IT Capability and Firm Performance: Findings from Periods of Economic Downturn

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ABSTRACT

Information technology is crucial in many industries and is seen as a decisive factor of a firm's performance and financial success. Based on the dynamic capabilities view, this paper aims at extending existing research on organizational IT capability and performance. In particular, this work examines if firms exhibiting superior IT capability outperform their competitors, especially during two phases of economic downturn: the burst of the dotcom-bubble in 2000 and the recent financial crisis in 2008. Applying secondary statistics on different performance measures and proxies of IT capability among publicly traded US companies, we found that firms characterized by superior IT capability outperformed their competitors during both crises in all but one performance indicator. This paper contributes to research by investigating two crisis periods and using up-to-date data to reconcile prior research.

Keywords

Business Value of IT, IT Capability, Economic Crisis.

INTRODUCTION

Today, Information Technology (IT) permeates the entire society. IT is embedded in products, business processes, public life, and at home. Consequentially, IT became crucial in many industries, is seen as a distinguishing factor regarding key performance criteria of firms (e.g. Bhatt and Grover 2005), and in the end generates business value (Kohli and Grover 2008).

One of the research strands dealing with the business value of IT is based on the resource-based view of the firm (RBV) and its derivate the dynamic capabilities view (DCV). In their definition Amit and Schoemaker (1993, p. 35) state that capabilities "refer to a firm's capacity to deploy resources, usually in combination, using organizational processes, to effect a desired end", where the desired end can be interpreted "as the generation of competitive advantage" (Barney 2001, p. 647). Teece et al. (1997), Eisenhardt and Martin (2000), and Teece (2007) extend this somewhat static capability view by introducing the notion of dynamic capabilities as a mean to integrate, reconfigure, add, and release resources. Within this stream of research, studies identified components of an organizational IT capability and investigated the effects on organizational outcomes such as competitive advantage (Bhatt and Grover 2005; Kohli and Grover 2008).

Although these studies highlight that IT strongly contributes to business value, it is still a challenging question how IT leads to these outcomes (cf. Davern and Kauffman 2000; Kohli and Grover 2008). Therefore, we follow the question, how IT capability and business performance are interlinked in phases of economic downturn. We solely focus on phases of economic

downturn, because preceding or succeeding phases of economic growth allow firms to perform well on the marketplace without necessarily having the most effective business processes that fit best to their products and customer requirements. Deficiencies are somewhat masked because growing markets absorb not only the best and price-efficient products but also second- or third-best solutions, due to the fact that money for consumption or investments is readily available and production capacities of the top-performers are not sufficient to serve the complete market. On the other hand, phases of economic downturn are characterized by decreases in sales and revenue that reveal deficiencies in firms' competitiveness, e.g. in terms of cost position or of providing the best fitting products.

Recent research in this area has investigated the impact of IT or in particular of IT capability on performance (Bharadwaj 2000; Santhanam and Hartono 2003) and competitive advantage (Bhatt and Grover 2005; Dehning and Stratopoulos 2003). In this context, Bharadwaj (2000, p. 171) defines IT capability as "ability to mobilize and deploy IT-based resources in combination or copresent with other resources and capabilities". Bharadwaj (2000), as well as others (e.g. Dehning and Stratopoulos 2003; Santhanam and Hartono 2003), build on secondary statistics before 1995. In these times, strategic information systems and integrated ERP systems had been introduced by innovative firms providing them with competitive advantage regarding costs or flexibility (e.g. Barua, Kriebel and Mukhopadhyay 1995; Clemons and Row 1991). In the meantime, especially large firms have heavily invested in IT, whereby ERP and CRM systems, outsourcing, and sophisticated IT governance practices diffused widely. For example, solely the investments in advance of Y2K lead to a tremendous rejuvenation of the IT landscape (Anderson, Banker and Ravindran 2006). This resulted in a discussion about IT as a commodity providing no differentiation (Carr 2003). Moreover, economies suffered from two distinguished crises over the last years; the burst of the dotcom-bubble in 2000 and the recent financial crisis of 2008. To sum up, since the studies of Bharadwaj (2000, p. 171) and Santhanam and Hartono (2003), who both use IT capability data before 1995 and performance data until 1997, many things have changed dramatically. Chen et al. (2011) at least cover the period of the dot-com bubble in their analysis, but focus on sustainability of IT capability and effects on abnormal return on equity. However, to the best of our knowledge there are no studies investigating the linkage between IT and accounting-based performance at the firm level using current secondary statistics to test whether or not prior findings still hold and whether or not IT capability as well makes a performance difference in economically turbulent times.

We strive to fill this gap by investigating the timeframes of the latest economic downturns to account for contemporary developments. According to this, we posit the following research question:

Does IT capability distinguish high-performing firms from competitors in phases of economic downturn?

To answer the research question we draw on existent research in the field of IT capability (Bharadwaj 2000; Dehning and Stratopoulos 2003; Santhanam and Hartono 2003). Based on the dynamic capabilities view, we theoretically develop our research model linking IT capability to performance outcomes. For empirical analysis, we use secondary statistics to test the questioned relationship following the approach of Bharadwaj (2000) and Santhanam and Hartono (2003) for IT capability.

This paper is organized as follows. The next section offers a brief theoretical foundation of the main concepts, followed by the development of our research model. Subsequently, the methodological aspects are outlined. Finally, the results are discussed and the paper concludes with the contribution, limitations, and managerial implications.

THEORETICAL FOUNDATIONS

Dynamic Capabilities View (DCV)

Study results reveal that mere resource endowment does not seem to be sufficient to explain performance impacts. Therefore, it has been suggested that, especially due to an increasingly turbulent environment, the key to success rather resides in a firm's ability to be adaptive, responsive, and aligned to business needs (Ross, Beath and Goodhue 1996). Whereas physical assets and tangible resources can be replicated by competitors, long-term advantage in the market often depends on the expertise of the people within the organization (Bhatt and Grover 2005). These considerations have led to the development of the capability-building perspective which is part of the RBV.

The capability-building perspective is based on the availability of valuable resources and examines how the productivity and deployment of these resources can be enhanced (Makadok 2001). Resources such as IT do not create value on their own (Grant 1991) but must work together in order to create organizational capabilities. These capabilities can then generate competitive advantages (Barney 2001). Thus, capabilities are a special, organizationally-embedded and therefore immobile resource that enhances the productivity of other resources (Dehning and Stratopoulos 2003; Makadok 2001).

In the context of turbulent environments where firms are required to demonstrate responsive, fast, and flexible product innovations, Teece et al. introduced the notion of dynamic capabilities, where the "term 'dynamic' refers to the capacity to

renew competences so as to achieve congruence with the changing business environment" (1997, p. 515). The term "renew" in our understanding goes beyond the notion of adaptability, integration, and reconfiguration in that it points not only to the (re)deployment of existing resources, but also to the development of new ones. Dynamic capabilities, then, are defined "as the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (see also Teece 2007; Teece et al. 1997, p. 516).

IT Capability

According to DeSarbo et al. (2005), IT capability refers to information systems that facilitate internal communication, technology and market knowledge creation, and cross-functional integration.

The effect of IT capability was underpinned by a study presented by Bharadwaj (2000) who discovered that superior IT capability was associated with significantly higher profit ratios. She gives a particular example of IT capability in the reaction of a new product at Provident National Bank – a free checking service – offered by its main competitor. Based on its flexible IT infrastructure, strong customer orientation, and a competent IT skill base, Provident was able to implement the required application within a very short time. This example shows the teaming of resources to achieve the desired outcome. In other cases, cost pressure, massive and rigid infrastructures, and an IT staff interested in preserving legacy systems made it impossible to support change (e.g., to new systems). IT capability is thus not seen as a set of technologies but as an enterprise-wide capability to leverage technology (Bharadwaj, Sambamurthy and Zmud 1999). Bharadwaj (2000, p. 171) defines IT capability as the "ability to mobilize and deploy IT-based resources in combination or copresent with other resources and capabilities". Bharadwaj (2000) hypothesized and empirically verified the influence of the IT capability on firm performance (i.e. higher profit ratios and lower cost ratios). More recent studies provided further evidence for the importance of the IT capability and especially for this specific relationship (e.g. Santhanam and Hartono 2003). Other studies for example investigated the effects on process agility (Tallon 2008), integration (Ray, Dazhong and Konana 2009), or market opportunities (Chi, Ravichandran and Andrevski 2010). Nevertheless, the majority of publications focused on performance (e.g. Bharadwaj 2000; Santhanam and Hartono 2003) or competitive advantage (e.g. Bhatt and Grover 2005; Dehning and Stratopoulos 2003) as the dependent variable.

RESEARCH MODEL

Performance

Most research chooses some form of performance measures as dependent variable. Performance variables reflect the firm's resource endowment and its ability to deploy these resources to achieve e.g. a customer satisfaction (Tatikonda and Montoya-Weiss 2001). A broad range of those variables are applied in literature. These examples encompass productivity, profitability, and quality measures (see also Palmer and Markus 2000). Based on "superior" products or services a firm can achieve a relative performance plus with respect to competitors over some period of time that is called competitive advantage (Bhatt and Grover 2005).

This relative performance advantage eventually cumulates into financial figures that can be expressed in terms of higher profit ratios and lower cost ratios as compared to competitors. These ratios can then be found in balance sheets and are available in financial databases. Accordingly, e.g. Bharadwaj (2000) and Santhanam and Hartono (2003) employed profit and cost ratios and used multidimensional measures to capture these ratios by including the return on asset and total operating expenses to sales, for example.

IT Capability and Performance

"Strategic advantage results to organizations that can exploit IT functionality on a continuous basis" (Bharadwaj et al. 1999, p. 383). This statement refers to IT capability that is not merely seen as a set of technologies but as an enterprise-wide capability to leverage technology (Bharadwaj et al. 1999) encompassing IT infrastructure, human IT resources, and IT-enabled intangibles. Deploying IT resources appropriately results in reaping the benefits and outperforming poorly equipped competitors. The effect of IT capability was underpinned by a study presented by Bharadwaj (2000) who discovered that superior IT capability was associated with significantly higher profit ratios. In a similar vein, Santhanam and Hartono (2003) and Dehning and Stratopolous (2003) demonstrate this positive relationship between IT capability and performance.

Analyzing IT capability, Bharadwaj et al. (1999, p. 380) identified several components of IT capability. Among those are business process integration that refers to enhancing effectiveness and efficiency of existing business and IT work processes and the provision of IT infrastructure. The latter deals with data, network and processing architecture and forms the foundation for enterprise applications and services. Mooney et al. (1996, p. 73) identify three different organizational effects

of IT: automation, information, and transformation effects. The former refers to advances in productivity, and cost reductions. Information effects impact for example decision quality and organizational effectiveness. Process improvements and innovations as part of transformational lead to "reduced cycle times, improved responsiveness, downsizing, and service and product enhancement" (Mooney et al. 1996, p. 74). These opportunities for applying IT and for optimizing resource endowments help companies to maintain their relative advantage throughout the different economic situations.

Drawing on above argumentation, the advantage derived from efficient and effective IT employment is relevant in all phases of an economic cycle especially in downturns such as during the dot-com bubble or more recently during the financial crisis. In economically critical times, companies benefit basically twofold: firstly, due to information benefits, analytical skills, and market sensors companies detect market anomalies faster and are able to react to changes before competitors do. Secondly, during critical times, companies benefit from efficiency and cost improvements realized by IT employment prior to a crisis. Anticipatory IT employment for example affects the feasibility and cost of technology-based business innovations, and a firm's ability to refine or reengineer business systems (Duncan 1995, p. 43).

Considering IT capability as a dynamic capability (cf. Teece et al. 1997) and the reasoning outlined above, we hypothesize analog to previous research (cf. Bharadwaj 2000; Santhanam and Hartono 2003) that superior IT capability results in higher performance in economically turbulent periods of time. Therefore we formulate:

Hypothesis: IT capability is positively related to superior performance outcomes in economically downturns.

METHODOLOGY

Sample and Data

The sample and analysis is restricted to US firms, because of availability of IT capability proxy data (see below). Furthermore, US companies listed at the major American stock exchanges are regulated by the U.S. Securities and Exchange Commission (SEC) and therefore subjected to high disclosure standards. This ensures both, depth and quality of secondary corporate data. Accordingly, we match data from two different sources to test our hypothesis: (1) the InformationWeek 500 ranking of most innovative IT organizations and (2) financial performance data retrieved from Thomson Reuters.

To identify firms with superior IT capability we use the InformationWeek 500 ranking. The annually published ranking exhibits the biggest and best corporate users of information technology every year. This ranking has been used widely in past (e.g. see Bharadwaj 2000; Santhanam and Hartono 2003) and recent research (Banker, Hu, Pavlou and Luftman 2011; Chen et al. 2011; Chi et al. 2010; Lim, Stratopoulos and Wirjanto 2012; Saldanha and Krishnan 2011; Wang and Alam 2007). The InformationWeek data provides several advantages, such as availability, high response rates, and experienced respondents (Lin and Bush 2010) and has been found to be "consistent with data from other secondary sources, such as IDG and BEA" (Rai, Patnayakuni and Patnayakuni 1997).[1] In accordance with Bharadwaj (2000) we define firms with superior IT capability as those that have been listed at least twice in the 1998-2000 respective 2006-2008 rankings.

We operationalize financial performance in terms of accounting-based performance as used in prior research by Bharadwaj (2000) and Santhanam and Hartono (2003). In accordance with these studies we measure performance with several key figures: return on assets (ROA), return on sales (ROS), cost of goods sold to sales (COGS/S), selling and general administrative expenses to sales (SG&A/S), and total operating expenses to sales (OEXP/S). These measures are widely adapted in strategic management and accounting research and proved to be reliable (Santhanam and Hartono 2003). Venkatraman and Ramanujam (1986) provided a profound review on the benefits and limitations of different performance measures. The performance data has been retrieved from the Worldscope and Reuters Fundamentals databases, both provided by Thomson Reuters.

Method

Following Santhanam and Hartono (2003), several performance measures of companies listed in the IW ranking are compared to their industry average at the four- and two-level SIC code by the Wilcoxon rank sum test. This homogeneity test compares if two samples significantly differ regarding the variable of interest (in this case profit-based and cost-related measures). Corresponding to contemporary research (e.g. Brynjolfsson and Hitt 2003) we expect a lagged performance effect of one period. Two periods of time around economic downturns in the last decade are selected: The first around the dot-com bubble in 2000 and the second around the recent financial crisis in 2008.

[1] Further justifications as well as limitations to this approach can be found in (Banker et al. 2011; 2000; 2003).

According to prior research (e.g. Santhanam and Hartono 2003), the sample of leading IT companies consists exclusively of companies that have been ranked by InformationWeek since 1996. The control sample is comprised of publicly listed U.S. companies that have never been ranked by IW since 1996 and was further grouped by industries to calculate the average performance measures at the two industry levels (four- and two-level SIC code). Non-publicly traded companies have been excluded from the samples due to limited availability of actual and historic data. Furthermore, companies with extreme negative values regarding performance variables over several subsequent years are eliminated from the control sample as well. This results in an increased validity of the results because affected companies reduce the average industry performance dramatically.

RESULTS

As stated above we combine the sample of any given year (t_0) – which is constituted by the population from the IT ranking and the four-level and two-level SIC code control groups of the same year – with performance data of the succeeding year (t_{+1}). Thereby, we apply an one-year lag effect which is in line with the argumentation of Santhanam and Hartono (2003).

Table 1 shows the results for the years 2008 to 2006 (sample population by IT ranking and control groups) linked to performance data for the years 2009 to 2007. Equally, Table 2 displays the results for the years 2000 to 1998 linked to performance data for the years 2001 to 1999. For each sample period (t_0), the first row displays the median performance respectively cost values in the succeeding year (t_{+1}) for the three subsamples. The second row displays the resulting Z-values and their significance level from comparing the superior IT capability firms with the two control groups by the Wilcoxon rank sum test.

Overall, the two distinct periods show similar results. The profit ratios during both economic downturns were significantly higher than the industry control samples. Considering the cost ratios, the companies with superior IT capability show significantly lower total operating expenses to sales (OEXP/S). The same turns out for the selling and administrative expenses to sales ratio (SGA/S), however the difference between high and low performers diminished during the two downturns. The cost of goods sold to sales (COGS/S) ratios showed no significant effects, despite week significance in a single year. Besides the COGS/S ratios, all performance measures turned out to be significantly different between the two samples.

Thus, the hypothesis is supported with the exception of COGS/S: Firms exhibiting superior IT capability perform better than the industry average in times of economic downturns as well as in recovering periods (one year after) and former phases of stability or growth (one year before).

	Sample (t_0 = 2008)		Sample (t_0 = 2007)		Sample (t_0 = 2006)	
Performance / Costs	Median	Z-Value	Median	Z-Value	Median	Z-Value
ROA-superior IT (t_{+1})	3,3341		4,4180		6,2721	
ROA-control SIC4 (t_{+1})	-1,1921	-6,724***	2,2355	-7,409***	-4,8871	-7,927***
ROA-control SIC2 (t_{+1})	-2,4000	-9,376****	1,3183	-10,396***	-6,6609	-11,278***
ROS-superior IT (t_{+1})	4,1938		4,4911		11,3124	
ROS-control SIC4 (t_{+1})	-1,2286	-7,802***	-4,5719	-7,044***	-3,2221	-8,456***
ROS-control SIC2 (t_{+1})	-9,5927	-10,124***	-2,3065	-6,815***	-1,8268	-10,659***
COG/S-superior IT (t_{+1})	0,5765		0,5858		0,5784	
COG/S-control SIC4 (t_{+1})	0,5792	-1,279	0.5845	-1,188	0,5855	-1,614
COG/S-control SIC2 (t_{+1})	0,5904	-0,996	0,5894	-0,690	0,6058	-1,488
SGA/S-superior IT (t_{+1})	0,2116		0,1961		0,2799	
SGA/S-control SIC4 (t_{+1})	0,3585	-8,490***	0,3448	-8,630***	0,3937	-8,765***
SGA/S-control SIC2 (t_{+1})	0,4175	-10,703***	0,4109	-10,564***	0,4369	-10,579***
OPEXP/S-superior IT (t_{+1})	0,9043		0,9097		0,9532	
OPEXP/S-control SIC4 (t_{+1})	1,0650	-9,686***	1,0375	-8,403***	1,1023	-9,244***
OPEXP/S-control SIC2 (t_{+1})	1,1689	-12,478***	1,1206	-9,397***	1,2049	-12,515***
***significant at the 1% level; *significant at the 10% level						

Table 1. Results for IT capability in the financial crisis

	Sample (t_0 = 2000)		Sample (t_0 = 1999)		Sample (t_0 = 1998)	
Performance / Costs	Median	Z-Value	Median	Z-Value	Median	Z-Value
ROA-superior IT (t_{+1})	2,5520		6,4725		6,4288	
ROA-control SIC4 (t_{+1})	0,8833	-9,175***	-4,4613	-9,634***	-2,2970	-9,718***
ROA-control SIC2 (t_{+1})	0,7190	-11,315	-4,6861	-11,613***	-5,9362	-12,841***
ROS-superior IT (t_{+1})	3,3738		8,9566		8,7216	
ROS-control SIC4 (t_{+1})	-63,4730	-10,086***	-33,0610	-9,828***	-7,2648	-9,866***
ROS-control SIC2 (t_{+1})	-71,9001	-12,787***	-42,5122	-12,531***	-10,3383	-12,053***
COG/S-superior IT (t_{+1})	0,6269		0,6377		0,6431	
COG/S-control SIC4 (t_{+1})	0,6591	-1,584	0,6368	-0,709	0,6283	-0,740
COG/S-control SIC2 (t_{+1})	0,6507	-2,294	0,6248	-1,237	0,6238	-1,846*
SGA/S-superior IT (t_{+1})	0,2063		0,1803		0,1862	
SGA/S-control SIC4 (t_{+1})	0,6712	-10,112***	0,9139	-8,584***	0,5321	-8,835***
SGA/S-control SIC2 (t_{+1})	1,0029	-11,742***	0,8200	-11,743***	0,8780	-11,289***
OPEXP/S-superior IT (t_{+1})	0,9319		0,8891		0,8873	
OPEXP/S-control SIC4 (t_{+1})	1,6964	-11,601***	1,4325	-11,160***	1,3347	-11,280***
OPEXP/S-control SIC2 (t_{+1})	1,8911	-13,946***	1,6370	-13,623***	1,6516	-13,531***
***significant at the 1% level; *significant at the 10% level						

Table 2. Results for IT capability in the dot-com bubble

DISCUSSION

Based on prior work (Bharadwaj 2000; Dehning and Stratopoulos 2003; Santhanam and Hartono 2003), we extend and contribute to IT capability research by investigating the performance effects of companies characterized by a superior IT capability. Specifically, we compare well-resourced companies to their industry before, during, and after the last two economic downturns.

At this point a few limitations of our approach should be mentioned. Firstly, we use highly aggregated constructs, such as IT capability, which does not allow digging deeper into the relationship among the constructs. For example, we are not able to distinguish between different types of IT capability such as relationship or IT infrastructure capability. Secondly, employing data from databases implies the use of proxies that are commonly defined for all firms but do not allow looking into details and thus may comprise aspects which are not accounted for by the use of our theoretical concepts. Thirdly, we used the ranking data for a defined selection of years. However, future research should comprise more years.

We hypothesize that IT capability is positively related to superior performance outcomes in economic downturns like the dot-com bubble and the financial crisis. In accordance with Bharadwaj (2000) and Santhanam and Hartono (2003)we use often employed profit-based and cost-related performance measures to increase reliability. Our results show that firms exhibiting high IT capability, reflected by the IW ranking, demonstrate higher performance outcomes than firms within the same industry. These results are basically consistent throughout most of the performance measures with the exception of COGS/S.

This corresponds to findings of Bharadwaj (2000) who detected a weak effect (significant at 10% level) of IT capability on COGS/S. However, this effect seems to be too weak to be recognizable across various periods of time. In contrast to findings of Bharadwaj (2000) we found that the selling and administrative expenses to sales ratio (SGA/S) is significantly lower for firms exhibiting superior IT capability than for firms of the control group. Bharadwaj hypothesized this relationship but found the opposite and explained it by findings of another study that found high IT spenders exhibiting “higher overhead costs per unit of output and, therefore, had higher than average SGA expenses” (2000, p. 182). However, we investigate periods of economic downturn that are typically characterized by cost cutting measures affecting IT spending and overhead costs. Thus this might be the reason for detecting an effect as hypothesized by Bharadwaj.

From a management perspective, this result raises two major consequences: Firstly, IT capability allows outperforming competitors even in phases of economic downturn. Hence, carefully and continuously investing into IT and building an IT capability is a strategic necessity. Secondly, IT capability is no commodity and enables to differentiate from competitors. Building IT capability takes time and cannot easily be imitated and thus is a strategic asset. Therefore, it should be considered this way by top management in general, namely the CEO and the CFO.

Further research should investigate more time periods and extend this study by longitudinal analysis to account for time effects and how they change as well as to better identify the length of lag effects. Furthermore, further analysis is needed regarding why COGS/S is an exception among the used performance criteria.

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