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# Using resource-based theory to interpret the successful adoption and use of information systems and technology in manufacturing small and medium-sized enterprises

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**Abstract**

The purpose of this paper is to consider how resource-based theory can be used to explain success with the adoption and use of information systems and information technology (IS/IT) in manufacturing small and medium-sized enterprises (SMEs). A number of authors have explored the applicability of resource-based theory to the IS/IT domain, mainly at a conceptual level. Overall they infer that the key differentiators for long-term successful IS/IT deployment reside within the internal context of an organisation, based on organisational competences. This paper is based on in-depth case study research in 12 Portuguese manufacturing SMEs, which identified two factors that, from the empirical evidence, appeared to be the determinants of the different levels of success in IS/IT adoption and use. These factors were also primarily associated with the internal context of the organisations. Therefore, the findings were analysed from the perspective of resource-based theory, to understand why and how the attributes of these factors caused the differential levels of IS/IT success in the firms studied.

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**Keywords:** IS/IT adoption and success; manufacturing SMEs; resource-based theory

**Introduction**

The globalisation of the economy is forcing many enterprises to change in order to survive. To compete in these global markets, many manufacturing small and medium-sized enterprises (SMEs) need to develop new business strategies and employ new technologies. However, manufacturing SMEs usually have poor human and financial resources (Welsh & White, 1981; Bridge *et al.*, 1998) and are therefore likely to be less prepared and less able to change. A better understanding of the ways in which SMEs adopt and implement new technologies, like information technology (IT), is necessary because previous research in the area is limited and a significant percentage is out of date due to the rapidly changing economics of using IT, and the resulting increased adoption by smaller enterprises.

This research, conducted in Portuguese manufacturing SMEs, was designed to provide an in-depth understanding and explanation of the relative levels of success in Information Systems (IS)/IT adoption and use. The definition of an SME for this research was in accord with Portuguese legislation: it must have fewer than 500 employees; turnover must be less than (approximately) £10m; it cannot be more than 50% owned by a

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non-SME enterprise. Through detailed case studies in 12 firms, factors and factor relationships were determined that provide a coherent explanation of the evidence collected. The findings from this aspect of the research are described in detail in an earlier paper by the authors (Caldeira & Ward, 2002).

A second objective of the research was to provide further understanding of the causes of the relative levels of adoption and success, by reference to appropriate theory. IS research is often criticised for insufficient reference to theory in explanations of findings. This paper describes how the findings from the study can be understood with reference to resource-based theory.

Resource-based theory treats enterprises as potential creators of value-added capabilities. Understanding the development of such capabilities, and the underlying organisational competences, involves viewing the assets and resources of the firm from a knowledge-based perspective (Winter, 1988; Prahalad & Hamel, 1990; Conner & Prahalad, 1996). Prahalad & Hamel's concept of 'core competences' relates to the mechanisms by which firms develop and accumulate knowledge and skills and deploy them to produce business capabilities which are superior to competitors. One of the objectives of the theory is to help managers to appreciate why individual skills and organisational knowledge and competences can be perceived as valuable assets and to understand how these assets can be used to improve business performance. As is explained in more detail in the fifth section, a business capability results from the organisational competences to acquire and use resources effectively, especially the knowledge and skills of individuals.

This research provides evidence that differing levels of IS/IT capabilities in the organisations studied are related to the skills, knowledge and competence in the organisation. In particular the development of internal IS/IT skills *combined with* top management's knowledge and attitudes towards IS/IT adoption produce the competences required to achieve higher levels of success with IS/IT adoption and use in manufacturing SMEs. Resource-based theory enables a coherent explanation for interpreting and understanding the research findings.

This paper is structured in five sections followed by a summary of the conclusions. After this 'Introduction', we present an 'Overview of the research method and results'. Since the research relies on a clear differentiation of degrees of success in IS/IT use, the next section ('Concept of IS/IT success') discusses the rationale for the measure of success chosen in this research. The fourth section is a summary of the empirical findings from the 12 case studies. Finally, the fifth section, introduces the principles of resource-based theory, with particular emphasis on its prior use in the IS/IT field, and presents a 'Discussion of the empirical findings in relation to resource-based theory' in the light of resource-based theory, bringing the evidence and theory together to discuss how resource-based theory can provide an explanation of the findings in this study.

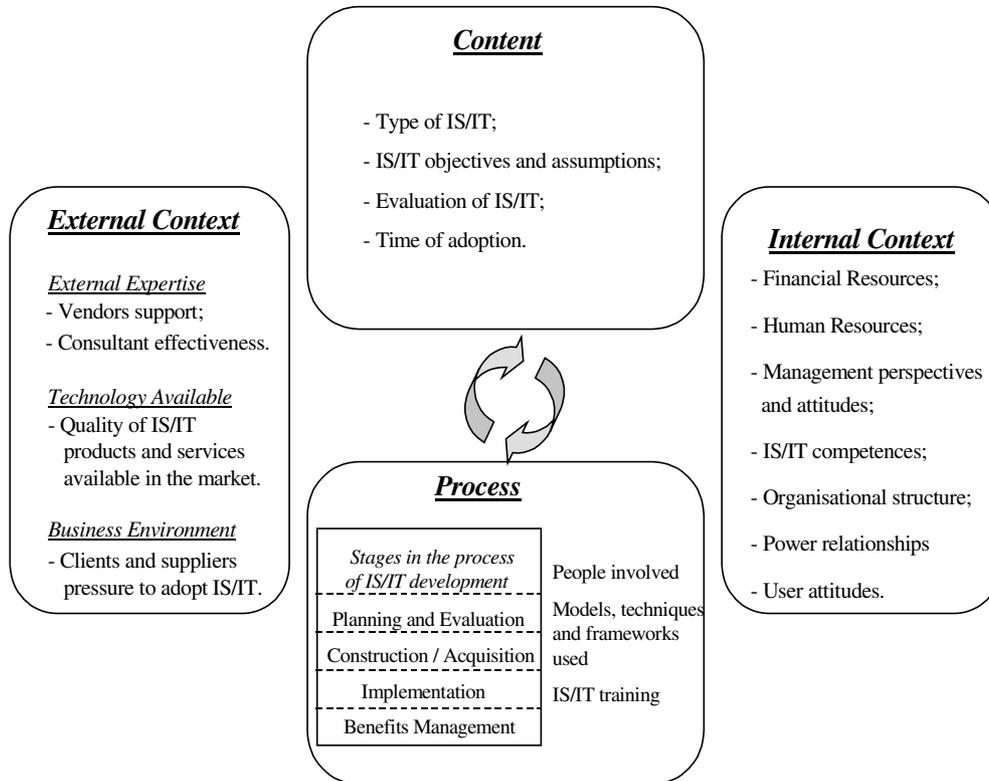
## Overview of the research method and results

Although there are many case studies and resulting theories explaining success and failure of IS/IT projects in large organisations (for example, Sauer, 1993; Flowers, 1996), the literature review revealed that there is little research explaining the different levels of overall success in IS/IT adoption and use in manufacturing SMEs (some examples can be found in Raymond, 1985; Delone, 1988; Yap *et al.*, 1992) and none applied to Portuguese manufacturing SMEs. As Dandridge (1979) clearly expresses, small businesses are significantly different from large enterprises, and theory and management frameworks developed for large organisations frequently do not fit. Moreover, previous research in SMEs was mainly carried out in more developed Western countries, like Canada, USA or the UK, with different national cultures compared with Portugal (see, for example, Hofstede, 1980, 1991). Several studies present the relevance of national culture in the adoption of IS/IT or strategic choice (Schneider & De Meyer, 1991; Doukidis *et al.*, 1996) but there are no significant conclusions about differences in IS/IT success factors. Only a cross-national cultural study could clarify this issue. Another important aspect is that nearly 80% of the 36 previous empirical research studies of IS/IT in SMEs prior to this work, which were identified in the literature review, were based on surveys (for example, Raymond, 1985; Delone, 1988; Lefebvre & Lefebvre, 1988; Montazemi, 1988; Cragg & King, 1993; Chen & Williams, 1993). These collectively identified a reasonably consistent range of relevant adoption and success factors, but failed to explore relationships among the factors, and hence provide explanations.

A framework, based on the work of Pettigrew *et al.* (1989), was used to structure the factors identified from the previous research and analyse the data from the fieldwork (see Figure 1). The factors identified as associated with IS/IT adoption and success were mapped across four dimensions, according to their primary nature. These dimensions are: internal context, external context, process and content.

The *external context* includes the knowledge available in the market plus the business and technological environment that, although external to the firm, influences IS/IT adoption and use. The *internal context* includes the set of resources, competences, management perspectives, structures and relationships that are inherent to the organisation. *Content* refers to the type of IS/IT implemented, IS/IT objectives, assumptions, evaluation and time of adoption. *Process* is defined as a set of actions that lead to IS/IT adoption and use in organisations. It relates to the models, techniques and frameworks used, along with the stages of IS/IT development in the firm (IS/IT planning and evaluation, IS/IT construction/acquisition, implementation and benefits management).

Based on the review of the results of previous studies, it was clear that in order to understand the successful adoption and use of IS/IT in manufacturing SMEs it



**Figure 1** Initial framework for analysis of IS/IT in SMEs (Compiled by the authors, based on Pettigrew *et al.*, 1989).

would be necessary to understand relationships among factors within and across the dimensions of *internal context*, *external context*, *process* and *content*, since the factors identified in previous research could be aligned to these dimensions (see, for example, Yap *et al.*, 1992; Thong & Yap, 1995; Thong *et al.*, 1996; Premkumar & Roberts, 1999).

Twelve enterprises in several manufacturing industries were selected for in-depth case study research: see Table 1 for information about firms and interviewees. The firms chosen were expected to cover different levels of IS/IT success and adoption. In this research, *user information satisfaction* was used as a surrogate measure of IS/IT success, based on the general definition suggested by Ives *et al.* (1983, p. 785) — user information satisfaction is “the extent to which users believe the information system available to them meets their information requirements’. There is a considerable volume of literature concerning how best to measure ‘user information satisfaction’ and how to construct an organisational interpretation from the views of multiple users. This is discussed in the next section, where the rationale for adopting *user information satisfaction* as the measure of success in this research is explained.

The enterprises involved in the case study research may not represent the general situation of Portuguese SMEs. The sample was selected on the basis of studying firms that could be deemed successful or unsuccessful with IS/IT adoption and use, and does not enable any type of

statistical generalisation to be made for Portuguese industry.

Semistructured interviews with 68 questions/topics based on the framework shown in Figure 1 were the main research method used. Semistructured interviews are able to generate rich data that allow an understanding of the research topic according to the perspectives of the key actors involved. This research is explanatory by nature and the use of in-depth case studies, based on semistructured interviews, is an appropriate research method. It enables the interviewees to express their perspectives beyond the limits imposed, for example, by a structured questionnaire or by a survey. This method of data collection was complemented by an analysis of the documents provided by the firm and a short questionnaire to confirm the level of IS/IT success perceived in the interviews.

The data were coded and analysed by the use of a software package for qualitative data analysis — *NUD\*IST* (now called *NVivo*). The structure of the framework was introduced into the index system of the software package and the software helped to structure and analyse the data, according to the dimensions provided by the research framework.

The criteria used to interpret the data gathered in the fieldwork and cluster the firms according to their relative level of success with IS/IT adoption and use are essentially based on three issues: the level of user information satisfaction expressed by the interviewees; problems and

Table 1 Characteristics of the firms and interviewees in the case study firms

Firm	Industry	No of employees	Turnover (million £)	Interviewees
1	Mould	450	16.0	CEO (50% owner), VP for operations, industrial director and IS/IT expert, former top manager and IS/IT manager (4)
2	Textiles	121	4.8	Entrepreneur/top manager (50% owner), IS/IT expert, general manager (3)
3	Mould and cement structures	196	9.2	CEO, Finance and IS/IT manager, computer system administrator (3)
4	Mould	138	11.2	CEO, IS/IT manager, finance manager (3)
5	Textiles	290	8.0	Manufacturing and IS/IT manager, finance manager, computer programmer/analyst (3)
6	Wine	58	6.4	Finance manager, IT analyst, software house supplier (3)
7	Textiles	340	12.8	CEO (50% owner), administrative director, IS/IT expert (3)
8	Footwear	250	6.0	CEO (50% owner), finance manager, IT specialist, IS/IT expert (software house) (4)
9	Wine	165	20.0	CEO (50% owner), manufacturing manager, finance and IS/IT manager, IS/IT expert, external software supplier (5)
10	Textiles	160	11.2	CEO (50% owner), manufacturing manager, IS/IT specialist, external IS/IT supplier (4)
11	Footwear	123	4.0	CEO (50% owner), general manager, IS/IT expert/vendor (software house) (3)
12	Textiles	350	10.0	Finance manager, IS/IT manager/consultant, computer programmer/analyst, computer programmer/analyst (4)

potential solutions identified by the interviewees related to IS/IT adoption and use; and the contribution of IS/IT to the business as perceived by the interviewees. Similar criteria to evaluate IS/IT success can be found in the IS/IT literature (Earl, 1990, 1993; McGolpin & Ward, 1997). For example, Earl (1993) reports that in the field of IS most measures of IS/IT success have relied upon satisfaction scores, absence of problems and audit checklists.

From the analysis of the data, four clusters (named A–D) emerged as clearly distinguishable, based on the combination of levels of management information satisfaction and the extent of IS/IT adoption and use (see Figure 2). The purpose of this research was to identify, classify and analyse factors and their interrelationships that may explain what enables or inhibits the successful adoption and use of IS/IT in manufacturing SMEs. In order to achieve this objective, it was essential to study manufacturing SMEs that showed different relative levels of satisfaction with IS/IT.

Three of the firms studied were classified in *cluster A*. In these firms, managers interviewed stated that they were highly satisfied with the adoption and use of IS/IT in the enterprise (the level of satisfaction with IS/IT was rated 4 or 5 in the questionnaire). No actual significant problems were reported nor were better, feasible solutions for IS/IT adoption and use identified by the interviewees. The

interviewees also stated that significant business benefits were achieved by the use of IS/IT. All the firms in *cluster A* had their core processes integrated by the use of IS/IT and two had interorganisational information systems with their major customers (external integration).

The two firms in *cluster B* presented lower levels of management satisfaction with IS/IT adoption and use. Although the interviewees were positively satisfied with IS/IT adoption and use in the firms (in the questionnaire, the level of satisfaction with IS/IT was scored 3 or 4), some problems still existed or better ways of using IS/IT had been identified. The firms in this cluster had core processes integrated by the use of IS/IT and interviewees could describe specific business benefits achieved by the use of IS/IT.

In the four firms in *cluster C*, managers had similar levels of satisfaction to those in *cluster B* (the level of satisfaction with IS/IT was scored 3 or 4) but their level of IS/IT adoption was lower. The firms in *cluster C* did not have their core administrative and manufacturing processes integrated. However, two of these firms (5 and 7) were trying to integrate their administrative and manufacturing systems and one (firm 10) was implementing interorganisational information systems with its major suppliers without integrating its core processes (as the arrows in Figure 2 indicate).

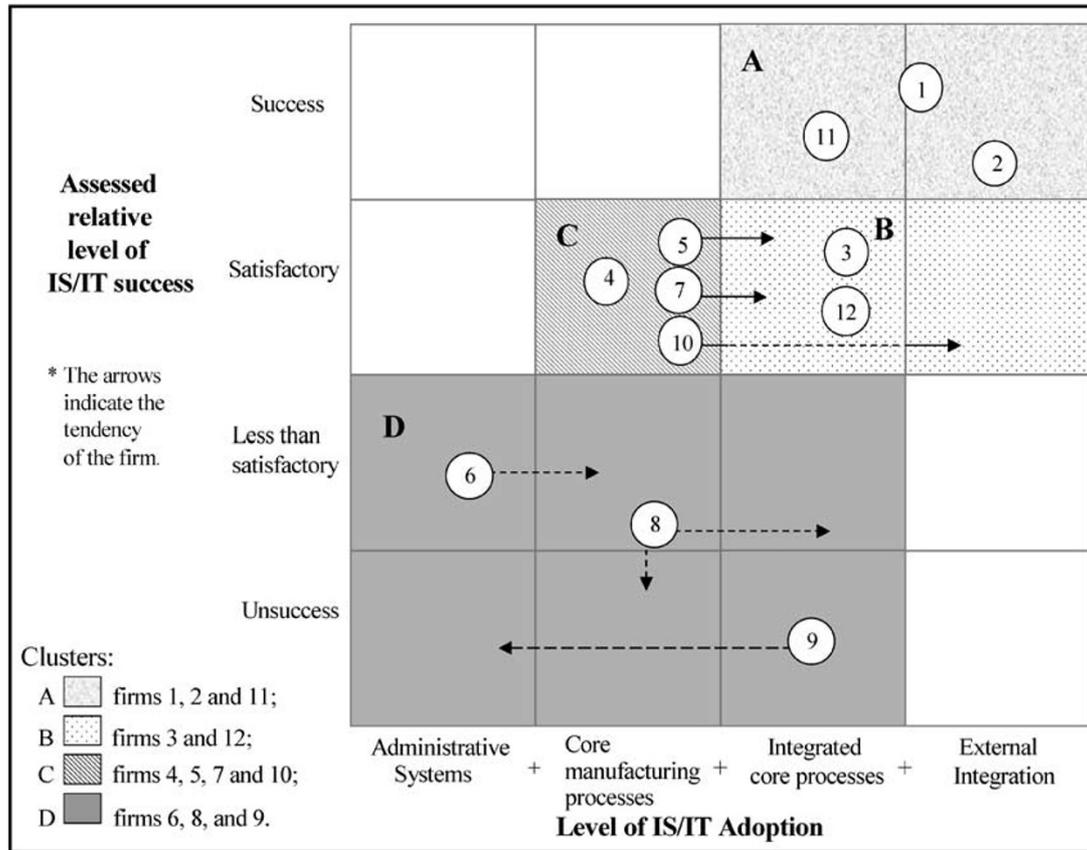


Figure 2 Clusters for analysis.

Firms were classified in *cluster D* when all or almost all of the interviewees were not satisfied with the level of information provided by IS/IT (the level of satisfaction was rated 1 or 2 in the questionnaire) or serious problems with IS/IT adoption and use were reported, for which no feasible solutions had been identified in the short/medium term. IS/IT was also perceived as making little, if any, contribution to business performance. The level of IS/IT adoption of these firms varied. One enterprise had only administrative systems (but was trying to develop manufacturing systems), one had its core administrative and manufacturing processes computerised, and one had achieved a stage of integration between core administrative and manufacturing processes, although these were badly integrated and the manufacturing information systems did not provide the information required.

### Concept of IS/IT success

The concept of IS success is recognised as problematic and can be interpreted in many different ways. Given the objectives of this research, it was important to define a legitimate measure of 'success' that could clearly and unambiguously differentiate a number of levels of success in the case studies. Very few SMEs actually undertake any formal measure of their IS/IT performance (Evans & Nesary, 1991), and the literature did not present any

concept of IS/IT success that was developed particularly for SMEs. A brief resume of the main options follows before explaining the chosen measurement in more detail.

To Brabander & Thiers (1984, p. 139) IS success is related to 'the final efficiency in the accomplishment of the task for which the information system is to be developed'. From the perspective of cost-benefit analysis, Ives & Olson (1984) attempted to define information systems success as 'the aggregate organisational benefit accruing from it (the computer-based IS) when compared with alternative investments' (p. 591). However, a cost-benefit analysis approach justifying the purchase and use of computer-based IS is difficult (Ives *et al.*, 1983; Ives & Olson, 1984; Ballantine *et al.*, 1998) and previous studies failed to provide definitive evidence that the use of computers improves financial performance in SMEs (Turner, 1982; Cron & Sobol, 1983; Yap & Walsham, 1986; Cragg, 2002).

'IS effectiveness' is also often used in relation to IS/IT success (Raymond, 1990). IS effectiveness can be defined as 'the extent to which an information system actually contributes to achieving organisational goals, i.e. its effect on organisational performance' (Thong *et al.*, 1996; p. 252). Measuring IS/IT effectiveness is also a complex task because it is not easy to isolate and evaluate

the effect of IS/IT among a large set of linked organisational factors. DeLone & McLean (1992, p. 74) state that: 'MIS academic researchers have tended to avoid performance measures (except in laboratory studies) because of the difficulty of isolating the effect of the IS effort from other effects which influence organisational performance'.

Since it is difficult to evaluate IS/IT success objectively, two variables are commonly used as surrogate measures: level of computer utilisation and user information satisfaction (Raymond, 1985; Baroudi *et al.*, 1986; DeLone, 1988; Montazemi, 1988; Melone, 1990; DeLone and McLean, 1992). According to DeLone & McLean (1992, p. 69), 'user satisfaction or user information satisfaction is probably the most widely used single measure of IS success'. This is due to the fact that 'satisfaction' has a high degree of 'face validity', since it may be hard to classify as not successful a system that users say they like. The usefulness of user information satisfaction is higher when compared to the conceptual weaknesses of most other potential measures of IS/IT success.

The extent of systems usage as a surrogate measure of IS/IT success was not considered appropriate for this study. Baroudi *et al.* (1986), studying user satisfaction and systems usage, reached the conclusion that usage was dependent upon satisfaction. Srinivasan (1985) argues that in certain types of IS/IT a positive association may exist between systems usage and IS/IT effectiveness, but in other types of IS/IT this relationship may be non-existent. Igbaria *et al.* (1997) concluded that perceived ease of use is a dominant factor in explaining systems usage. Moreover, due to the traditionally weak position of employees in SMEs (Carson *et al.*, 1995), for many organisations, systems usage may be compulsory. As Gatian (1994, p. 119) points out, 'systems usage does not necessarily translate into improved productivity or effectiveness, especially when usage is mandatory'.

In SMEs, entrepreneurs and senior managers are usually involved in every organisational process, and hence they tend to have a comprehensive perspective of all organisational issues, including IS/IT. Therefore in this study, user information satisfaction is considered synonymous with 'management information satisfaction', based on interviewees' expressed satisfaction with the performance of IS/IT in the enterprise.

User information satisfaction is clearly a subjective concept and may be interpreted differently by the different key actors. In reality, there was generally little disagreement among interviewees regarding IS/IT success in each firm in this study, across these three issues.

### Summary of findings from the empirical study: success factors

The analysis of the data, using NUD\*IST, identified 15 factors that related to IS/IT success in the cases studied. As described in the previous paper (Caldeira & Ward, 2002),

two of these factors were identified as *determinant factors* (see below). The others were denominated *secondary factors* since they are important for IS/IT adoption but are not critical to achieving IS/IT success.

#### Secondary factors include:

- availability of financial resources;
- availability and quality of human resources;
- quality of the software available in the market;
- quality of IS/IT external expertise and services available;
- type of IS/IT to be implemented;
- definition of IS/IT objectives;
- the time of IS/IT adoption;
- user attitudes;
- power relationships between the members of the firm;
- IS/IT vendors' support;
- business pressure to adopt IS/IT;
- IS/IT training;
- people involved in the process of IS/IT development.

While the focus of the rest of this paper is on the determinant factors, it is worth considering briefly the reasons why some of the other factors above were identified as 'secondary'. For example, user attitudes were only a problem in the firms where top managers were not exerting pressure on employees to use computer systems properly. In the firms where top managers were involved, problems of resistance to change were not an issue.

Lack of financial resources, although important, was not stated by interviewees as a significant constraint to IS/IT adoption. Some of the more successful enterprises made large investments in IS/IT without having enough money, using bank loans, because managers believed IS/IT adoption would be important for the firm. It is also interesting to note that in the firm that invested the most in IS/IT, managers showed very low levels of satisfaction with IS/IT adoption and use.

The type of IS/IT implemented was found to be relevant in understanding the assessed relative level of IS/IT success of the firm. Most firms had significant problems implementing systems to support their core manufacturing processes but not with administrative systems, although the attempt to integrate both manufacturing and administrative systems was found to be a source of potential problems, as experienced by firm 9. In this firm, the attempt to integrate all the systems led to poor administrative and manufacturing systems (see the arrow in Figure 2). The difficulties implementing and integrating manufacturing systems, which fulfil the organisational requirements, imply that manufacturing SMEs may have their particular problems adopting IS/IT, when compared to other types of SMEs.

*Determinant factors* are those that appear to explain relative IS/IT success. Data collected in the fieldwork provided evidence that these factors actually determine why some firms in this research are more successful than

others with IS/IT adoption and use. Only two of the factors analysed are in this category:

- IS/IT competences (IS/IT people and knowledge available);
- management perspectives and attitudes towards IS/IT adoption and use.

The development of IS/IT skills in-house is limited by the difficulty of hiring qualified IS/IT experts. The firms that were less successful adopting and using IS/IT put more emphasis on the perceived quality of the software systems they were buying, than the need to develop IS/IT competences in-house. On the contrary, the more successful firms concentrated on acquiring expert help to develop in-house knowledge, in order to be prepared to build, buy or contract out computer solutions to meet their business requirements.

In manufacturing SMEs, the CEO and other top managers are frequently owners and entrepreneurs. In many cases, these top managers/owners established the firm and had been there since its foundation. They have comprehensive knowledge of the business and are personally involved in most strategic, tactical and even operational decisions (as explained in Shuman *et al.*, 1985). Therefore, the CEO has the authority to influence other members of the business and he or she is likely to overcome any resistance to change (Markus, 1983; Thong *et al.*, 1996). The data show that SMEs invest in IS/IT if top managers believe they will get benefits from those investments. Evidence from the study confirms that commitment to and involvement of top management in the process of IS/IT adoption and use is extremely important for the success of the IS/IT investments in SMEs.

The attributes of these two determinant factors clearly distinguished and explained the relative success of IS/IT adoption in the firms studied. Those firms in clusters A and D showed distinct differences as outlined above, whereas in clusters B and C only one factor had similar attributes to the more successful group of firms in cluster A.

Five factors suggested in the literature to be related to IS/IT success were not found to be significant in this study. These factors were consultant effectiveness; position of the IS/IT manager in the organisational structure; evaluation of IS/IT benefits; stages followed in IS/IT development; frameworks and techniques used in IS/IT development.

Since both the *determinant factors* are aspects of the internal context of the firm (see Figure 2), an explanation of the findings was sought by considering the applicability of resource-based theory, which asserts that an organisation's ability to achieve sustainable advantages is related to a set of attributes, internal to the organisation. In this research, the evidence suggests that an organisation's ability to implement and use IS/IT successfully over an extended period also related to factors internal to the firm.

The discussion in the next section attempts to explain how and why the particular combination of factor attributes caused differing levels of IS/IT capability in the firms studied.

### Discussion of empirical findings in relation to resource-based theory

Resource-based theory has been developed to understand how organisations achieve sustainable competitive advantages. The theory focuses on the idea of costly-to-copy attributes of the firm as sources of business returns and the means to achieve superior performance and competitive advantage (Barney, 1986; Rumelt, 1987; Conner, 1991; Hamel & Prahalad, 1996). According to resource-based theory, a firm must look for unique attributes that may provide superior performance.

A firm can also be understood as a collection of physical capital resources, human capital resources and organisational resources (Barney, 1991). Resources that cannot be easily purchased, that require an extended learning process, or are a result of a particular corporate culture are more likely to be unique to the enterprise and, therefore, more difficult to imitate by competitors. It is argued that performance differentials between firms depend on having a set of unique inputs and capabilities (Conner, 1991). IS/IT is one of the inputs and, depending on how it is managed, can be a differentiating capability (Keen, 1993). According to resource-based theory, competitive advantage occurs only when there is a situation of resource heterogeneity (different resources across firms) and resource immobility – the inability of competing firms to obtain resources from other firms (Barney, 1991).

Barney (1991) argues that in order to provide competitive advantage, a resource must fulfil four criteria:

1. *Valuable*: The resource must have strategic value to the firm (for example, by exploiting opportunities or neutralising threats).
2. *Rare*: The resource must be unique or rare to find among the current and potential competitors of the firm.
3. *Imperfect imitability*: It must not be possible to perfectly imitate or copy the resource (because it is difficult to acquire; because the link between the capability or the achieved sustained competitive advantage is ambiguous; or because it is socially complex).
4. *Non-substitutability*: Competitors cannot substitute the resource by another alternative resource to achieve the same results.

Table 2 provides an example from one of the firms in cluster A – i.e. highly successful – of how each of the four criteria for competitive advantage from resources, as presented by Barney (1991), were met.

The idea that complex internal resources and capabilities are critical to a firm's success is not new (Selznick, 1957). However, the concepts of knowledge, capability and competence have aroused much interest in the 1990s

Table 2 Exemplifying the 4 key attributes of a resource for achieving competitive advantage

<i>Resource-based theory criteria for advantage</i>	<i>Evidence from the most successful SMEs — e.g, mould manufacturer</i>
1. Valuable	IS/IT applied to the core competitive processes of the business—integrated design and manufacture and customer trading activities.
2. Rare	Integration and customisation of a range of IS/IT products plus CEO vision to persuade customers (larger companies) to trade on-line.
3. Imperfect imitability	Personal relationships/partnerships with key IS/IT suppliers for mutual long-term benefits <i>and</i> provision of technology education and training service to the whole industry, in Portugal (inc. competitors), to ensure 'competent image' of industry to international customers, and avoid poaching of key staff!
4. Non-substitutability	Continuous, incremental IS/IT innovation in partnership with associated IT supplier(s) to enhance the product or service offer through applications of IS/IT.

(Prahalad & Hamel, 1990; Barney, 1991; Amit & Schoemaker, 1993; Hamel & Prahalad, 1996; Von Krogh & Roos, 1996). Recently, Bharadwaj (2000) provided evidence that firms with IT capability tend to outperform a control sample of firms on a variety of profit and cost-based performance measures.

Frequently, in the literature, the words skills, resources, competences, capabilities or organisational knowledge are used interchangeably. Furthermore, many studies found no significant differences in the use of the concepts 'core competence' and 'capabilities' (Von Krogh & Roos, 1996).

An interesting model shedding some light on the problem is presented in McGrath *et al.* (1995), and is further developed by Lambert & Bytheway (1998). These authors establish a link between the concepts of capability and competence. Capability is defined as 'the ability of an organisation to deliver a product or service into the market place' while competence is seen as 'the ability to develop, manage and deploy resources in support of a capability or capabilities' (Lambert & Bytheway, 1998: p. 3). Within this perspective, a competence is an organisational attribute resulting from processes which bring together the individual skills and knowledge of the members of the organisation.

Hamel & Prahalad (1996, p. 236). also argue that a 'competence represents the synthesis of a variety of skills, technology and knowledge streams' To have a competence, it is necessary to have an organisational context with processes enabling the effective application of individual skills and knowledge, and in order to exploit the core competence perspective the entire management team must participate in five key management tasks: identifying existing core competences; establishing a core competence acquisition agenda; building core competences; deploying core competences; and protecting and defending core competence leadership. Ciborra & Andreu (1998, p. 89) express the concept of capability by saying that: 'capabilities are developed by combining and using resources (and/or other capabilities) with the aid of organisational routines'.

Some other researchers regard competence from an individual perspective. For example, Von Krogh & Roos

(1996: p. 107) argue that a competence enables 'the application of knowledge to solve tasks in a known or unknown way' and present competence as the result of knowledge, experience, attitudes and personal characteristics of an individual. In this study, the research object is the organisation as a whole and its ability to adopt and use IS/IT. Therefore, the concept of competence adopted here is an organisational one, as argued by Lambert and Bytheway (1998). A *skill* is defined as the ability of an individual to apply his/her own personal characteristics and knowledge to solve tasks and, in this context, *knowledge* is the ability to apply information in order to understand and resolve a particular issue or situation (Tobin, 1997). Von Krogh & Ross (1996) argue that there are tasks where particular individual characteristics are required, as well as the necessary knowledge that people may have to solve the problem. Figure 3 shows the relationships between the concepts of capability, competence, skills and knowledge used in the context of this research. Processes are required both to combine individual skills into organisational competences and to allocate resources to convert sets of competences into a business capability.

Unlike transaction-cost economics (Williamson, 1975), a resource-based view of the firm does not depend on opportunistic behaviour. It focuses on developing internal knowledge and competences to enable the firm to improve its competitiveness. It accepts that attributes related to past experiences, organisational culture and competences are critical for the success of the firm (Campbell & Luchs, 1997; Hamel & Prahalad, 1996). Furthermore, it is argued that the identification of these attributes is a creative act and depends on managerial orientation, vision and intuition (Conner, 1991). Conner (1991, p. 140) suggests that 'an in-house team is likely to produce technical knowledge, skill, or routine that fits better with the firm's current activities'.

Mata *et al.* (1995), in a conceptual study looking at five attributes of IT (customer switching costs, access to capital, proprietary technology, technical IT skills and managerial IT skills), concluded that managerial IT skills are the only one of these attributes that can provide

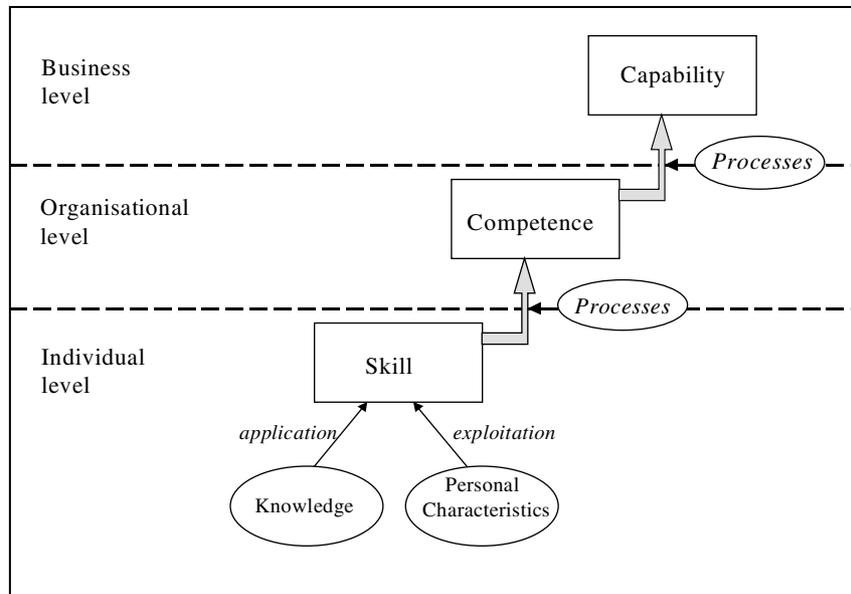


Figure 3 Relationships between capabilities, competences, skills and knowledge.

sustainable advantage. According to these researchers, managerial IT skills include:

- (1) the ability of IT managers to understand and appreciate the business needs of other functional managers, suppliers and customers;
- (2) the ability to work with these functional managers, suppliers and customers to develop appropriate IT applications;
- (3) the ability to coordinate IT activities in ways that support other functional managers, suppliers and customers;
- (4) the ability to anticipate the future IT needs of functional managers, suppliers and customers.

Unlike technical IT skills that can be diffused relatively easily among a set of competing firms, managerial IT skills are usually developed over long periods of time through learning and experience (Mata *et al.*, 1995). However, since technical IT skills are valuable to the firm, these skills may be a source of 'temporary' competitive advantage, until competitors acquire their own IT skills (Mata *et al.*, 1995).

Other literature emphasises the importance of leadership and the relationship between the role of the CEO in relation to IS/IT (Earl & Feeny, 1994; Peppard & Ward, 1999). Feeny & Willcocks (1998a, p. 20) state that 'core IS capabilities are those necessary and sufficient to ensure that an organisation can exploit changing markets of technological services – to achieve business advantage through IT over time'. These researchers identified nine core IS/IT capabilities: IS/IT leadership, business systems thinking; relationship building, architecture planning, making technology work, informed buying, contract facilitation, contract monitoring, and vendor development (Feeny & Willcocks, 1998a, b). They concentrate on

the capabilities of the IT function rather than the organisation as a whole and argue that the development of IS/IT capabilities must be proactively planned before using external service providers. However in small businesses, it may not be practical to develop all these core IS/IT capabilities internally. Therefore, some of these capabilities may be obtained by 'insourcing', using high-qualified IS/IT experts belonging to external organisations but working under the direction of in-house management.

Grover *et al.* (1998) state that, according to resource-based theory, "insourcing" is a strategic decision that can be used with the purpose of filling the gap between the desired IS/IT capabilities of the firm and the actual ones. Grant (1991) argues that 'insourcing' not only maintains a firm's stock of resources and capabilities but also augments resources and capabilities in order to buttress and extend positions.

Thong (2001) developed a resource-based model to analyse resource constraints and information systems implementation in Singaporean small businesses and found that external technical expertise is a very important factor of IS/IT implementation success. According to Thong (2001; p. 154), 'due to the lack of internal IS expertise, small businesses need to engage experienced consultants and IT vendors to undertake their information systems implementation'. However, the 114 enterprises analysed by Thong were firms with less than 100 employees and annual sales below 9 million US dollars while this research included medium-sized enterprises.

However, filling gaps of resources and capabilities through an external sourcing strategy can inhibit the development of IS/IT capabilities in the firm, if top managers believe that by externally sourcing IS/IT services they completely resolve the firm's need to have

IS/IT capabilities in-house. Ciborra & Andreu (1998) are of the opinion that IT is not only a technology to shape a firm's core capabilities but also has a role in incorporating these core capabilities into the organisational context of the firm by facilitating the learning process and enabling capability sharing and diffusion in the whole organisation.

In almost all the firms that were in clusters A–C, the top managers and the IS/IT managers/experts interviewed declared that they had, or were looking for, customised software systems that matched the core manufacturing processes of the enterprise. Because these systems are a specific asset, critical for the firm, managers wanted a stable relationship with the IS/IT supplier and to avoid being dependent on an unreliable supplier or one whom they did not trust. The CEO of one of the mould-making firms, when speaking about its process of software acquisition, illustrated this perspective by saying, '*we believed that when we would do business with a firm, we would be married for life, because of that we had to choose very carefully our partners*'. The partnership with IS/IT suppliers did not make the firm vulnerable to imitation by competitors because in most firms that were using IS/IT successfully there was a very strong relationship with the IS/IT suppliers based on family ties, shared capital or long-term relationships.

The 'resources' or competences classified as determinant factors – IS/IT competences and top management perspectives and attitudes towards IS/IT adoption and use – are critical for the firm. Mata *et al.* (1995) and Keen (1993) argue that IS/IT managerial skills, and the consequent organisational competences, are a source of competitive advantage as they are socially complex, involving friendship, trust and interpersonal relationships between senior management and IS/IT managers. Managerial IS/IT skills are obviously heterogeneously distributed across firms and due to their social complexity they are not subject to low-cost imitation (Mata *et al.*, 1995).

In the firms studied, the personal relationships between CEO/top managers and the IS/IT managers, or the IS/IT suppliers, seemed to explain why those firms were more successful adopting and using IS/IT. The IS/IT manager or the IS/IT supplier must have top managers'/owners' trust (essentially CEO's trust). Examples were found in all the firms that showed positive levels of satisfaction with IS/IT adoption and use. As expressed in the literature, informal relationships in SMEs assume a very important role (Olaisen, 1990; Blili & Raymond, 1993; Martin & Staines, 1994) and IS/IT is not an exception.

Unlike larger enterprises, in manufacturing SMEs even technical IS/IT skills can be a source of competitive advantage, because SMEs usually have scarce financial resources and do not have the same ease of hiring qualified IS/IT experts. Moreover, it may be difficult to bring highly qualified IS/IT experts to remote areas, far from major towns (where many Portuguese manufactur-

ing SMEs are located). Therefore, qualified IS/IT expertise is likely to be relatively rare among SMEs. In one of the firms in cluster A (that operates in the textile manufacturing industry), the CEO stated that he was 'lucky' in finding his IS/IT manager/expert, a local young person who was interested in computers. This IS/IT manager/expert is self-educated, having received little formal education in computer science. In another firm in the same cluster, the IS/IT experts developed their computer skills working in the firm.

However, since many top managers in manufacturing SMEs do not have much IS/IT knowledge, they may not be able to evaluate adequately the profile of the IS/IT experts that they need to hire. In the fieldwork, it was found that in some of the less successful firms the person responsible for IS/IT (who was not an IS/IT expert) did not seem to realise the professional limitations of the IS/IT people of the firm.

Where the CEO was not personally involved in IS/IT adoption, another senior manager (most commonly the production manager) with power in the organisation and whom the CEO/owners trusted (sometimes a relative) was directly involved in leading the adoption process. In the less successful cases, IS/IT was the responsibility of the administrative/financial manager, who rarely had significant influence over other managers such as production or sales. In the most successful cases studied, the CEOs also had a vision about the strategic use of IS/IT in the business. For example, in one of the most successful firms in the mould industry the CEO identified the need to change from two-dimensional computer aided design systems (CAD) to three-dimensional before the firm's (much larger) customers, and took advantage of investment grants to upgrade the firm's technology and skill base. In another of the successful firms, the executive team visited similar firms in the USA to understand how IS/IT was being used in more developed countries. Alternatively, the CEO's knowledge was acquired from close personal relationships with IS/IT experts within the firm or 'insourced' to provide the expertise (eg from universities). Top managers know the firm well and are in a privileged position to understand how IS/IT can be used to improve business performance. However, this must be complemented by the existence of internal IS/IT skills to develop or acquire computer-based systems.

In the firms studied, the 'differentiating' managerial IS/IT skills could be shown to derive from the attributes of the two determinant factors, in terms of how successfully some skills resident in the CEO/business managers combined with some resident in the IS/IT experts are brought together, not by formal processes or structures but by strong inter-personal relationships.

Where only one factor had the attributes of the most successful firms, either extensive IS/IT adoption was less than successful or the firm was using limited IS/IT, albeit successfully. The existence of these relationships, in addition to technical and general managerial skills enable the SME to develop the competences to address the

factors that other research shows influence the extent of IS/IT adoption and use and the levels of success achieved.

Figure 4 suggests how the determinant factors of IS/IT success, identified in the research, enable the required skill sets to develop and, based on the more successful firms, be used effectively to address the range of key tasks associated with successful IS/IT deployment through the combination of skills resident in the IS/IT specialists or general management separately and acting together. For example, acquiring software from vendors requires business skills in negotiation of terms, contracts etc, plus technical skills in software evaluation and design, but also 'managerial' skills to implement the resulting systems to deliver the benefits expected from the software in conjunction with changes to business processes and practices.

Figure 5 attempts to synthesise the explanatory details of Figure 4 with the earlier model derived from resource-based theory (see Figure 3) to explain how, in the more successful SMEs, their distinctive business capability based on IS/IT has developed.

It is the two determinant factors that together underpin the model: first, the existence of IS/IT knowledge in the firm or in a closely associated, specialist IS/IT enterprise and, second, a top management that supports the development of IS/IT capabilities, is involved in the process of IS/IT adoption and use, and understands the IS/IT needs of the business.

The technical skills are either developed in-house or insourced appropriately due to the active intervention of the top management, who also contribute their business

knowledge and personal abilities to the management of IS/IT. This in turn enables the establishment of, albeit normally informal, 'processes' or ways of working to ensure that IS/IT products and services are selected and acquired successfully and economically. At the same time top management, in their general management role, using the knowledge of the IS/IT experts establish organisational 'processes' which ensure that non-IS/IT managers, professionals and staff use the IS/IT applications to deliver the actual business benefits envisaged. It is the alignment of these processes, sustained by the firm's managerial IS/IT skills, that determines the overall organisational competence in IS/IT.

However, these in themselves are not sufficient to build a distinctive business capability from IS/IT investments. The final piece of the jigsaw is the top management's ability to establish the appropriate priority to allocate scarce financial and people resources to the IS/IT investments. This implies knowing how much resource to invest and when, even when this might involve significant financial risk (often personal financial risk), or being the first firm in the industry to invest in 'leading edge' software or hardware. Two of the three most successful firms were very innovative in IS/IT terms, even in comparison to much larger firms.

It must be stressed that the 'processes' described are not formal; they are really 'ways of doing things' based on informal agreement and appropriate behaviour, derived from the personal relationships of the people involved. In the less successful firms, where neither of the determinant factors had appropriate attributes, there was little

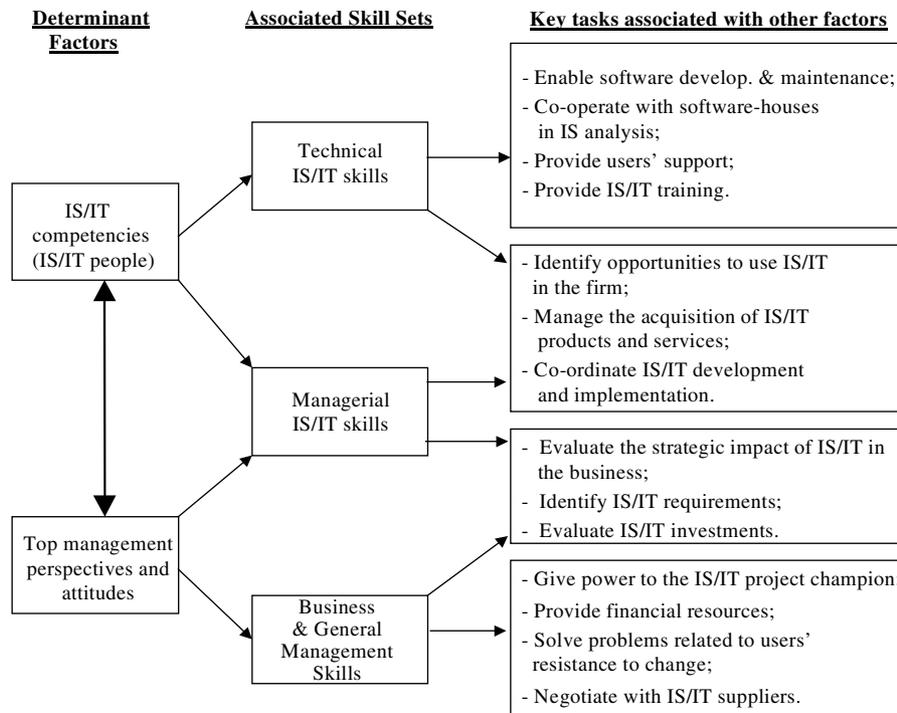


Figure 4 Analysis of the determinant factors of IS/IT success and the consequences.

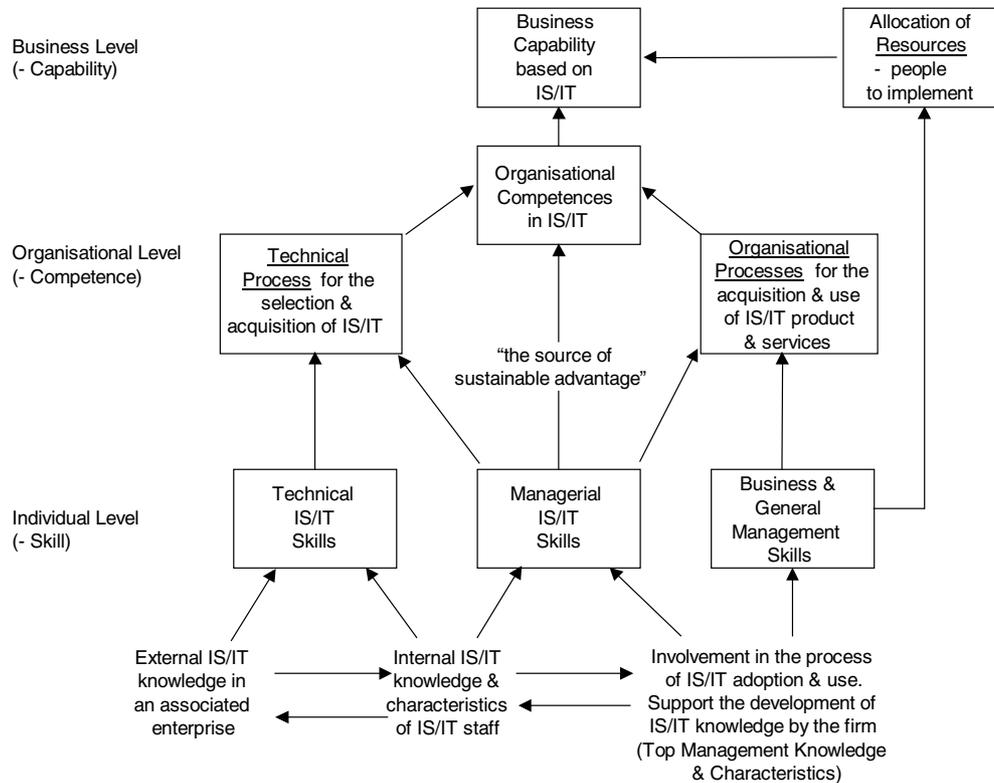


Figure 5 A resource-based model to understand the successful adoption and use of IS/IT in manufacturing SMEs.

agreement on what was required or how to do it. These firms were characterised by discord and conflict among management and IS/IT experts, creating either a vacuum or 'turf wars' in the managerial IS/IT skills 'box', which this research suggests is at the heart of the structure.

## Conclusions

The objectives of this research were to identify and understand factors that determined the relative success in the adoption and use of IS/IT in selected manufacturing SMEs, and to find a satisfactory theoretical explanation of the findings. The empirical study involved in-depth case studies in 12 organisations, all manufacturing SMEs in Portugal, but in a variety of industries. They covered the greater part of the possible spectrum of levels of adoption and use as well as success, the latter being defined by a well-established surrogate measure. Four distinct clusters emerged against which patterns of factors could be distinguished that appeared to account for the variations in successful adoption in the firms studied. The two *determinant* factors had different attributes in the most and least successful groups. In the other two groups, only one of the factors aligned with the most successful firms. These factors are:

- management perspectives and attitudes towards IS/IT adoption and use;
- development of internal IS/IT competences.

Initially, two theories that might enable the findings to be interpreted were considered: transaction cost theory and resource-based theory. Both theories have attracted interest in the IS/IT field in the last 10 years, the former mainly in relation to the study of insourcing and outsourcing options, and the latter in relation to sustaining advantages from IS/IT through the development of differential competences.

The findings do not fit with the principles of transaction cost theory. Transaction costs and benefits that may be achieved by purchasing a service in the market are difficult to measure, especially for 'intangible' products such as information or IS/IT services. None of the firms studied evaluated either the production costs associated with insourcing the IS/IT function or the transaction costs associated with buying IS/IT products and services in the market. A basic assumption of transaction cost theory is that the risk of opportunism creates a need for formalised governance structures and 'contracts'. However, the findings of this research support the views of other researchers that '... trust, due to either social norms or personal relations, may serve as a substitute for formal mechanisms such as contracts and direct controls' (Rindfleisch & Heide, 1997; p. 48). Business relationships related to IS/IT products and services in the firms studied were based on trust and personal relationships, and cost was not usually considered as important. As Ghoshal & Moran (1996, p. 42) suggest in their analysis of transaction cost theory, 'in a theory of organisations and

markets, learning and trust may well take the place that efficiency and opportunism occupy in the theory of markets and hierarchies'.

Resource-based theory appeared to offer possible explanations, given that the determinant factors identified were both clearly associated with the internal contexts of the firms. Moreover, resource-based theory argues that sustained advantage results from unique attributes of a firm; therefore, it could explain why some of the firms in this study had become more successful in IS/IT adoption and use than others. In order to relate the findings to the core tenets of resource-based theory, the focus of the analysis of the case study evidence has been on the three most successful firms, contrasting this where appropriate with the three least successful.

To date, the majority of papers on the applicability of resource-based theory to IS/IT in firms has been largely conceptual, but this research, we believe, provides some empirical support to previous arguments. Evidence from one of the cases (see Table 2) provides examples of each of the four criteria for competitive advantage from resources (Barney, 1991). More generally the case studies provided consistent data, which when viewed from the resource-based perspective, enable the likely causes of relative success to be interpreted.

The firms that were more successful in adopting IS/IT did not rely on external solutions as an alternative to the development of IS/IT knowledge and competences in-house. In these firms, access to unique software was not seen as critical to the business and some even sold their software to potential competitors. The objective of these firms was to stay ahead of competitors by using their IS/IT knowledge. Management viewed IS/IT as a dynamic, constantly changing variable, and to cope with this pace of change these firms developed IS/IT competences in-house, in order to ensure the core software permanently fitted the business requirements. Resources and knowledge developed were either in the organisation or obtained from a closely associated IS/IT enterprise.

In contrast, in the less successful firms, the problems with the adoption and use of IS/IT were often thought to be due to external factors. They expected to obtain

solutions from the market and had little understanding of the need to have in-house IS/IT competences, in order to obtain and deploy the systems they required.

By providing a set of models, based on specific definitions (within the inconsistent terminology of resource-based theory), we believe that, based on the case study evidence, it is possible to explain how the determinant factors in combination cause the requisite skill sets to be developed. These in turn cause appropriate organisational competences and processes to come into being, which enable effective adoption of technology and its successful exploitation in use.

This research was essentially exploratory and the findings were inducted from the empirical evidence then interpreted from a resource-based view. The case study approach using semistructured interviews, plus corroborative data, enables a deeper understanding of the social dimensions and relationships that contribute to successful IS/IT adoption than surveys that have more traditionally been used to research IS/IT in SMEs. However, knowledge of this increasingly important topic could be furthered by deductive research using quantitative methods to test the validity of these research results and conclusions in the same or a related context.

Although the specific context and methodology of this research does limit the ability to generalise the findings and conclusions, we believe the explanations and models derived here can be helpful to practitioners involved in the development of IS/IT in SMEs and could be used by other researchers in different contexts – SMEs in different industries, countries or even in larger organisations. The last of these could prove more difficult, since the advantage of SMEs for such studies is their size and relatively simple business processes and organisation structures.

Research in the topic of IS is often criticised for insufficient reference to theory to explain the findings from empirical studies. Although alternative interpretations are possible, resource-based theory offers a plausible and coherent explanation of the findings from this study. As such, we believe this work provides some direct empirical evidence to support the more conceptual arguments of previous writers.

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