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# RESOURCE-BASED VIEW IN INFORMATION SYSTEMS RESEARCH: A META-ANALYSIS

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## Abstract

*Resource-based view is the theory that has been applied to analyze the impact of information technology on business performance. Its main argument is that competitive advantages are determined by the unique valuable resources controlled by an organization. IT as a valuable asset will have positive effect on firm performance. However, previous research on the issue is inconsistent. This paper reports a meta-analysis of 42 papers published in major journals in information systems. Our findings indicate that the capability mediated model is better than the direct effect model and the major impact of IT is on efficiency indicators.*

Keywords: Resource-based View, Firm Performance, IT Value, Meta Analysis


## 1. INTRODUCTION

How information technology can help improve firm performance is an important research issue in information systems research. A major theory that has been adopted to analyze the issue is the resource-based view (RBV) proposed by Wernerfelt in 1984. The basic argument of RBV is that firm performance is determined by the resources it owns. When RBV is applied to analyze the effect of information technology (IT), IT is considered an organizational resource that can enhance organizational capabilities and eventually lead to higher performance.

Although the use of RBV in analyzing the contribution of IT to firm performance makes a great sense and a large number of papers related to this approach have been published, the findings are inconclusive. There are also some criticisms on the value of the RBV approach (Saeed, Yujong et al. 2002; Barua, Konana et al. 2004). Therefore, it is useful to conduct a meta-analysis that consolidate the findings and examine possible problems so far.

The purpose of this paper is to report the findings from a meta-analysis on papers published in major research journals after 1990. We propose a framework to integrate measures used in previous research and examine the overall effect of different constructs. The remainder is organized as follows. In section 2,

we review existing literature to aggregate different independent, dependent and mediating variables used in different papers to build our research framework. The sample and method used for the study is explained in Section 3. The result is presented in Section 4. The final section provides discussion and conclusion.

# 2. LITERATURE REVIEW AND RESEARCH FRAMEWORK

There are three major constructs in the RBV model. The first is resources that include all of the asset, capability, organization process, enterprise character, information and knowledge, etc. that an enterprise be able to control, give the ruling, allocate the efficiency improving or achieve efficiency strategy (Barney 1991). The dependent construct is firm performance that may include management and financial performance. Although some papers focus on the direct relationship between resources and performance, many recent papers also include organizational capabilities as the mediator between resources and performance. Therefore, we will examine both the direct and indirect effect of resources on firm performance.

### 2.1 IS as Organizational Resource.

When RBV is applied to analyze the value of IT, information systems are usually considered to be a type of resources. Barney(Barney 1991) argues that organizational resource that can create advantage must have the following attributes:

- *Valuable*: the resource can enable a firm to conceive or implement strategies that improve its efficiency or effectiveness;
- *Rare*: the resources should not be possessed by a large number of competing firms;
- *Imperfectly Imitable*: the resources should not be easily imitated due to unique historical conditions, causally ambiguous, or social complex;
- *Non-Substitutable*: The resource should not be easily replaced by other substitutes.

Because not all resources are considered having value in RBV, the first issue facing IS research is the selection of resource variables. Some studies only chose technology context such as IT investment, IS adoption, and IT infrastructure as resources (Weill 1992; Mitra and Chayam 1996; Kar Yan 1998; Banker, Bardhan et al. 2006); others also included intangible resources such as management skill, staff training, and knowledge management (Byrd and Davidson 2003; Ranganathan, Dhaliwal et al. 2004; Bhatt and Grover 2005; Ravinchandran and Lertwongsatien 2005).

A more comprehensive approach proposed by Zhu (Zhu, Kraemer et al. 2004) adopted the TOE framework in firm performance research, which includes Technology, Organization, and Environment. The TOE framework was originally developed by Tornatzky and Fleischer (Tornatzky 1990), who identifies technological, organizational, and environmental contexts to be three major aspects that influence the process of adopting and implementing a technological innovation.

Technological context describes both the internal and external technologies relevant to the firm. These include existing technologies inside the firm, as well as the pool of available technologies in the market. In Zhu's study, technology readiness (usage, front-end and end-front function) was used as a resource. Other factors that can be considered to be technological factors include information infrastructure, IT investment or information system usage. Organizational context is defined in several ways: firm size and scope, the centralization, formalization, and complexity of managerial structure, human resources quality; and the amount of available slack resources. In Zhu's study, it included firm size, global scope, and financial resource. However, other factors that need to be considered are also included in our study. Environmental context is the arena in which a firm conducts its business-its industry, competitors, access

to resources supplied by others, and dealings with government. The inclusion of this kind of factors is quite diversified and hence is not chosen in our meta-analysis.

## 2.2 Firm Performance

The major dependent variable in the RBV model is firm performance. Previous research has used a number of indicators to measure firm performance. These indicators fall into three general categories: 1.finance, 2.efficiency and 3.others. Financial Indicators include commonly used measures such as ROI (Mahmood and Mann 1993), ROE (Hitt and Brynjolfsson 1996; Rai, Patnayakuni et al. 1997; Shin 2006), ROS (Mahmood and Mann 1993; Kar Yan 1998; Bharadwaj 2000; Tanriverdi 2006), revenue (Francalanci and Galal 1998; Devaraj and Kohli 2000; Rai, Patnayakuni et al. 2006) and sale (Weill 1992; Mahmood and Mann 1993; Rai, Patnayakuni et al. 1997; Palmer and Markus 2000; Zhuang and Lederer 2006). These indicators usually can show the firm's capability in making profits. In addition to financial indicators, many research also uses indicators for measuring efficiency improvement such as productivity (Brown, Gatian et al. 1995; Mukhopadhyay, Javier Lerch et al. 1997; Rai, Patnayakuni et al. 1997; Zhu, Kraemer et al. 2004; Zhuang and Lederer 2006), cost reduction (include COG/S, SGA/S and so on) (Mitra and Chayam 1996; Zhu and Kraemer 2002; Ranganathan, Dhaliwal et al. 2004; Banker, Bardhan et al. 2006; Wang, Tai et al. 2006) to examine the impact of IS on the operational efficiency of a firm. There are other special indicators being used in certain circumstances such as customer satisfaction (Devaraj and Kohli 2000; Ranganathan, Dhaliwal et al. 2004; Ray, Muhanna et al. 2005), Tobin' q (Saeed, Grover et al. 2005; Tanriverdi 2006), and market share (Barua, Kriebel et al. 1995; Sircar, Turnbow et al. 2000; Byrd and Davidson 2003). Because the indicators in the third category many not have enough commonality, we only include financial and efficiency indicators in our study.

## 2.3 Capabilities as Mediators

Although resources can have direct effect on firm performance, most recent understanding is that the effect of valuable resource may need other factors. One of which is resource complementary, which argues that the integration of different complementary resources can generate synergy that can lead to better performance (Melville, Kraemer et al. 2004; Wade and Hulland 2004; Zhu 2004). Other studies also propose factors such as strategic fitness that argue the alignment between IT and business strategy can enhance firm performance (Chan, Huff et al. 1997; Palmer and Markus 2000; Choe 2003). Outsourcing (Bardhan, Whitaker et al. 2006) and innovation (R&D) (Li and Ye 1999; Shin 2006) are also examined in a few articles.

Among those possible factors, organizational capabilities (Chan, Huff et al. 1997; Bharadwaj 2000; Santhanam and Hartono 2003; Bhatt and Grover 2005; Ravinchandran and Lertwongsatien 2005; Rai, Patnayakuni et al. 2006; Karimi, Somers et al. 2007) are the most liked mediators in existing literature. The rationale is that valuable resources can provide or enhance certain strategic capabilities to deal with competitors through the integration and utilization of these resources. These enhance capabilities can result in higher firm performance. For instance, Bharadwaj's (Bharadwaj 2000) examined the effect of high and low capability and found that high IS capability group performs significantly better than the control group.

In a comprehensive review, Wade and Hulland (Wade and Hulland 2004) divided capabilities into three categories: outside-In, inside-Out and spanning. In a later study, Hulland and Wade (Hulland, Wade et al. 2007) further simplify the capabilities into internal and external.

(1) *Internal capability*: It emphasizes on utilizing resources to enhance internal controls capabilities and strengthen cooperation performance between the departments, and improve capacity of the system and development, including the management of internal relationships, IS Planning, management skill, and IT experience(Hulland, Wade et al. 2007).

(2) *External capability*: It emphasizes on capabilities related to the ability to adapt to the external environment, the ability to work with external partners (such as upstream and downstream suppliers and manufacturers) for cooperation and information sharing, the capacity of facing the market and customer needs promptly. They are mainly concerned with partnership management, market response and organizational agility (Hulland, Wade et al. 2007).

**2.4 Research Framework and Hypotheses**
According to the literature review as described above, we can develop a research model as shown in Figure 1 and posit the hypothesis. The research framework includes two paths: one shown the direct effect of resources on performance and the other shows the path mediated by organizational capabilities.

*H1: Direct Effect Model*
*Technology and organization resource is positively associated with firm performance.*
H1 can be divided into four sub-hypotheses:
*H1a: Technology resource is positively associated with firm financial performance*
*H1b: Technology resource is positively associated with firm efficiency performance*
*H1c: Organization resource is positively associated with firm financial performance*
*H1d: Organization resource is positively associated with firm efficiency performance*
*H2: Effect of resource on capabilities*
*Technology and organization resources are positively associated with organizational Capabilities.*
Since both resource and capability include two categories, H2 can be divided into four sub-hypotheses:
*H2a: Technology resource is positively associated with firm's internal capability*
*H2b: Technology resource is positively associated with firm's external capability*
*H2c: Organization resource is positively associated with firm's internal capability*
*H2d: Organization resource is positively associated with firm's external capability*
*H3: Effect of capabilities on performance*
*Firm capability is positively associated with firm performance.*
H3 can be divided into four sub-hypotheses:
*H3a: Firm internal capability is positively associated with firm's financial performance*
*H3b: Firm internal capability is positively associated with firm's efficiency performance*
*H3c: Firm external capability is positively associated with firm's financial performance*
*H3d: Firm external capability is positively associated with firm's efficiency performance*
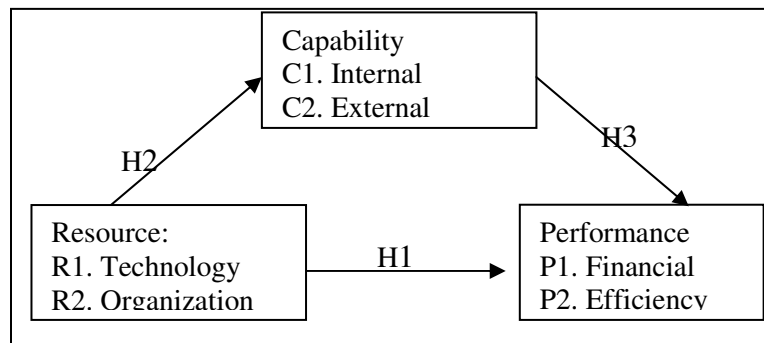


*Figure 1        The Framework of This Research*

# 3. RESEARCH METHODOLOGY
This study use meta-analysis on published research findings. The research procedures include the following.

### 3.1 Data Collection

The sample for this research includes empirical studies reported in top 10 journals in the MIS area. We used multiple keywords to search relevant papers, including firm or business performance, resource, capability, and competitive advantage. A total of 118 papers were found in the initial search. We then applied three criteria to identify useful papers. First, the study must be empirical or fields studies and provide quantitative data. Second, the topic of paper must be IT-enable firm performance study, and the unit of analysis must be organizations rather than individuals, groups or sectors of an organization. Third, it must report the correlation between dependent and independent variables. The screening resulted in 42 studies published between 1990 and 2007.

### 3.2 Variable Coding

The selected articles were coded based on our research framework. Two independent experts in the MIS area conducted the coding. Inconsistent coding was resolved through discussion and the participation of the third expert. The classification of organizational resources is shown in Table 1 below.

| Technology Resource | |
| --- | --- |
| Variable | Including Items |
| IT Investment | IT Investment<br>IT Budget<br>IT Spend<br>IT Purchase<br>IT Expenditure |
| IT Infrastructure | IT Infrastructure<br>Number of PC ,server<br>PC/worker ratio<br>Network (infrastructure) |
| IT Assets | IT assets,value<br>IT capital<br>IT stock |
| Software or System Application | IT innovation<br>System adoption (ERP,DSS, etc.) |
| Organization Resource | |
| Variable | Including Items |
| Knowledge Resource | knowledge capital, assets<br>Management processes |
| IS Human Resource | Human Resource, numbers, skill<br>staff expenses,<br>training (spending) |
| Financial Resource | Financial Resource<br>non-IT budget(funds) |

*Table 1          The Rules of Resource Coding*

The coding of capabilities follows Hulland's structure to divide them into internal and external capability (Hulland, Wade et al. 2007). Individual variables included in each category are described in the following.

**Internal capability (IC)**: According to our discussion of the previous section, IC represents the internal capacity within the enterprises for execution. Therefore, we included measures such as capability for managing internal relationships and IS planning and change management. Managing internal relationships mainly comes from the effect of internal use of IT resources to reduce internal communication costs, enhance efficiency, or improve the utilization rate of resources within the firm; that is, synergy (Bharadwaj 2000), assimilation (Armstrong and Sambamurthy 1999), and collaboration (Heeseok and Byounggu 2003; Nosek and McManus 2008). This usually comes from the efficiency of the use of IT to enterprises and it makes sectors work in between more closely and get better relationship. Moreover, such relationships help to span the traditional gaps that exist between functions and departments, resulting in superior competitive position and firm performance.

**External capability (EC)**: This includes external relationship and market responsiveness. External relationship indicates capabilities from the infrastructure and systems that help maintain good relationship with business partners. The ability to share information in SCM or CRM in customer services is an example of external capability. Market responsiveness is also taken from Wade (Wade and Hulland 2004) and Hulland (Hulland, Wade et al. 2007). It represents the adjustment capacity that a firm reacts to major changes in the market. IT can help an organization meet the rapid change of its external environment. The common indicators include flexibility (Heeseok and Byounggu 2003; Wade and Hulland 2004), agility (Sambamurthy, Bharadwaj et al. 2003), quick response (Palmer and Markus 2000), and strategic fitness.

Firm performance measures were coded into financial and efficiency performance. Financial indicators are common measures in performance-related research. All financial indicators such as ROA, ROI, ROE, ROS, Sale (growth), and stock share returns were coded into this category. Efficiency indicators are those related to the non-financial productivity of the organization.

### 3.3 Data Analysis

A total of 72 usable relationships were identified from coding the 42 published studies. Table 2 shows the descriptive result of the relationships. As shown in the table, the number of studies that can be used to test our hypotheses varies from 3 to 8. A preliminary examination of the result shows overwhelming positive relationships but inconsistent findings do exist in existing published literature. For example, three positive, one insignificant and one negatively significant relationship has been reported between organizational resources and internal capabilities.

| Relationship | No. of Studies | Significant Positive | Not Significant | Significant Negative | Remarks |
|---|---|---|---|---|---|
| H1a: TR-IC | 3 | 2 | 1 | 0 | TR: Technology Resource |
| H1b: TR-EC | 6 | 4 | 2 | 0 | OR: Organizational Re-source |
| H1c: OR-IC | 5 | 3 | 1 | 1 | IC: Internal Capability |
| H1d: OR-EC | 3 | 2 | 1 | 0 | EC: External Capability |
| H2a: IC-FP | 4 | 2 | 1 | 1 | FP: Financial Performance |
| H2b: IC-EP | 3 | 3 | 0 | 0 | EP: Efficient Performance |
| H2c: EC-FP | 8 | 5 | 3 | 0 | |
| H2d: EC-EP | 4 | 2 | 2 | 0 | |
| H3a: TR-FP | 4 | 2 | 2 | 0 | |
| H3b: TR-EP | 6 | 3 | 3 | 0 | |
| H3c: OR-FP | 8 | 5 | 3 | 0 | |
| H3d: OR-EP | 5 | 3 | 2 | 0 | |

*Table 2        Descriptive Statistics of the Coding Result*

# 4. HYPOTHESIS TESTING RESULTS

Methods commonly used in meta-analysis include Hunter and Schmidt (Hunter and F.L. Schmidt 1990), Hedges and Olkin (Zhu and Kraemer 2002) and Rosenthal (Rosenthal 1991). In this study, we use the average plot of product moment correlation r as the fundamental basis of meta analysis, and combined Fish Z scores and Fail Safe N (Rosenthal 1991) for each construct to test the significance of our hypothesis. The fail-safe N statistic was to provide the number of insignificant correlations that would have to be included in the sample to reverse the conclusion that a significant relationship exists. According to Rosenthal's (Rosenthal 1991) suggestion, the significant threshold of fail-safe N in 95% confidential level is $Nfs > 5 * k + 10$, where Nfs is the fail-safe N and k is the total number of studies in each relationship. The results are shown below.

## 4.1 Resource to Capability.

The resulting statistics between resources and capabilities are shown in Table 3. According to Cohen (1977)'s definition, when the True Population Effect Size (r)> 0.1 is known as the low-scale effect, r> 0.3 is medium effect scale, and r> 0.5 is the high effect scale. Therefore, H1a (TR-IC) has a high effect on capabilities and H1b (TR-EC) has a medium effect. Both are supported. H1c (OR-IC) is also supported with a medium effect size. The only hypothesis that is not supported is H1d (OR-EC), which means insignificant relationship between organizational resources and external capabilities. The Combined Z Scores and the test results on Nfs further strengthen the above result. Except for H1d, all combined Z Scores are significant at $p < 0.001$, and Nfs are significant at $p < 0.05$.

| Relationship | H1a: TR-IC | H1b: TR-EC | H1c: OR-IC | H1d: OR-EC |
|---|---|---|---|---|
| No. of Studies | 4 | 3 | 8 | 4 |
| Total samples size | 817 | 847 | 1173 | 1126 |
| True Population Effect Size (r) | 0.508 | 0.461 | 0.430 | 0.025 |
| Combined Z Scores | 15.617*** | 14.234*** | 15.4833*** | 0.869 |
| Threshold of Fail-safe N (p=0.05) | 25* | 40* | 35* | 25 |
| Fail-safe N (p=0.05) | 28 | 50 | 39 | -1 |
| Hypothesis Supported | Supported | Supported | Supported | No |
| *: p < 0.05; **: p < 0.01; ***: p < 0.001 | | | | |

*Table 3        Correlations between Resource and Capability*

Therefore, we can conclude that enterprises with higher technology resources can significantly enhance their internal and external capabilities but organizational resources can only improve internal capabilities.

## 4.2 Capability to Performance.

The result from meta-analysis on the correlations between capability and performance is shown in Table 4. Three hypotheses have medium effect and one (H2d) has no effect due to insignificant statistically. H2b (IC-EP) is supported significantly, which means internal capabilities has a significant positive effect on the efficiency of the organization. H2a and H2c are weakly supported, which indicates that both internal and external capabilities can enhance financial performance of a firm. They are significant by combined Z score but do not pass the Nfs thresholds.

| Relationship | H2a: IC-FP | H2b: IC-EP | H2c: EC-FP | H2d: EC-EP |
|---|---|---|---|---|
| No. of Studies | 7 | 6 | 8 | 8 |
| Total samples size | 1352 | 640 | 861 | 1361 |
| True Population Effect Size (r) | 0.336 | 0.386 | 0.353 | 0.029 |

| | | | | |
|---|---|---|---|---|
| Combined Z Scores | 12.711*** | 14.397*** | 10.708*** | 1.092 |
| Threshold of Fail-safe N in 0.05 | 45 | 40 | 50 | 50 |
| Fail-safe N (p=0.05) | 26 | 44 | 29 | -3 |
| Hypothesis Supported | Weakly Supported | Supported | Weakly Supported | No |
| *: p < 0.05; **: p < 0.01; ***: p < 0.001 | | | | |

*Table 4          Correlations between Capability and Performance*

### 4.3 Direct Effect of Resource on Performance.

Table 5 shows the result of the direct effect model. Unfortunately, we find only one significant combines Z score (H3b) to show weakly support of the positive impact of technology resource on efficiency, but its effect size is low (<0.3) and does not pass the Nfs threshold. The other three relationships are insignificant.

| Relationship | H3a: TR-FP | H3b: TR-EP | H3c: OR-FP | H3d: OR-EP |
|---|---|---|---|---|
| No. of Studies | 4 | 6 | 8 | 5 |
| Total samples size | 865 | 623 | 650 | 465 |
| True Population Effect Size (r) | 0.018 | 0.272 | 0.153 | 0.219 |
| Combined Z Scores | 0.911 | 2.121* | 1.143 | 1.185 |
| Threshold of Fail-safe N in 0.05 | 30 | 40 | 50 | 35 |
| Fail-safe N (p=0.05) | 1 | 25 | 15 | 21 |
| Hypothesis Supported | No | Weak support | No | No |
| *: p < 0.05; **: p < 0.01; ***: p < 0.001 | | | | |

*Table 5          Correlations between Resource and Performance*

## 5. DISCUSSION AND CONCLUSION

In this study, we have reviewed 42 published studies on using RBV to investigate whether IT can enhance firm performance and found the following. First, the mediated model that includes organizational capabilities as mediators between organizational resources and firm performance can better explain the value of IT than the direct effect model without organizational capabilities. Second, we find that technology resources can improve internal capabilities and efficiency but its effect on external capabilities and financial performance is relatively insignificant. This may be related to the nature of information technology. Another possible explanation is that there are so many different factors that may affect the financial performance of an organization. The effect of IT may be overshadowed by those other factors. Other potential reason is that the effect of IT investment may have time lag as argued in Kohli's paper (Kohli and Devaraj 2003; Wu and Chen 2006). Unfortunately, we do not have adequate data to examine the effect due to time lag or whether the effect exists.

Meta-analysis has some inherent limitations. First, we are comparing data collected from different sources and at different time. These data may have very different attributes such as different industries(Weber and Pliskin 1996; Prattipati and Mensah 1997; Shin 2001; Zhu and Kraemer 2002; Shin 2006) ,firm size(Mitra and Chayam 1996; Zhu, Kraemer et al. 2004) national conditions (Kar Yan 1998; Zhu, Kraemer et al. 2004; Zhu and Kraemer 2005), or economic environment. All these factors could cause biased observations. Nonetheless, the aggregated results from our meta-analysis provide more robust conclusions as they are derived from large samples to even out possible errors due to data collection in individual studies. The second limitation is that different coding may lead to different results. This exists in all research that involves human coding. We believe that we have done our best to ensure a consistent

coding process. Our findings also indicate that more research may be needed to investigate why certain relationships are insignificant and whether there are better measures that can reveal more insights about the role of IT in enhancing firm performance.

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