can learn which IT solutions were

adopted by which company and for what reason, and with what result.

In order to compare corporate performance based on successful IT investment using the information from IT success cases, two assumptions can be formulated. The first one is the relationship between successful IT investment and IT success cases while the second one is the relationship between IT success cases and IT capabilities.

1) ***Successful IT investment and IT success cases***: IT success cases are the result of successful IT investment because each success case has its customers' testimonies supporting why they started the implementation of IT solutions and what kind of benefits they gained from the implementation. Generally, IT success cases were generated from IT magazines and IT vendors because a success case is something to share with subscribers and customers of IT vendors, with project information, history, and benefits.

2) ***IT success and IT capability***: IT success cases usually provide the general status of corporate IT capabilities, because each IT success case can be classified as a solution deployment status by the corporation and an integrated task with three IT-based resources of RBV. For example, the success of SCM (Supply Chain Management) solution implementation in the manufacturing industry reveals the fact that the specific corporation has IT capability related to the SCM area including technical IT systems, human resources, knowledge assets, and synergy while the success case related BI (Business Intelligence) implementation shows that the corporation has BI related IT capability with technical IT infrastructure, human resource, and IT intangibles such as knowledge assets and customer orientation.

While IT success cases reflect the level of corporation capability by managing the dynamics and complexity of IT system implementation successfully, the information from IT success cases such as the number of IT success cases and annual IT success cases can explain the level of IT capability.

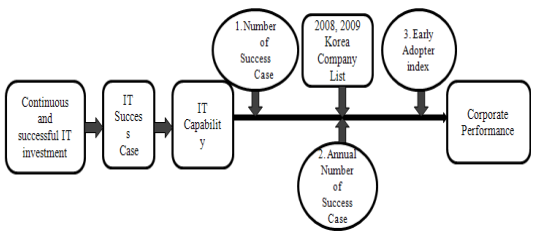
Because all IT success cases are difficult for other companies to acquire and imitate, studying these IT capabilities through IT success cases can provide companies with insights into gaining a competitive advantage in the same industries. Therefore, we would like to confirm whether companies which have more competitive advantages through IT capabilities can provide better corporate performance.

While the corporate performance measurement is related to such salient variables as financial performance, customer satisfaction, operating efficiency, employee performance, community environment, and innovation challenge [Ittner and Larcker, 1998], several previous researchers have previously examined the relationship between IT capability and firm performance using financial measurements [Bharadwaj, 2000; Brynjolfsson and Hitt, 1996; Hitt and Brynjolfsson, 1996]. In this paper, the measurement for financial performance such as profit- and employee productivity-related data were selected and analyzed in order to ascertain whether the companies with better IT capability have achieved better financial performance. In terms of cost related metrics, due to limited availability of data to test, cost-related measurements were excluded.

For this analysis, the following research model is suggested <Figure 2> and this research

model directly leads us to two main hypotheses:

- Hypothesis 1 (H1): Superior IT capability will be related to significantly higher corporate performance related with profit ratio and revenue ratio.
- Hypothesis 2 (H2): Superior IT capability will be related to significantly higher corporate performance related with the productivity of the employee.



<Figure 2> Research Model

In order to analyze this relationship in multiple ways, the following three different methods for collecting primary groups are suggested for 32 industry groups.

1) ***The Number of Success Cases***: The first way to collect primary group is using the total number of IT success cases during the published 28 year period in 32 industries. For example, Shinhan Bank, one of the major banks in Korea, published 13 success cases since 1993 and is number one in the banking industry of the finance industry group.

2) ***Annual Success Case Number***: In addition to the total number of success cases, in order to calculate annual result of continuous investment of each specific company, the annual case number was developed. The annual case number for each company was calculated by dividing the total number of success cases by the total number of years between the year of the first case published and the current year, 2010. Below is the equation for this method:

- Annual Success Case Number = Number of Cases/(2010-First Success Case of each company).

For example, Samsung Electronic published 19 success cases from 1983 to 2009. The value 0.77 is the annual success case number.

3) ***Early Adoption Index***: The early adoption index is derived by calculating how fast a company deployed IT solutions compared to other companies. The early adopter index is a sum of the differences between published year of each case and the average published year of each solution. We use another metric, early adoption rate, to calculate early adoption index:

- Early Adoption Rate (EAR) = Year of success case published-Average published year of specific IT solution
- Early Adoption Index (EAI) = $\sum \frac{1}{n}$(Early Adoption Rate)/Number of success cases (n is the number of IT success cases of a company).

For example, if a company's ERP case was published in 1999, because the average published year of ERP is 2003, the early adopter rate is -4.4 (1999～2003). The larger negative number of the EAI (Enterprise Application Integration) means a company published the success stories of their implemented IT solutions earlier than the average of other companies. The benefit of using EAI is to ascertain which

companies are the early movers in terms of deploying IT solutions rather than just identifying the primary companies from the number of their success cases.

These three different criteria are used for choosing the best company in each industry. In order to carry out the statistical test, the matched sample comparison group methods such as the T-test and Mann-Whitney test were used to find the statistical relationship between superior IT capability and corporate performance among the three different primary groups and one control group.

Ⅳ. Collection and Preliminary Analysis of IT Success Case

4.1 IT Success Case

Usually corporations publish their successful IT investments in seminars, presentations, consulting reports, IT magazines, and publications from vendors. Publishing their achievements outside of the company shows that they have better solution deployment benefits and project management than other companies. While gaining information of successful IT investments has been limiting, these success cases have been a major source of information of successful IT investments.

IT success cases reflect successful implementation of specific IT solutions in a company, and they are often published in IT magazines and vendor web pages. Usually an IT success case is a result of successful IT investments, and each success case is shown with a description of deployed solution and its benefits along with an interview with customers. The success stories published by magazines and vendors represent a rich source of carefully collected, accessible, up-to-date information about IT solutions that have not been available hitherto for research into information systems [Shang and Seddon, 2002]. Therefore, gaining knowledge of other companies' success cases is very important as it can be used for reducing potential risks and save project costs. Consistent development of success cases shows that a company has invested consistently in its IT environment and has made good IT ROI.

Unlike the success cases reported in IT magazines, the risks in using vendor published data are already discussed by Shang and Seddon [2002]. They say that "stories published by vendors could be representing their products in the most favorable light and are therefore unlikely to discuss any failures. On the other hand, vendors need approval from their clients to publish, and the client can be contacted directly to confirm the details of the claimed benefits. When the above limitations are recognized and compensated for, web published vendor success case stories represent a new and valuable source of information about the benefits from implemented IT solutions."

When it comes to collecting information about IT success cases, there are eight important facts to include: 1) company name, 2) industry of company, 3) IT success case name, 4) solution category, 5) Solution name, 6) Benefit of IT success case, 7) Source of IT success case, and 8) Publication date (year and month).

4.2 Collection of IT Success Case

A total of 1,240 IT success cases, published

between 1982 to 2009, were collected from 8 different sources such as Management and Computer (the oldest IT specialized magazine in Korea), Computer World, CIO Korea, eWeek, Electronics Times, custom magazines from Oracle Korea and Microsoft Korea, and web sites from HP Korea. Management and Computer discontinued publication in 2009, and eWeek in 2008 <Table 2>.

Management and Computer published 337 cases from 1982 to 2008 while Computer World published 281 cases. From IT vendors, Microsoft Korea published 194 cases on its web site (www.microsoft.com/korea/customerevidence/) and in Innovator, Microsoft Korea's internal magazine for customers, while Oracle published 124 cases on its web site (http://www.oracle.com/global/kr/customers/index.html)

<Table 2> Sources of IT success cases

Year	Management and Computer	Computer World	Electronic Times	CIO Korea	eWeek	Microsoft Korea	Oracle Korea	HP Korea	Total
1982	11								11
1983	10								10
1984	9								9
1985	13	0							13
1986	26	0							26
1987	8	1							9
1988	2	0							2198960
1990	3	0							3
1991	0	0							0
1992	4	0							4
1993	9	2							11
1994	2	0							2
1995	12	0					1		13
1996	19	0		0			2		21
1997	13	0		10			10		33
1998	15	9		12		5	3		44
1999	29	4		16		10	0		59
2000	22	5		1		12	4		44
2001	17	20		6		12	6		61
2002	17	17		7		21	20		82
2003	9	29		8	18	17	15		96
2004	14	17		3	37	20	14	1	106
2005	19	22		8	13	28	13	0	103
2006	29	42		13	17	28	8	3	140
2007	18	64		23	26	19	10	0	160
2008	0	34		8	12	19	7	0	80
2009	1	15	57	5		3	11	0	92
Total	337	281	57	120	123	194	124	4	1240

and in its magazine to customers. The numbers in <Table 2> show the years and magazines that were checked for collection. Empty cells in <Table 2> represent no publication in those particular years.

4.3 IT Success Case Analysis by Year

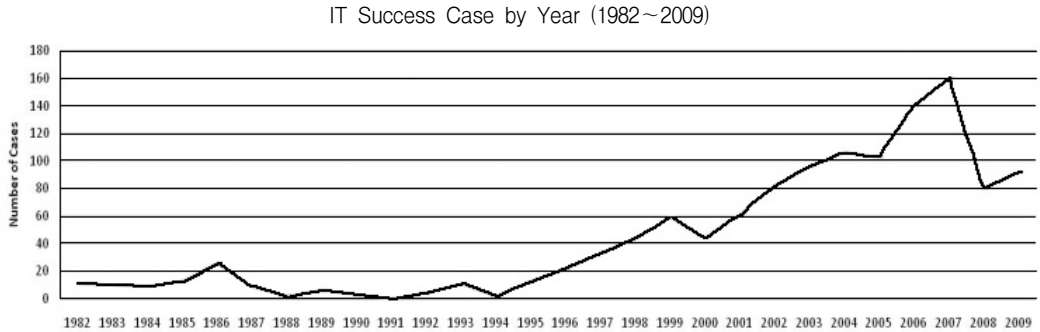
According to a yearly analysis, 2007 was the most vigorous year in terms of publishing success cases with 160 cases, and 2006 follows as the second with 140 cases <Figure 3>. Up until 2007, success cases were growing consistently. However, due to the economic downturn in 2008 and 2009 and fast growing on-line news service, two IT magazines, Management and Computer and eWeek, discontinued publication, and the number of IT success cases dropped significantly in 2008. For example, Microsoft Korea discontinued its local customer-focused magazine, Innovator, in 2009 and turned on-line.

As it can be seen from the above chart, IT success cases increased in the mid 1990s due to strong IT investment from the commercial sector in the implementation of new ES systems such as ERP, SCM, and CRM. From 1998 and 1999, with an aim for Y2K readiness, corporations invested heavily in IT systems.

4.4 IT Success Case Analysis by Industry

Based on the KSIC (Korea Standard Industry Classification) guidelines, 1,240 success cases from the commercial and non-commercial sectors and appropriate industries were analyzed <Table 3>. Out of these 1,240 cases, 221 cases were from five industry groups in the non-commercial sectors such as the government ministries, government agencies, hospitals, and higher educational institutes, and 1,019 cases were from twelve commercial industries including finance, manufacturing, information and communication, wholesale, and construction.

The result of the analysis shows that the manufacturing industry has the largest number of IT success cases with 405 success cases (33%), and the finance industry has the second largest, with 256 cases (21%), while the information and communication industry has 169 success cases (14%). These three commercial industries account for 68% of the total number of success



<Figure 3> IT Success Cases by Year

<Table 3> IT Success Cases by Industry

Industry name	Commercial/ Non-Commercial	KSIC Code	Case Number	Percent
Manufacturing	Commercial	10～33	405	32.7%
Financial and insurance activities	Commercial	64～66	256	20.6%
Information and communications	Commercial	58～63	169	13.6%
Public administration and defense; compulsory social security	Non-Commercial	84	112	9.0%
Wholesale and retail trade	Commercial	45～47	83	6.7%
Education	Non-Commercial	85	47	3.8%
Transportation	Commercial	49～52	39	3.1%
Construction	Commercial	41～42	33	2.7%
Human health and social work activities	Non-Commercial	86～87	32	2.6%
Professional, scientific and technical activities	Commercial	70～73	22	1.8%
Electricity, gas, steam and water supply	Non-Commercial	35～36	16	1.3%
Accommodation and food service activities	Commercial	55～56	9	0.7%
Business facilities management and business support services	Commercial	74～75	8	0.6%
Membership organizations, repair and other personal services	Non-Commercial	94～96	4	0.3%
Real estate activities and renting and leasing	Commercial	68～69	2	0.2%
Agriculture, forestry and fishing	Commercial	05～08	2	0.2%
Mining and quarrying	Commercial	01～03	1	0.1%

cases. From this analysis, we posit that these three industries are most active in terms of continuous and successful IT investment.

Ⅴ. Statistical Test

5.1 Comparison Group Selection

In order to identify primary companies and control companies using three different methods from 32 industries, the first step was to classify 32 industries based on the KSCI classification method and the company data from Edaily (a Korean news provider) [Edaily, 2008; Edaily, 2009] which annually publishes a list of the largest companies of each industry. The lists from 2008 and 2009 were used for this analysis. <Table 4> shows the company rankings by the revenue size across 32 industries, provided by the Edaily newspaper.

Using the first method, 32 primary companies were identified which have 297 success cases, and with the second method 32 companies were selected which have 253 success cases. With the third method 32 companies were chosen which have just 197 success cases <Table 5>.

In terms of collecting companies for the control group from the 32 industries, as shown below, three guidelines were used based on the Edaily lists and Korean company database from the Korea Information Service Incorporated (KIS).

- We selected the companies which did not have any IT success cases from the Edaily-

<Table 4> Company List from Edaily (32 Industries)

Industry	Company 1	Company 2	Company 3	Company 4	Company 5
Commercial Banking	Kookmin Bank	Woori Bank	Shinhan Bank	Hana Bank	KEB
Insurance	Samsung Life Insurance	Daehan Life Insurance	Kyobo Life Insurance	ING Insurance	Mirae Asset Insurance
Fire Insurance	Samsung Fire Insurance	Hyundai Fire Insurance	Dongbu Fire Insurance	LIG Fire insurance	Meritz Fire Insurance
Securities	Woori Investment and Securities	Daewoo securities	Hankook Investment and Securities	Hana Daetoo Securities	Hyundai Securities
Card	Shinhan Card	KB Card	Samsung Card	Hyundai Card	Lotte Card
General Electronics	Samsung Electronics	LG Electronics	Daewoo Electronics	Woongjin Co-way	
Electronic Components	Samsung Electro-Mechanics	Samsung Techwin	LG Innotek	LS Cable	Daehan Cable
Display	Samsung Electronics	Samsung SDI	LG Display		
Telecommunication	KT	SK Telecom	LG Telecom		
IT Services	Samsung SDS	LG CNS	SK CandC	IBM Korea	Autoever systems
Semiconductor	Samsung Electronics	Hynix semiconductor			
Oil Refinery	SK Energy	GS Caltex	S-oil	Hyundai Oil-Bank	
Chemical	LG Chemical	Honam Petroleum Company	Hanhwa Petroleum	Daelim Industry	Kumho Petroleum
Pharmaceutical	Dong-A Pharmaceutical	Yuhan	Hanmi Pharmaceutical	Daewoong Pharmaceutical	Green-Cross
Automobile	Hyundai Motors	GM Daewoo Motors	Ssang Yong Motors	Renault-Samsung Motors	
Automobile Parts	Hyundai Mobis	Mando	Halla Climate Control	Delphi Korea	
Air cargo	Korean Air	Asiana Air			
Shipping Industry	Hanjin Shipping	Hyundai Shipping	STX Pan Ocean	Daehan Shipping	SK Shipping
Parcel Service	Korea Express	Haniin	CJ GLS	Hyundai Express	
Construction	Hyundai Construction	Samsung Corp	Daewoo Construction	GS Construction	Daelim Industry
Shipbuilding	Hyundai Heavy Industry	Daewoo Shipbuilding	Samsung Heavy Industry	STX Shipbuilding	Hanjin Heavy Industry
Steel maker	POSCO	Hyundai Steel	Dongkook Steel	Hyundai Hysco	Dongbu Steel
Broadcasting	KBS	MBC	SBS		
Internet Portal	NHN	Daum	SK Communication	KTH	
On-line Game	Ncsoft	NHN	Nexon	Neowiz	CJ Internet
Food	CJ Cheiljedang	Ottugi	Daesang	Dongwon F&B	Pulmuwon
Apparel	Cheil Apparel	Eland	FNC Kolon	LG Fashion	Shinwon
Department Store	Lotte Department Store	Shisegye Department Store	Hyundai Department Store	Hanhwa Galleria	
Convenient Store	Family Mart	GS25	Seven Eleven (Korea Seven)		
Open Market	Gmarket	ebay Auction	Lotte.com		
Trading	SK Networks	Daewoo International	Samsung Corp	LG Corp.	
Engineering Service	Samsung Engineering	Hyundai Engineering	KEP Engineering		

<Table 5> Company List of Three Primary Groups

	Method 1		Method 2		Method 3	
Industry	Company Name	Case		Case		Case
Bank	Shinhan Bank	13	Industry Bank of Korea	12	Kookmin Bank	10
Life Insurance	Kyobo Life Insurance	12	Kyobo Life Insurance	12	Daehan Life Insurance	5
Fire Insurance	Dongbu Fire Insurance	7	Dongbu Fire Insurance	7	Dongbu Fire Insurance	7
Securities	Daewoo Securities	7	Daewoo Securities	7	Hyundai Securities	3
Card	Samsung Card	6	Hyundai Card	2	Samsung Card	6
Construction	Samsung Corp	7	Samsung Corp	7	Hyundai Construction	3
Engineering Service	KEP Engineering	4	KEP Engineering	4	KEP Engineering	4
Retail(CVS)	GS retail	6	GS retail	6	GS retail	6
Retail(On-line)	Auction	4	Gmarket	2	Auction	4
Retail	Lotte Shopping	8	Eland Retail	6	Hyundai Department	3
Trading Company	Samsung Corp	7	Samsung Corp	7	Daewoo International	2
Air Cargo	Korean Air	7	Korean Air	7	Korean Air	7
Shipping	Hanjin Shipping	5	Hanjin Shipping	5	Hanjin Shipping	5
Parcel Service	CJ GLS	5	CJ GLS	5	Korea Express	4
Telecommunication	KT	44	KT	44	SK Broadband	3
IT Service	LG CNS	6	LG CNS	6	Samsung SDS	4
Information Service	KTNET	3	Daum	2	Daum	2
Broadcast	MBC	3	SBS	1	MBC	3
On-line Game	Ncsoft	4	CJ Internet	3	NeoWiz	2
Manufacturing (Food)	CJ Corporation	7	CJ Corporation	7	CJ Corporation	7
Manufacturing (Electronics)	Samsung Elec.	19	Samsung Elec.	19	Samsung Elec.	19
Manufacturing (Display)	Samsung SDI	4	LG Display	4	Samsung Corning	2
Manufacturing (Semiconductor)	Samsung Elec.	19	Hynix Semiconductor	12	Samsung Electronics	19
Manufacturing (Electronics Parts)	Samsung Electro-mechanics	8	Samsung Electro-mechanics	8	Samsung Electro-mechanics	8
Manufacturing (Shipbuilding)	Hyundai Heavy Industry	15	Samsung Heavy Industry	4	Samsung Heavy Industry	4
Manufacturing (Motor Parts)	Mando Corporation	5	Hyundai Mobis	1	Mando	5
Manufacturing (Motors)	Hyundai Motors	14	Hyundai Motors	14	Hyundai Motors	14
Manufacturing (Pharmaceutical)	Dong-A Pharmaceutical	8	Joong-Oi Pharmaceutical	2	Dae-woong Pharmaceutical	5
Manufacturing (Oil)	SK Corporation	6	GS Caltex	3	GS Caltex	3
Manufacturing (Chemical)	Honam Petrochemical	7	Honam Petrochemical	7	Hanhwa Petrochemical	3
Manufacturing (Steel)	POSCO	23	POSCO	23	POSCO	23
Manufacturing (Apparel)	E-land	4	E-land	4	FnC Kolon	2
Total		297		253		197

listed companies.

- When we failed to find companies which had no success cases in the Edaily list, we chose the largest companies with no IT success cases out of the Edaily listed companies.
- Once unable to find a company by the guidelines above, we chose the company with the least success cases in the same industry from the Edaily list.

Based on the guidelines above, a control group of 32 companies was selected, which turned out to be nine success cases in total. Though we tried to find companies that showed no success cases, because of a small number of companies in specific industries, only six companies with nine success cases were selected. For example, in the Air Cargo industry of Korea, there are only two major companies, Korean Air and Asiana Air. In this case Asiana was selected as one of the control group companies even though it had only four IT success cases. <Table 6> is the control group and its numbers of IT success cases.

5.2 Corporate Performance Data

Corporate performance is measured by various metrics, including finance and manufacturing metrics, among others [Bharadwaj, 2000; Santhanam and Hartono, 2003; Ittner and Larcker, 2003]. In this paper, finance metrics were used for testing the hypothesis. Due to limited availability of raw data, we could test only four finance metrics: Return on Asset (ROA), Return on Sales (ROS), Operating Income to Employee (OIE), and Revenue per Employee (RPEM). The KIS value III database from Korea Information

<Table 6> Company List of a Control Group

Industry	Company Name	Case
Bank	Jeju Bank	0
Life Insurance	Dong-Yang Life Insurance	0
Fire Insurance	Heung-kook Fire Insurance	0
Securities	Bukook Securities	0
Card	Shinhan Card	1
Construction	Hyundai Industry Development	0
Engineering Service	Byuck San Engineering	0
Retail (CVS)	Korea Seven	0
Retail (On-line)	Lotte.Com	0
Retail	Grand Department	0
Trading Company	Hyundai Corporation	0
Air Cargo	Asiana Air	4
Shipping	Hyundai Shipping	0
Parcel Service	Hanjin	0
Telecommunication	Onse Telecom	0
IT Service	Autoever Systems	0
Information Service	KT Hitel	1
Broadcast	YTN	0
On-line Game	Wemade	0
Manufacturing (Food)	Sajo Industry	0
Manufacturing (Electronics)	Daewoo Electronics	1
Manufacturing (Display)	Iljin Display	0
Manufacturing (Semiconductor)	Fairchild Korea	0
Manufacturing (Electronics Parts)	LS Cable	0
Manufacturing (Shipbuilding)	Seongdong Shipbuilding	0
Manufacturing (Motor Parts)	Delphi Korea	0
Manufacturing (Motors)	Ssang Yong Motors	1
Manufacturing (Pharmaceutical)	Hanmi Pharmaceutical	0
Manufacturing (Oil)	Hyundai Oil-Bank	0
Manufacturing (Chemical)	DongYang Petro Chemical	0
Manufacturing (Steel)	Hyundai Hysco	1
Manufacturing (Apparel)	Shinwon	0
Total		9

Service system has been used for getting the corporate finance data.

The detailed and summarized information of the corporate performance data which was used in the analysis of this paper is presented below.

- Period: 2003～2007 (5 Year Data)

Due to non-existing or inconsistent data for some companies before 2003 and after 2008, the 5 year period between 2003 and 2007 was used.

- Data Source: KIS Value III
- Performance Metrics
- Return On Asset (ROA)
- Return On Sales (ROS)
- Operating Income to Employee (OIE)
- Revenue Per Employee (RPEM)

ROA, ROS, and OIE reflect corporate profit perspective while RPEM represents the productivity of employees.

5.3 Statistical Tests

We tested the hypotheses whether corporations with high IT capability from IT success cases tend to have better corporate performance in terms of profit perspective and the productivity of employee, when 32 companies from three different primary groups and control group are compared with a matched sample test.

While t-test is a method for verifying the difference of mean levels between two groups, t-test has been used for the main matched sample test with PASW 17.0 (SPSS 17.0). <Table 7> is the t-test result of profit related ratios, and <Table 8> is the t-test result of employee related ratio. First, we explain the result from the analysis of profit related ratios.

1) ***Analysis of Method 1***: Analysis 1 is the t-test between the primary group, which has the most IT success cases in each group, and the control groups. In this analysis, four ratios out of 16 such as ROA 2003, ROS 2003, OIE 2004 and OIE 2006 are statistical differences with a 5% significance and three metrics such as ROA 2005, ROS 2004, and OIE 2003 are statistical differences with a 10% significance (<Table 7> and <Table 9>). Other ratios of specific years have relatively high t-test numbers. This shows that in some ratios and years the two groups have a statistical difference, and this can be interpreted as an indicator that the primary group performs better than the control groups do.

2) ***Analysis of Method 2***: Analysis 2 is the t-test between the primary group, which has a greater number of annual IT success cases in each industry, and the control group. In this analysis, 3 ratios out of 16 such as ROA 2003, OIE 2004 and OIE 2006 are statistical differences with a 5% significance and three metrics such as ROA 2005, OIE 2003 and OIE 2005 are statistical differences with a 10% significance. Other ratios of specific years have a relatively high t-test number. This also shows that, in some ratios and years, the two groups have statistical differences and this can mean that the primary group performs better than the control groups, especially in the OIE related ratios.

3) ***Analysis of Method 3***: Analysis 3 is the t-test between the primary group which has a low early adopter index in each industry and the control group. In this analysis, four ratios

<Table 7> Statistical Result of Profit Related Ratios

Metrics	Groups	N	Method 1			Method 2			Method 3		
			mean	t	sig (2-tailed)	mean	T	sig (2-tailed)	mean	t	sig (2-tailed)
ROA 2003	Primary	32	5.5691	2.916	0.005[1)]	3.1383	2.024	0.047[1)]	5.8149	2.913	0.0051)
	Control	32	-5.0707			-5.0707			-5.0707		
ROA 2004	Primary	32	8.3065	1.333	0.187	6.2201	0.755	0.453	6.2757	0.751	0.456
	Control	32	3.7734			3.7734			3.7734		
ROA 2005	Primary	32	6.7403	1.990	0.051[2)]	6.2255	1.741	0.087[1)]	6.4411	1.647	0.105
	Control	32	2.7789			2.7789			2.7798		
ROA 2006	Primary	32	5.5564	1.639	0.106	5.4775	1.560	0.124	5.9488	1.491	0.141
	Control	32	2.3392			2.3392			2.3392		
ROA 2007	Primary	32	4.9641	1.299	0.199	4.7968	1.242	0.219	5.4871	1.448	0.153
	Control	32	1.4247			1.4247			1.4247		
ROS 2003	Primary	32	0.0529	2.179	0.033[1)]	-0.0050	0.828	0.411	0.0615	2.309	0.024[1)]
	Control	32	-0.0573			-0.0573			-0.0573		
ROS 2004	Primary	32	0.0836	1.823	0.073[2)]	0.0620	1.342	0.185	0.0515	1.067	0.290
	Control	32	0.0008			0.0080			0.0080		
ROS 2005	Primary	32	0.0594	1.202	0.234	0.0673	1.271	0.209	0.0586	1.192	0.238
	Control	32	-0.1060			-0.1060			-0.1060		
ROS 2006	Primary	32	0.0757	1.105	0.273	0.0787	1.119	0.267	0.0802	1.124	0.266
	Control	32	-0.1368			-0.1368			-0.1368		
ROS 2007	Primary	32	0.1187	1.382	0.172	0.0649	1.084	0.283	-0.0883	-0.033	0.974
	Control	32	-0.0809			-0.0809			-0.0809		
OIE 2003	Primary	32	5.0648E+07	1.767	0.082[2)]	5.4047E+07	1.845	0.070[2)]	6.0573E+07	1.945	0.0562)
	Control	32	-3.6340E+07			-3.6340E+07			-3.6340E+07		
OIE 2004	Primary	32	9.7776E+07	2.491	0.015[1)]	9.3524E+07	2.256	0.028[1)]	9.8699E+07	2.498	0.015[1)]
	Control	32	3.3480E+07			3.3480E+07			3.3480E+07		
OIE 2005	Primary	32	6.3218E+07	0.766	0.446	8.2762E+07	1.781	0.080[2)]	7.0718E+07	0.996	0.323
	Control	32	4.1162E+07			4.1162E+07			4.1162E+07		
OIE 2006	Primary	32	6.7258E+07	2.113	0.039[1)]	7.3098E+07	2.280	0.026[1)]	7.4414E+07	2.366	0.021[1)]
	Control	32	2.4962E+07			2.4962E+07			2.4962E+07		
OIE 2007	Primary	32	2.2002E+08	1.633	0.101	1.4390E+08	1.589	0.404	1.1623E+08	1.047	0.299
	Control	32	4.0438E+07			4.0438E+07			4.0438E+07		

Note) [1)] Significant at the 5% level.
[2)] Significant at the 10% level.

out of 16 such as ROA 2003, OIE 2003, OEM 2004, and OIE 2006 are statistical differences with a 5% significance and one ratio, OIE 2003, has statistical differences with a 10% significance. This analysis shows, in some ratios and years, that the two groups have statistical differences and the ratios related with OIE have the statistical difference every five years. This

can be interpreted that the primary group performs better than the control group especially in the OIE metric.

Among the three analyses, the first analysis using Method 1 has more ratios, which shows the difference with a significance level of 5% or 10% compared to the other two analyses.

Second, for the revenue per employee metric, we conducted the same statistical test based on three different methods. However, contrary to the hypothesis, as shown in <Table 8>, we did not find any statistical difference at significance levels of 0.05 or 0.10 in specific years. Therefore, the second hypothesis, H2, was not accepted. This result shows that the company with high IT capability did not have high revenue per employee, and this may be related with the relatively weak investment in the IT solutions which affected the employees' productivity such as unified communication, enterprise search and enterprise portal, during the past several decades.

In addition to the t-test, in order to check for any difference between tests for the matched sample comparison, we tested all ratios with a non-parametric test, namely Mann-Whitney test using three methods; however, we did not find any difference from the t-test result.

<Table 9> is the summary which shows ratios at significance levels of 0.05 and 0.10. As

<Table 8> Statistical Result of Revenue Per Employee

Metrics	Groups	N	Method 1			Method 2			Method 3		
			Mean	t	sig (2-tailed)	Mean	t	Sig (2-tailed)	mean	T	Sig (2-tailed)
RPEM 2003	Primary	32	8.6063E+08	0.658	0.513	9.1507E+08	0.840	0.410	8.2239E+08	0.445	0.658
	Control	32	7.2747E+08			7.7247E+08			7.7247E+08		
RPEM 2004	Primary	32	9.6650E+08	0.602	0.549	1.0409E+09	0.830	0.410	1.0199E+09	0.660	0.511
	Control	32	8.1612E+08			8.1612E+08			8.1612E+08		
RPEM 2005	Primary	32	1.0029E+09	0.708	0.482	1.0517E+09	0.836	0.406	9.8225E+08	0.588	0.559
	Control	32	8.2476E+08			8.2476E+08			8.2476E+08		
RPEM 2006	Primary	32	1.0566E+09	0.517	0.607	1.1315E+09	0.694	0.490	1.1012E+09	0.589	0.558
	Control	32	9.0971E+08			9.0971E+08			9.0971E+08		
RPEM 2007	Primary	32	1.8706E+09	1.032	0.306	2.0012E+09	1.172	0.246	1.9849E+09	1.142	0.258
	Control	32	1.0320E+09			1.0320E+09			1.0320E+09		

<Table 9> Statistical Result with Significant Ratios

Method	Significance level	Performance Metrics				
Method 1	5%	ROA 2003	ROS 2003	OIE 2003	OIE 2004	OIE 2006
	10%	ROA 2005	ROS 2004			
Method 2	5%	ROA 2003	OIE 2004	OIE 2006		
	10%	ROA 2005	OIE 2003	OIE 2005		
Method 3	5%	ROA 2003	ROS 2003	OIE 2004	OIE 2006	
	10%	OIE 2003				

the table above shows, there are statistical differences under the significance levels of 0.05 or 0.10 in specific years. This means that the first original hypothesis, H1, that the two groups are statistically equivalent in terms of profit related ratios, was only partially accepted.

In this part, the two hypotheses tested are whether corporations with high IT capability by continuous and successful IT implementations tend to achieve better performance in light of profit and productivity when compared with a matched sample of corporations. In terms of profit-related data, we can say that the companies show better corporate performances than those by other groups who did not have strong IT capability.

Ⅵ. Implications and Discussion

In this paper, we have discussed two aspects which present the IT investment status analysis during the past 28 years from 1982 to 2009. The first aspect is the IT solution implementation analysis by years and industries based on 1,240 IT success cases from 8 different sources such as major Korea IT newspaper, IT magazines, and IT vendors during the last 28 years. By collecting and analyzing the IT success cases, we found that we can get valuable information such as what IT solutions were implemented, what benefits were provided, when IT solutions were adopted, what IT capability corporations were wanted and gained.

The second aspect presented in the paper is the relationship between IT capability through IT success cases and corporate business performances among 32 industries. As a result of statistical analysis, primary group companies which have stronger IT capability, assumed by the number of IT success cases, annual case numbers, and early adoption index, show statistically better business performances in some metric and years than the control group companies which have very few IT success cases during the five years from 2003 to 2007. With this, we may posit that companies which had successful and continuous investments in IT solutions achieved better financial performance, especially from a profit point of view, than companies which had fewer success cases during the same period.

We usedthe corporate performance data of KIS Value Ⅲ database. Due to consistency in the profit, sales, employee-related data since 2000, it was possible to analyze the profit-and employee-related performance metrics. However, due to the lack of consistent and reliable corporate performance data before 2000, we cound notconduct the research on the long-term corporate performance analysis. Since around 2005, fortunately, the quality of corporate performance data has improved and, in a near future, more rigorous research can be conducted to this area.

By using normalized metrics such as ROA, ROS, and OIE, we tried to minimize the impact of size of corporations for the IT investment on the result of this research. Additionally, we focused on the analysis of revenue-per-employee because improving it is one of potential reasons to invest in IT solutions [Nurmilaasko, 2009]. While previous research showed somepartial contribution of ICT to labor productivity [Nurmilaasko, 2009], this research did not find any statistical difference between those

two groups. This can be interpreted that companies in the same industry deployed almost the same IT solutions; thus, the impact of IT solutions is not enough to make a statistical difference in revenue-per-employee. However, by the emergence of new IT solutions for the productivity of employee such as UC and enterprise search, in the future, IT solutions are expected to make greater contributions to increasing the productivity of employee.

In all, this result shows that although the strategic importance of IT technology has diminished as Carr mentioned [Carr, 2003] as a result of prevalent commoditization of IT diminishing the advantage as all competitors have adopted it, continuous and successful IT solution adoption may still remain effective in increasing business performance for companies to stay more competitive in the industry in the long run.

Ⅶ. Potential Data Issues and Future Research

7.1 Potential Data Issues

There are two potential data issues used in this paper: 1) a selection of companies in the control group and 2) cost-related data in Korean companies.

7.1.1 Selection of Companies in the Control Group

First, some companies in the control group have IT success cases. We tried to collect control companies which had no IT success cases in order to compare two extreme cases: companies with the most and those with no IT success cases. However, due to the limited number of companies in some industries, we ended up selecting six companies which have nine IT success cases in total. For example, as we discussed before, there are only two major air cargo companies in Korea, and Asiana Airlines, the second largest airline company, was selected as one of the control companies even though Asiana has only four success cases. Second, for the business performance comparison of the two groups, the sizes of the companies need to be similar, between 70~130% [Bharadwaj, 2000]. However, in this research, the revenue of some primary companies with a lot of success cases is much bigger than that of the control companies because there are limited numbers of companies in some specific industries and the revenue sum of the control companies is somewhat smaller than the primary companies. Also, in order to minimize the impact from the size of companies, four normalized metrics, namely ROS, ROA, OEI, and RPEM, are used.

7.1.2 Cost-related Data in Korean Companies

The business performance of the company is measured mainly with two kinds of metrics: profit and cost. However, we tested five metrics which are related with profit and productivity due to limited availability of cost data in Korea during the test period of 5 years from 2003 to 2008, and we needed consistent data from the 32 industries during this term for proper testing. However, unlike the profit-related data such as profit, sales, and assets, cost-related data from KIS III was not consistent for

the 5 year period. Thus, cost-related business performance analysis was not completed and remains as a future research item.

7.2 Limitations and Future Research

Generally, because of the time lag impact, we can assume that the impact of IT investment on the real business situation can surface several years after the adoption of IT solutions; thus, time series analysis can generate more detailed information about statistical relationship between the IT investment and business performance. However, due to the limitation of corporate business performance data from the KIS Value III database before 2003, we analyzed the relationship between IT success cases from 1982 to 2009 and business performance data from 2003 and 2007. As the data quality of corporate performance database has been making steady improvement in the recent years, we expect to be able to conduct the time series analysis in line of this research topic in future research.

Another limitation of this research stems from the validation of reverse relationship between the IT capability and the corporate performance based on the IT success cases. However, in this paper, we validated that some companies with better IT capabilities show better business performance. The reverse research question can be developed, therefore: whether better business performance can positively induces better IT capability producing more IT success cases. This aspect can be further investigated and is left to the future research.

In addition, two more areas can be considered for future studies. The first area involves an analysis from a cost perspective. To better understand the relationship between IT investment and business performance, it is necessary to analyze cost-related data such as the ratios of total operating expense to sales and cost of goods sold to sales. Currently, this analysis remains incomplete because of the lack of reliable data for major Korean companies. Further research on other analysis methods for cost can be also valuable as it can shed more light on the relationship between IT investment and cost-related business performance.

Second, we can analyze some available data to better understand the benefit of IT implementation based on success cases. Some data supporting the benefits of implementing IT solutions are already collected and available for an analysis, As such, more detailed analysis of IT benefits may give rise to several new salient research items such as classifying, identifying yearly trends of, and differentiating the benefits by different IT categories.

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