ERP Systems and the Strategic Management Processes that Lead to Competitive Advantage

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ABSTRACT

This paper describes the processes that firms and managers go through in their quests to create and sustain competitive advantages based on so-called Enterprise Resource Planning (ERP) systems. It is based on resource-based theory, combined with the strategy process perspective and with existing literature on information technology and ERP. The theoretic framework is extended through a detailed case study of a specific in-house ERP venture in a European multinational manufacturing company in the paper packaging industry. The emergent resource management framework describes cognitive and cultural factors that support or hamper progress, including uncertainty, knowledge gaps, knowledge transfer issues and the problems of ensuring that ERP usage is converted into competitive advantage. The framework also addresses managerial implications and potential solutions to such obstacles, throughout the process.

Keywords: ERP; IT strategy; competitive advantage

INTRODUCTION

The demand for so-called Enterprise Resource Planning (ERP) systems[1] has soared. Triggered by Y2K-compliance problems and the popularity of systems such as SAP's R/3, corporate investments in ERP have been significant over the last years. (In 2003, the global market was expected to reach $180 billion; source: AMR Research.) Research into ERP has focused on how these systems add value (Markus & Tanis, 1999; Ross & Vitale, 2000; Somers and Nelson, 2001), implementation issues (Parr et al., 1999; Scott & Vessey, 2001), and how they should be combined with other information technology (IT) resources (Hayman, 2000).

Being a relatively novel phenomenon, there are aspects of ERP that have not been covered well in research – yet. Two such interrelated issues are: 1) the relation be-

tween ERP and competitive advantage, and 2) the managerial and organisational processes that lead to ERP-based competitive advantage.

Relating to the first issue, it is still questionable whether investments in ERP systems have produced *competitive advantages* for investing companies, a question that is valid for IT in general as well. There is a shortage of empirical research on the specific matter, and the few references that do exist treat the issue of gaining competitive advantage in a relatively simplistic fashion (Kirchmer, 1998) or simply overlook it. The so-called *Resource-Based View* (RBV) provides a broader perspective because it focuses the sustainability of competitive advantage (Dierickx & Cool, 1989; Barney, 1991). Within IT, this need has been addressed by Clemons and Row (1991) and Powell and Dent-Micallef (1997) in the application of the so-called *competitive necessity* concept, and also by Ciborra (1994) and Bharadwaj (2000).

However, RBV too has limitations, for which it has been criticised (cf. Williamson, 1999; Eisenhardt & Martin, 2000; Priem & Butler, 2001). One such limitation is the relative focus on the strategy content (e.g., strategic resource attributes) rather than the strategy process (e.g., how resources become valuable and unique). In relation to IT, this stream of criticism corresponds to the second issue described above: not only is there lacking insight into the attributes of ERP resources that enable competitive advantage, there is also lacking insight into the processes that lead to ERP-based competitive advantage. Within the field of IT, only Ciborra (1994) and Andreu and Ciborra (1996) have addressed the importance of combining RBV with a process perspective. There is a relative focus on IT *content* or *conditions* (Mata et al., 1995; Powell & Dent-Micallef, 1997). The *processes* by which such advantages evolve, and how managers and users manage the IT resource to become a source of competitive advantage, are still relatively obscure.

The aim of this paper is to develop a framework that improves our understanding of the processes organisations go through as they try to gain competitive advantage based on ERP applications. This is done by addressing RBV and process theories, extended with theory on ERP. Subsequently follows a discussion of the method applied. In the next section, an emergent framework is presented, based on an analysis of how the empirical findings assist in developing the theory. The concluding section discusses the validity of the emergent framework and summarises managerial implications.

THEORY ON RESOURCE MANAGEMENT PROCESSES

The core of RBV is the assumption that industries are heterogeneous and that resources are imperfectly mobile across firms within industries. This juxtaposes RBV from the *Industrial Organisation* perspective (Bain, 1968; Porter, 1980), which uses firm-external factors such as the "five forces" to explain competitive advantage. According to RBV, firms have competitive advantage when they have one or more resources that are *idiosyncratically fit, valuable, leveraged, unique, and costly to copy or substitute* (cf. Barney, 1986, 1991). Consequently, one preliminary assumption is that the overarching process of creating competitive advantage involves attempts to meet these resource attributes. For the sake of simplicity, the outline of the discussion about such processes can be structured in accordance with these tasks, or sub-pro-

cesses: Idiosyncratic fit has to do with resource *identification* processes. Value, in turn, refers to resource *development* processes, whereas resource leverage requires (internal) resource *distribution*. Uniqueness and costly imitation/substitution, finally, require resource *protection*. By this simple transformation of attributes into verbs, we have a structure for the review below, which is based on a combination of (process-orientated) RBV and strategy process literature, and on theory on IT and ERP. Hence the following discussion addresses how resources (e.g., IT) can be managed in different stages, according to theory.

Resource Identification

The ability to identify ex ante which resources to invest in, and how much to pay, is crucial in any procurement situation. It affects the price the resource obtains on the factor market, and if successful it allows for a quicker pay-back, ceteris paribus (Barney, 1986; Peteraf, 1993). Literature on identification processes implies that the task is complex and related to the management of different constraints on 'rationality.'

Resource investment decisions are difficult because of *uncertainty* about technology, markets, and firm capabilities (Amit & Schoemaker, 1993). The consequence might be over-emphasis on past strategic actions and, ultimately, a lack of creativity. For competitors that approach the decision more 'imaginatively,' there might be opportunities for resource investments with first-mover advantages. The decision context is often multivariate, creating problems for decision-makers working under bounded rationality (March & Simon, 1958). According to Schoemaker and Amit (1994), there are two ways, ex ante, to assess how a resource will affect competitiveness: *correlational* and *causal* reasoning. Correlational reasoning means learning through empirical association between variables, and relies on the notion of correlation. Causal reasoning is deductive in nature and based on theory. Correlational reasoning is difficult due to the tendency to disregard minor correlations and non-linearity if there is no guiding theory or statistical analysis at hand. Conversely, when *a priori* theory exists, humans tend to overestimate the relation. Thus resource decisions can turn out as either 'unrealistic' or too conventional (Schoemaker & Amit, 1994).

Parallel to knowledge, decision-makers have to manage social constraints, such as norms and values, and reach a workable level of consensus. They need to desire common resources, under the constraints provided by the parallel demands on knowledge. Social problems can arise when the resource decision challenges the identity of the organisation and the legitimacy of its norms and values. However, the more homogeneous the values of the group of decision-makers, the more difficult it is to make radical decisions (Ginsberg, 1994). Although consensus is important, uniqueness often requires a radical approach: politically incorrect decisions may thus actually be a factor behind resource uniqueness (Oliver, 1997).

In sum, identification is about managing knowledge and culture to ensure that resource ventures are related to strategy and fit with the knowledge and culture of the organisation.

Resource Development

A resource is valuable if it helps the firm implement strategies that reduce costs or increase sales turnover (Barney, 1991). This implies that as the resource has been

acquired, internalised, firms should develop it in order to enhance the effects it has on cost and quality features of the end product/service. The logic is based on the assumption that resources affect processes (e.g., the value chain), which in turn affect product/service features.

This is fundamentally a knowledge issue and hence related to learning (McGrath et al., 1995) about resources and their fit with operations and strategy. From a managerial perspective, this involves the allocation and balancing of slack resources to projects.

Knowledge infusion, experimentation, continuous improvement, and the establishing of dynamic routines facilitate development (Lei et al., 1996). Exploration and discovery are critical. Opportunities to learn from outsiders, such as customers or alliance partners, should be taken. Organisation, particularly the composition of project groups, needs to be dealt with. Different types of knowledge (comprehension) and the ability to work as a team (deftness) are two group characteristics that drive competence (McGrath et al., 1995).

Culture and beliefs are also important. Knowledge that has proved itself successful over the years can be difficult to challenge, due to unbridgeable perceptions of perfection. Stronger communication channels and internal "marketing" efforts, as well as clear structures, may help organisations overcome such obstacles (Leonard-Barton, 1992).

Development of resources, initiated when the resource is internalised, is fundamentally a learning issue requiring both organisation and a coordinative management style.

Resource Protection

A central RBV criterion for strategic resources is that they are unique and costly to imitate or substitute (Barney, 1991). Thus it is important to protect resources from being acquired or otherwise obtained by competitors. Unique historical conditions, social complexity and causal ambiguity are factors that hinder imitation and substitution (Barney, 1991).

Roughly, there are two ways to protect resources: by legal arrangements or by 'isolating' the resource (Collis, 1996). However, legal protection can be costly. Property rights and patent applications require costly administration and still have limited duration, a more undisclosed organisation constrains communication, and so forth (Liebeskind, 1996). Other ways to protect resources include isolationistic measures, e.g., preservative actions such as external resource acquisition and deterrence. However, apart from isolating the resource by means of increasing social complexity and causal ambiguity, organisations can also sustain uniqueness by continuously developing the resource. Flexible, modular resources and the ability to create alternative resources may help firms to 'protect by developing' (Rotem & Amit, 1997).

In sum, protection is costly and about making sure to balance spending on patenting, deterrence, etc. with the benefits of uniqueness. Certain resources are not worth protecting.

Internal Distribution of Resources

Strategic resources need to be organised and leveraged across intra-organisational boundaries and used in as many product applications as relevant, given the costs associated with internal resource transfers (Prahalad & Hamel, 1990; Barney, 1994; Szulanski, 1996). Consequently, a central management task is the

internal distribution of resources.

Distribution problems are created by the propensity of knowledge to be 'stuck' departmentally or individually, due to so-called 'knowledge barriers.' This stickiness is caused either by the characteristics of the knowledge transferred, the source of the knowledge, the recipient, or the context in which the transfer takes place (Szulanski, 1996). Empirical evidence indicates that lack of absorptive capacity at recipient, causal ambiguity, and arduous relationships are key knowledge barriers (Szulanski, 1996).

Organisational context is another potential constraint. Autonomous organisational units, such as profit centres, may find it uneconomical to cooperate and share resources corporately. As a consequence, synergies are not realised. Some of these problems can be handled by the formation of explicit rules. Another way to deal with it is to simply refrain from trying to distribute resources at all. Artefacts such as IT tend to impose their own views of the world on businesses and operations, and may not suit all local units (cf. Grant, 1996).

Resource distribution requires efforts both by the source and the recipient of knowledge. It also requires a facilitating management style, supporting through incentives and structure.

IT, ERP, and Strategy

There is a large body of theory on IT and strategy, but not such a large one on IT and sustained *competitive advantage* or *the processes* that lead to competitive advantage. Furthermore, the number of texts that describes processes that lead to sustained competitive advantage through *ERP systems* is yet smaller. This section discusses such theory.

A fundamental assumption among "content-orientated" IT and RBV researchers is that IT only produces sustained competitive advantage when it supports (is *embedded* with) other valuable and unique firm resources (Clemons & Row, 1991; Mata et al., 1995; Powell & Dent-Micallef, 1997). However, others claim that a unique system (possibly created in-house) as such can be a source of advantage (Ciborra, 1994; Bharadwaj, 2000).

Among the relatively few texts on the *longitudinal organisational processes* that lead to IT-based sustainable competitive advantages, it is assumed that such processes are culturally, politically, cognitively constrained, and rarely the result of grand plans set by apex decision-makers (Ciborra, 1994). Instead, IT processes are bottom-up in nature, incremental rather than radical, local rather than central, ad hoc rather than planned, and so forth. *Bricolage*, meaning local tinkering and trial-and-error learning, is often the antecedent to larger, leveraged IT projects, which tend to develop in three 'learning loops,' as individual routines are improved, capabilities created, and strategic advantages generated through the use of IT. These processes are often bottom-up in nature, without a clear strategic intent up front (Andreu & Ciborra, 1996). The role of top management is to empower and create slack for such local ventures. Uniqueness is created through the idiosyncratic embeddedness IT has with operational routines (Ciborra, 1994).

The (strategy-orientated) ERP literature is focused on success factors in implementation and project phases, and the preceding strategy decision process and the succeeding ERP deployment are still relatively obscure. Process descriptions focus on alterations of the design, implementation, stabilisation, continuous improvement, transformation stages and imply that problems include the underestimation of re-

quirements on organisation and business changes, failure to set objectives, and technical issues such as data clean-up and bug hunting. Frameworks are relatively close to technology and functional operation, not strategy or sustainability of advantages (cf. Markus & Tanis, 1999; Ross & Vitale, 2000).

Texts on success factors in relation to ERP systems often list top management support, project team competence, interdepartmental cooperation, clear goals and objectives, project champions, vendor support, and the balancing of business and IT skills. In these approaches, 'success' appears not to be sustained competitive advantage, but rather having a functional system up and running (Somers & Nelson, 2001; Parr et al., 1999).

The above literature review is aimed at providing means by which to interpret the process of managing ERP systems to become competitive advantages. The theory is used as a 'platform' by which to 1) enquire about matters in the case and 2) interpret empirical findings.

METHOD

This study is qualitative, partly bearing resemblance with so-called Grounded Theory (Glaser & Strauss, 1967), which normally is seen as inductive in nature. The researcher approaches the object of study free from any theory or preconceptions, conducts field studies, retreats to existing theory for comparison, adds more empirical data and so forth, to emerge theory iteratively until it is 'saturated.' A key question over which researchers still debate is the extent to which *a priori* theory should be applied in a Grounded Theory study. Some claim that a clear mindset is important in order to avoid interpreting in accordance with existing theories (Glaser & Strauss, 1967), whereas others (Miles, 1979; Eisenhardt, 1989; Yin, 1994) claim that *a priori* theory is important for positioning emergent theory and stimulating analysis. This study acknowledges this logic and is based on the theories briefly described above.

The Case

The reported case describes the development of an integrated ERP system (called "CBS," see Appendix for short introduction) within SCA Packaging (SCAP), a Swedish MNC supplying paper packaging via more than 200 plants across Europe. The reason for choosing one, and this particular case, was primarily the access provided and the aspect richness this allowed. Although this case covers one firm and one system, the sample of units (plants run as profit centres) is broader and taken from different (European) countries, offering diversity. The disadvantage of only using one case, versus using 10 cases, is obvious: lack of generalisation. However, the purpose of this study is exploratory in nature, dealing with phenomena that are relatively novel. In such a setting statistical generalisation is limitedly relevant.

Data and Analysis

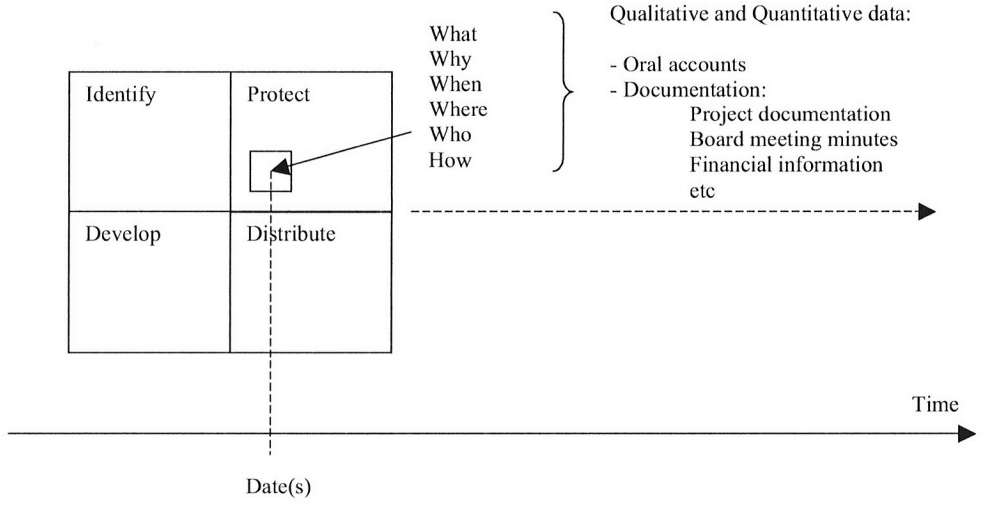
Data was gathered through interviews, archival research and by observation. Seventy-seven in-depth structured and unstructured interviews were made with 51 top managers, representatives for users and operational management, alliance partners, and consultants and vendors. Written sources include more than 2,500 pages of project documentation (project plans, evaluation reports, audits, specifications, selected sections of contracts, correspondence), board meeting minutes, annual reports, in-

dustry organisation reports, personnel magazines, internal market analyses, and consultants' reports, ranging from 1991 to 2001.

Data gathering aimed to outline the longitudinal, historical sequence of incidents and events (cf. Van de Ven & Poole, 1990) in terms of decisions, actions, and factors that were important in SCAP's quest to build and use a system that would help them improve their performance and realise their strategic goals. This meant creating a chronological outline ranging from the very conceptualisation of the idea to use ERP until the system was installed and employed. The theoretical constructs of Identification, Development, Protection, and Distribution were used as 'sensitising categories' (Glaser & Strauss, 1967).

As a consequence, data gathering firstly centred upon capturing the key events in relation to the overarching question of how organisations act when they attempt to gain ERP-based competitive advantage. All in all, more than 30 such events where identified (with different degrees of importance). Examples include events such as the decision to invest in ERP, the selection of consultants and vendors, the specification of functionality, the feasibility studies, software evaluation, the range of (local) implementation experiences, (local) business change programmes, capital applications routines, control exercises, and other events similar in magnitude. These events where then scrutinised, by seeking answers to why, what, how, where, when, and who questions, which in turn required both quantitative and qualitative data. Causal relations between events were of course studied, being an important feature of longitudinal research. Oral accounts of incidents were controlled using multiple sources, such as other respondents and documentation. Quantitative data, including a variety of different types of data, such as vendor selection comparison results, contract cost details, labour costs, order frequency, FTEs (full-time equivalents), stock levels, and profit and loss figures were of course also used. Figure 1 shows the approach to data gathering. To ensure reliability, all accounts have been cross-

Figure 1. Data Gathering (the figure illustrates how one event is studied)



checked with multiple sources, and the span of sources has been extended until no more new data or contradictions could be obtained about an event. Inter-rating of accounts has also been used.

The ambition has been to challenge and develop the framework with the empirical data. The emergent theory is thus the product of an iterative process, including comparison to the initial theory, analysis of the empirical contributions, and proposed extensions/refinements of the initial theory. This relation between data and theory corresponds to Yin's (1994) concept of 'pattern-matching' between data and initial propositions. Three aspects of validity have been particularly important (Glaser, 1978). *Integration* refers to the coherence of emergent theoretic models, i.e., how well theory components are inter-related. *Explanatory power* refers to the relative ability of the framework to explain the empirical phenomenon, and is assessed by comparing it to 'competing' theories. *Relevance* is determined by the extent to which the results of the study give ideas and constructs that are useful either in the theoretical or empirical context of the study.

EMERGENT THEORY AND DISCUSSION

The case study helped develop theory in different ways. It provided a sequence to the overarching management tasks (or phases) described earlier, it identified particular problems and challenges in the overall and individual phases, and showed how such problems can be managed. Process-pervading properties were also identified. This section discusses key empirical findings in relation to theory and outlines a model for how ERP resources are managed over time, in order to become sources of sustained competitive advantage.

Overarching Process

The process of building competitive advantage can be seen as holding four major tasks, or phases, i.e., identification, development, protection, and internal distribution. In relation to that, the case findings offer two observations that extend theory. The theory should include a fifth task – *usage* – to clarify managerial efforts post-implementation. Also, ways to interpret relations between the phases are identified.

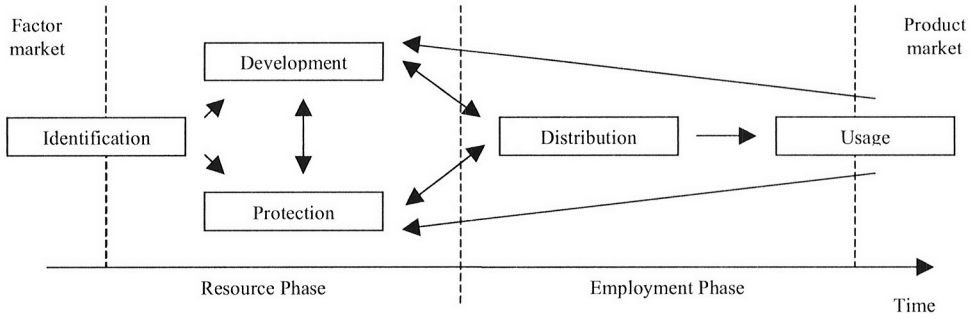
A central interpretation is that the theory needs to be extended with a phase that describes usage, i.e., managerial efforts and organisational activities focused on business, not technology, occurring post-implementation. Surprisingly, these matters are not well addressed either by RBV or ERP literature. It appeared after cross sub-case comparisons that more successful units had moved away from focusing on the system as such, and focused instead on changing their businesses, taking into account both the system *and* other business opportunities, such as labour cost rationalisation, business process reengineering, organisational specialisation and integration, meeting specific supply chain performance targets (response times, delivery performance, stock levels), etc. The successful plants put more emphasis on actually changing (local) strategy and structure, without explicitly attempting to optimise the system. Costs went down, since the work of administrative personnel in related functions was automated and there was less need for communication through time-consuming meetings. In one plant, the amount of staff in Customer Service and Sales was reduced from 38 to 16, allowing for an annual labour cost reduction of approximately one EURM. Re-

sponse times were reduced from hours or days to minutes due to improvements in communication and information access. Delivery performance was improved and delivery times were reduced overall, from on average two weeks to four working days. These improvements generated a cash-flow that paid back the plant's investment in less than two years. It is incorrect to state that all payback is caused by the system only, but the system was *enabling*. However, few of the studied units had received anything in terms of financial payback, due to reasons discussed in subsequent sections. Nonetheless, including usage is key, since installing a system means nothing economical has happened apart from the creation of a sunk cost that has to be dealt with.

With a longitudinal approach it becomes obvious that initially, the system is the object of attention, whereas once it is applied it becomes an independent variable that supports or restrains business performance. It has to be viewed as part of a larger resource base, holding several opportunities for business improvements. Usage is imperative in order to generate value and to enforce uniqueness of the system-organisation match. And because there are different levels of usage, it appears correct to view usage as distinct from internal distribution, and view *system employment* (distribution, usage) as distinct from *resource creation* (identification, development, protection). We thus have a distinction in the chronological dimension: a *resource phase* (the output is a system) and an *employment phase* (the output is improved business). The distinction is important particularly because the management attention differs. Distinguishing resource processes from employment processes is not interesting if one is only concerned with resource attributes or the strategic status of a system. But for a manager, resource development and employment are distinguished by time and should be separated in a process-based framework. ERP-based competitive advantages stem from interdependent development of the system and of the way it is used.

The case also gave some indications as to how the five phases can be interrelated over time. *Identification* is bound to occur before the other phases, for a given system, even if, naturally, there is often reiteration between phases. This phase includes clarifying a business strategy, identifying action areas among which are systems improvements, feasibility studies, specifying business needs and requirements, selecting vendors, signing contracts, etc. Logically it ends with a binding commitment. *Development* is initiated with the commitment to continue and includes specification and programming (or selecting functionality if it is an 'off the shelf' product), meaning that functionality has to be decided upon in great detail. The firm also takes action to secure uniqueness, hence *Protection* efforts occur in parallel. Observations indicate that there is causality between development and protection efforts, for instance in the way functionality is selected and in the way that firms *evaluate* uniqueness. Exclusive rights and other protection mechanisms are costly, thus reducing resource value. *Internal distribution* follows upon having prepared a system that is possible at least to pilot in a business context. As systems are tentatively being used, new learning processes are initiated, regardless of whether users and managers have been involved in previous phases. Problems become different in nature: business is highlighted, as well as initial ambitions and visions. When business concerns start to dominate the attention of staff, firms enter the *Usage* phase, during which the system

Figure 2: A conceptual framework for systems resource management processes



is subordinate to business improvements. Managers and users learn new ways to conduct business and identify needs to improve the system.

Figure 2 shows the five phases outlined. It highlights the overall process of fusing resources from the *factor market* through the processes of the firm, and materialising it through the offering on the *product market*. In the CBS case, successful units created and employed a resource that rendered unique cost positions and service levels on the product market. The system was a source of *temporary* competitive advantage. But which were the obstacles?

Within Phases

This section describes obstacles and means to resolve them throughout the process.

Identification

During identification, uncertainty, cognitive limitations and social limitations affect decision-making. Processes take place primarily through bottom-up processes, i.e., 'bricolage,' with limited interaction by top management.

Uncertainty: Empirical findings imply firstly, that because there are few opportunities to fully test and try the system prior to starting to develop it, a 'practical uncertainty' leaves decision-makers with the option to deduce and hypothesise about the resource in question. A *strategic vision*, which in the case was formulated as "differentiation of supply chain management" by having highest service levels (response times, delivery performance, etc.) and the most efficient administration (reduced labour cost, reduced stock levels, etc.) in competition, was key to provide a business context to the CBS venture. The strategic vision also needs to be broken down into a *resource vision*, which is fit with other firm-specific factors (e.g., size, culture, structure). Other factors that reduce uncertainty are the *involvement of top management* and *commitment to the resource vision* and its objectives and time frames. In the case, the main driver was the president of the corporation, who led and supported the identification efforts relatively closely. These propositions confirm and extend the view of Amit and Schoemaker (1993) and Schoemaker and Amit (1994).

Cognitive limitations: The case gives some examples of 'cognitive strategies' during identification: *deduction and causal reasoning* are important. *Access to knowledge* (internal and external skills) within the three key fields of *operations* (as held

by, e.g., a functional expert), *strategy* (as held by, e.g., a CEO) and *technology* (as held by, e.g., an IT consultant) is equally important due to the practical uncertainty that projects progress under. It requires *management of a large and fragmented network* of stakeholders and is a potential source of time consumption (cf. Amit & Schoemaker, 1993). In the case, this was managed by aggressive networking including knowledge from senior managers, users, operational expertise from different national units, and consultants and vendors.

Social limitations: ERP resources can challenge the view people have on work processes, organisation and strategy. Choice of vendor and technology, time frames, work process design are all potential hotspots. The case does indicate that firms can handle such limitations by a broader approach to understanding the different risks/benefits of different choices, including deeper analysis of possible scenarios. "*Cognitive variety,*" e.g., a wide representation of different units and internal and external functional fields, may assist. *Top management* plays an important role, due to their holistic view, business understanding, and as communicators of values and norms, and indirectly as providers of 'purpose' to the investment. The communication of *new strategic and technical values and visions* is important. These propositions stand in contrast to, e.g., Ciborra (1994).

Development

The case gives some perspectives on how development can be managed and organised.

Learning: The case suggests that 'bricolage' can be combined with more top-down approaches (cf. Ciborra, 1994). Certain elements of the process, for instance the coupling of the system with the strategy vision, require a strong top-down approach. Decisions about finer details of functionality may be solved by operational and technology experts. Given the ambition to gain competitive advantage, the case implies that a 'bricolage' approach could be too costly, limitedly radical and novel, and difficult to distribute. For the radical approach that uniqueness requires, all three knowledge fields of IT, operations and strategy must be managed and coordinated. Local, detailed knowledge is necessary, but a strategic logic is the fundamental platform for a project with such high ambitions.

Organisation: During specification of the CBS, a large sample of experts was involved and had "their say." This had obvious benefits: broader sets of knowledge were included, people felt they were part of the development of a path-breaking system, and they all got a glimpse of what ERP systems could do to their business. The negative side to this was high costs, time-consuming discussions and occasional animosity between a diverse range of functional experts from several European countries. In the end, many questions about functionality had to be resolved by democratic vote. This indicates that diversity is double-sided in nature and has to be balanced carefully. It is valuable for group comprehension but might be destructive to deftness. Comprehension and deftness could be negatively correlated, offering some nuance to the models of McGrath et al. (1995). Increased formalisation, centralisation, planning and budgetary procedures are means to handle questions of this nature. External knowledge partners, such as consultants, are important, but costly.

Protection

Efforts to protect the resource from imitation are parallel and partly identical to the efforts applied to develop it (such as

specifying idiosyncratically fit functionality). Exclusive rights and resource isolation are means to prevent from imitation, and the case gives perspective on situations managers can be faced with trying to protect resources.

Legal protection: Concerning ERP resources, there is always a risk that they are bought 'off the shelf' by competitors. There is also a risk that systems are created that provide the same effects on the product market, for instance lower costs for service or better delivery performance. In the CBS case, there were no similar business-specific systems that substituted the effects. Hence SCAP eventually turned to the vendor with the system that was best suited to build specific, customised functionality into. Alternative solutions were based on interfaced modules for Sales, Production and Logistics, with limited swiftness and communication. However, in other instances, systems are often duplicated and substituted. Thus *legal protection* is the only means to obtain exclusivity of the *system*. Within SCAP, it was the clear intention of top management to create a customised system that would not be obtained by other competitors. However, the negotiator (a senior manager) came under press to cut project costs, and against his instructions, signed a contract which did not grant the company exclusive rights. The software vendor offered SCAP to buy restricted sale of select functionality to a select number of competitors for a given time period, which was rejected. Today, the system is available to competitors, but only a few have bought it, and only bought selected modules. Competitors perceive the system as complex and unfit with business processes. This implies that in order to gain exclusivity and uniqueness, managers need to communicate the *value of uniqueness*, especially to key people such as negotiators. In this case, the price of buying exclusivity should be seen as an 'investment' in uniqueness.

Isolation: Firms can also use ERP systems in ways that enable sustained advantages. The case offers some examples of how *radical changes* in all the three knowledge dimensions (technology, strategy and operations) can enforce causal ambiguity for an outsider. If the changes in the three dimensions are also interrelated, ambiguity increases further. SCAP, who specified the system, knew better than competitors how to apply it and modify business processes. Thus in-house development may be a factor in creating ambiguity (cf. Clemons & Row, 1991). Furthermore, resource exposure to outsiders (e.g. consultants, vendors) may be necessary to obtain critical knowledge. The (social) *complexity* of a resource depends on who is observing it. For a project member it is clearer than for a competitor because of superior knowledge about the system and how it is embedded with routines and strategy.

Internal Distribution

Many theoretically proposed problems were observed in the study, which also indicated how they could be managed.

Observations imply that in ERP cases, the main transfer problems relate to weak motivation and weak absorptive capacity at recipient units, and, importantly, the structural context in which the transfer takes place. There was resistance when the system was launched, despite the fact that local staff always had had their say during specification periods. There was a lack of knowledge and of will to change. What could be referred to as *cognitive* and *cultural sediments* impaired the implementation in some plants. Users and managers had retreated to praising the old systems, claiming that key features of the new sys-

tem were not needed. Even the strategy the system was meant to support was questioned. An important factor was the time span between 'specification' (1994) and implementation (1997). Original suggestions were almost forgotten, business changes had already occurred and technology was no longer leading edge. There is a range of arguments why projects should be sped up, including cost escalation and first-mover advantages. The fact that the logic behind an investment may become obsolete prior to implementation is another argument.

Learning processes: The system was initially implemented stepwise in 20 plants. Lessons from previous installations were documented. Local learning strategies included continuously improved installation processes and preparations, utilisation of accumulated experience of implementers, customised support, unlearning of old systems, and hands-on user experience. Less successful units were unable to take it further than installation and were happy when their operations were as *reliable* as they were with the old systems.

Structural context: The role of the structural context cannot be underestimated. The case shows some examples of how structure affects distribution. SCAP has a *decentralised culture* and plant units are profit centres. This means that local general managers have significant autonomy, and although installing the system has been commanded from top management, it is imperative to ensure local managers are both knowledgeable and committed to the system. In the CBS case, they were not well informed, since they had never really partaken in development. This meant they also found it difficult to attach a meaning to the system. In that sense, more central efforts could have helped also in the implementation phase, but this was neglected initially by top management who assumed that local managers would optimise the use of the system due only to the communicated ambition that CBS should give advantages. The resource allocation was based on implementation being driven locally. This supports strongly the concept of the 'tyranny of the SBU' (Prahalad & Hamel, 1990), which stipulates that autonomous (profit) centres might have a conflict of interest with the corporation.

Usage

The case implies that usage consists of attempts to have a *valuable and unique use* of the system. In the SCAP case, the superior knowledge of the system and the interrelations between the system, the operations and strategy served as the platform for advantages.

Learning processes: Learning in relation to IT and ERP can take the form of 'loops' (Andreu & Ciborra, 1996), but it does not have to be a bottom-up process. A change of strategy may be the starting point, and it may be that 'routinisation' learning loops only occur after the system has been created, in the reverse order, or in an iterative fashion, which contradicts the learning processes introduced by Andreu and Ciborra (1996).

Cognitive obstacles: Knowledge of how the system, the strategy and the operational aspects are interrelated must be held by users and local managers, in order to generate business benefits. Learning can be stimulated by, e.g., control incentives such as capital investment responsibility, communication and support through direct channels or through local champions.

Cultural issues: Reaping the business benefits of an ERP system may require making personnel redundant, changing structures and reshuffling hierarchical po-

sitions and changing work processes. Being able to deal with such problems is an everyday issue for many managers, but not for all. In certain settings these management tasks may be completely new, even to an experienced manager. It could be that the attitude towards the ERP resource declines and stimulates further political problems.

In the SCAP case, it turned out that the conversion of the resource into profit was far from automatic. And to decentralised corporations the success of an ERP is ultimately dependent upon local understanding and commitment not just to a system but to the optional changes that follow with it. If this is not intact, structure and directives might be the only means at hand.

To conclude, Figure 3 shows how the different phases can be viewed. It is based on the initial interrelation of the five phases, yet with the inclusion of the *problems and solutions* discussed above. This model highlights the questions, challenges and possible solutions that managers have to deal with in relation to ERP systems.

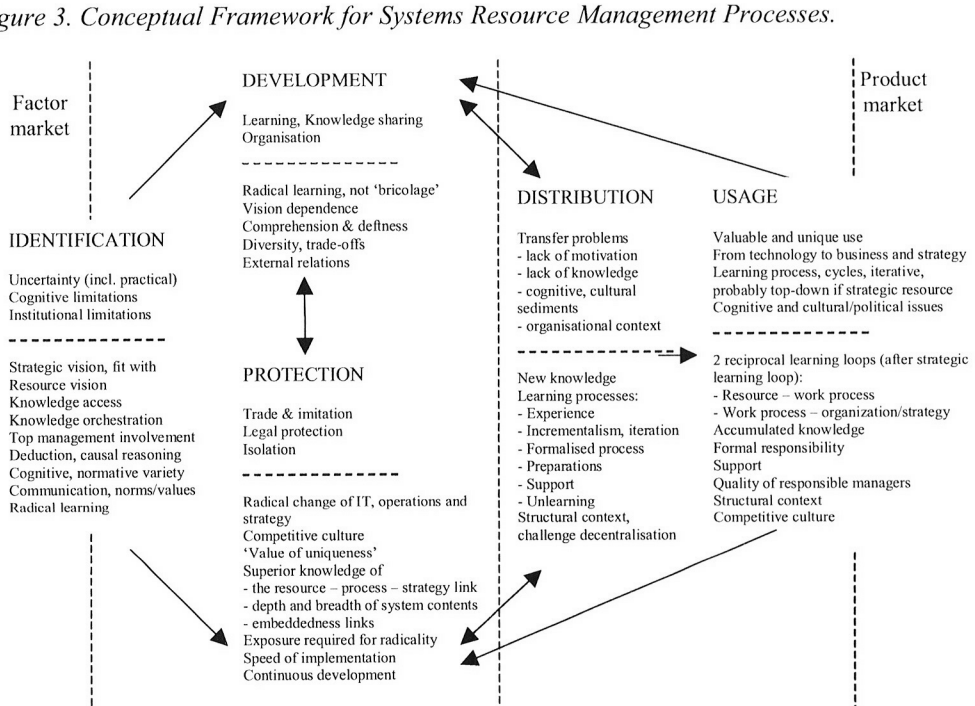
Pervading Properties

The case also indicates that three pervading properties affect processes of this kind: 1) irreversibility, 2) cognition and 3) top management involvement.

Irreversibility – Key Premise

A prime property is the *irreversible nature* of ERP ventures. The case implies that ERP ventures are at least imperfectly reversible, due to financial, cognitive and

Figure 3. Conceptual Framework for Systems Resource Management Processes.



cultural commitments.

Firstly, *financial commitments* tend to be significant, due to the high costs of both 'off the shelf' and in-house solutions. These costs have to be committed to relatively early on in the process, without prior testing and hands-on experience in the actual settings of business. Having made the commitment (by contract), other alternatives, including switching system, become costly in comparison. Thus financial commitments create path dependency.

Secondly, from a *cognitive perspective* it appears that the 'learning curve' firms and users go through is equally difficult to reverse. Moving from one system to another requires unlearning as well as learning. The commitment that people have to make in unlearning and learning may be an obstacle in its own right. As a consequence, firms might be unwilling to invest in new, cognitively demanding ERP systems too frequently, limiting the abilities to reverse projects and choose alternative solutions. Thus, having initiated learning – which is a requirement – firms are likely to be less tolerant with infusing new, competing knowledge to the process, and consequently less tolerant to changes of solutions.

Thirdly, systems and processes are *cultural embodiments* of norms about how to conduct business. They are political, meaning wide-swept agreement upon them requires "internal marketing" between stakeholders. Once this has been achieved, people tend to "lock in" one way of doing things. Any changes to a system, including replacing it, may cause declining motivation. Thus one argument against halting ERP projects is that the restart would require too much of costly convincing. The saying that a system is never as popular as when it is about to be replaced probably bears some truth.

Cognition – Main focus of Managerial Attention

Cognition is a factor in all the processes discussed. Access to knowledge about operations technology and strategy is key and affects both the resource and how it is employed.

During the resource phase, learning is essentially experimental and explorative. Deduction, scenario-based analysis and tentative, causal reasoning are the main learning mechanisms. During the employment phase, hands-on experience, trial-and-error, empirical, inductive learning is possible, and it is only then that the visions and ambitions can be realised. It is then that the actual value of the resource becomes apparent. Experience from using the system then feeds back negatively in order to modify the resource to fit better the operations and strategy as they evolve. At some point in time, strategy, operations or new technology will force the firm to abandon the system definitely to develop a new one.

The statement that cognition is important sounds tautological, but the important consequence for managers is that they understand what types of knowledge they need, that they are prepared to search and access them and pay to get it. It must be orchestrated and interrelated in order to generate new knowledge and challenge inherent knowledge and norms and values.

Top Management Involvement – Key Organisational Challenge

A third property is related to the involvement of top management. If the ambition is to create an ERP that gives competitive advantage, business strategy is bound to set the direction of the venture. And business strategy is normally shaped by top management. Top management in-

fuses the project with (their) meaning. Furthermore, strong involvement by top management will ensure practical facilitation such as funding and access to resources.

Of course, without the efforts of local staff, technologists and operational experts, little will happen. But if top management does not take the lead and sponsor the venture, others will achieve little. Bottom-up approaches will be costly, the political risks are presumably equally high, the timeframe will probably be extended, but most importantly, it will lack strategic insight, even though it may well be operationally fit.

The idea that the centre of firms need to be involved is not new. For organisations where cooperation and knowledge-sharing between autonomous units are favoured, this appears inescapable. Despite a relative distance from practical matters, managers do not automatically lack knowledge about IT resources and operation. In a business world where diversified firms 'downscope' to focus on core businesses, top managers are often qualified to understand matters close to the operative core. The proposition that strategic ERP ventures require a strong top management involvement, and a top-down approach, is in contrast with some propositions about ventures of this kind, like Ciborra (1994), Andreu and Ciborra (1996), and supports the view of, e.g., Prahalad and Hamel (1990).

Implications for Management

The resource management model describes implications of a decision to implement an ERP system. More specifically, the following implications appear important to management.

IT is just a tool. It is a potential resource at best. Sometimes it is an obstacle. Hence managers should strive to hold knowledge sufficient to understand the business improvement opportunities that ERP can provide. This involves ensuring that managers are surrounded by knowledgeable experts, to secure that ERP ventures have strategic fit and purpose.

Managers should be prepared to engage in *hefty investments*, with a relatively obscure pay-back and pay-back period. This does not mean committing to ERP investments without scrutiny. On the contrary, a careful cap app. exercise, with line managers expressing commitment both to the investment and the pay-back mechanisms, is a valuable tool.

Managers should also be prepared to enforce *new organisational structure and control mechanisms*. This means, potentially, to ease up deep decentralisation and alter incentive structures. This could have far-reaching consequences on morale.

Managers should also consider the *value of uniqueness*. Uniqueness can come through the system and/or the use of the system, but uniqueness in relation to competitors' cost, regardless of protection strategy. Managers must understand what system uniqueness is worth to them: is the ERP a strategic resource? Or is it something needed just to stay in the game?

Finally, ERP investments challenge not just the finances of the firm, but also existing *knowledge bases and culture*. Managers must make sure they are prepared to pursue the potential improvements in the face of these challenges.

CONCLUSION

The purpose of this paper is to shed light on the processes of managing ERP systems in order to gain competitive advantages. The end product is the ERP resource management process framework described and illustrated above. It was

stated, initially, that the validity of a framework such as the one presented depends on three attributes; integration, relative explanatory power and relevance (Glaser, 1978). Integration, i.e., the coherence of the model, will not be discussed further, as it has been described above. Overall, the presented framework does not primarily contradict previous approaches to ERP and strategy. The contribution, I believe, lies in the longitudinal outline and the detailed discussion about managerial challenges that lie ahead of anyone attempting to utilise ERP to gain competitive advantage.

Regarding *explanatory power*, one distinctive property of the framework is the use of RBV and strategy process theory. These are relatively scarcely used in IT/ERP research, and they are rarely combined (exceptions include Ciborra, 1994; Andreu & Ciborra, 1996). They are, however, often asked for (Powell & Dent-Micallef, 1997). With RBV, the resource uniqueness is put in focus, which is important. The process focus says something about the flora of problems and challenges managers face and have to solve in order to gain sustained ERP advantages. It also allows us to separate between resource phases and employment phases, to identify pervading properties, and shows, over time, how difficult it can be to gain advantages based on ERP. In relation to the RBV-based IT and ERP research, the framework gives some indications of what it might be like to 'embed' ERP systems with other organisational resources (cf Clemons & Row, 1991; Mata et al., 1995; Powell & Dent-Micallef, 1997). Ciborra's (1994) and Andreu and Ciborra's (1996) approaches to IT are possibly the concepts that this paper is closest to. The difference here is the focus on ERP, not IT in general. This may be the reason for the different views on, for instance, the role of top managers, the structural context and the learning cycles that occur in processes of this nature. This paper has overlaps with other process approaches as well, but it differs with its focus on strategy and advantages, not just improved operations (e.g. Markus & Tanis, 1999; Ross & Vitale, 2000). In relation to content-orientated research on ERP systems (e.g., Somers & Nelson, 2001; Parr et al., 1999), this study is supportive; the difference lies in the process focus used here, as well as the wider focus on uniqueness.

The methodological objective in case research is not to be able to generalise to a larger population, but rather in relation to theory (Yin, 1994). Nonetheless, it is important to discuss the academic and practical *relevance* of the framework. The CBS case is explicit, and competitive advantage is actively searched for, meaning that for ventures that unintentionally become competitive advantages, selected parts of the model are less interesting. The same goes for cases where firms buy systems 'off the shelf,' rather than develop them in-house, they probably put less emphasis on identification, development and protection. Regarding practical relevance, the framework describes managerial processes and should be useful for any manager in any of the stages of ERP implementation. To strengthen practical relevance, managerial advice has been listed too.

Given the popularity of ERP, there are plenty of research opportunities. We need to know more about the processes organisations go through when they invest in, nurture and exploit ERP systems. The RBV with its focus on uniqueness, and the strategy process view with its focus on the obstacles to rational change, are vital also for the future, e.g., given the increasing tendency to buy systems 'off the shelf.' The emergent framework, which is relatively

diverse, could also be studied "section-wise." It is difficult to statistically test the proposed model in a true/false sense. It is a supporting model.

APPENDIX: AN INTRODUCTION TO SCA PACKAGING AND THE CBS

SCA Packaging (SCAP) is one of the largest European suppliers of corrugated paper packaging, with a sales turnover of roughly 4 BEUR per annum. Having been a relatively small business unit within the SCA group, it started to grow, by acquisition, during the late 1980s, a strategy that took them from being a business unit with less than 10 plants in a few European countries to a company with more than 200 across Europe and in Southeast Asia and the USA. The current structure of SCAP is geographical, with each geographic region holding 10-30 production units, each of which is run as a profit centre.

The CBS ERP system was initiated in 1990 by the newly appointed president. CBS was the result of the growth strategy; in order to standardise communication and to link acquired plants, a new system was needed. The system was also intended to help SCAP improve so-called supply-chain management. Previously, the company and the industry had been very focused on production. Machine utilisation and productivity were key variables, and other functions were largely non-prioritised. The ambition was to use the system to differentiate and make functions such as customer service, production planning and logistics more efficient. At the time it could take several days to give customers a price for a box, it could take hours to inform customers whether they would receive orders on time. Delivery lead-times occasionally amounted to several weeks. In addition, there were many different systems used in the group (36 different systems), and none of them were very good. Although it was not addressed in 1990, most of them were not Y2K compliant. In 1991, a strategic vision was set and formulated, and a number of action programmes were initiated, one of which was the CBS, intended to help gain competitive advantage through supply-chain management.

SCAP cooperated with Digital Equipment, which helped SCAP envision what sort of system and technology they would need, given operations and strategy. In 1993, a project team of seven SCAP staff (representing all countries) and two consultants, sponsored directly by the president and cooperating with a network of local experts, summarised the business requirements in a comprehensive document detailing all requirements down to individual work tasks in different functions. The team also evaluated all available systems (23, globally), and found that none matched the requirements very well. The choice eventually fell on a German software provider who already had a relatively usable Manufacturing module. The system lacked functionality in Sales and Logistics, and it was decided that SCAP would help develop these and further refine the existing Manufacturing module to fit SCAP's requirements. SCAP – at least the President and the project team – had the ambition all along that sales of the system would be restricted, but when the contract was signed in April 1994, it turned out that the main negotiator (not a member of the project team) had turned it down in order to reduce the programme costs.

The system was specified during 1994 and 1999, and the first modules were piloted in 1997. Of the 60 plants in SCAP that are going to use it, only 20 have so far (2001). The modules were specified se-

quentially, starting with Sales, then Manufacturing, followed by Logistics. It is based on Windows NT and was programmed with Visual Basic. There were many factors that caused the prolongation of the system: development took longer, mainly due to problems of agreeing upon functionality, technical problems (Visual Basic 4 was severely delayed), poor preparations both in SCAP and at the vendor, and lack of resource allocation. Implementation was led by a corporate team (four people) and national teams (10-25 people) of business experts and structured in sequential mode, with two pilot plants in the UK and The Netherlands, respectively. As the project lagged, the decision was made in 1997 to install it in plants with Y2K problems, meaning France, Benelux and the UK started.

Implementation has been a mixed experience. The piloting of the Sales module (1997) went fine, but when the Production module was installed (1998), things took a turn for the worse. The plant operations were disrupted for several days. Practical issues such as invoicing, planning, order-entry, administration and work instructions had to be communicated manually. The relation between the plant and the project teams turned arduous. Eventually, the system started to work, and operations became reliable. Hands-on lessons learned as the implementation evolved were important in improving the rollout process at each plant, and subsequent installations went increasingly smoother.

However, many of the plants never took the level of utilisation further then the 'reliable level,' corresponding, basically, to the level of performance they had with their old systems (by 2001, less than half of the 20 plants can claim payback streams). Those plants that succeeded in not only stabilising operations but improving business had an active commitment from local managers, drew upon corporate expertise, appointed 'champions' and approached the situation as a business project. They asked themselves where they could take their business, given the new system *and* other resources at hand. Those that succeeded cut personnel costs and capital costs through rationalisation, and increased customer-perceived quality by improving response times to customer enquiries, and by improving logistics performance (smaller orders, just-in-time delivery, reduced stocks, etc.). In terms of advantages, they decided, explicitly, to make sure their level of systems *usage* was unique now that the system was available on the market. In line with the deeply decentralised nature of SCAP, senior management has done little to enforce a local level of usage that aggressively brings back the investment. Control mechanisms have not been modified. Whether local plants (profit centres) actually embark – and succeed – with change and improvement of supply chain functions is down to the aspiration levels of local general managers.

The cost of the project has been allocated across plants. For successful plants, the cost has been paid back in less than two years by cost reduction enabled. Regarding uniqueness, a handful of smaller competitors have bought certain sub-modules, but the larger competitors have turned it down, arguing that the system is too idiosyncratic, imposing a view of work that is too different from theirs. Consequently, successful SCAP units enjoy advantages, but whether they are sustained remains to be seen. Cost advantages can be gained by other means, such as manufacturing benchmarking, business process reengineering, etc. But since SCAP is equally strong in these areas, it is increasingly difficult to compete on costs.

ENDNOTES

[1] While acknowledging ERP's increasing importance for areas other than the 'enterprise' (such as in supporting SCM, CRM and other application types), I follow Esteves and Pastor's (2001) relatively 'internal' definition, stating that "ERP systems are software packages composed of several modules, such as human resources, sales, finance and production, providing cross-organisation integration through embedded business processes."

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