E-COMPLEMENTARITY
The Link to e-Business Value

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Abstract: In recent years, much debate about the value of e-Business and information technology (IT) has been raised. Although the macro-level effect of IT and e-Business is undisputed, a question remains on whether e-Business can provide differential benefits to individual firms. In this sense, there is a need to further investigate whether and how e-Business creates value. To respond to this challenge, this paper develops a conceptual model, grounded in the resource-based theory, which analyzes the complementarity of Internet resources and e-Business capabilities as source of business value. This model posits three relationships: Internet resources and business value, internal e-Business capabilities and business value, and the complementarity of Internet resources and internal e-Business capabilities. To test hypotheses, a sample comprising 1,010 Spanish firms is employed. The results show that, as hypothesized, Internet resources per se are not positively related to business value and that internal e-Business capabilities have a positive significant impact on business value. In addition, the results offer support for the complementarity of Internet resources and internal e-Business capabilities as source of business value.

1 INTRODUCTION

The relationship between information technology (IT) and business value has been the subject of much research over the past decade. The results of these studies were varied and the term "productivity paradox" was coined to describe such findings. Nonetheless, recent studies have found positive and stronger linkages, and have attributed the productivity paradox to variation in methods and measures (Devaraj and Kohli, 2003)

Today IT is surpassing its traditional "back office" role and is evolving toward a "strategic" role with the potential not only to support chosen business strategies, but also to shape new business strategies (Henderson and Venkatraman, 1999). However, much debate about the value of IT and e-Business has been raised, due to the gap between e-Business investment and the lack of empirical evidence on e-Business value. Although showing recent signs of advance, much of the existing e-Business literature still relies, to a great extent, on case studies, anecdotes, and conceptual frameworks, with little empirical research directed to assessing the impact of IT on firm performance – especially in traditional companies (Brynjolfsson and Kahin, 2002). Case studies on firms such as eBay and

Amazon show e-Business can create business value, but there is a question as to whether the lessons learned from these "Internet giants" are more widely applicable. At the same time, Carr's assertions (2003), in his article "IT Doesn't Matter", have raised the discussion about the value of IT. Carr's argument, in a few words, is that because every firm can purchase IT in the marketplace and because IT is now a commodity based on standards that all companies can freely use, IT is no longer a differentiating factor in organizational performance. What makes a resource truly strategic – what gives it the capacity to be the basis for a sustained competitive advantage - is not ubiquity but scarcity. Carr argues that no firm can use IT to achieve a competitive advantage over its competitors. Therefore, Carr concludes, firms should reduce spending on IT, follow rather than lead IT in their industry, and avoid deploying IT in new ways.

Most management information systems experts disagree with Carr's assertions. However, his argument is appropriate when he points out that not all IT investments have strategic value. Some IT investments only allow firms to stay in business. The technology itself will rarely create superiority. For that reason, some research studies found that IT spending rarely correlates to superior financial

results (Hoffman, 2002). However, even though competitors may copy an IT innovation, relative advantage can be created and sustained where the technology leverages some other critical resource. Kettinger et al. (1994) draw a number of such complementary resources, such as size, structure, culture, and so on, that could make it difficult for competitors to copy the total effect of the technology. This complementarity of resources is a corner stone of the resource-based theory and has been offered as an explanation of how IT has largely overcome its paradoxical nature and is contributing to business value (Bhatt and Grover, 2005; Clemons and Row, 1991).

Consequently, to respond to these challenges, this paper develops a conceptual model, grounded in the resource-based view (RBV) firms, to analyze the complementarity of Internet resources and capabilities as source of business value at the level of an individual firm. The analysis employs a large sample of companies from different industries for hypothesis testing. Moreover, although recent studies (Zhu, 2004; Zhu and Kraemer, 2005) have analyzed the relationship between e-Business capabilities and firm performance, very little work has been undertaken to identify Internet resources and capabilities. Similarly, the complementarity of Internet resources and capabilities has not been studied. The present study attempts to cover these gaps in the research.

The paper consists of six sections and is structured as follows: The next section reviews the relevant literature. In Section 3, hypotheses and research models are specified. Following that, the methodology used for sample selection and data collection is discussed. Then, data analysis and results are examined. Finally, the paper ends with a discussion of research findings, limitations and concluding remarks.

2 LITERATURE REVIEW

2.1 The RBV and e-Business

The RBV suggest that the effects of individual, firm-specific resources on performance can be significant (Mahoney and Pandian, 1992). The RBV generally tends to define resources broadly and include assets, infrastructure, skills, and so on. While resources serve as the basic units of analysis, firms create competitive advantage by assembling resources that work together to create organizational capabilities. Grant (1991) suggests that the capabilities of a firm

are what it can do as a result of teams of resources working together. Teece et al. (1997) argued that capabilities cannot easily be bought; they must be built. Thus, building capabilities is not only a matter of combining resources; capabilities are rooted in processes and business routines. Also capabilities involve complex patterns of coordination between people and between people and other resources (Grant, 1991), and between an organization and other organizations. In this respect, Day (1994) describes capabilities as complex bundles of skills and accumulated knowledge, exercised through organizational processes, which enable firms to coordinate activities and make use of their assets. Day argues that capabilities and organizational processes are closely entwined, because capabilities enable the activities in a business process to be carried out. More recently, Makadok (2001) considers capability as a special type of resource. More specifically, he defines capability as an organizationally embedded non-transferable firm-specific resource whose purpose is to improve the productivity of the other resources possessed by the firm.

For the purposes of the present study, the above definitions of capability permit the identification of three important characteristics:

- Capabilities are rooted in processes and business routines, because it is capability that enables the activities in a business process to be carried out.
- Capabilities are firm-specific, while an ordinary resource is not. Because of this embeddedness, ownership of a capability cannot easily be transferred from one organization to another.
- The primary purpose of a capability is to enhance the productivity of the other resources that the firm possesses.

2.2 e-Business Resources and Capabilities

The RBV provides a solid foundation to differentiate between IT resources and IT capabilities and to study their separate influences on performance (Santhanam and Hartono, 2003). Based on this analysis, Bharadwaj (2000) suggested that if firms can combine IT related resources to create unique IT capabilities, they can improve their performance. IS researchers have followed this consideration of IT capability because competition may easily result in the duplication of investment in IT resources, and companies can purchase the same hardware and

software to remove competitive advantage (Santhanam and Hartono, 2003). In this respect, IS research offers a useful distinction between IT resources and IT capabilities. The former is asset-based, while the latter comprises a mixture of assets formed around the productive use of IT.

In general, IT resources are not difficult to imitate; physical technology is by itself typically imitable. However, firms may obtain competitive advantages from exploiting their physical technology in a better (and/or different) way than other firms, even though competing firms do not vary in terms of the physical technology they possess. IT resources are necessary, but not a sufficient condition, for competitive advantages (Clemons and Row, 1991). IT resources rarely contribute directly to competitive advantage. Instead, they form part of a complex chain of assets (IS capabilities) that may lead to better performance. Thus, some researchers have described this in terms of IT capabilities and argue that IT capabilities can create uniqueness and provide organizations a competitive advantage (Bhardwaj, 2000, Bhatt and Grover, 2005; Mata et al., 1995; Ross et al., 1996; Santhanam and Hartono, 2003).

Consequently, the present study seeks to demonstrate that although Internet resources (considered as physical IT) are not responsible for the creation business value, their complementarity with e-Business capabilities is critical to firm value.

2.3 Business Value from a Process Perspective

Although much research using the RBV has focused on an aggregated dependent variable, namely, firm performance, this may not be the best way to test the RBV (Ray et al., 2004). For example, because firms can have competitive advantage in some business activities and competitive disadvantage in others, examining the relationship between resources and capabilities associated with different processes within a firm and its overall performance can lead to misleading conclusions. Ray et al. (2004) proposed examining the effectiveness of business processes as a way to test the RBV logic. Another issue is that some IT investments may provide benefits after a certain period but increase operating costs in the short term. Thus, using firm performance at the macro level is meaningless and can again lead to misleading conclusions. These arguments lead to the conclusion that a process approach should be used to explain the generation of e-Business value within the RBV, and this is the approach adopted in the present study. The present research uses the effectiveness of

online procurement to measure e-Business value. The business value of this process is discussed below.

e-Procurement, or buying online, can potentially provide distinct value propositions to the firm. These come from the reduction of procurement and inventory costs, as well as strategic networks with suppliers that allow effective and efficient supply chain management (SCM). With regard to procurement costs, Kaplan and Sawhney (2002) indicated that buying in e-marketplaces considerably reduces transaction costs. With regard to strategic links and SCM, Internet technologies can enhance SCM decision making by enabling the collection of real-time information, and access to and analysis of this data in order to facilitate collaboration between trading partners in a supply chain. In this sense, Frohlich and Westbrook (2002) showed the importance of linking customers and suppliers together in tightly integrated networks. As a result of e-Procurement, the collection of real-time information on demand is possible and, more importantly, products and services are delivered quickly and reliably when and where they are needed (Frohlich, 2002).

In sum, e-Business value may lead to improved performance on the part of the firm in procurement. Although it could be argued that customers, suppliers and/or the firm's wider value network can benefit from online procurement, this study focuses on analyzing business value at the level of an individual firm.

3 DEVELOPMENT OF HYPOTHESES

This section develops hypotheses for the present study, drawing on the existing information systems and e-Business literature. Three relationships will be explored: Internet resources and business value, internal e-Business capabilities and business value, and the complementarity of Internet resources and internal e-Business capabilities (see Figure 1).
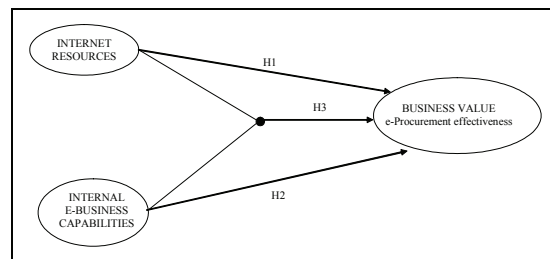

Figure 1: Research model.

3.1 Internet Resources and Business Value

Firms obtain competitive advantages on the basis of corporate resources that are firm specific, valuable, rare, imperfectly imitable, and not strategically substitutable by other resources (Barney, 1991). IT resources are easy to duplicate, and, hence, IT resources per se do not provide competitive advantages (Santhanam and Hartono, 2003). Although IT infrastructure is argued to be valuable, it is not a source of competitive advantage (Bhatt y Grover, 2005). Thus, IT infrastructure will rarely lead to superior performance. Similarly, Internet resources – as defined above – are not difficult to imitate. In general, Internet technology is by itself imitable. If one firm can purchase certain Internet technologies and thereby implement some strategies, then other firms should also be able to purchase these technologies, and thus such tools should not be a source of competitive advantage. Furthermore, as the diffusion of the Internet continues, the ability of proprietary IT to be a source of competitive advantage continues to be eroded. These arguments suggest that Internet resources may not have a significant impact on business value. Thus, the following hypothesis is proposed:

Hypothesis 1: There is no relationship between Internet resources and business value

3.2 Internal e-Business Capabilities and Business Value

Investing in IT is not a necessary nor sufficient condition for improving firm performance, since IT investments might be misused (Tallon et al., 2000). In this sense, IT assets cannot improve organizational performance if they are not used appropriately. However, when used appropriately IT is expected to create intermediary effects, such as IT being embedded in products and services, streamlined business processes, and improved decisions, which can be expected to have an influence on the performance of the firm (Ravichandran and Lertwongsatien, 2005).

Grant (1991) and Makadok (1991) emphasize that while resources by themselves can serve as basic units of analysis, firms create competitive advantage by assembling these resources to create organizational capabilities. Makadok states that these firm-specific capabilities, embedded in organizational processes, provide economic returns because that firm is more effective than its rivals in deploying resources. IS researchers have adopted

this capability logic of resources by arguing that competitors may easily duplicate investments in IT resources by purchasing the same hardware and software and, hence, IT resources per se do not provide competitive advantages. Rather, it is the manner in which firms leverage their IT investments to create unique capabilities that impact firm performance (Clemons and Row, 1991; Mata et al, 1995). Thus, it is expected that internal e-Business capabilities are positively associated with business value. The following hypothesis incorporates these expectations:

Hypothesis 2: There is a positive relationship between internal e-Business capabilities and business value

3.3 The Complementarity of Internet Resources and Internal e-Business Capabilities

Although there is research that posit a direct relationship between IS resources/capabilities and firm performance (Bharadwaj, 2000; Feeny and Willcoks, 1998; Santhanam and Hartono, 2003), others have questioned the direct-effect argument and emphasized that IS resources/capabilities are likely to affect firm performance only when they are deployed to create unique complementarities with other firm resources (Clemons and Row, 1991; Powell and Dent-Micallef, 1997).

Firm resources are considered complementary when the presence of one resource enhances the value or effect of another resource (Ravichandran y Lertwongsatien, 2005; Zhu, 2004). For example, the complementarity between online offerings and offline assets is the essence of "clicks-and-mortar" companies. Customers who buy products over the Internet value the possibility of getting support and service offered through bricks-and-mortar retail outlets, including the convenience of in-store pickup and return (Zhu, 2004). Hence the RBV highlights the role of complementarity as a source of value creation in e-Business, though is not the only source as suggested by Amit and Zott (2001). As mentioned earlier, Internet resources are not difficult to imitate and per se do not provide competitive advantages. However, having a proper Web infrastructure may facilitate the internal processing of online operations and this way influence positively firm performance. That is, the fact of possessing an adequate Web infrastructure can be critical for the influence of internal e-Business capabilities on business value. Thus, the following hypothesis is proposed:

Hypothesis 3: The complementarity between Internet resources and internal e-Business capabilities explains variations in business value

4 METHODOLOGY

4.1 Data

The data source for the present study is the e-Business W@tch survey 2004, an initiative launched by the European Commission for monitoring the adoption of IT and e-Business activity. The decision-maker targeted by the survey was normally the person responsible for IT within the company, typically the IT manager. Alternatively, particularly in small enterprises without a separate IT unit, the managing director or owner was interviewed.

The population considered in this study was the set of all enterprises which are active at the national territory of Spain and which have their primary business activity in one of ten sectors considered. The sample drawn was a random sample of companies from the respective sector population with the objective of fulfilling strata with respect to business size. A share of 10% of large companies (250+ employees), 30% of medium sized enterprises (50-249 employees) and 25% of small enterprises (10-49 employees) was intended. The number of firms totalled 1 010. 91.1% of firms were small and medium-sized enterprises (less than 250 employees) and each sector considered had a share of around 10% of the total sample.

With regard to respondents' titles, 54.4% were IS managers, nearly 20% were managing directors, and 12.1% were owners. The dataset was examined for potential bias in terms of the respondents' titles. Since respondents included both IT managers and non-IT managers, one could argue that IT managers may overestimate e-Business value. To test this possible bias, the sample was divided into two groups: IS managers (head of IT/DP and other IT senior managers) versus non-IS managers (owner, managing director, strategy development and others). One-way ANOVA was used to compare the means of factor scores between the two groups. No significant differences were found, suggesting that the role of the respondents did not cause any survey biases.

4.2 Measures of Variables

Measurement items were introduced on the basis of a careful literature review. Confirmatory factor analysis (CFA) was used to test the constructs. Based on the CFA assessment, the constructs were further refined and then fitted again. Constructs and associated indicators are listed in the Appendix and discussed below.

- Internet resources construct. This construct represents the adoption of physical Internet technologies. In this sense, respondents were required to assess the presence of four Internet tools: website, Intranet, Extranet and LAN (local area network).
- Internal e-Business capabilities. This construct represents the use of online technologies for supporting internal business processes.
- Business value. As discussed earlier in section 2.3, the present research uses the effectiveness of e-Procurement for measuring business value. That is, business value is assessed through the business impact of purchasing online.

4.3 Instrument Validation

CFA using AMOS 4.0 was conducted to assess empirically the constructs theorized. Multiple tests on construct validity and reliability were performed. Model fit was evaluated using the maximum likelihood (ML) method. The measurement properties are reported below.

Construct reliability. All constructs had a composite reliability over the cut-off of 0.70 (Straub, 1989), and also the average variance extracted for all exceeded the preferred level of 0.5 (Churchill, 1979).

Content and construct validity. Content validity was verified by checking the meanings of indicators and by a careful literature review. Construct validity is the extent to which a construct measures the concepts that it purports to measure (Straub, 1989). It has two components: convergent and discriminant validity. After dropping insignificant items, all estimated standard loadings were significant, suggesting good convergent validity. To assess the discriminant validity Forell and Larcker's (1981) criterion was used. All constructs met this criterion.

Table 1 lists several goodness-of-fit statistics to assess how well specified models explain the observed data. The insignificant p-value ($p = 0.187$) for the chi-square statistics implied good absolute fit. The root mean square error of approximation (RMSEA) is was below the cut-off value 0.08 suggested by Browne and Cudeck (1993). Five incremental fit indices were all above the preferred level of 0.9 (Gefen et al., 2000).

Table 1: Measurement Model Fit indices.

Goodnesss-of-Fit Indices	
Chi-Square	66.054
p-value	0.246
RMSEA	0.032
Normed Fit Index (NFI)	0.971
Relative Fit Index (RFI)	0.955
Incremental Fit Index (IFI)	0.997
Tucker-Lewis Index (TLI)	0.995
Comparative Fit Index (CFI)	0.997

5 EMPIRICAL RESULTS

Hypotheses were tested using hierarchical regression analysis. Table 2 shows Internet resources construct is not statistically significant, whereas e-Business internal capabilities construct is positive and significant (regression 1), as predicted. Regression 2 includes both main and the interaction effect. The interaction effect between Internet resources and internal e-Business capabilities was found significant, thus, supporting the complementarity of Internet resources and internal e-Business capabilities. To further test the significance of the interaction effect, the incremental R^2 between the full model (with interaction term) and the partial model (without the interaction terms) was compared. The result is reported in the lower rows of table 7. In regression 2, the incremental R^2 was 0.026, meaning that approximately an additional 3 percent of explained variance has resulted from the inclusion of the interaction effect with respect to regression 1. To compare the partial model against the full models, a Wald test was performed and the differences were found to be statistically significant. Based on this, the partial model was rejected in favour of the full model (Greene, 2000).

Table 2: Complementarity results: Impact on procurement.

Independent variables	Regr. 1	Regr. 2
Internet resources (IR)	0.083	0.099
Internal EB capabilities (IEBC)	0.196***	0.151**
IR * IEBC	-	0.167**
F	6.595***	6.633***
R2	0.047	0.069
ΔR2		0.026**
p<0.1*; p<0.05**; p<0.01***		

Through this analysis, hypotheses H1, H2 and H3 found support.

6 DISCUSSION

The results showed that Internet resources are not positively related to business value. This finding is not surprising, since competitors may easily duplicate investments in IT resources by purchasing the same hardware and software, and hence IT resources per se do not provide better performance (Santhanam and Hartono, 2003). This can be explained through the RBV, because IT is not considered a resource that is difficult to imitate; IT is by itself typically imitable. This result supports the findings of recent research (Batt and Grover, 2005) that did no find evidence of a positive link between IT quality and firm performance. Similarly, Powell and Dent-Micallef (1997) showed that IT by itself cannot be a source of competitive advantage. Thus, our results confirm that Internet technology by itself will rarely create business value.

Furthermore, results demonstrate that there is a positive relationship between internal e-Business capabilities and business value. Our findings confirm the existing empirical literature. Bharadwaj (2000) and Santhanam and Hartono (2003) found that firms with superior IT capability do indeed exhibit superior firm performance. Ravichandran and Lertwongsatien (2005) showed that an organization's ability to use IT to support its core competences depends on IS capabilities. Thus, even though competing firms do not vary in terms of the IT they possess, IS capabilities are rooted in processes and business routines and provide competitive advantage. In this sense, the results of the present study support the proposition that internal e-Business capabilities are positively associated with business value.

Finally, the empirical results offer support for the complementarity of Internet resources and internal e-Business capabilities. The RBV highlights the role of complementarities between resources as a source of business value. Researchers such as Steinfield et al. (1999) suggest that e-Business value can come from synergies between online and offline presence. In this sense, using case studies, they showed the lack of exploitation of these synergies in SMEs. Zhu (2004) developed a study which evaluates the impact of e-commerce and IT on firm performance (financial measures), studying both the main effects and the interaction effect of e-commerce and IT on firm performance. Our results support the RBV and e-Business literature, therefore, it can be concluded that having an adequate Internet infrastructure can be critical for the impact of internal e-Business capabilities on business value.

7 CONCLUSIONS, LIMITATIONS AND FUTURE RESEARCH

In recent years, much debate about the value of IT and e-Business has been created, due to the gap between e-Business investment and the lack of empirical evidence on e-Business value. Thus, today IS researchers face pressure to answer the question of whether and how e-Business creates value.

The complementarity of resources is a corner stone of the resource-based theory and has been offered as an explanation of how IT has largely overcome its paradoxical nature and is contributing to business value (Bhatt and Grover, 2005; Clemons and Row, 1991). Thus, to respond to these challenges, this study developed a conceptual model, grounded in the resource-based view (RBV) firms, to analyze the complementarity of Internet resources and e-Business capabilities as source of business value at the level of an individual firm. The analysis employed a large sample of companies from different industries for hypothesis testing. Broadly, this research offers several contributions: (1) it identifies Internet resources and internal e-Business capabilities; (2) it shows that Internet technology by itself will rarely create business value; (3) it sheds light on the complementarity of Internet resources and internal e-Business capabilities as source of business value.

While the contributions of the present study are significant, it has some aspects which can be addressed in future research. First, the sample used was from Spain. It may be possible that the findings could be extrapolated to other countries, since economic and technological development in Spain is similar to other OECD Member countries. However, in future research, a sampling frame that combines firms from different countries could be used in order to provide a more international perspective on the subject. Second, the business value measure is subjective in the sense that it was based on Likert-scale responses provided by managers. Thus, it could also be interesting to include objective performance data for measuring business value. Third, the key informant method was used for data collection. This method, while having its advantages, also suffers from the limitation that the data reflects the opinions of one person. Future studies could consider research designs that allow data collection from multiple respondents within an organization. Fourth, this research takes a static, cross-sectional picture of capabilities, which makes it difficult to address the issue of how capabilities

are created over years. A longitudinal study could enrich the findings.

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APPENDIX: MEASURES

Internet Resources:
Does your company have a website? (Y/N)
Does your company use an Intranet? (Y/N)
Does your company use an Extranet? (Y/N)
Does your company use a LAN? (Y/N)

Internal e-Business capabilities:
Do you use online technologies to share documents between colleagues or to perform collaborative work in an online environment? (Y/N)
Do you use online technologies to track working ours and production time? (Y/N)
Do you use online technologies to support human resources management? (Y/N)
When an online order comes, is the order fully integrated with the back-end system? (Y/N)

Business value: e-Procurement effectiveness
What effect has online procurement on the procurement costs? (1-5)
What effect has online procurement on your relations to suppliers? (1-5)
What effect has online procurement on the costs of logistics and inventory? (1-5)

Note. (Y/N), dummy variable; (1-5), five-point Likert-type scale.