

THE IMPACT OF INFORMATION TECHNOLOGY ON BUSINESS COMPETITIVENESS

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Abstract

In this paper, the theoretical contributions from *resource-based view* of the relationship between investment in information technology and firm performance are revised and they are related to the empirical works in this field. The conclusion of the revision is the necessity to consider a series of additional factors that moderate the studied relationship and that, therefore, determine the competitive potential of this technology.

1. Introduction

In recent years, one of the fundamental aspects in the study of information technology (IT) in the managerial field has been the impact of the application of this technology on performance. In fact, during the nineties a lot of studies have appeared that analyse this relationship.

One of the qualities that characterizes the study of this relationship is the underlying heterogeneity as well as in the approach to the analysis of the relationship as in the used variables. This heterogeneity has two clear implications in the revision of the previous studies. First, difficulties appear when the different studies are compared since, on occasions, they analyse totally diverse aspects and, are therefore, not comparable. Second, the complementary relation among studies enriches the analyses and facilitates a basis for subsequent studies.

The evolution of these studies has followed the line of research set out by strategic studies. During the eighties, the influence of the *industrial organization school* appears in several papers that study the competitive effects of new technologies, among which the approach of the pattern of the five forces and the value chain are especially relevant (Porter, 1980, 1985). In the nineties, after the development of the *resource-based view*, some studies that adopt this perspective appear in the specialized literature (Clemons and Row, 1991; Kettinger *et al.*, 1994; Mata *et al.*, 1995; Powell and Dent-Micallef, 1997). Apart from the fact that these contributions clearly contributed to the main currents in the study of *strategic management*, many studies have adopted certain aspects of both theories in the analysis of the relationship among investment in IT and firm performance.

In this paper, we will revise the main contributions from the *resource-based view* to the relationship between IT and performance. We will begin with the analysis of the first works that consider the studied relationship from this point of view. In the third section we will extend the preliminary conclusions and examine several empirical contributions in this field. Lastly we will discuss some conclusions that must keep in mind to carry out future investigations in the study of the competitive potential of IT.

2. First approaches from Resource-Based View to the study of the competitive impact of IT

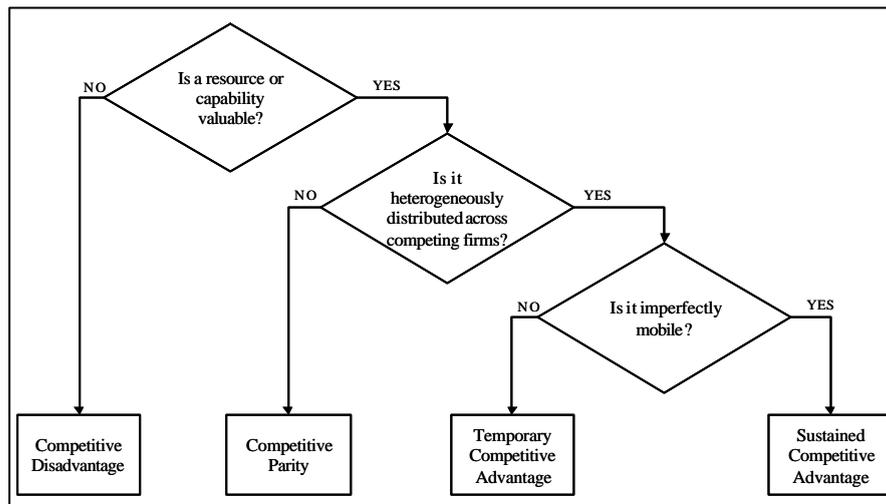
One of the approaches to the study of IT in the managerial field can be carried out from *resource-based view*. This focuses on the creation and maintenance of competitive advantages (taking account of some of the most relevant hypothesis in the eighties) and is based on two fundamental suppositions:

1. Heterogeneity: each company is heterogeneous, since it possesses different endowment of resources, as a result of its own history, its luck and past decisions.
2. Immobility: the company can maintain heterogeneity through time, that is, the competitive advantage can be sustained to provide extraordinary rents for an extensive period of time (Barney, 1991).

IT can be considered as a resource in the company. If we concentrate on the material content of this technology, we can define it as “any form of computer-based information system, including mainframes as well as microcomputers applications” (Orlikowski and Gash, 1992:2). This definition can be enlarged to include technologies that facilitate communication within the company. According to this definition, the question is whether availability of these resources can provide the company with a sustainable competitive advantage.

Several theoretical frameworks have outlined the conditions that a resource should satisfy to provide and to sustain an advantage position (among other Barney, 1991; Grant, 1991; Peteraf, 1993). Barney (1991) establishes a model to define the competitive potential of the resources, starting from three aspects: the value of the resource, the heterogeneity in its distribution along the companies and its mobility (figure 1).

Figure 1. A Resource-Based Model of Competitive Advantage



Source: Mata *et al.* (1995)

If we stick to the definition of IT that we have used, investment in this technology cannot be the foundation of a competitive advantage since it is freely available in the market to any company. However, the question does not consist exclusively on the assessment of the material possibilities of this technology. We also have to bear in mind the intangible ones that are derived from its application in the managerial field.

Starting from the theoretical framework presented in the figure 1, Mata *et al.* (1995) study five IT-derived factors that have been considered in the literature as sources of competitive advantage. The authors conclude that only managerial IT skills are susceptible to provide and to sustain a competitive advantage (figure 2).

Figure 2. Some IT-Related factors that are studied in the first approaches

Factor	Can it provide a competitive advantage?	Can it sustain a competitive advantage?
“Create-Capture-Keep Paradigm”	YES Clemons and Kimbrough (1986); Feeny and Ives (1990); Clemons and Row (1991)	NO Wiseman (1988); Malone <i>et al.</i> (1989)
Access to capital	YES McFarlan (1981, 1984)	NO Cash and Kosynski (1985); Lieberman and Montgomery (1988);
Proprietary technology	YES Porter (1980)	NO Lieberman and Montgomery (1988); Clemons and Row (1991)
Technical IT Skills	YES Copeland and McKenney (1988)	NO Teece (1988)
Managerial IT Skills	YES Katz (1974); Castanias and Helfat (1991)	YES Katz (1974); Castanias and Helfat (1991)

Source: Own elaboration from Mata *et al.* (1995)

This analysis leads to the conclusion that the application of IT implies a situation of competitive parity. However, following Clemons and Kimbrough (1986), many applications of this kind of technology become strategic necessities. This happens when their use becomes pervasive among companies in a sector. This idea, developed in subsequent

works (Floyd and Wooldridge, 1990; Clemons and Row, 1991; Kettinger *et al.*, 1994), has been named as the *strategic necessity hypothesis* and it is explained starting from the two following propositions:

- 1) IT provides value to the firm by increasing internal and external coordinating efficiencies, and firms that do not adopt them will have higher cost structures and will therefore be at a competitive disadvantage,
- 2) Notwithstanding this, companies cannot expect those applications to sustain competitive advantages since most of these technologies are available to all companies (current and potential competitors, clients, suppliers) in factor markets.

This reasoning is suggested in the pattern presented in Figure 1. The strategic necessity hypothesis of IT includes the implicit idea that these technologies are valuable resources for the company and can put the companies that do not acquire them in a position of competitive disadvantage.

In fact, the results of the empirical studies carried out are contradictory, as we will see. Nevertheless, in recent years, several studies have demonstrated that IT provides value to the firm, facilitating improvements in a lot of kind of measures: productivity, quality, timeliness, etcetera. Obviously, these increases do not imply the generation of extraordinary rents since such improvements are freely available in the market for any company -rather, from our point of view, they could lead to a situation of competitive disadvantage, if any firm does not invest in that technology. In this sense, Weill and Olson (1989) distinguish four investment types in IT. One of those types is named *threshold investment*, referring to the minimum quantity that a company should invest to be in situation of competitive parity within the sector.

The possibilities to gain an advantageous competitive position from IT depends on the existence of other resources, fundamentally, intangible resources. Powell and Dent-Micallef (1997) analyse the complementarities that can exist between IT resources and other ones. They distinguish between complementary and cospecialized resources. The complementary resources are defined as those whose value rises if they are exploited jointly. In this case, all resources that are part of the relationship increase their value, although the causation is ambiguous (Barney, 1991). The complementary resources are also cospecialized if, separately, they lose all its value, that is, when the absence of complementary resources inhibits their possibilities of exploitation.

Also starting from *resource-based view*, Bharadwaj (2000) examines the impact of IT in the results of the company. Nevertheless, in this paper the author bears in mind the distinction made by Grant (1991) between resources and capabilities, and distinguishes between tangible and intangible resources. So Bharadwaj starts from the supposition that organizational capabilities that are understood as the ability of the organization to contain, integrate and deploy valuable resources, usually in combination (Amit and Schoemaker, 1993), set a basis of the competitive advantage of companies.

In the cited paper the concept IT capabilities is developed (already introduced by Grant, 1996), and defined as the ability to mobilize and deploy IT-based resources in combination with other resources and capabilities (Bharadwaj, 2000:171). Following the classification of resources carried out by Grant (1991) and transferring it to the field of IT, the author distinguishes between active tangible, formed by the denominated Infrastructure of IT, Human IT Resources and, lastly, the IT-Enabled Intangibles.

The IT Infrastructure consists of all type of communication technologies and computers as well as the shared applications and the databases (Bharadwaj, 2000). In contrast with the aforementioned studies, this resource is considered as the base of a sustainable competitive advantage. Following Broadbent and Weill (1997), although the individual elements that form the IT Infrastructure of the company are available in the market, the integration of those components to develop this infrastructure, adjusted to the strategic context of the company, is a complex process and imperfectly understood. Consequently, following the framework proposed by Barney (1991), IT infrastructure will be a

resource able to sustain a competitive advantage. Nevertheless, from our point of view, the capacity to configure the infrastructure is mainly a complementary resource to IT but different from this.

The IT Human Resources include the technical and the managerial abilities that are referred by Mata *et al.* (1995). In this way, again these abilities should be considered as complementary resources respect to IT.

Regarding the IT-Enabled Intangibles, the study emphasises the complementary aspect of the technology of information as a basis to exploit other resources, as suggested by Powell and Dent-Micallef (1997). However, from our point of view, these resources make reference again to the managerial abilities in IT since the elements considered in the analysis are the orientation to the customer, the support to the coordination of activities, the search for synergies, etcetera, that are the consequence of these abilities.

Starting from these contributions, the question is the delimitation of those resources that are susceptible to complement IT, and, in this way, to provide and to sustain a position of competitive advantage. We will dedicate the following section to examine the references to these resources in the main studies in the field.

3. The complementary relationship of IT with other resources

In the eighties, a series of empirical studies were carried out that try to relate the investment in IT with firm performance. The initial optimism toward the competitive possibilities of IT was based on the existence of many cases that showed the successful application of this technology. However, another group of studies that tried to test this relationship in companies of one or several sectors obtained ambiguous results.

In Figure 3 we observe the improvement of the results when additional factors are considered. The first studies that relate the investment in IT with managerial results adopt a rather simplistic approach to the problem, they try to explain firm performance in terms of investment in these technologies, using excessively parsimonious models in which the absence of intermediate variables and the shortage of control variables stand out. Specifically, the main deficiencies of these that stand out in the literature are:

1. Mistakes in the measurement of the resources of IT and of firm performance (Brynjolfsson, 1993; Bakos, 1998).
2. A lagged response due to the adjustment and learning necessity (Weill and Olson, 1989; Brynjolfsson, 1993; Bakos, 1998).
3. Deficient administration of the resources of IT (Weill and Olson, 1989; Brynjolfsson, 1993; Bakos, 1998; Stratopoulos and Dehning, 2000).
4. Redistribution and dissipation of the benefits (Brynjolfsson, 1993).

In recent years, the models have become more sophisticated with the inclusion of factors analysed in the theoretical works. In this way, many studies have solved the paradox and have overcome the aforementioned limitations. Thus, our starting point is reaffirmed since it implies the necessity of conjunction of IT with other factors to explain its impact on firm performance.

Nevertheless, in spite of the abundance of papers that establish factors in the study of the competitive impact of IT, the incorporation of these variables has not been homogeneous. This way, excluding the study of the alignment between business strategic orientation and information systems (IS) strategic orientation (King, 1978; King and Zmud, 1981; Teo and King, 1996; Chan *et al.*, 1997; Bergeron *et al.*, 2001) and the incidence of the environmental factors, the articles that consider another variables constitute a limited group of exceptions, among which we can mention the study of Powell and Dent-Micallef (1997) as a specially outstanding contribution. From the revision of the literature, the main factors that influence in the studied relationship appear picked up in the Figure 4. Obviously, we recognize the partiality of the factors enumerated in the figure. The determination of those resources that are susceptible of being supplemented with IT to base a competitive advantage requires of exploratory empirical analysis that support the theoretical frameworks.

Figure 3. Some empirical studies on IT investment-firm performance relationship

Study	IT Measure	Another considered variables	Result Measure	Empirical results
Turner (1985)	Data processing expense as a percentage of operating expenses	- Organization size - Banks	Net incomes over total assets	No relationship between organizational performance and IT investment
Bender (1986)	IT expenses as a percentage of premium income	- Insurance	Ratio of expenses over premium income	Optimum level of IT investment exist
Loveman (1988)	IT budget	- Other expenses - Work force composition - Manufacturing	Net sales	No relationship between organizational performance and IT investment
Harris y Katz (1991)	IT expenses over total operating expenses	- Cost IT efficiency - Insurances	Operating expenses over premium incomes	Positive relationship between IT investment and firm performance
Weill (1992)	IT investment. Three types of IT investment are distinguished: strategic, transactional and informational	- Conversion effectiveness – organizational climate - Valve manufacturing sector	Six financial measures	No relationship between strategic IT investment and firm performance. Transactional IT investment is related to company results and this relation is moderated by conversion effectiveness.
Mahmood y Mann (1993)	IT budget as a percentage of revenue, value of an organization's IT as a percentage of revenue, percentage of IT budget spent on staff, percentage of IT budget spent on the training of IT staff and number of PCs and terminals as a percentage of total employees	- Other investments in production factors	ROI, return on sales, growth in revenue, sales by total assets, sales by employee and market to book value	Positive relationship between IT investment and firm performance
Barua <i>et al.</i> (1995)	IT budget	- Other investments in production factors - Intermediate performance measures - Environmental factors (industry and economy)	Market share and ROA	IT investment influence positively in intermediate performance measures and these influence positively in firm performance measures
Hitt y Brynjolfsson (1996)	IT budget, IT stock and work forced involved in IT management	- Other investments in production factors - Environmental factors (industry) - Consumer surplus	Productivity and profit measures	Positive relation between IT investment and productivity measures. No relation between IT investment and profit measures.
Rai <i>et al.</i> (1996)	IT budget	- Conversion effectiveness o Cost efficiency o Sales efficiency - Environmental factors (industry) - Organizational size - Intermediate performance measures	ROI, ROA, market share and total sales.	Positive relation between IT investment and market share and total sales. No relation between IT investment and ROA and ROI.
Powell y Dent-Micallef (1997)	IT application investments	- Human and business resources - Retail industry	Subjective firm performance measures	Positive relationship between human resources and IT resources complementarities and firm performance measures.
Li y Ye (1999)	IT budget over total assets	- Organizational size - Environmental factors - Alignment between business strategic orientation and information system strategic orientation - Strategic orientation	ROA	Positive relationship between IT investment and firm performance. This relation is influenced by other factors presence
Stratopoulos y Dehning (2000)	IT budget	- IT Management efficiency	Profits and efficiency measures	Positive relation between IT investment and both kind of firm performance measures. This relation is influenced by IT management efficiency
Sircar <i>et al.</i> (2000)	Same measures as Mahmood and Mann (1993)	- Other investments in production factors	Same measures as Mahmood and Mann (1993)	Positive relationships between IT expense and firm performance measures, except for ROI

Figure 4. Main Influence Factors in the IT-Performance Relationship

Resource	References
Open organization	Zuboff (1988); Orlikowski and Gash (1992); Powell and Dent-Micallef (1997)
Open communications	Zuboff (1988); Orlikowski y Gash (1992); Powell and Dent-Micallef (1997)
Organizational consensus	Rockart and Short (1989); Weill (1992); Clemons and Row (1993); Powell and Dent-Micallef (1997)
Organizational flexibility	Huber (1990); Orlikowski and Gash (1992); Benjamin and Levinson (1993); Powell and Dent-Micallef (1997)
Supplier relations	Neo (1988); Johnston and Vitale (1988); Holland <i>et al.</i> (1992); Keen (1993); Kettinger <i>et al.</i> (1994); Powell and Dent-Micallef (1997)
Customer orientation	Neo (1988); Mahmood and Soon (1991); Kettinger <i>et al.</i> (1994); Mata <i>et al.</i> (1995)
Alignment between business strategic orientation and IS strategic orientation	King, 1978; King and Zmud, 1981; Teo and King, 1996; Chan <i>et al.</i> , 1997; Bergeron <i>et al.</i> , 2001

On the other hand, in the figure we have not picked up the existence of external factors that affect on the relationship. From our point of view, in order to control this type of variables analysis should be restricted to one sector. Even, some authors have distinguished in their analyses the different strategic groups with the objective of bearing in mind the incidence of these external factors (Segars and Grover, 1994).

4. Discussion

The revision of the main papers that study the proposed relationship leads to the determination of several conclusions that can guide the later empirical studies.

On the one hand, the innocent consideration of the relationship between IT and firm performance does not provide the explanation of the extraordinary results obtained by companies. Nevertheless, some of the revised analyses, fundamentally those have been centred in the incidence of this technology on company productivity, demonstrate the positive impact of technology investment on results. This conclusion is compatible with the low explanatory level of this investment on the differences of results among companies. Many applications of IT become strategic necessities, so the investment in them can only lead to a situation of competitive parity. Also, in the definition of this strategic necessity hypothesis there is an implicit argument that inhibits the possibility to explain extraordinary yields as a consequence of the investment in these technologies since the consideration of necessity is reached, in fact, when the most of the companies that compete in a sector has adopted this technology. This way, the homogeneity in the endowment of the resource eliminates the explanatory power regarding the difference of results but not to the positive impact on the results of most of the companies.

Nevertheless, in spite of the absence of explanatory power regarding the obtaining of superior yields, the strategic necessity hypothesis implies the possibility that a few companies do not acquired that technology and, therefore, they are in a position of competitive disadvantage, following the logic of the pattern exposed in the Figure 1. This way, it is necessary to carry out some empirical investigations to test the validity of this hypothesis.

On the other hand, as much the theoretical arguments as the empirical approaches to the relationship indicate the necessity to include additional variables that moderate the relationship. However, the absence of solidity in most of the developments that have been reached, gets the attention on the lack of rigorous exploratory studies that help to determine the group of variables that should be kept in mind. Nevertheless, we can conclude from the revision the existence of two significant factors in this relationship: the alignment between business strategic orientation and information systems strategic orientation and the characteristics of the activity sector.

The consideration of these additional variables constitutes, from our point of view, the key to overcome the deficiencies marked by the literature. The problems of measurement arise of the independent consideration of this technology, using excessively narrow concepts that do not reflect the dimension of the information system of a company. Also, the

observation of other resources can overcome the limitations corresponding to the lack of attention on the adjustment and learning necessities as well as of the technology management. These variables will be measured since, undoubtedly, they will moderate the studied relationship.

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