

Examining the Influence of ERP Systems on Firm-Specific Knowledge and Core Capabilities: A Case Study of SAP Implementation and Use

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Abstract

There is a paucity of in-depth research on the effects that enterprise resource planning (ERP) systems have on firm-specific intangible assets, such as firm-specific knowledge and core capabilities. Accordingly, this paper explores the implementation of SAP in two operational units of the Boxit Group—a global player in the manufacture of paper and packaging. Leonard-Barton's (1995) theory of knowledge creating activities, knowledge sets, and core and non-core capabilities is employed as a conceptual framework to examine the implementation and use of SAP modules in the firm studied. The findings of this in-depth exploratory case study illustrate that the introduction of SAP-specific business routines can threaten established core, enabling and supplemental capabilities and related knowledge sets. The integration of SAP's embedded business routines and reporting functionality contributed to the creation of (a) highly rigid reporting structures; (b) inflexible managerial decision-making routines; and (c) reduced autonomy on the factory floor in the firm studied. SAP thus endangered the firm-specific knowledge creating activities that underpinned core operational capabilities in this organization. Finally, Leonard-Barton's conceptual framework is extended to incorporate insights into the manner in which ERP systems such as SAP affect the various aspects of organizational knowledge sets.

Keywords

Enterprise Resource Systems, SAP, Firm-Specific Knowledge, Core Capabilities

1. Introduction

Previous research on enterprise resource planning (ERP) systems centers on business modeling, product development issues, the life cycle of ERP systems, and the knowledge required to manage the implementation of ERP systems (Esteves and Pastor 2001). Studies of ERP system implementation and use, which focus on knowledge and its management, address such issues as (a) change management around ERP system implementation (Al-Mashhari 2000); (b) senior managers' perspectives on knowledge management in ERP environments (Klaus & Gable 2000); (c) knowledge requirements for ERP systems

implementation and management (Jones and Price 2001); (d) the relationship between ERP, knowledge and organizational effectiveness (Hedman 2000); and (e) ERP systems and the integration of knowledge in organization (Esteves & Pastor 2001). There is, nevertheless, a paucity of research on how ERP systems influence extant *knowledge creation activities* and associated *core capabilities* in organizations.

This lacuna is addressed in the present paper, which deepens the IS field's understanding of the relationship between the introduction of ERP systems and the *core capabilities* of manufacturing organizations. Leonard-Barton's (1995) research illustrates that *knowledge creation activities* such as problems solving, experimentation, importation of external expertise, and the introduction of new methodologies and tools underpin the development of firm-specific *knowledge sets*. She argues that such *knowledge sets* give rise to *core capabilities*. The following analysis of the ERP literature helps illustrate the relevance of Leonard-Barton's theoretical perspective as this study's conceptual framework.

2. The Promise and Reality of ERP Systems

More and more firms are turning to ERP systems to leverage knowledge assets at all levels in the organization. So much so, ERP systems have replaced legacy systems in informing and automating core business processes (Holland, Light, & Kalwalek 1999). This trend is reflected by Davenport (1998, p. 122) who states that "*the business world's embrace of enterprise systems may in fact be the most important development in the corporate use of information technology in the 1990s.*" By 1999, a total of 53,000 firms worldwide had implemented ERP systems (Cerullo & Cerullo 2000). Unlike legacy systems, ERP systems tend to take the form of customizable software packages. Leading vendors are SAP, Oracle, Peoplesoft, Baan, and J. D. Edwards, with SAP being the dominant market player. Cooke and Peterson (1998) illustrate that the principle reasons why firms implement SAP R/3 is to standardize business processes and support globalization of activities. Despite its popularity, however, SAP does not have a reputation for being user-friendly (Stedman 1999). For example, Caldwell and Stein (1998) found that managers at Amaco refused to operate SAP because they found it to be user-unfriendly. Another drawback concerns customization—Holsapple and Sena (1999) observe that while software modifications of SAP modules are possible, they are not recommended. The rationale for this is that organizations implementing ERP systems wish to improve the efficiency and effectiveness of business processes by importing best practices embedded in software like SAP (Curran & Ladd 1998, Bancroft 1998). For that reason, firms rarely attempt customization, as less than 5% of the Fortune 1000 companies customized an ERP system to support idiosyncratic business processes (Davis 1998). Hence, most organizations adapt or reengineer their business processes to accommodate SAP modules. This has prompted some to argue that the implementation of an ERP system should be considered a business project rather than an IS project (Shanks, Parr, Hu, Corbitt, Thanasankit & Sheddon 2000). Davenport (1998) highlights that ERP systems generate an imperative to establish common business and information technology processes across diverse functional boundaries in organizations. This has major implications for the roles and actions of organizational actors (Hanseth & Braa 1998). Furthermore, it has enormous implications for firm-specific *knowledge sets*, as researchers in the resource-based view hold that an organization's knowledge is embedded in its organizational and managerial processes, business routines and practices (Leonard-Barton 1995).

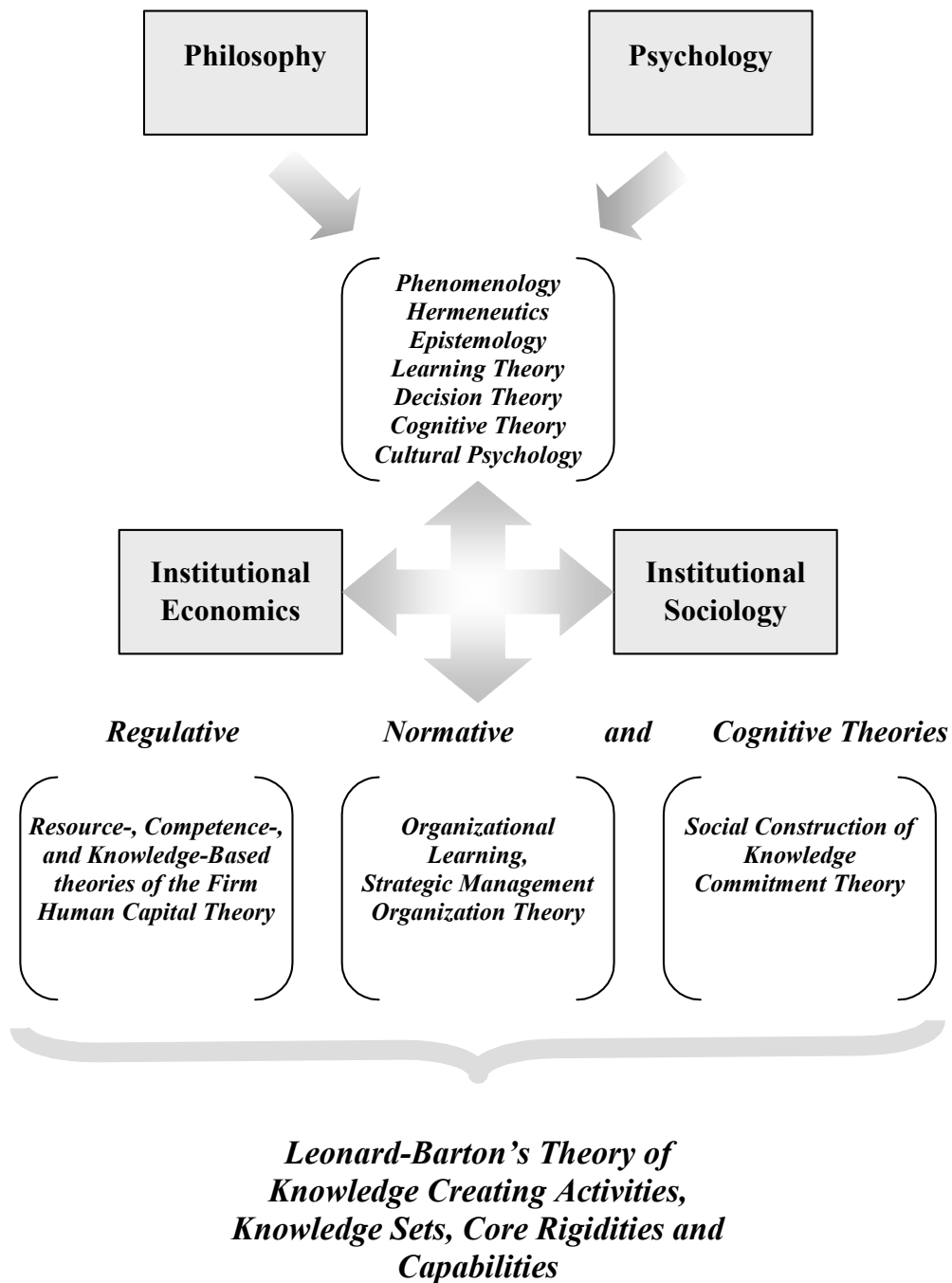


Figure 1 Foundations of Leonard Barton's Theory of Knowledge Creating Activities, Knowledge Sets, Core Rigidities and Capabilities

3. A Framework for Building Organizational Knowledge Sets and Core Capabilities

Leonard-Barton (1995) argues that a firm's *core capabilities* arise out of its *knowledge creating activities*. In articulating her theory, Leonard-Barton integrates several theoretical perspectives with her own empirical research: Figure 1 indicates the related disciplines, theories and research streams that she draws upon to build her conceptual framework. Leonard-Barton's theory of firm-specific competencies posits three types of organizational capability viz. *core*, *enabling* and *supplemental* (See Figure 2). She argues that *core capabilities* provide a firm with a sustainable competitive advantage; hence, they are distinguished from *supplemental* and *enabling capabilities*. Leonard-Barton conceptualizes a *core capability* as a firm-specific *knowledge set*, this, she argues, is reflected in a firm's *values and norms*, *physical technical systems*, *employee knowledge and skills*, and *managerial systems*. Figure 3 captures these four dimensions to firm-specific *knowledge sets*.

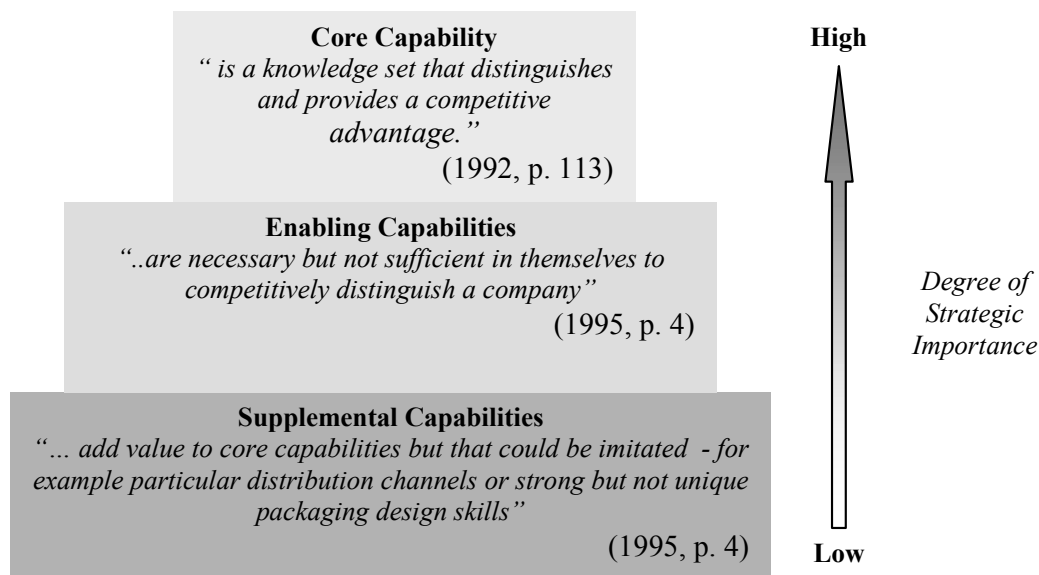


Figure 2 A Taxonomy of Capabilities: Core, Enabling and Supplemental (Adapted from research by Leonard-Barton)

With some notable exceptions (e.g., Barney 1986), the influence of *values and norms* are not usually associated with the creation of core capabilities. Leonard-Barton (1995) illustrates that *values and norms* can be dynamic and positive, or they can act to preserve outmoded routines and capabilities, contributing to the creation of *core rigidities*. Leonard Barton (1992) argues that *core rigidities* are essentially redundant and inefficient organizational practices and routines. These are shaped by dysfunctional *values and norms* that fail to evolve and to meet the challenges in a dynamic and changing environment. Hence, dysfunctional *values and norms* are argued to constrain the development of new *knowledge sets* and associated productive capabilities. Nevertheless, Leonard-Barton (1995) argues that dynamic *knowledge creating activities* counter the problem of *core rigidities* by ensuring that

new knowledge circulates, in so doing, revitalizes firms and the communities-of-practice that constitute them. Figure 4 presents a model of the *knowledge creating activities* that underpin the development of firm-specific knowledge in the each of the dimensions to an organization's *knowledge set*. As with extant perspectives on the resource-based view of the firm, Leonard-Barton highlights the role that problem solving, experimentation, importing expertise from outside the firm, and implementing and integrating new methodologies plays in shaping a firm's *knowledge set* by acting on all four of the dimensions previously delineated.

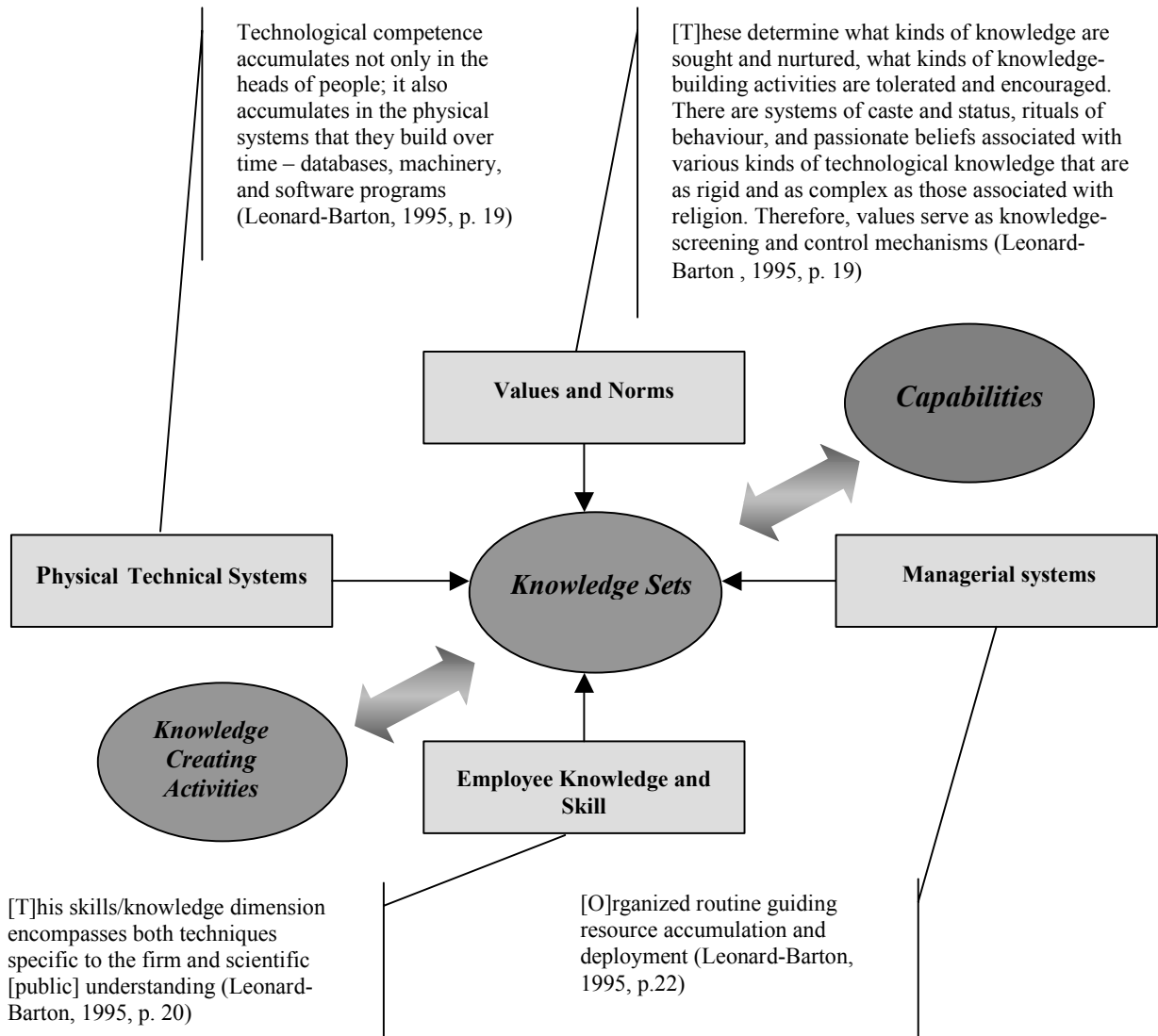


Figure 3 Values and Norms, Physical Technical Systems, Employee Knowledge and Skills, and Managerial Systems as Firm-Specific Knowledge Sets

3.1 Research Objective

This study's objective is to explore the organizational consequences and outcomes of importing 'best practice' embedded in ERP systems, such as SAP, as non firm-specific organizational routines. Of special interest is the organizational ability to maintain successful *knowledge creating activities* and *knowledge sets* relevant to its *core capabilities*, while at the same time, overcoming potential *core rigidities*. Formally stated, this study's research objective is:

To deepen the IS field's understanding of SAP's influence on firm-specific knowledge creating activities, knowledge sets, and associated core, enabling and supplemental capabilities through the importation and implementation of non-firm specific routines, embodying industry-wide best practice.

Leonard-Barton's (1992, 1995) theory of *knowledge creating activities* and the resultant *knowledge sets* that underpin *core, enabling and supplemental capabilities* is used as conceptual framework to structure the case report and its findings. This operates to direct attention on the operational *core capabilities, knowledge creating activities, and knowledge sets* in order to evaluate the affect that SAP has on each.

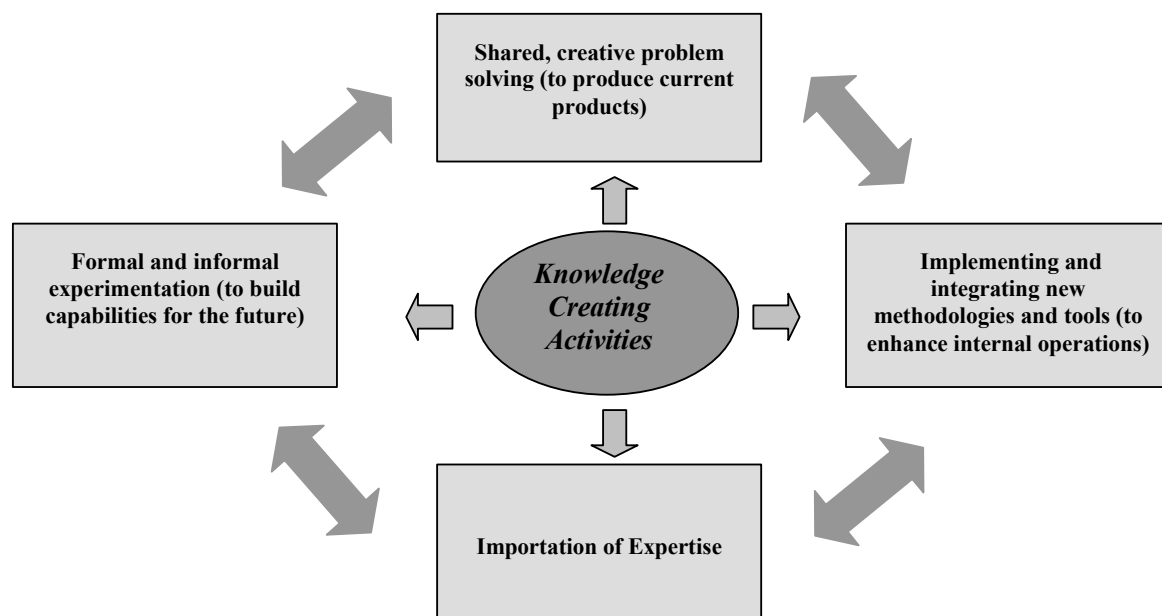


Figure 4 Knowledge Creating Activities (Adapted from Leonard-Barton 1995)

4. A Case-based Research Strategy

A naturalistic research approach was adopted for the present study. Accordingly, a qualitative, interpretive, case-based research strategy was implemented with reference to constructivist thought in the social sciences (see Lincoln & Guba 1985, Stake 1995) and interpretivist approaches in the IS field (Walsham 1995). Stake (1995) contends that case studies can be *intrinsic, instrumental, or collective* in focus. An *instrumental* case study is

one where the case forms a backdrop or context and is of secondary importance. Such a study is undertaken to validate a theory or to explore a particular phenomenon as it is manifested in the case. Yin (1994, p. 42) argues that a case may “*involve more than one unit of analysis ... such as meetings, roles, or locations,*” this he terms an “*embedded case study design.*” The present study incorporates an instrumental case study incorporating two embedded units of analysis.

The case selected for study is the Boxit Group, an Irish owned and managed transnational corporation specializing in the manufacture of packing cases and associated materials. Boxit Group and its affiliates employ over 43,000 people in 23 countries worldwide. Two production facilities constitute the embedded units of analysis—Boxit Corrugated Cases (BCC) and Boxit Corrugated Services (BCS). The embedded units were purposively selected because they possess different operational *core capabilities, knowledge sets* and *knowledge creating activities*, and were in different stages of development—BCC was established in 1973 and BCS in 1998. Both participated in the roll-out of the corporate ERP system, which involved the implementation of SAP’s Financial and Purchasing modules—the latter of which included support for the engineering maintenance of production equipment at both plants.

Purposeful sampling was employed throughout. Research was conducted in 2001 at two sites. Twenty social actors participated in the study, through formal and informal interviews over a period of several months. Each of the formal interviews was tape-recorded, while extensive case notes were taken on informal conversations and observations while on-site at the research locations. A wealth of documentary evidence was also gathered. Naturalist techniques were employed to analyze and report on the research data (see Lincoln & Guba 1985; Stake 1995).

5. Core Operational Capabilities at BCC and BCS

The Boxit Corrugated Cases (BCC) manufacturing plant supplies the dairy and food sectors with packaging materials. The packaging requirements of such customers are easily projected and facilitate large production runs by BCC with minimum change in its standard operational routines. The emergence of a dynamic and highly successful electronics industry in Ireland during the early 1990s presented new market opportunities for the Boxit Group. Firms in this emergent sector had radically different, more sophisticated, and varied packaging requirements than those of BCC’s traditional customer base. While exciting new opportunities were presented, so too were possible negative consequences associated with the dynamic, market-led production schedules and idiosyncratic needs of the electronics industry. This arose because firms operating in the electronics sector could not provide suppliers with the exact delivery schedules. Suppliers had to respond quickly, and on short notice. However, the production capabilities of BCC were not aligned with the needs of firms operating in the electronics industry, as BCC’s Customer Services Manager pointed out that:

...customers’ requirements [in the electronics sector] range from pallets to foam inserts to cartons—this is not BCC’s core business and is not cost effective for us to engage in this work.

BCC’s *core capabilities* were de facto *core rigidities* when it came to servicing the requirements of the electronic industry, while altering *values and norms* in the company. After several unsuccessful attempts to reconfigure its production routines, BCC’s management considered that smaller production runs and products with non-standard

specifications were too disruptive to the efficient operation of the plant. Thus, due to the need to maintain its lucrative revenue flows from existing markets, management at BCC were unable and unwilling to adapt its production activities to service the electronics market. The choice was clear to BCC, cede the new niche market to other companies, or establish a production facility with core production capabilities to deliver the product and service in a way that met customer's requirements. Hence, Boxit Corrugated Services (BCS) was established to service the packaging needs of the dynamic electronics industry.

While the BCC was unable to reconfigure its asset and capability portfolios to meet the dynamic demands of the electronics sector, it did possess a tradition of introducing technical innovation in its production processes through the *knowledge creation activities* of its employees, coupled with the introduction of new technology. For example, BCC pioneered the process of four-colour printing on corrugated packaging. Consequently, it was five to ten years ahead of the competition in terms of its technical capabilities. Evidence of this firm-specific 'knowledge set' comes from BCC's Production Manager:

[Competitors] cannot get the same print quality from the four-colour machines, despite having very good machinery. The difference is down to skills. They have four-colour machines in Lurgan and Dublin and they cannot produce the same quality as we can in [BCC]. They would have broadly the same machines, so it's down to skills.

BCC's management was aware that capability-based advantages erode over time; hence, it upgraded production equipment on a regular basis. Significantly, the installation, operation, and customization of new technology provided a platform for knowledge creation and capability development, as the production manager commented:

In the past, operators quickly mastered the knowledge and skills required to run new technologies. When a technological investment has matured, in terms of quality and efficiency of output, we assess our competitors' positions and when we determine that they are closing the gap, in terms of quality and output, we invest again.

Thus, BCC coupled *learning-by-doing* with the experiential knowledge of long serving staff to produce and retain skills and related knowledge in a tacit form—in the production area this method of learning was known as *Standing-by-Nanny*. Group learning was critical here as production operators worked in teams of four. In this scheme of things, a lead operator assumed responsibility for training other members of the team. This helped build and reinforce a team's *norms and values* and enabled *knowledge and skill* transfers. This approach to mentoring was widely used in all Boxit's production facilities. A training manager usually facilitated the process, as management was mindful that success in such endeavors could not be left to the communication skills of the lead operator. This approach to organizational learning created a highly idiosyncratic production-oriented *knowledge and skills* resource within the Boxit group of companies. Thus *knowledge and skills* developed over time through *learning-by-doing* and was transmitted through socialization within and between in communities-of-practice.

When the BCS facility was established in 1998 to meet the idiosyncratic needs of the electronics sector, BCS' plant manager opted not replicate BCC's operational routines by transferring workers and work practices from BCC. Thus, BCS did not directly import the *knowledge and skills* and associated *values and norms* of BCC's workforce. His aim was to introduce more flexible operational routines that would help BCS to meet the particular needs of the electronics sector; to achieve this, he felt that a radically different set of *values and norms* needed to be established in the new plant—*values and norms* that were congruent with the use of emergent technologies, like SAP. By so doing, he wished to avoid introducing

rigidities associated with outdated conditions of employment, including, for example, pay differentials and demarcation. He clearly recognized that this might prevent the attainment of flexibility in the manufacturing process deemed to be critical to the success of BCS. Nevertheless, the knowledge and skills of workers at BCC were recognized as being valuable to the new operation at BCS. The problem was how to import much-needed *knowledge and skills* while filtering out the rigidities and inappropriate *knowledge sets* associated with the *managerial systems, values and norms* at BCC. Accordingly, BCS' new plant manager decided to use technology to import the required experiential *knowledge and skills* while, at the same time, instituting a different set of *values and norms* through the process of socialization. However, his first task was to install the production plant. This had been sourced from BCC, which was in the process of upgrading its production facilities. In order to operate the machines, workers had to adopt appropriate operational routines: this constituted the importation of explicit *knowledge and skills* from BCC. The importation of tacit knowledge proved difficult to address, however explicit knowledge of efficiency levels, quality parameters, and maintenance routines proved easier to import. A task made all the easier when SAP was introduced, as these were eventually programmed into SAP's purchasing module.

While the forgoing describes operational routines at both plants, an understanding of the forces underpinning managerial decision-making is also important. Before the introduction of SAP, Boxit Group's general management philosophy ensured that operational managers had significant autonomy to run their logistics, production and marketing activities with respect to local conditions. Boxit found that this strategy helped develop strong local management teams who understood, and were responsive to, the fluctuations in demand for the products produced in their plants. Regional manufacturing and sales operations were monitored and controlled by Boxit's corporate management team through a system of regular financial reporting and review, coupled with tight capital and operating expense controls. This regional decentralization and close central monitoring coupled with performance related incentives for local managers provided motivation for improvements in performance. The implementation of SAP changed both the reporting structure and the way in which the organization measures and improves performance at plant level.

6. The Implementation of SAP and its Effect on Core Capabilities, Knowledge Sets and Knowledge Creating Activities

As with most organizations that introduce SAP, Boxit's corporate management employed a firm of consultants to help implement the system—this constituted an importation of expertise. However, Boxit's management considered that it was necessary for consultants to be familiar with its industry and culture, if they were to leverage fully their *knowledge and skills*. Hence, Boxit attempted to train the consultants in its business routines and inculcate them in its *values and norms*. This proved unproductive and expensive, consequently Boxit's IT Function opted to train selected end-users to the level of SAP super-users. The rationale behind this was to have super-users provide one-on-one training to other staff, thereby increasing the skill level and commitment of end-users. Managers noted that super-users had developed a valuable and unique knowledge set. They understood Boxit's business processes, industry dynamics, and the capabilities of SAP. The role of the super-user evolved

to one of redesigning the way in which staff implemented business routines and integrating SAP's routines with the 'Boxit way'.

6.1 An Examination of SAP's Influence on Operational Capabilities at Boxit

One of Boxit's primary goals was to use SAP to standardize the performance of each of its manufacturing plants. As the Human Resource Manager notes:

[W]e have identified approximately 25 key performance criteria for our plants. If we could transpose the average of the top ten across all firms then our bottom line would be transformed.

While recognizing that each manufacturing plant has its own *values and norms*, the HR manager expected that SAP would help to define the appropriate mix of resources to ensure that plants improved their performance, as measured by these key performance indicators. Hence, through SAP, production output from the same make and model of machine operating in production plants in different locations were compared and analyzed for efficiencies. Performance that varied from the accepted norm was the subject of remedial action. Once the best practice was identified, it was adapted and applied to all of the firm's operations. SAP therefore facilitated the identification of 'slacks' through benchmarking of activities. However, the managers of individual plants argued that such 'slacks' were beneficial for competence development.

The implementation of SAP provided Boxit's management with an opportunity to attempt operational change in structure and process in several areas, as the IT manager pointed out:

[W]e have seen a major change in the structure of the organization since SAP has been introduced. For the first time in the corporation's history a senior vice president with responsibility for purchasing was appointed.

The information SAP provided enabled the Senior Vice President to negotiate the purchase of raw materials, such as starch, in bulk for Boxit's entire European operation. The savings were significant at corporate level, but centralized purchasing prevented plant managers from sourcing raw materials locally, thereby introducing time efficiencies and cost savings at the plant level. Thus, they felt that SAP prevented them from lowering the overall cost of production at their plants. Worse still, according to the plant managers, SAP's dynamic reporting capability enabled corporate management to make *ad hoc* inquiries and to drill down and examine performance in greater detail than ever before. As a manager of BCS explained:

Now the theory is that we will all run on SAP...from a sheet plant point of view SAP is a nightmare, I mean it is an enormous amount of work for no benefits at all. In fact it adds cost to the operation here. For a corrugated plant it has obvious benefits, for an accountant sitting in Paris it is brilliant because he can see everything and he can drill-down into any level of detail he wants, down to what machines are producing what. Obviously, this leaves comparison wide open.

Local managers were concerned that variances attributable to fluctuations in local demand were not understood at corporate headquarters. Analyzing performance using limited criteria, they argue, risked producing misleading results; especially if SAP's non-firm specific operational routines were misaligned with local conditions. BCS managers therefore contended that in order to assess the performance of plants in disparate locations, local

factors must be taken into account. For example, inventory was sometimes maintained at high levels due to local agreements with customers, while underutilized production capacity was often due the seasonal fluctuations in the firm's customer base. Hence, some plants might not compare favorably with others serving different customer groupings, or when compared with the requirements of firms in the same industry operating in different regions. Managers at BCC and BCS felt that this process might be used as a lever to increase operating efficiencies irrespective of local contingencies. They also argued that SAP-enabled benchmarking of units acted as a barrier to innovation.

In order to compare favourably with other units, managers at BCS and BCC were under pressure to commit their resources to maximize current performance; however, as resources were finite they were unable to dedicate sufficient 'slacks' to help maintain plant-specific innovation through *knowledge creating activities*. The temptation for local managers was to leave their successors allocate the required resources to develop the capabilities necessary to address future problems and opportunities. Hence, managers underlined that SAP-enabled benchmarking had to involve more than comparing the costs of a series of activities or services required to produce the products. Using this criterion, there was no accounting for intangible resources such as *knowledge and skills*. Under SAP, this was considered a cost rather than a learning opportunity. It is long recognized that knowledge redundancy is essential for the well-being of a learning organization and its *knowledge creating activities*. Managers and operational staff at BCS and BCC were of the opinion that SAP endangered the organizational learning process as it led managers to concentrate on attaining short-term quantifiable gains, thereby depleting the firm's 'wellsprings of knowledge'.

6.2 Transferring Explicit Knowledge and Operational Skills Through SAP

Attitudes toward SAP varied, however, BCC's production manager identified that it had the potential to solve problems that were emerging in the workforce by educating technicians as they performed their duties. When experienced maintenance technicians found solutions to problems with manufacturing equipment, they recorded them using the facility supplied by SAP. Thus SAP permitted the explicit experiential knowledge of technicians to be captured and transferred to less-experienced co-workers. This was seen as supporting Boxit's *learning-by-doing* philosophy—except in this case '*Standing-by-Nanny*' was effectively augmented by a '*Standing-by-SAP*' approach. SAP's capabilities in effecting knowledge transfers were reported by the BCC's production manager viz.

We [were] starting to lose maintenance personnel [to other companies] and the information which the [SAP] system provide[d] help[ed] new maintenance personnel, who ha[d] no experience of working with packaging equipment. The information on the system provide[d] points of reference to help technicians to diagnose and rectify problems. Consequently, each technician [was] aware of work previously undertaken on each machine.

Ironically, the manager at BCS, who later was highly critical of SAP, exploited this facility early on to help transfer explicit knowledge of the operation and maintenance of former BCC plant to BCS, thus avoiding the importation of what were operational *core rigidities* at BCC. Nevertheless, the maintenance community perceived the introduction of SAP as an additional method of supervision and quality control. They objected to the implementation of SAP on the basis that it required them to do additional clerical work and it distorted the existing chain of command within their department.

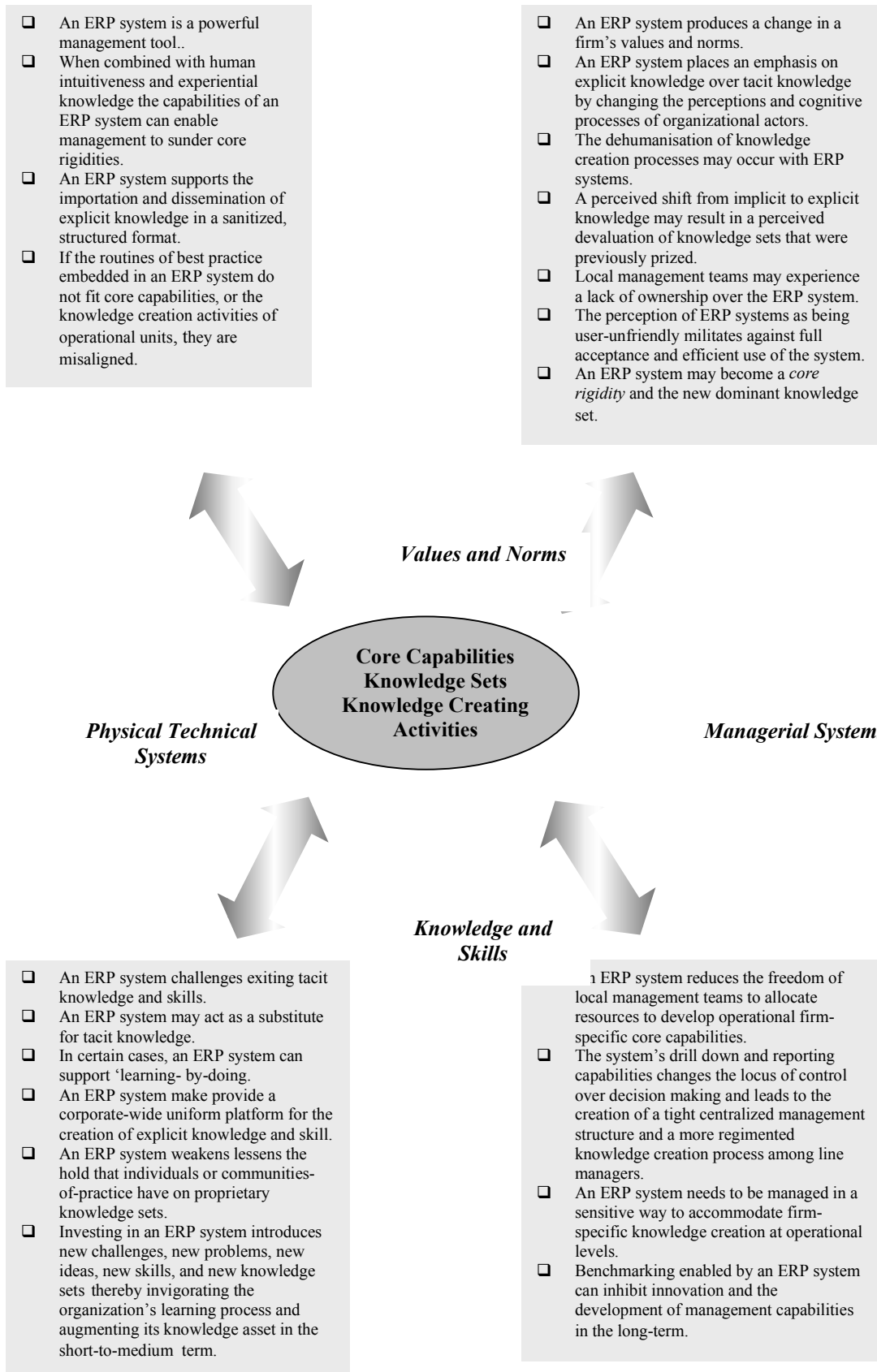


Figure 5 An Integrative Model of ERP System Implementation

As previously stated, communities-of-practice in the Boxit organization possessed a long held belief in the supremacy of experiential knowledge and the knowledge creating routine of *learning-by-doing*. The implementation of SAP caused a change in the *values and norms* of the organization in regard to the long-established primacy of tacit over explicit knowledge. Indeed, Boxit's CEO was famous (or infamous) for his application of tacit knowledge in sizing up a competitor for potential takeover. However, the consensus on the importance of tacit knowledge that had existed prior to the implementation of SAP was no longer evident in 2001. Local managers were concerned that this shift to SAP's prepackaged solutions would ultimately dehumanize the manufacturing process and eliminate opportunities (or the motivation) for problem solving at plant level. Without such opportunities, much-prized problem-solving activities and *core capabilities* could be lost.

7. Conclusions

This study has shown that SAP can have a significant effect on an organization's knowledge creating capabilities. Based on this study's findings, Figure 5 presents an integrative model of ERP system implementation that captures the salient issues surrounding, and consequences of, such endeavors. Briefly, the findings illustrate that the introduction of routines of 'best practice' via SAP had unanticipated consequences for *knowledge creating activities* at management and operational levels which challenged the *knowledge sets* on which unit-specific *core capabilities* were based. When imaginatively applied, SAP helped negate potential *core rigidities*, particularly where explicit knowledge was transferred between manufacturing units. Nevertheless, managers and operational staff felt that SAP (a) endangered tried and tested learning routines; (b) attenuated valuable *knowledge creating activities*; (c) depleted the firm's *intangible knowledge assets*; and (d) threatened established *core, enabling and supplemental capabilities*. The dynamic reporting capability of SAP to make ad hoc inquiries, to drill down, and to examine managerial and operational performance in greater detail than ever before, contributed to the creation of a rigid, centralized management structure and further reduced the autonomy of plant managers and operational staff. This signaled a shift in emphasis from tacit to explicit knowledge, and changed the system of *values and norms* within the organization.

In conclusion, this paper argues that organizations should take extant *knowledge creating activities*, such as tried and tested firm-specific routines for problem solving, organizational learning, and decision-making into account when implementing SAP modules. Hence, senior management must regard SAP as a means to an end, rather than an end in itself. Accordingly, business and IT managers should apply SAP in a sensitive and judicious manner, rather than be driven by its capabilities. Finally, it is clear that SAP has the potential to become the dominant *knowledge set* within an organization and therefore has the potential to become a *core rigidity* in itself.

References

- Al-Mashari, M (2000), 'Constructs of Process Change Management in ERP Context: A Focus on SAP/R3' in the *Proceedings of the Americas Conference on Information Systems* (AMCIS), August 10-13, Long Beach, CA, pp. 977-980.
- Barney, JB (1986), 'Organizational Culture: Can it be a Source of Sustained Competitive Advantage?' *Academy of Management Review*, vol. 11, no. 3, pp. 656-665.
- Caldwell, B & Stein, T (1998), 'Beyond ERP: New IT Agenda', *Information Week*, November.
- Cerullo, M & Cerullo V (2000), 'The Internal Auditor's Role in Developing and Implementing Enterprise Resource Planning Systems', *Internal Auditing*, vol. 15, pp. 25-35.
- Curran, TA & Ladd, A (1998), *SAP R/3. Business Blueprint*, Prentice Hall, Upper Saddle River, NJ.
- Davenport, T (1998), 'Putting the Enterprise into the Enterprise System,' *Harvard Business Review*, Jul-Aug, pp. 121-131.
- Esteves, J & Pastor J (2001), 'Enterprise Resource Planning Systems Research: An Annotated Bibliography', *Communications of the Association for Information Systems*, vol. 7, no. 8, pp. 1-51.
- Hanseth, O & Braa, K (1998), 'Technology as a Traitor: Emergent SAP Infrastructure in a Global Organization', in Larsen, TJ, Levine, L, & DeGross JI (eds) *Information Systems: Current Issues and Future Changes, Proceedings of the IFIP WG 8.2 and 8.6 Joint Working Conference*, Helsinki, Finland. IFIP, Laxenburg, Austria, pp. 155-174.
- Hedman, J (2000), 'The CES Framework for Discussing ES', in the *Proceedings of the Americas Conference on Information Systems* (AMCIS), August 10-13, Long Beach, CA, 649-654.
- Holland, CP, Light, B & Kalwalek, P (1999), 'Beyond Enterprise Resource Planning Projects: Innovative Strategies for Competitive Advantage', in Pries-Heje, J, Ciborra, C, Kautz, K, Vallor, J, Christiaanse, E, Avison, D & Heje, C (eds), *Proceedings of the 7th European Conference on Information Systems*, vol. I-II, June 23-25, Copenhagen, Denmark, pp. 273-287.
- Holsapple, C & Sena, M (1999), 'Enterprise Systems for Organizational Decision Support: A Research Agenda', in the *Proceedings of the Americas Conference on Information Systems* (AMCIS), Milwaukee, IL, pp. 216-218.
- Klaus, H & Gable, G (2000), 'Senior Manager's Understandings of Knowledge Management in the context of Enterprise Systems', in the *Proceedings of the Americas Conference on Information Systems* (AMCIS), August 10-13, Long Beach, CA, pp. 981-987.
- Leonard-Barton, D (1992), 'Core Capabilities and Core Rigidities: A Paradox in Managing New Product Development', *Strategic Management Journal*, vol. 9, pp. 41-58.
- Leonard-Barton, D (1995), *Wellsprings of Knowledge: Building and Sustaining The Sources of Innovation*, Harvard Business School Press, Boston, MA.
- Lincoln, JL & Guba EG (1985), *Naturalistic Inquiry*, Sage, Beverley Hills, CA.

- Shanks, G, Parr, A, Hu, B, Corbitt, B, Thanasankit, T & P Sheddon (2000), 'Differences in Critical Success Factors in ERP systems Implementation in Australia and China: A Cultural Analysis' in the Proceedings of the *8th European Conference on Information Systems*, Vienna, Austria, pp. 537-544.
- Stake, RE (1995), *The Art of Case Study Research*, Sage Publications Inc., Thousand Oaks, California.
- Stedman, T (1999), 'SAP, ERP Rivals will add Simpler Interfaces; Upgrades Target Biggest Sore Spot for Users', *Computerworld*. March 22, p. 4.
- Walsham, G (1995), 'Interpretative Case Studies in IS Research: Nature and Method', *European Journal of Information Systems*, vol. no. 2, pp. 74-81.
- Yin, RK (1989), *Case Study Research: Design and Methods*, Sage Publications Inc. Newbury Park, CA.