How Does the Rivalry between Firms Explain the IT Capability Gap, Leanness and Performance of Firms?

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Abstract

What is the role of IT capability in a competitive environment? Does IT capability contribute to the initiation of strategic actions within firms? To understand the relative position of IT in firms, we calculated the IT capability gap. This research has developed a research model in which the IT capability gap between two competing firms influences the leanness of a leading firm (Eroglu and Hofer, 2011). Also, we have suggested how the leanness of a firm is related to financial performance (i.e., ROS). Theoretically, this study is grounded in the competitive dynamics perspective (Ferrier et al., 1999), which emphasizes the role of rivalry between two competing firms. We empirically tested the research model using secondary data sets comprising of 322 firm-year panel data from 2002 to 2009. We have concluded that the IT capability of firms has a critical role to implement lean practices and eventually enhances firm performance.

Keywords
IS strategy, IT capability, competitive dynamics, empirical leanness, firm performance

Introduction

In some cities, Wal-Mart Stores promised same-day delivery service for orders placed online (Banjo, 2012). Following Wal-Mart’s competitive move, Home Depot Inc. considered initiating the same-day delivery service but it has not been rolled out (Banjo, 2013). Home Depot planned to spend at least $300 million on IT systems to being home delivery services. These two cases are a good illustration of the competitive dynamics of two rival firms. Both Wal-Mart and Home Depot are leading firms in the retail industry. In a competitive environment, a focal company (i.e., Wal-Mart) sustains a competitive advantage by taking a strategic action such as initiating same-day delivery service until its rivals (i.e., Home Depot) imitate and show a similar action (Ferrier et al., 1999). We can conjecture that Wal-Mart realizes abnormal financial return (i.e., return on sales) until Home Depot begins offering the same service.

In prior research, scholars have attempted to examine how a firm’s superior IT capability (Bharadwaj, 2000; Chae et al., 2014) or a lean practice (Eroglu and Hofer, 2011; Fullerton et al., 2014; Jayaram et al., 2008) enhances the financial performance of firms. However, scholars have not consistently showed that a higher level of IT capability and leanness leads to improved financial performance (Xue et al., 2012). We need to consider the rivalry between two firms, which can be measured by a leading firms’ actions and a rival firm’s reactions. To thoroughly understand whether IT capability and leanness of a firm lead to higher financial performance, it is necessary also to investigate a competing firm’s IT capability and leanness.
The main purpose of this study is to develop new theoretical insights and to validate the afore-mentioned relationships empirically. In this study, we measured lean practices as strategic actions of firms. We investigated three following research questions:

1. Will the IT capability gap between a leading firm and a rival firm improve lean practices of a leading firm?
2. Are the leanness of a leading firm and that of a rival firm associated with each other?
3. Does the improved leanness of a leading firm contribute to the financial performance of the firm?

By answering these research questions, this study offered several contributions. First, we leverage the competitive dynamics framework. Until now, except for a few papers (Ndorfor et al., 2011), the majority of published empirical papers has used either the resource-based view or the competitive dynamics framework. For this reason, no clear answer exists to explain the relationship between IT capability, a construct from the resource-based view, and strategic actions, which is a major building block in competitive dynamics. We show that IT capability complements the strategic actions of firms.

Second, we introduce a supply chain phenomenon, leanness of firms, to the IS community to explain a firm's financial performance. Conventionally, to explain the role of IT on producing a competitive advantage, IS scholars have used business process variables (e.g., customer related processes, new product development processes, or manufacturing processes) as mediating variables (Melville et al., 2004). Using the empirical leanness indicator (Eroglu and Hofer, 2011), we show a positive association between IT and lean practice.

**Literature review**

**Competitive dynamics and IS research**

The competitive dynamics framework (Ferrier et al., 1999) is new to IS research, and little attention has been given to the framework thus far. According to the competitive dynamics framework, the source of a competitive advantage is not a resource, capability, or industry structure but instead comes from the competitive action of firms. A firm that introduces new products earlier than its competitors, changes product prices more frequently than rivals, and adjusts to new regulations more effectively than others enhances their firm performance. The competitive advantage of a firm exists until competitors take the same action. However, this framework does not deny the core tenet of the resource-based view or Industrial Organization Economics. Competitive actions are concerned with the resources or capabilities of firms. A superior functional capability helps a firm to take strategic actions and react to a competitor's actions. Furthermore, the competitive dynamics framework also focuses on the rivalry among firms in the same industry do. Thus, the competitive dynamics framework does not substitute for previous theories but instead complements them. In IS research, Sambamurthy et al. (2003) conceptually demonstrated the nomological network from IT competence to firm performance using the competitive dynamics concept. In this nomological network, IT competence contributes to the development of the capability-building, entrepreneurial action, and coevolutionary adaptation processes. These improved processes lead to a higher level of financial performance through competitive actions. In sum, without considering competitive actions, it is difficult to understand the extent to which IT capability enhances a firm's performance.

**IT capability and lean practices**

Several previous IT investment and firm performance papers have empirically investigated the impact of IT on organizational capabilities and strategic action. This type of research papers focused on a specific capability, such as new product development capability (Pavlou and El Sawy, 2006), customer service process (Ray et al., 2005), performance management, customer management, and process management capability (Mithas et al., 2011). In this study, we examined how superior IT capability of a leading firm improves the lean practices of the firm, which are regarded as strategic actions, and how improved inventory management performance from lean practices enhances the firm’s financial performance. Shah and Ward (2007) articulated that “lean production is an integrated socio-technical system whose main objective is to eliminate waste by concurrently reducing or minimizing supplier, customer, and internal
variability” (p. 791). Jayaram et al. (2008) argued that a lean strategy can be traced to Porter’s value chain model and linkages among value activities can be exploited to engender a competitive advantage. Recent research has shown that a lean strategy must be adopted as a holistic business strategy, rather than simply an activity in operations (Fullerton et al., 2014). Thus, we agree that the inventory lean practice is a strategic weapon of a firm performance. To examine the concept of lean practices, we employed the empirical leanness indicator (Eroglu and Hofer, 2011). In an empirical condition, improved inventory management performance is a good surrogate to measure a firm’s lean practice output.

**Empirical leanness indicator**

In this study, we are using the empirical leanness indicator to measure the rivalry between firms. The empirical leanness indicator (ELI) was introduced to measure firms’ inventory level (Eroglu and Hofer, 2011). Previous indices, such as inventory turnover (Chen et al., 2005) and inventory efficiency (Mishra et al., 2013), do not measure the effect of economies of scale at the inventory level, but the ELI explains the economies of scale effect. As firm size increases, the inventory level does not have to increase proportionally to the size. For instance, a wholesaling firm with ten regional distribution centers and one million items in stock would not need to hold two million items in stock if its sales double. A distribution center can share inventories with other centers. Figure 1 demonstrates this relationship.

![Figure 1. The relationship among inventory, sales, and ELI; adapted from Eroglu and Hofer (2011, p.360)](image)

As the turnover curve in Figure 1 represents, the relationship between a firm’s size measured by its sales and inventory level has a non-linear relationship (Ballou, 2000). A functional form, I=βλ^α, depicts the non-linear curve, which shows that α= 0.7. If they have a linear relationship, then α must be equal to 1. The empirical leanness indicator measures how the inventory level of the firm deviates from the turnover curve. Firm A in Figure 1 is located below the curve, which means the inventory level of the Firm A is more efficiently managed than that of other firms. On the other hand, Firm B’s inventory level is higher than the curve, and its empirical leanness indicator has a negative value. In Firm C’s case, the empirical leanness is almost equal to zero. The inventory of these firm is regressed on sales, and the negatively transformed residual is the empirical leanness indicator of the firm. Statistically, it is written as follows:

\[
\ln(INV_{it}) = \alpha_i + \beta \ln(Sale_{it}) + u_{it}, \forall i = \text{firms, } \forall t = \text{years}. \text{And, ELI is } -u_{it}.
\]

The residual is the basis of the ELI. The residuals are multiplied by -1 so that negative deviations from the curve represent positive empirical leanness. We used the empirical leanness indicator to measure the output of lean practices of firms.
Research model and hypotheses

Research model

The association between IT capability and firm performance (Bharadwaj, 2000) has been an important issue in IS research. Researchers have adopted the resource-based view and dynamic capability, but the competitive dynamics view has seen limited investigation in IS research. The competitive dynamics framework emphasizes competitive action and rivalry between firms in the same industry to predict market position and financial performance. Grounded in the competitive dynamics framework, we examined the impact of IT on the leanness of a firm and how the relationship is related to the firm’s financial performance. The relationship is summarized in our research model (Figure 2). Since we are interested in the rivalry of two firms in the same industry, we first theorize about the IT capability gap between two firms.

![Figure 2. Research Model](image)

Hypotheses

Previous research has assessed a firm’s absolute resource position of IT investment, IT assets and IT capability. Peteraf and Barney (2003) argued that a “comparative advantage is the result of having more valuable resources than other firms” (p. 317). Thus, we assessed the difference between a leading firm’s IT capability and a rival firm’s IT capability rather than using the absolute value of the IT capability. This comparative approach delineates the value of IT capability across rivals. In this paper, we operationalize the relative position of IT as the IT capability gap. In our understanding, when a firm has a better IT capability, the firm’s IT function effectively supports organizational capabilities and strategic actions. This belief is also compatible with Sirmon and Hitt (2009)’s argument that a low investment relative to rivals in physical capital, such as IT and facility, negatively affects a firm’s performance.

Shah and Shin (2007) analyzed how IT contributes to inventory efficiency in an industry-level analysis and found significant increases in inventory efficiency from IT investment in manufacturing sectors. However, in wholesale and retail sectors, IT investment does not necessarily improve the inventory management performance. Recently, Mishra et al. (2013) demonstrated that IT capability improves inventory efficiency, and the improved efficiency leads to a higher level of shareholder wealth, such as stock market returns and stock market risk. Following the same reasoning, we believe that a relatively superior IT capability of a leading firm may be helpful to improve a leanness of the firm. If both a leading firm and a rival firm have a similar level of IT capability regardless of the absolute level, it is difficult to realize a superior leanness that will surpass the rival’s leanness. Given this argument, we hypothesize the following:
H1: IT capability gap between a leading firm and a rival firm is positively associated with the empirical leanness of a leading firm.

A main tenet of the competitive dynamics framework is that the rivalry between a leading firm and a rival firm explains strategic actions between them, and those strategic actions eventually improve firm performance. As we saw in the cases of Wal-Mart and Home Depot, competing firms are aware of the other firm’s actions, and they will react to the action if they have enough motivation and resources to do so. Since strategic actions taken by a firm in a dyadic rivalry are highly identifiable, a pairwise comparison is appropriate. In their research model in which a rival firm’s environmental management practices influence a challenging firm’s environmental management, Hofer et al. (2012) suggested that when a rival firm initiates new actions about a lean practice, the market’s leading firm will also follow the same action. Also, lean practices of firms are strategic actions (Fullerton et al., 2014) in which a leading firm and a rival are interested. Depending on the level of leanness of a rival firm, a firm can determine the level of investment in leanness. Also, in the opposite manner, a leading firm’s impact on a rival firm’s strategic action is possible. Thus, we can suggest the following hypothesis:

H2: Empirical leanness of a rival firm is positively associated with the empirical leanness of a leading firm.

The purpose of taking lean practice is to improve financial performance by reducing waste. Prior research has tested whether leanness improves the performance of firms by measuring operational performance (Shah and Ward, 2003) and financial performance (Jayaram et al., 2008). Most published studies have supported the contribution of lean practice management to financial performance (Eroglu and Hofer, 2011). In this study, we believe that a higher level of empirical leanness of a leading firm in competitive dynamics comes from the leanness of the firm. As in other strategic actions, lean practice also can be exercised to increase firm performance. Thus, we posit the following:

H3: Empirical leanness of a leading firm positively affects financial performance (i.e., ROS) of a leading firm.

Research methodology and results

Data and variables

To identify the competitive rivalry between two firms, most variables used in this research were measured for both a leading firm and a rival firm. In other words, we selected firms according to market share (e.g., the two top ranked firms based on market share) in a specific industry and the rival firm with the second largest market share. However, not every rival firm effectively competes with a market leader. To initiate and react sufficient strategic actions, both firms’ market shares should be larger than 20% (Connelly et al., 2010). After screening industries (six-digit North American Industry Classification System codes were used) according to the 20% rule, 41 industries remained from manufacturing, wholesaling and retailing sectors.

We gathered data for this research from two primary sources. First, to measure a firms’ IT capability gap, we used the Information Week 500 list. Every year since 1989, Information Week has announced the top 500 firms that possess the highest levels of IT capability, and this data set has been used as a proxy for IT capability (Bharadwaj, 2000; Mishra et al., 2013; Chae et al., 2014). When Information Week editors assessed a firm’s IT capability, the priority was given to the innovative use of IT (Chae et al., 2014). In this research, we assumed that a firm on the Information Week 500 list has superior IT capability as Bharadwaj and Chae et al. suggested. The firm’s IT capability value was assigned as 1. Otherwise, the IT capability value was equal to 0. Second, we extracted firm-level financial data such as sales, inventory, ROS, and industry-level data, such as market share, HHI index, and sales growth, from WRDS COMPUSTAT. From 2002 to 2009, 5,245 firm-years of data were used to calculate the empirical leanness indicators of a leading and a rival firm. After that, we selected 322 firm-year panel data, which were used in regression analyses. To test the suggested research model, we operationalized several variables. All variables used in this research are summarized in Table 1.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Symbol</th>
<th>Definition</th>
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Table 1. Operational definition of variables

Econometric analysis

Table 2 reports the means, standard deviations, and correlations for all variables used in this study. Most of the correlations are less than 0.5. However, correlations between SIZE and R&D are greater than 0.6. To a certain point, a bigger firm has more resources to invest in R&D. Thus, we do not believe that the correlation is a significant problem in this research. To avoid multicollinearity, we did not include SIZE and R&D in the same regression model.
In this paper, the Ordinary Least Squares (OLS) are not appropriate method since there is a possibility of heteroscedasticity and autocorrelation in the panel data we used. Some variables in multiple years in our data may be correlated with the variables in other years, which violates the homoscedasticity assumption of OLS. Thus, we used Feasible Generalized Least Squares (FGLS) regression with random effect models which correct autocorrelation and heteroscedasticity (Wooldridge, 2010). We investigated our hypotheses using regression model from (A) and (B). In the model, $i$ and $t$ represent firms and years respectively.

\[(A) \text{ELI}_{L_it} = \text{IT}_G + \text{ELI}_R + \text{IT}_G \times \text{ELI}_R + \text{GROWTH}_{it} + \text{HHI}_{it} + \text{SIZE}_{it} + \text{M}_i + \text{W}_i + \varepsilon_{it} \]

\[(B) \text{ROH}_{L_it} = \text{ELI}_{L_it} + \text{ELI}_R + \text{IT}_G + \text{ROH}_R + \text{GROWTH}_{it} + \text{HHI}_{it} + \text{R&D}_{it} + \text{M}_i + \text{W}_i + \varepsilon_{it} \]

Regression model (A) was designed to test hypothesis 1 and 2, model (B) was tested for hypothesis 3.

**Results**

We tested whether the IT capability gap of a leading firm increases the ELI of a leading firm through two regression models. Table 3 shows the summarized results of regression model (A). The coefficient of IT_G in Model 3 is 0.065, significant at the 10% level. A unit increase in the IT capability gap of a leading firm improves the ELI of a leading firm by 0.065. When we consider the distribution of ELI of leading firms (mean=0.01 and standard deviation=0.45), the positive association between the IT capability gap and the ELI of leaders has a substantial effect size. This result supports Hypothesis 1. Model 3 in Table 3 was also tested to examine whether the ELI of a rival firm influences the ELI of a leading firm and how the interaction between the IT capability gap of a leader and the ELI of a rival firm influence the ELI of a leader. The coefficient of ELI_R is 0.178, which is significant at the 5% level. Therefore, the ELI of a leading firm is highly influenced by the ELI of a rival firm. If a rival firm initiated a new type of lean practice, a leading firm would also be likely to adopt the same practice. This result supports Hypothesis 2.

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<tbody>
<tr>
<td>IT_G</td>
<td>Coef. 0.074*** 0.035</td>
<td>Coef. 0.178** 0.073</td>
<td>Coef. -0.364*** 0.094</td>
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<tr>
<td>ELI_R</td>
<td>Coef. -0.235*** 0.068</td>
<td>Coef. -0.200** 0.088</td>
<td>Coef. -0.210** 0.067</td>
</tr>
<tr>
<td>IT_G $\times$ ELI_R</td>
<td>Coef. -0.158* 0.073</td>
<td>Coef. -0.170** 0.088</td>
<td>Coef. -0.171** 0.088</td>
</tr>
<tr>
<td>M</td>
<td>Coef. 0.562** 0.229</td>
<td>Coef. 0.509** 0.228</td>
<td>Coef. 0.521** 0.228</td>
</tr>
<tr>
<td>W</td>
<td>Coef. -0.100 0.157</td>
<td>Coef. 0.156 0.156</td>
<td>Coef. 0.152 0.152</td>
</tr>
<tr>
<td>HHI</td>
<td>Coef. 0.070 0.070</td>
<td>Coef. 0.070 0.070</td>
<td>Coef. 0.070 0.070</td>
</tr>
<tr>
<td>GROWTH</td>
<td>Coef. -0.100 0.157</td>
<td>Coef. 0.156 0.156</td>
<td>Coef. 0.152 0.152</td>
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* Bold and Italic numbers are significant at 5%.

Table 2. Descriptive data and correlation of variables
We also examined whether an increased ELI of a leading firm leads to a higher level of financial performance (ROS). The regression results are summarized in Table 4. The coefficient of ELI_L of Model 3 (b=0.035, p< 0.014) is significantly positive. Thus, we would say that the leanness of a leading firm contributes to the financial performance (ROS) of a leading firm, as we assumed in Hypothesis 3. However, we did not find the significant direct impact of IT_G on ROS_L.

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Dehning et al. (2003) suggested that IT-enabled initiatives can be assessed most validly in the context of the competitors' IT-enabled actions. In this study, we have investigated the role of the IT capability gap in the rivalry among firms based upon competitive dynamics framework (Ferrier et al., 1999). Our research results supported the argument that the IT capability gap of leading firms increases lean practices of the firms. Also, the leading firms' strategic action (i.e., lean practices) is influenced by the rival firms' strategic actions as described in the competitive dynamics framework. The improved leanness of leading firms results in a higher level of financial performance (ROS). The contribution of this research is that we brought competitive dynamics to IS research and empirically tested the associations among IT capability gap, strategic actions, and financial performance. Also, we considered the relative resource position of IT by measuring the IT capability gap whereas prior research measured the IT capability as an absolute value of firms. Lastly, we introduced an index-related supply chain process to the IS discipline. The leanness of a firm is new to IS research and it will expand our understanding about how firms effectively and efficiently manage their resources through IT.

This study has several limitations. We did not find the significant direct impact of IT_G on ROS_L. As prior research (Melville et al, 2004) suggested, the positive influence of IT on firm performance is realized through other functional processes. To examine the mediation effect of IT_G on ROS_L, future research should conduct path analysis. Also, we found a strong negative coefficient of IT_G× ELI_R on the ELI_L. A potential explanation is that a rival firm's ELI has a bigger impact on leading firm's ELI. We need to consider two cases: (1) IT_G and ELI_R are both positive and (2) IT_G and ELI_R are both negative. We have found that when IT_G and ELI_R are negative, in the second case, the coefficient of IT_G× ELI_R on the ELI_L is significantly negative. It means that, when a rival firm has inferior ability to manage lean practice and a higher level of IT capability, the leading firm also has inferior leanness. Lastly, we have seen the strong positive association between ROS_R and ROS_L. In our sample, both leading firm and rival firm compete in the same market, and they have similar resources. This result is consistent with McGahan and Porter (1997) which suggested that industry specific effects explain the aggregate variance in profitability.

This study also suggests potential topics for future research. First, we considered the leanness of a firm as the strategic actions of firms. However, other strategic actions concerned with IT can be adopted and assessed to generalize the association between IT and strategic actions in future research. Second, this research accounted for the financial performance of several industry sectors, such as manufacturing, wholesaling, and retailing sectors by analyzing 5,245 firm-years of data. Further research may examine other industry sectors, and this will certainly help to substantiate the impact of IT on strategic actions and the rivalry between firms. Third, we used secondary data sets to measure the IT capability gap and the leanness of a firm. Secondary data have advantages in that they are objective and are more easily accessible to large volume of data including historical data. However, a survey or qualitative research is required to investigate the internal mechanism of firms. For instance, qualitative research may explain under what circumstances or what characteristics of firms accelerate the initiation of strategic actions (i.e., leanness) and reaction to rival firms' actions. Internal decision making processes or demographic characteristics of top management groups is certainly concerned with the strategic actions and rivalry between firms (Chen et al., 2007).

In conclusion, this study emphasized the role of IT capability in the rivalry among firms, and we found that IT capability gap enhances a leading firm’s leanness and improves financial performance. We believe the result of this research has a practical implication is when business practitioners invest money in IT, they should be aware of the rival firms’ IT capability and the rivals’ intention to strategic actions. Simply assigning more budgets into IT does not guarantee the firm’s superiority in financial performance.
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