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PERFORMANCE IMPACTS OF INFORMATION SYSTEMS USE: IS COMPETITIVE ACTION A MISSING LINK?

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Abstract

The use of information systems for competitive advantage has been the topic of much writing and research. As a successful example, American Airlines' aggressive use of its computer-based reservation system, SABRE, has often been cited for improving operational efficiency, increasing organizational flexibility, and altering interorganizational relationships. Yet, little attention has been given to a series of competitive actions that were generated through the use of SABRE along its evolutionary trajectory. These competitive actions enabled American to disrupt competitive forces and remain as a market leader in the airline industry for decades.

Stimulated by American's case and today's widespread use of IS, this study asks two interesting questions: Is there a systematic link between IS use and competitive action? If so, how do they relate to each other? In addressing these questions, we integrate competitive dynamics research and organizational information processing theory to examine the roles of IS in influencing firm behavior and resultant performance. Collecting second-hand data from multiple sources, this study empirically investigates competitive action and IS use of nine major automakers in 2003.

Results from this study suggest a strong link between IS use and competitive action. Specifically, greater IS use is strongly associated with undertaking more competitive actions and with greater heterogeneity of competitive actions; in other words, a firm with an extensive IS use is likely to undertake fast competitive moves in an innovative manner.

This study makes multiple contributions to IS theory. It introduces a unique perspective by conceptualizing competitive behavior as being significantly influenced by IS use. It makes explicit the IS use-competitive action-firm performance link. Establishing this link introduces a new, measurable way to examine the effects of IS use on firm performance. To IS methodology, this study represents a pioneering effort at collecting second-hand data about actual, voluntary IS use. To IS practice, results from this study inform strategists and IS managers to focus on aggressive pursuit of new possibilities for performance improvement via IS for achieving competitiveness.

Keywords: *Information systems use, Competitive action, IT value measure*

1 INTRODUCTION

The use of information systems (IS) for competitive advantage has been the topic of considerable research (e.g., Kaufman 1966; Barret et al. 1982; Johnston et al. 1989). American Airlines' computerized SABRE reservation system is an often cited example (e.g., Copeland et al. 1988). American has been well recognized for its aggressive use of SABRE to improve operational efficiency, increase organizational flexibility, and alter interorganizational relationships. Yet, IS research has paid little attention to the series of specific competitive actions undertaken by American using SABRE, which enabled it to disrupt competitive forces and remain as a market leader in the airline industry for decades.

In the late 1970s, to deal with heightened competition, American started leasing necessary hardware and software to travel agents for linking to SABRE; this initial *retail automation* yielded substantial profits to American and its travel agents by automating seat inventory and passenger reservation (Copeland et al. 1988).

American then launched a *co-host program* whereby other airlines were given preferential treatment in the display of flights on SABRE. Five airlines with route structures complementing American's joined the system. As a result, American's network of routes was increased and its prime competitor United had to fight back with a similar move (Monteiro et al. 1996).

Next, American used SABRE for *exclusive arrangements* with travel agents that limited entry and competition with other vendors. American also used *discriminatory pricing* for bookings based on the extent of competitive threat represented by carriers. In addition, to respond more rapidly to market changes than its rivals, American was found to have *discriminatory access* to SABRE, using it to gain immediate access to information on all carriers' prices and bookings in any market, and so obtain anti-competitive market intelligence (Shaw 1990), while delaying the loading into the system of fare and schedule data of rivals.

As a competitive action directed at building customer loyalty, American introduced its *frequent flyer programs (FFPs)*, *AAdvantage*, in 1982. American used SABRE to identify its second largest group of customers after the travel agents – business travelers, and reward them for continuing to fly American. The innovation of AAdvantage proved to be very effective, enabling new services to be added into American's FFPs – *joint marketing arrangements* with hotel, rail, rental car companies. These new services enabled American to use detailed customer information for finer market research, specialized promotions, and product differentiation (Monteiro et al. 1996).

To counter lower fares offered by new entrants, American introduced *dynamic pricing* into its fare structure. Enabled by SABRE, dynamic pricing let American to respond quickly to low fare entrants (Monteiro et al. 1996).

Building upon SABRE, American developed a sales management and report tracking system (SMARTS) in 1990. SMARTS helps identify which airlines' market share is lost and on which city-pairs. Using this information, American is able to develop targeted *incentive programs* to influence channel relationships (Christiaanse et al. 2002).

Retail automation, co-host program, exclusive arrangement, discriminatory pricing, discriminatory access, AAdvantage, joint marketing arrangement, dynamic pricing, and incentive program are examples of competitive actions that were enabled by the use of SABRE along this system's evolutionary trajectory. These competitive actions enabled American to extract greater profits, achieve better productivity, respond with agility to the competitive environment, induce innovations, and generate substantial market influence.

American's story stimulates us to ask: *Is there a systematic link between IS use and competitive action? If so, how do they relate to each other?* These questions have not heretofore been explored. Answers to these questions not only highlight new considerations to take into account in designing IS research

studies, but also provide insights for guiding a firm's e-business initiatives aimed at enhancing competitiveness via IS.

To address the above questions, this study integrates competitive dynamics research and organizational information processing theory to examine IS roles in influencing firm behavior. Collecting second-hand data from multiple sources, the study empirically investigates competitive action and IS use of nine major sports car makers. The results have implications for research, methodology, and practice.

The remaining paper is organized as follows: section 2 discusses theoretical background and identifies the link between IS use and competitive action; section 3 introduces a research model of the link between IS use and competitive action; section 4 describes data collection methodology; section 5 discusses data analysis methods and results; section 6 finally concludes with contributions, limitations, and future research directions.

2 THEORETICAL BACKGROUND

2.1 Competitive Dynamics Research

Competitive dynamics research emphasizes the dynamic process of how firms act/react to an environment in order to achieve greater competitiveness. It has three distinguishing characteristics (Smith et al. 2001). First is its focus on specific, observable firm actions in the market, each of which is distinctive with regard to the time (day/month/year) it occurs and where (the market) it occurs. Second is its focus on competitive interdependence, meaning that firms are not independent; they feel moves of one another and tend to interact. Third is its broad attempt to explain both causes and consequences of competitive actions.

Employing these three characteristics of competitive dynamics research in our current study yields a fresh, valuable approach to understanding IS initiatives. The first characteristic introduces *observable* measures (i.e., specific firm actions) to examine the effects of IS use. Prior IS literature largely focused on the implicit, hard-to-measure IS effects in terms of increasing organizational efficiency or power controls. The second characteristic introduces a *dynamic* view of using IS in influencing firm behavior and the resultant firm performance.

2.2 Organizational Information Processing Theory

Organizational information processing theory assumes that organizations are open social systems that must process information (Mackenzie 1984). Organizations process information in order to reduce uncertainty and equivocality (Daft et al. 1986). Uncertainty may arise from the variability of the tasks in hand or from the interdependencies involved in inter-unit, inter-firm processes due to the lack of information (Galbraith 1977). Equivocality may arise from the ambiguity of the nature of the tasks or from the differences among business units and related partners due to the existence of multiple and conflicting interpretations, goals, and practices (Weick 1979; Daft et al. 1981). Uncertainty and equivocality may also arise from the external environment, such as changes in market conditions due to competitor's (tactical or strategic) moves.

Organizational information processing theory emphasizes that to reduce uncertainty requires increasing information volume, while to reduce equivocality requires increasing information richness. And the design of organizational structure needs to fit its dual information needs for uncertainty and equivocality reduction in order to enhance organizational performance.

Integrating organizational information processing theory into our study helps *make explicit* the linkage between IS use and competitive action by identifying the effects of IS use on three implicit yet essential antecedents of competitive action.

2.3 An Integrative View of Competitive Dynamics Research and Organizational Information Processing Theory

In competitive dynamics research, *awareness*, *motivation*, and *ability* are acknowledged as three internal drivers that underpin competitive actions (Chen 1996; Smith et al. 2001). *Awareness* is proactive attentiveness to information of the competitive environment, quickly sensing external challenges and opportunities (Chen 1996; Zaheer et al. 1997; Sambamurthy et al. 2003). *Motivation* is the intent for undertaking moves against competitors (Chen 1996). *Ability* denotes physical ability to act/react speedily (Chen 1996; Zaheer et al. 1997). In general, *awareness* is considered a prerequisite for any move; *motivation* is influenced by both *awareness* and *ability*.

Organizational information processing theory suggests that IS use is critical in reducing uncertainty and equivocality by increasing information volume and richness required to accomplish internal tasks, to coordinate diverse activities, and to interpret the external environment (Daft et al. 1986).

IS assume an important role in sensing and interpreting the external environment. Some emergent systems such as intelligent agents and environmental scanning systems greatly increase information processing efficiency, facilitating acquiring, classifying, storing, retrieving, editing, verifying, aggregating, and distributing (Ghoshal et al. 1991) a large amount of competitor information, e.g., competitors' cost structures, production cycles and schedules, procurement and distribution channels, inventory timeliness, and turnover rates (Sheng et al. 2004). Some systems such as data mining systems, text mining systems, and competitor analysis systems enhance the ability to analyze and interpret a large amount of competitor data obtained, while increasing the prediction accuracy of competitors' moves. Some others such as multi-participant decision support systems, teleconferencing, videoconferencing, and Web conferencing possess the capacity to process rich information by facilitating immediate feedback and personalization among the decision makers, and increasing the number of cues and channels utilized and language variety as well. These systems reduce uncertainty and ambiguity involved in a firm's strategic, operational, and tactical decision-making in response to market challenges and opportunities. Thus, IS use, by enhancing the understanding of external environment, increases a firm's *awareness* of opportunities for competitive moves, e.g., what are the potential gains and risks by introducing a new product or by undertaking an acquisition (or divestments) of certain assets, firms, or technologies; are these moves irreversible or likely to induce countermoves from major competitors; what are the possible countermoves of those competitors; in response to a competitor's attack, what countermoves can a firm take to regain its market share – whether to imitate competitors or not; what are the possible outcomes of various moves.

IS also play an important role in increasing operational efficiency and managing inter-unit and inter-firm interdependencies. Some emergent systems such as electronic data interchange (EDI) systems facilitate fast data manipulation, problem diagnosis and identification. Some others such as eHubs, electronic marketplaces, and supply chain systems greatly enhance the capacity for sharing task performance among business units and related partners, while reducing ambiguity resulted from differences among various parties involved by standardizing processes and procedures. These systems may go beyond one-to-one relationship and enable network-level optimization. They provide capabilities of joint inventory management and collaborative planning and forecasting and allow information to be monitored, exchanged, and acted upon in real-time across a supply chain (Christiaanse 2005) or even an entire value chain involving customers, suppliers, 3rd-party logistics partners, service providers, and external designers (Keen 1991). These systems enhance process coordination and facilitate cost reduction (e.g., reduction in inventory costs). Thus, IS use also increases a firm's *ability* for undertaking competitive moves.

Taken together, integrating competitive dynamics research and organizational information processing theory, the foregoing analysis *makes explicit* the link between IS use and competitive action, by explaining how IS use can affect the three implicit yet essential antecedents of competitive actions and thus influence the likelihood of undertaking such actions.

Competitive actions are defined as externally-oriented, specific, observable competitive moves that a firm takes to enhance performance during a time period (Smith et al. 2001). They can be tactical or strategic. Strategic actions tend to involve larger expenditures of resources, longer time horizons, and more departure from the status quo than tactical actions (Miller et al. 1994). Examples of strategic action are major facility expansion, joint collaborative arrangements, major new product/service introductions; tactical action examples are price changes and advertising campaigns. Action events can range from procurement to product development, production, marketing & sales, and service. Potentially, they can disrupt competitive status quo, causing disequilibrium in the product-market space (Ferrier et al. 1999). Successful actions may yield new customers and profits, enhance efficiency or innovation, or increase market influence, thus positively impacting firm performance.

The link between competitive action and firm performance is extensively studied in the competitive dynamics literature (Ferrier et al. 1999; Miller et al. 1994, 1996). Yet the link between IS use and competitive action has not been studied. As a first attempt in identifying the link between IS use and competitive action, we thus introduce a research model in that direction. We assume that competing firms are voluntary IS adopters.

3 RESEARCH MODEL AND HYPOTHESES

3.1 Variable Constructs

IS use is denoted as the use of information systems with different technological functionalities and application services to support a firm's internal and interorganizational operations. *The extent of IS use* is defined as the total number of technological functionalities and application services a firm provides. IS technological functionalities and application services are classified based on a scheme developed by Chi and Holsapple (2005). This scheme provides a continuum with respect to an information system's capacity for reducing uncertainty or for resolving equivocality.

Competitive actions are defined as externally-oriented, specific, observable competitive moves that a firm undertakes to enhance performance in a given time period (Smith et al. 2001). Our scope of competitive action here is a firm-level analysis: the entire set of competitive actions carried out by a firm in a given year. We focus on characteristics of competitive actions that are identified as the most salient constructs in prior competitive dynamics research: action volume, and action heterogeneity. *Action volume* is found to have the strongest and most consistent impacts on firm performance (e.g., Smith et al. 1991; Young et al. 1996; Ferrier 1999). *Action heterogeneity* is found to have a strong influence on changing market shares and shifting rules of competition (e.g., Ferrier et al. 1999).

Action volume denotes the total number of competitive actions carried out by a firm in a given time period (Chen et al. 1995). *Action heterogeneity* is the extent to which a firm's entire set of competitive actions carried out in a given time period deviates from the industry norm (Miller et al. 1994).

3.2 Hypotheses

Using the foregoing theoretical bases and variable constructs, we advance two hypotheses to characterize the link between IS use and competitive action:

Hypothesis 1: All else being equal, the extent of IS use is positively related to action volume.

Hypothesis 2: All else being equal, the extent of IS use is positively related to action heterogeneity.

IS use reduces uncertainty and equivocality involved in interpreting external environment, accomplishing tasks, and coordinating activities. An extensive IS use not only promotes a firm's awareness of opportunities for undertaking competitive actions, but also allows a firm to achieve greater efficiency, enhancing its ability and motivation to respond quickly to the competitive environment. Thus, a firm with a greater extent of IS use is likely to undertake a greater number of competitive actions within a given time period (i.e., fast moves).

In addition, an extensive IS use allows more timely access to diverse external environment data, such as data about market, customer/supplier, technology innovation, and global economy (Strader et al. 1998). Real-time access to critical information enhances a firm's ability to place itself in an information-rich position for exploiting more market opportunities, thus undertaking competitive actions that are different from others in the marketplace (i.e., innovative moves).

In summary, a firm that has an extensive use of information systems along a continuum with respect to a system's capacity for reducing uncertainty or for resolving equivocality is likely to undertake fast competitive moves in an innovative manner.

4 METHODOLOGY

4.1 Data Collection

For an empirical investigation of the model and hypotheses, we look at the sports car segment of the automotive industry and collect one year of data (2003) from multiple second-hand data sources. There are two major reasons for choosing the automotive industry. First is because of its extensive inter-firm collaboration spanning wide-ranging dimensions from procurement through marketing and sales. Second is because of its widespread use of IS, being among the earliest industries to adopt EDI for purchasing, inventory management, and production scheduling (Cash et al. 1985). Many major automakers are aggressive IS users. They are trying to digitize their core business processes and link suppliers, dealers, logistics partners, and customers on common computing platforms. Choosing the sports car segment is because focusing on one segment lets us examine a complete competitive network in depth, excluding confounding factors related to different segment characteristics. Additionally, focusing on sports cars makes data collection easier because sports cars are distinct from other vehicles such as sedans, SUVs, and minivans, and are easy to identify.

Based on the sports car segment SIC code (3711125), a population of nine major sports car makers (almost the entire population of the sports car segment) are identified for data collection. These automakers are BMW, DaimlerChrysler, Ford, GM, Mazda, Mitsubishi, Nissan, Toyota, and Volkswagen. The second-hand data involve 106 IS technologies and applications used by the nine automakers and 305 of their competitive actions undertaken in 2003. Their IS use is *actual* and *voluntary*. *Actual use* refers to the manner in which IS are implemented and, in effect, used.

Several issues related to the second-hand data collection need to be addressed here. One concern is that second-hand data might subject to media bias. That is, some automakers may get more media attention than the others, resulting in more data collected about those automakers' system usages and competitive actions than others and thus biasing data analysis results. One way to address issues related to media bias is to conduct a comprehensive search of the data sources. To achieve this, we use F&S Predicasts Index (which classifies business news of over 2900 trade publications) as our reference and collect thousands of articles from major trade publications. We also go to the nine automakers' corporate Web sites to gather data about them. A second issue is that the nine automakers are producing other types of vehicles (such as sedan, SUV) besides sports cars. It is likely that some IS are used to support activities involved in those product lines. This is not very much a concern. We don't think influences from other product lines will produce much bias on the effects of IS on sports cars, for example, under such a circumstance that an Internet-based EDI system used for components purchasing may be shared by many different product lines, including sports cars. In addition, we read through the full text of the news articles to identify as closely as possible those IS applications specifically related to sports cars. For example, Ford's C3P system is specifically mentioned in the news to be involved in the design of Ford's 2005 GT.

4.2 Data Reliability

All the data used in this study involve categorization and coding. Competitive action data are categorized based on Porter's (1985) value chain. IS use data are categorized based on Chi and Holsapple's (2005) technology classification. To ensure the clarity and accuracy of this categorization, all coding categories

were discussed at two doctoral seminars. These categories were further fine-tuned through discussions with several academic experts, plus IS managers and engineers at Ford, Nissan, and Toyota. The data were then coded into the resultant categories.

To check reliability of this coding, two academic judges independently recoded the data. Coding reliability was tested using Perreault and Leigh's (1989) reliability index. This test yielded a value of 0.9, indicating a high degree of coding reliability. When disagreements on codes were identified, a third judge was used and discrepancies were resolved by majority rule.

4.3 Variable Measures

Table 1 gives details about the variable measures used in this study. *The extent of IS use* is measured as the number of technological functionalities and services provided by an automaker's IS in 2003. *Action volume* is the total number of competitive actions initiated by an automaker in 2003, as reported in the second-hand sources. *Action heterogeneity* is computed as the Euclidean distance that measures how different an automaker's 2003 competitive actions are from the industry mean: following the industry norms (homogeneity) vs. bringing innovative surprises (heterogeneity).

VARIABLE	MEASURE	SOURCE
<i>IS Use</i>		
Extent of IS Use	The total number of technological functionalities and services provided by IS.	Keen 1991; Chi et al. 2005
<i>Competitive Action</i>		
Action volume	The total number of actions initiated by an automaker at time t .	Chen et al. 1995
Action heterogeneity	$S_t(X_i, \bar{X}) = \sqrt{\frac{(x_{i1} - \bar{x}_1)^2 + (x_{i2} - \bar{x}_2)^2 + \dots + (x_{i,72} - \bar{x}_{72})^2}{72}}$ $X_i = [x_{i1}, x_{i2}, \dots, x_{i,72}]'$ $\bar{X} = \frac{1}{9} \sum_{i=1}^9 X_i = [\bar{x}_1, \bar{x}_2, \dots, \bar{x}_{72}]'$ $i = 1, 2, \dots, 9$	Miller et al. 1994; Johnson et al. 1998

Table 1. Details of variable constructs and their measures

5 DATA ANALYSIS AND RESULTS

5.1 Hypothesis Tests

Based on coding categories and variable measures developed in the previous section, data obtained from various sources are categorized, coded, and calculated. The data are then analyzed via hypothesis testing. Due to the relatively limited data size (nine sports car makers), Pearson and Spearman correlations are used in the data analysis. Pearson correlation measures a relation between two variables only to the extent that it is linear. In case of a strong correlation but nonlinearity, nonparametric correlation (Spearman's R) works better than Pearson correlation. Nonparametric correlation is sensitive only to the ordinal arrangement of values and thus ignores the monotonic curvilinearity. So, Spearman's R is also calculated to supplement Pearson correlation. Table 2 gives descriptive statistics of these data and their corresponding sources.

Variable	N	Mean	Std. Deviation	Data Source
IS Range	9	95.222	77.068	IS use data (Computerworld, corporate Web sites)
Action Volume	9	33.889	24.251	Competitive action data (F& S Predicasts Index, trade
Action heterogeneity	9	0.805	0.264	Competitive action data (F& S Predicasts Index, trade

Table 2. Data description

5.2 Discussion

Table 3 gives hypothesis test results regarding the relationship between IS use and competitive action. As the table shows, most of the hypotheses are supported. When the Pearson correlation is significant, interpretation is based on this alone.

HYPOTHESES			SUPPORTED
H1: All else being equal, the extent of IS use is positively related to action volume			1
H2: All else being equal, the extent of IS use is positively related to action heterogeneity.			2
(HYPOTHESIS) VARIABLE	CORRELATION	(H1) Action Volume	(H2) Action Heterogeneity
Extent of IS Use	Pearson Correlation	.811(**)	.786(*)
	Sig. (2-tailed)	.008	.012
	Spearman Correlation	.603	.700(*)
	Sig. (2-tailed)	.086	.036
N = 9			
** Correlation is significant at the 0.01 level (2-tailed).			
* Correlation is significant at the 0.05 level (2-tailed).			

Table 3. Hypothesis tests for the IS use–competitive action relationship

The results show that greater IS use is strongly associated with more undertaking of competitive actions and with greater heterogeneity of competitive actions.

The strong relationship between IS use and competitive action that we found in the automotive industry suggests a potentially rich research direction: investigations to create an in-depth understanding of IS roles in influencing firm behavior and achieving competitiveness in today's e-business. Moreover, by recognizing competitive actions as the first specific moves observed following a firm's implementation of an IT competitiveness initiative, this research pioneers development of a new kind of IT value measure.

Traditional IT value measures are of three major types: *IT productivity*, *IT profits*, and *consumer surplus* (Hitt et al. 1996). They provide a limited view of IT investment returns. First, traditional measures provide aggregate-level gauges of IT investment returns and cannot be observed within short time periods. This is because a typical IT investment (e.g., implementation of a supply chain system) may take several years before reaping its benefits. Second, gains from an IT investment sometimes may be transformed into such soft gains as innovation, responsiveness, or market influence rather than harder gains like profits, productivity, or consumer surplus. As such, using traditional measures may not capture a full view of IT investment returns. For instance, in the automotive industry, when asked where they saw IT investment gains, many automotive suppliers cited improved communications, an intangible that is hard to quantify (Hoffman 2004).

As firms increasingly digitize their business processes and rely on IT-mediated interfirm relations to develop and deploy capabilities, firm behaviors become increasingly inseparable from IT, either IT-induced or IT-enabled. Gains (soft or hard) from an IT investment can be realized in and first observed as an action or a pattern of actions (e.g., IT-improved communications may manifest as a larger competitive action volume or faster action pace during a given time period). In this regard, competitive action offers a view of IT returns that may not be captured by the traditional measures. Additionally, competitive actions can be observed within any length of time interval, from as short as a month up to many years.

Using competitive action measures, as illustrated by this study, may greatly increase flexibility of measuring IT value (e.g., capturing both hard and soft benefits, doing so more quickly, doing so for relatively brief time windows). We contend that competitive action promises to serve as an additional IT value measure, supplementing traditional measures to give a more complete view of IT value.

6 CONCLUSION

6.1 Contributions

This study empirically investigates the link between IS use and competitive action. It makes multiple contributions to theory, methodology, and practice.

Contribution to theory. This study introduces a unique perspective by conceptualizing competitive behavior as being significantly influenced by IS use. This perspective provides a new theoretical integration of two previously distinct research streams: information systems and competitive dynamics. Specifically, this study adds value to the literatures of both IS and competitive dynamics in several ways.

First, through a theoretical integration of competitive dynamics research and organizational information processing theory and an empirical investigation, this study finds a strong link between IS use and competitive action. Building on competitive dynamics research where a robust link between competitive action and firm performance has been well-established, this study makes explicit the *IS use-competitive action-firm performance* link. The identification of this link is especially meaningful to IS research. The link between IS use and firm performance has been a central focus in IS research. Prior studies have heavily investigated the effects of IS use on firm performance in terms of increasing efficiency or managing relationships. Yet these effects are largely implicit and hard to measure. This study, by establishing the *IS use-competitive action-firm performance* link, introduces a new, measurable way to examine effects of IS use on firm performance (i.e., through specific competitive actions launched in the market that are first observed after a firm undertakes an IT initiative for competitiveness).

Second, this study introduces a new IS use measure based on the technological functionalities along a continuum of a system's capacity for reducing uncertainty or resolving equivocality. This measure provides a good basis for examining IS roles in accomplishing tasks, managing interdependencies, and interpreting the external environment. It enriches dimensions of system use for gauging IS effectiveness. Although IS use is regarded as a critical dimension of IS effectiveness measurement (DeLone et al. 1992), prior research too often uses a simple measure, *frequency of system use*, that fails to capture the multidimensionality of the complicated system use construct (DeLone et al. 1992; 2003). It is increasingly recognized that research needs to examine multiple dimensions of system use, such as its nature and extent (DeLone et al. 2003).

Third, the demonstrated *IS use-competitive action* association enriches competitive dynamics research as evidence of a previously unexplored antecedent of competitive actions.

Contribution to Methodology. This study is a pioneering effort at collecting second-hand data about *actual, voluntary* IS use. Prior studies of a *system usage-performance link* largely rely on self-reported use (Devaraj et al. 2003). Although self-reported usage measures offer one way of assessing IS effectiveness, they have some limitations: (1) Self-reported usage might induce biases due to obtaining information from a single source, known as common method variance; (2) Perceived usage may not be consistent with actual usage possibly due to subjects' difficulty in recalling past usage (Devaraj et al. 2003). There is increasing recognition that actual system usage provides better measures of IS impacts than self-reported usage (DeLone et al. 2003, Devaraj et al. 2003).

Second-hand data collection involves examination of news articles from multiple sources. It thus provides relatively objective and rich information about actual system use, allowing for in-depth data analysis. By obtaining data from multiple sources, second-hand data collection also increases data reliability. Furthermore, second-hand data sources (like news reports and trade articles) allow data to be collected in a relatively controlled manner, especially when collecting longitudinal data or sensitive data like significant system implementation and usage events, which are generally difficult to obtain in a self-reported manner. Thus, second-hand data collection about *actual, voluntary* IS use depicts a fairly novel, but very useful, methodology with potential for greater application in IS research.

Contribution to Practice. Results from this study identify key roles of IS related to firm behavior and performance. An extensive IS use facilitates rapid and innovative actions, and can be a source of competitive advantage. These results thus inform strategists and IS managers to focus on aggressive pursuit of new possibilities for performance improvement via IS for achieving competitiveness. Also, using competitive actions as an IT value measure suggests alternative ways for practitioners to evaluate their organizations' IS use.

6.2 Limitations

Rapid advances in digital technologies make it difficult to construct a comprehensive classification of IS technologies for operationalizing IS range. The data size of this study is limited by the modest population of a single industry segment.

6.3 Future Research

Future research can pursue exciting directions. First, a large-scale investigation in a multi-segment/industry context may provide a fuller understanding of the link between IS use and competitive action. Of particular interests are industries with widespread use of IS, such as financial services and health-care. Additional characteristics of competitive actions (e.g., *action magnitude*, *action timing*) could be examined. Second, this study employs *the extent of IS use* as an IS use measure and collects 106 IS technologies and applications. Future research may introduce more measures of IS use (e.g., *diversity of IS use*) and can collect additional real-world IS technologies and applications to further examine IS use measures. The resultant validation may suggest systematic ways for IS users to evaluate different IS technologies and for IS vendors to provide innovative IS solutions. A third intriguing research avenue is to examine the *IS use-competitive action-performance* link. Feasible research methods may include questionnaire surveys, longitudinal studies through second-hand data collection, and computer-based simulations. Results obtained along this direction may push a step further in developing competitive action as an IT value measure.

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