Coevolution of Firm Absorptive Capacity and Knowledge Environment: Organizational Forms and Combinative Capabilities

Frans A. J. Van den Bosch • Henk W. Volberda • Michiel de Boer
Department of Strategic Management and Business Environment, Rotterdam School of Management, Erasmus University Rotterdam, P. O. Box 1738, 3000 DR Rotterdam, The Netherlands,
f.bosch@fac.fbk.eur.nl • h.volberda@fac.fbk.eur.nl

Abstract

This paper advances the understanding of absorptive capacity for assimilating new knowledge as a mediating variable of organization adaptation. Many scholars suggest a firm's absorptive capacity plays a key role in the process of coevolution (Lewin et al., this issue). So far, most publications, in following Cohen and Levinthal (1990), have considered the level of prior related knowledge as the determinant of absorptive capacity. We suggest, however, that two specific organizational determinants of absorptive capacity should also be considered: organization forms and combinative capabilities. We will show how these organizational determinants influence the level of absorptive capacity, ceteris paribus the level of prior related knowledge. Subsequently, we will develop a framework in which absorptive capacity is related to both micro- and macrocoevolutionary effects. This framework offers an explanation of how knowledge environments coevolve with the emergence of organization forms and combinative capabilities that are suitable for absorbing knowledge. We will illustrate the framework by discussing two longitudinal case studies of traditional publishing firms moving into the turbulent knowledge environment of an emerging multimedia industrial complex.

(*Micro- and Macrocoevolution*; *Absorptive Capacity*; *Organization Forms*; *Combinative Capabilities*; *Knowledge Environment*; *Multimedia Industrial Complex*)

1. Introduction

How do firms coevolve with their environments? Recent publications (Cohen and Levinthal 1990, 1994, 1997; Lane and Lubatkin 1998) suggest that absorptive capacity is an important moderating factor for assimilating new knowledge. It may enable and restrict the level and range of exploration adaptations (Lewin et al., this issue). In this paper, we develop organizational determinants of absorptive capacity. Cohen and Levinthal (1990) proposed prior related knowledge as the determinant of absorptive capacity. The purpose of this paper, however, is to develop a more integrated framework of the coevolution of a firm's path-dependent absorptive capacity and the knowledge environment. Such a framework may contribute to a more general theory of firm-environment coevolution that describes organizations, their populations, and their environments as a joint outcome of managerial actions, institutional influences, and environmental phenomena (Lewin and Volberda, this issue).

In developing our framework, three mutually related *research questions* will be addressed. Given a firm's need for increased absorptive capacity, due to a more demanding knowledge environment, the first research question is: "What are important organizational determinants of absorptive capacity?" In addressing this research question, we argue that besides prior related knowledge as a determinant of absorptive capacity (Cohen and Levinthal 1990), organization forms and combinative capabilities also need to be considered. To advance our understanding of the phenomenon of coevolution, we raise two additional research questions, namely: "How does absorptive capacity influence the knowledge environment?" and "How can a firm's absorptive capacity be understood as a joint outcome of managerial actions and developments in the knowledge environment?"

The paper is structured as follows. First, we illustrate the importance of the absorptive capacity concept for firms confronted with changing knowledge environments. Based on a review of the literature, we suggest both organization forms and combinative capabilities as organizational determinants of absorptive capacity. Secondly, we assess these organizational determinants with regard

1047-7039/99/1005/0551/$05.00
1526-5455 electronic ISSN

to their influence on the level of a firm's absorptive capacity, ceteris paribus the level of prior related knowledge. Subsequently, we put the building blocks of the framework together and discuss how it contributes to the understanding of coevolutionary effects both within the firm (microcoevolution) and regarding the knowledge environment (macrocoevolution). Moreover, we will illustrate the framework by considering two longitudinal case studies of traditional publishing firms moving into the turbulent knowledge environment of the emerging multimedia industrial complex. The case studies show how these firms increased their absorptive capacity, not only by increasing the level of prior related knowledge, but also by deliberately changing their organization form and combinative capabilities. In the final section, we discuss the findings and limitations of the paper and give suggestions for future research.

2. Changing Knowledge Environments and Knowledge Absorption

Outside sources of knowledge are critical to the innovation process in general (Cohen and Levinthal 1990) and in particular in the context of changing knowledge environments. Hence, firms confronted with changing knowledge environments should, to a large extent, aim at reconfiguring existing component knowledge. For reasons of analytical simplicity, we distinguish three types of *component knowledge:* knowledge related to products or services, knowledge related to production processes, and knowledge related to markets. Component knowledge can reside within the firm itself, within a firm's traditional knowledge environment, and within knowledge environments that have yet to be explored. Component knowledge consists of both explicit and tacit knowledge (Nonaka 1994, Boisot 1998). Reconfiguring existing component knowledge builds on the distinction made by Henderson and Clark (1990) between four types of innovations: incremental, modular, architectural, and radical innovation. Henderson and Clark (1990, p. 12) have pointed out that "The essence of an architectural innovation is the reconfiguration of an established system to link together existing components in a new way." Reconfiguring existing component knowledge by a firm leads, at least to the firm involved, to a new *knowledge configuration.* This new knowledge configuration consequently serves as a platform for producing both adapted and new product-market combinations. This approach to organizational knowledge reconfiguration closely resembles Schumpeter's (1934) definition of innovation as a process of combining existing stocks of productive means in new ways. In the context of a changing knowledge environment, the opportunities to combine existing component knowledge may be more appealing than the opportunities to change the component knowledge itself. Rather, new knowledge is often the product of a firm's combinative capabilities to generate new applications from existing knowledge components (Kogut and Zander 1992).

The challenge to create new knowledge configurations within the firm implies that the absorption of different types of new component knowledge becomes a key ability to master for a firm's management. Consequently, the ability of the firm to evaluate, assimilate, and utilize outside knowledge for commercial ends is of crucial strategic importance. As Grant (1996a) has argued, the primary role of the firm is the integration and, of course, utilization of knowledge. This ability is labeled by Cohen and Levinthal (1990) as a firm's *absorptive capacity* and stems from the premise that a firm needs prior related knowledge to absorb and use new knowledge. We assume that knowledge integration (Grant 1996a) within the firm is part of the absorptive capacity concept. That is, absorptive capacity comprises evaluation, acquisition, integration, and the commercial utilization of new outside knowledge. Building on Grant's (1996a) three characteristics of knowledge integration, we assume the content and process of a firm's knowledge absorption can be analyzed using *three dimensions of knowledge absorption.* These dimensions are efficiency, scope, and flexibility. Efficiency of knowledge absorption refers to how firms identify, assimilate, and exploit knowledge from a cost and economies of scale perspective. Scope of knowledge absorption refers to the breadth of component knowledge a firm draws upon. Flexibility of knowledge absorption refers to the extent to which a firm can access additional, and reconfigure existing, component knowledge. March's (1991) distinction between *exploration* and *exploitation* in the development of organization knowledge can be associated with these three dimensions of knowledge absorption. We assume that the efficiency dimension of knowledge absorption is associated with the exploitation adaptation of a firm's knowledge configuration, as the "essence of exploitation is the refinement and extension of existing competencies, technologies and paradigms." (March 1991, p. 85). Furthermore, we assume that the scope and flexibility dimension of knowledge absorption is associated with the exploration adaptations of a firm's knowledge configuration.

Table 1 illustrates our arguments. In developing a coevolutionary framework, we will consider two opposite types of knowledge environment. In *a stable knowledge environment,* like a mature single industry, in which we

Table 1 Assumptions Regarding Types of Knowledge Environments, Focus of Knowledge Absorption, and Requirements Regarding Three Dimensions of Knowledge Absorption

		Requirements Regarding Three Dimensions of Knowledge Absorption:		
Types of Knowledge Environment:	Focus of Knowledge Absorption on:	Efficiency	Scope	Flexibility
(1) Stable knowledge environment Example: Mature single Industry	Exploitation	H	L	L
(2) Turbulent knowledge environment Example: Emerging industrial complex	Exploration	L	H	H

H: high; L: low

assume existing firms have a strong focus on the exploitation of knowledge, the knowledge domain the incumbent firm wishes to exploit is closely related to its current knowledge base (Cohen and Levinthal 1990). Contrary to firms in stable knowledge environments, firms in *turbulent knowledge environments* are likely to dedicate efforts exclusively to increasing their absorptive capacity. In such environments, a firm's knowledge absorption is likely to be focused on exploration and therefore on the scope and flexibility dimension of knowledge absorption. Table 1 shows the impact these different knowledge environments are likely to have on the requirements regarding the three dimensions of knowledge integration.

3. Building Blocks of Absorptive Capacity

Cohen and Levinthal (1989, p. 569–570) introduced the absorptive capacity construct as follows: "the firm's ability to identify, assimilate, and exploit knowledge from the environment," pointing out that "a stock of prior knowledge . . . constitutes the firm's absorptive capacity." In another paper, Cohen and Levinthal (1990, p. 128) again considered the level of prior related knowledge as the determinant of a firm's absorptive capacity: "We argue that the ability to evaluate and utilize outside knowledge is largely a function of the level of prior related knowledge." They pointed out, however, that it is: ". . . useful to consider *what aspects of absorptive capacity are distinctly organizational*" (Cohen and Levinthal 1990, p. 131, italics added). In their brief analysis devoted to this question, a few of these aspects are mentioned. Examples of these "internal mechanisms that influence the organization's absorptive capacity" (Cohen and Levinthal 1990, p. 135) are the transfer of knowledge across and within subunits; the structure of communication between the external environment and the firm, i.e. the centralization of the interface function; a broad and active network of internal and external relationships; and cross-function interfaces.

In considering these various organizational aspects or internal mechanisms that influence a firm's absorptive capacity, it is necessary to ask which important organizational determinants of absorptive capacity may be distinguished. This question has been addressed in earlier studies. For example, Pennings and Harianto (1992) analyzed the adoption of video banking by large U.S. banks, and the role played by a bank's absorptive capacity. They concluded that cumulative experience with IT and linkages to other firms do matter. Lane and Lubatkin (1998, p. 473) showed that "the ability of a firm to learn from another firm is jointly determined by the relative characteristics of the two firms," hence their emphasis on relative absorptive capacity, and that on the basis of their empirical findings, a firm's knowledge-processing system plays a key role in absorbing knowledge. According to Lane and Lubatkin (1998, p. 464): "We can think of a firm's knowledge-processing system as being analogous to a computer's operating system . . . ." In their analysis, two proxies for a firm's knowledge-processing system are suggested: (1) a firm's compensation practices and (2) a firm's organization structure. In our analysis, we will focus on the organization form as an important organizational determinant of absorptive capacity because we assume that a firm's organization form is strongly related to its knowledge-processing activities. Besides organizational forms, we suggest that combinative capabilities are an important organizational determinant of absorptive

capacity (Kogut and Zander 1992). This is in line with Cohen and Levinthal's (1994, p. 227) statement that absorptive capacity is ". . .comprised of the set of closely related abilities" to evaluate, assimilate, and apply external knowledge; these abilities ". . .collectively constitute what we have termed a firm's "absorptive capacity."

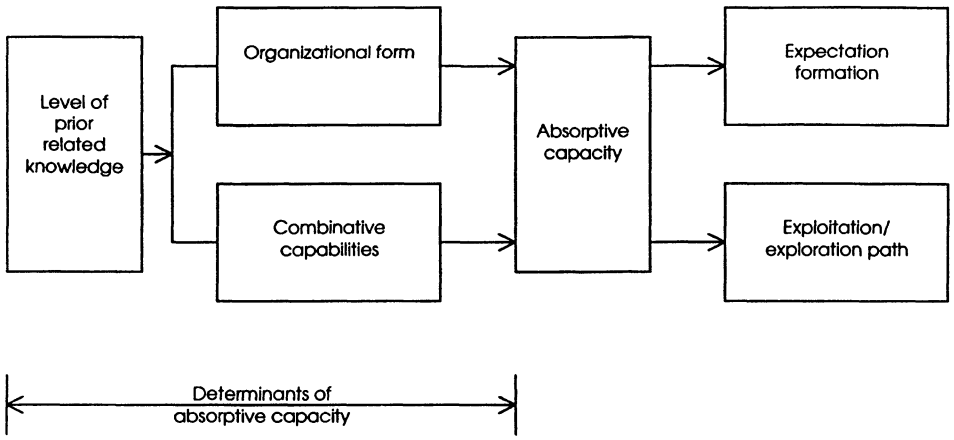
Figure 1 shows the major building blocks of the proposed framework. In the next two sections, we will argue that: (1) ceteris paribus, different organization forms enable or restrict absorptive capacity; and (2) ceteris paribus, different combinative capabilities enable or restrict absorptive capacity. Put differently, we assume that the level of absorptive capacity is not only determined by the level of prior related knowledge, but also by the moderating determinants of organization forms and combinative capabilities.

Obviously, a firm's organizational form and combinative capabilities may change over time. Below, we will further explain these dynamic aspects in the context of a coevolutionary approach. We limit ourselves here to a few remarks about the *path dependency* of absorptive capacity. Regarding the path-dependent feature of absorptive capacity, Cohen and Levinthal (1990, p. 136) pointed out that ". . .absorptive capacity affects a firm's expectation formation, permitting the firm to predict more accurately the nature and commercial potential of technological advances." In turn, these revised expectations, however, condition the firm's incentives to invest in absorptive capacity. A related aspect of Cohen and Levinthal's (1990) analysis that deserves more attention is the link between expectation formation, or a firm's aspiration level, and the sensitivity for emerging opportunities in the environment. Cohen and Levinthal (1990, p. 137) pointed out that the higher the absorptive capacity, the more likely it will be that a firm's aspiration level or *expectation formation* will be defined in terms of the opportunities present in its environment, independent of current performance criteria such as profitability. They suggested that firms with higher levels of absorptive capacity will tend to be more proactive. These "prepared" firms are better at anticipating the emergence of valuable developments (Cohen and Levinthal 1994). Firms having a modest absorptive capacity will tend to be more reactive regarding exploring opportunities. Several other scholars have recognized the importance of proactive firm behavior in turbulent environments. For example, Hamel and Prahalad (1994) use the concept of "industry foresight," and Volberda (1998) stresses the influence of a high level of absorptive capacity in developing industry foresight. In this respect, an understanding of distinctive organizational determinants of absorptive capacity is important. In the next two sections, we will assess these organizational determinants and their influence on the level of absorptive capacity.

4. Organization Forms and Knowledge Absorption

A firm's current knowledge base cannot be separated from how it is currently organized (Kogut and Zander 1992). The existing organization form influences how a firm processes knowledge. In this respect, an organization form is viewed here as a type of infrastructure which enables the process of evaluating, assimilating, integrating, and utilizing knowledge in a specific way. Burton and Obel (1995) and Volberda (1998) have provided a thorough analysis of various basic organization forms. As a determinant of absorptive capacity, organization forms are expected to have (ceteris paribus other determinants

Figure 1 **Building Blocks of the Framework: Determinants of Absorptive Capacity and Expectation Formation**



of absorptive capacity) a different potential for knowledge absorption and so have a different influence on absorptive capacity. To illustrate this argument, we limit ourselves here to three well-known basic organization forms: the functional, divisional, and matrix forms. For a comparable analysis regarding the impact of organizational form on knowledge integration, we refer to de Boer et al. (1999).

The three organization forms can roughly be described by analyzing methods of grouping activities, the number of hierarchical levels, and by the extent to which management is divided into various functional areas, commonly reflected in the organization chart. A description of the three organizational forms is given below and is derived from Volberda (1998, p. 142–143). We compare these basic organization forms in terms of their potential for the efficiency, scope, and flexibility of knowledge absorption. However, a growing number of new organization forms have been suggested (Dijksterhuis et al., this issue). Examples are the internal network form (Miles and Snow 1986), the N-form (Hedlund 1994), and the hypertext form (Nonaka 1994). Most of these new forms have not yet been described in sufficient detail to assess each of them regarding the three dimensions of knowledge absorption.

The *functional form* is based on a functional grouping of similar activities under major functional managers, a hierarchy of authority consisting of many hierarchical levels with small spans of control, and a degree of functionalization of management which may be limited (no staff functions) or high (staff functions with formal authority). Component knowledge is specialized according to functional areas. The principal advantage of the functional form is the efficiency it attains from economies of scale, overheads, and skills. The scope and flexibility of knowledge absorption of the functional form is rather limited. In stable and homogeneous environments where there are few product-market combinations with a relatively long life cycle, this form might be appropriate (Krijnen 1979). In more unstable conditions, priority conflicts occur, decisions and products begin to accumulate, communication lines get longer, and time responsiveness to external conditions is degraded (Ansoff and Brandenburg 1971). Consequently, we assume that the functional form has a high potential for efficiency, but a low potential for both scope and flexibility of knowledge absorption.

The *division form* is based on grouping by product-market combinations, a limited hierarchy of authority consisting of few hierarchical levels with large spans of control, and a limited functionalization of management in the form of some central staff functions. Because of the autonomy of divisions in terms of operational decisions and their direct contacts with the environment, the flexibility of knowledge absorption is higher than in the functional form. Furthermore, the scope of knowledge absorption is limited to a single division. The reconfiguration of component knowledge takes place at the divisional level. The loose coupling among divisions facilitates divisional knowledge absorption but suppresses integration and common utilization of knowledge between multiple divisions. Therefore, a division form is most appropriate in a dynamic environment with a large number of different product-market combinations that have few knowledge characteristics in common, and of which the life cycle is relatively long. Hence, we assume the division form has a low potential for both scope and efficiency, but a high potential for flexibility of knowledge absorption.

The *matrix form* is based on a dual grouping of activities, a dual hierarchy of authority consisting of few hierarchical levels, and a high degree of functionalization of management tasks. The matrix is a combination of the principle of specialized functional departments with the principle of self-sufficient, more or less autonomous units or divisions, in situations where a number of (temporary) divisions or autonomous units need to be created. The ability of each unit to seek the organization form most appropriate to the project it is handling facilitates the flexibility of knowledge absorption. The fact that available means and persons can be allocated to various projects enables a high scope and flexibility of knowledge absorption. On account of its high scope and flexibility of knowledge absorption, the matrix form is deemed appropriate for organizations that function in environments with many new product-market combinations that have relatively short life cycles. The high scope and flexibility of knowledge absorption of the matrix form is detrimental to its efficiency. Economies of scale will be rather small because different functions, experts, and tools will be needed in different projects that are simultaneously executed, which results in the fact that resources are only partially utilized. Consequently, we assume the matrix form has a low potential for efficiency, but a high potential for both scope and flexibility of knowledge absorption.

The assumptions regarding the potential for knowledge absorption of the three basic organization forms, including their influence on absorptive capacity, are summarized in Table 2. We assume that both the scope and flexibility dimension of knowledge absorption have a positive influence on the level of absorptive capacity, while efficiency has a negative impact. Nonetheless, the knowledge absorption potential offered by a certain organization

Table 2 Three Basic Organization Forms, Dimensions of Knowledge Absorption and Absorptive Capacity

	Organization Forms		
Dimensions of Knowledge Absorption	Functional Form	Divisional Form	Matrix Form
Efficiency of Absorption	H	L	L
Scope of Absorption	L	L	H
Flexibility of Absorption	L	H	H
Impact on Absorptive Capacity[a]	Negative	Moderate	Positive

H: high; L: low

[a]Assumption: Both scope and flexibility of knowledge absorption have a positive influence on the level of absorptive capacity, while efficiency has a negative impact.

form can be utilized by temporary task forces, standing committees, project teams, or various other liaison devices that overlay the basic organization structure (Galbraith 1973, Mintzberg 1979). Therefore, in the next section, we discuss three types of combinative capabilities that contribute to utilizing the potential of the knowledge absorption offered by the various organization forms.

5. Combinative Capabilities and Knowledge Absorption

In our conceptual framework, combinative capabilities are the second organizational determinant of the level of a firm's absorptive capacity. As Cohen and Levinthal (1990, p. 133) pointed out, these capabilities are important because ". . .an organization's absorptive capacity is not resident in any single individual but depends on the links across a mosaic of individual capabilities." A firm's combinative capabilities synthesize and apply current and acquired knowledge (Kogut and Zander 1992). The use of the term "combination" by Kogut and Zander is associated with "integration," as used by Grant (1996a), and "configuration," as used by Henderson and Clark (1990). We build on these contributions here in two ways. First, we distinguish *three types of combinative capabilities* a firm has at its disposal: systems capabilities, coordination capabilities, and socialization capabilities. Secondly, we analyze the impact these combinative capabilities are likely to have on the level of knowledge absorption. In principle, combinative capabilities can be of an intra- and interorganization nature. A firm reconfiguring existing component knowledge can use these three capabilities to absorb component knowledge located within the firm, within its own industry environment, or within other, related industry environments.

Systems capabilities in terms of direction, policies, procedures, and manuals are often used to integrate explicit knowledge. Nonaka (1994) calls this "combination." Systems capabilities describe the degree to which behaviors are programmed in advance of their execution (Galbraith 1973, Khandwalla 1977). They reflect the degree to which rules, procedures, instructions, and communications are laid down in written documents or formal systems. Individuals exchange and combine explicit knowledge through formal exchange mechanisms such as a priori procedures, formal language, codes, working manuals, information systems, etc. The primary virtue of systems capabilities is that they eliminate the need for further communication and coordination among subunits and positions. Consequently, they provide a memory for handling routine situations. In such routine situations, the behavior of participants is predictable, that is, they know what to do, and they can react very quickly. Systems capabilities, however, are not similar to routines defined by Nelson and Winter (1982, p. 14) ". . .routines play the role that genes play in biological evolutionary theory." Systems capabilities are more formalized, explicit, and changeable by management. While the efficiency of knowledge absorption by using systems capabilities is very high, the scope and especially the flexibility of knowledge absorption is supposed to be less. Hence, we assume that these capabilities have a negative impact on the level of absorptive capacity.

In contrast to systems capabilities that absorb knowledge by ex ante rules and procedures, *coordination capabilities* enhance knowledge absorption through relations between members of a group. They refer to lateral ways of coordination. These methods of coordination might be explicitly designed, but may also emerge from a process of interaction (De Leeuw and Volberda 1996). Coordination capabilities are path dependent; they accumulate in a firm as a result of (1) training and job rotation,

(2) natural liaison devices, and (3) participation. Education and training indirectly achieve what rules and procedures, as a part of systems capabilities, do directly. They control, coordinate, and help to absorb knowledge in the firm. On the job, professional or craft, workers appear to be acting autonomously, but in fact they are guided by trained skills and acquired knowledge. Regarding job rotation, Cohen and Levinthal (1990, p. 135) pointed out that ". . .this practice also suggests that some intensity of experience in each of the complementary knowledge domains is necessary to put an effective absorptive capacity in place."

In a turbulent environment, mutual adjustment (Mintzberg 1979) becomes the favored means of knowledge coordination. This brings us to liaison devices for regulating mutual adjustments between individuals or units. Such liaison devices result in lateral forms of communications and joint decision-making processes that cut across functions and lines of authority. Consequently, liaison devices facilitate knowledge absorption without creating self-contained units. The effect is that the capacity to process information and to coordinate knowledge is increased (Galbraith 1973). Cohen and Levinthal (1990) also stressed the importance of cross-function interfaces such as relationships between functional areas, personal contact across functions, and liaison roles in each unit for raising a firm's absorptive capacity.

Finally, in situations in which delegation is a necessity, participation in decision-making can bring about the knowledge integration and absorption to offset the differentiation that delegation causes (Khandwalla 1977). Participation describes the extent to which subordinates take part in the decision-making process of superiors. Low levels of participation therefore result in low levels of knowledge sharing. A high degree of participation results in a richer knowledge architecture, based on various contributions of participants at lower levels. We assume that coordination capabilities have a low potential for efficiency, but a high potential for both scope and flexibility of knowledge absorption. Based on the above arguments, we assume coordination capabilities have a positive influence on the level of absorptive capacity.

In addition to the explicit absorption of knowledge by systems capabilities and the implicit absorption of knowledge by coordination capabilities, we distinguish a third type of combinative capabilities: *socialization capabilities.* Socialization capabilities may influence absorptive capacity by specifying broad, tacitly understood rules for appropriate action under unspecified contingencies (Camerer and Vepsalainen 1988). These capabilities refer to the ability of the firm to produce a shared ideology that offers members an attractive identity as well as collective interpretations of reality. In this perspective, socialization capabilities result from the firm's culture in terms of a system of ideas, or "inferred ideational codes lying behind the realm of observable events" (Keesing 1974, quoted in Allaire and Firsirotu 1984, p. 197). Clearly, socialization capabilities are path dependent. The infusion of beliefs and values into an organization takes place over time and produces a distinct identity for its participants. Socialization capabilities give rise to a social integration that goes far beyond the systems and coordination capabilities discussed above. Camerer and Vepsalainen (1988) argue that the efficiency of knowledge integration and knowledge utilization of socialization capabilities is very high but question the scope and flexibility. Socialization capabilities can create mental prisons that prevent people from seeing important changes, for instance, in the market (De Leeuw and Volberda 1996). Moreover, strong cultures usually suffer from xenophobia (Ouchi 1981). Strong cultures resist deviance, slow down attempts at change, and tend to foster inbreeding. Socialization capabilities are found in firms with a strong identity. Here, one can find a coherent set of beliefs, a high degree of shared values, a common language, and a strongly agreed-upon kind of appropriate behavior. This situation leaves little room for absorbing outside sources of knowledge in ways that contradict shared beliefs. This corresponds with Cohen and Levinthal's (1990, p. 133) observation that, "If all actors in the organization share the same specialized language. . .they may not be able to tap into diverse external knowledge sources." Hence, we assume socialization capabilities have a high potential for efficiency, but a low potential for both scope and flexibility of knowledge absorption. Consequently, socialization capabilities have a negative influence on a firm's absorptive capacity.

The assumptions regarding the impact of the different types of combinative capabilities on the dimensions of knowledge absorption and a firm's absorptive capacity are summarized in Table 3. If a firm's current knowledge-base is inadequate, it may change either its organization form or its combinative capabilities or both. In Bartlett and Ghoshal's (1989) biological analogy of organizational characteristics, organization forms are related to organizational anatomy, systems and coordination capabilities to organizational physiology, while socialization capabilities are related to organizational psychology. Focusing on new organization forms without paying attention to the various combinative capabilities does not result in an increased absorptive capacity (see also the complementarity argument in Whittington et al., this issue). Organization forms are the "bones"; however, combinative capabilities, provide the necessary "flesh" and "blood."

Table 3 Basic Combinative Capabilities, Dimensions of Knowledge Absorption and Absorptive Capacity

	Combinative Capabilities		
Dimensions of Knowledge Absorption	Systems Capabilities	Coordination Capabilities	Socialization Capabilities
Efficiency of Absorption	H	L	H
Scope of Absorption	L	H	L
Flexibility of Absorption	L	H	L
Impact on Absorptive Capacity[a]	Negative	Positive	Negative

H: high; L: low

[a]Assumption: Both scope and flexibility of knowledge absorption have a positive influence on the level of absorptive capacity, while efficiency has a negative impact.

6. Absorptive Capacity and Coevolutionary Effects

By distinguishing two opposite types of knowledge environments, stable and turbulent, we will compare the influence of the type of knowledge environment on a firm's absorptive capacity and its organizational determinants. After this "comparative static" analysis, we will introduce important dynamic mechanisms representing key elements of coevolutionary processes.

Stable Knowledge Environment

In the context of a stable knowledge environment, presented in Table 1 above, we assume that the focus of knowledge absorption is on exploitation. The requirements regarding the three dimensions of knowledge absorption are high on efficiency and low on scope and flexibility. Based on these assumptions, the requirements correspond with the functional form, somewhat less with the divisional form (see Table 2), and with systems capabilities or socialization capabilities (see Table 3). These organization forms and combinative capabilities are likely to be negatively associated with the level of absorptive capacity. We will illustrate this on the basis of Cohen and Levinthal's (1990) analysis of various aspects of absorptive capacity.

Due to the focus on the efficiency of knowledge absorption, the interface function—capturing the structure of communication between the external environment and the firm and between subunits within the firm—will have a tendency to become more centralized, increasing the efficiency of internal communication. This centralization tendency is supported by a well-developed shared knowledge and an internal language, creating a more inward-looking absorptive capacity. Cohen and Levinthal (1990, p. 133) have observed that both inward-looking and outward-looking absorptive capacities are necessary for effective organization learning, but that "... excessive dominance by one or the other will be dysfunctional." An efficiency focus on knowledge absorption results in a low diversity of knowledge structures and few cross-functional relationships. Over time, this efficiency focus will result in path dependencies regarding the type of accumulated knowledge. This path dependency effect is illustrated in Figure 1 by the box "exploitation/exploration path." It results in a less developed sensitivity to emerging technological opportunities. Firms adapted to the knowledge absorption requirements of a stable knowledge environment will tend to become more reactive. These firms are likely not to have a high level of absorptive capacity and are therefore less proactive toward exploring opportunities outside their existing knowledge environment.

Turbulent Knowledge Environment

In the context of a turbulent knowledge environment, we assume that the focus of a firm's knowledge absorption will be on exploration. In such contexts, the required dimensions of knowledge absorption are low on efficiency and high on scope and flexibility (see Table 1). These requirements correspond with the matrix form and with coordination capabilities (see Table 3), and somewhat less with the divisional form (see Table 2). As we have argued above, a matrix form and coordination capabilities exert a positive influence on the level of absorptive capacity. We therefore suggest the following proposition:

PROPOSITION 1. *In increasingly turbulent knowledge environments, firms are likely to increase their absorptive capacity by developing organization forms and combinative capabilities that are conducive to high scope and flexibility of knowledge absorption.*

This proposition is in line with Cohen and Levinthal's (1990) analysis of the influence of different organizational aspects on absorptive capacity. Due to the high

scope and flexibility dimension of knowledge absorption, the interface function will become more decentralized, and more outward-looking absorptive capacities will be developed. This is reflected in an increasing diversity of knowledge structures and cross-functional relations within the firm. The influence of scope and flexibility of knowledge absorption at the level of absorptive capacity will be positive. Figure 1 shows that this higher level of absorptive capacity brings about two effects. First, it will positively influence the expectation formation or aspiration level of the firm, resulting in a more proactive attitude towards emerging opportunities. Secondly, the exploitation/exploration path will be changed towards more exploration adaptation.

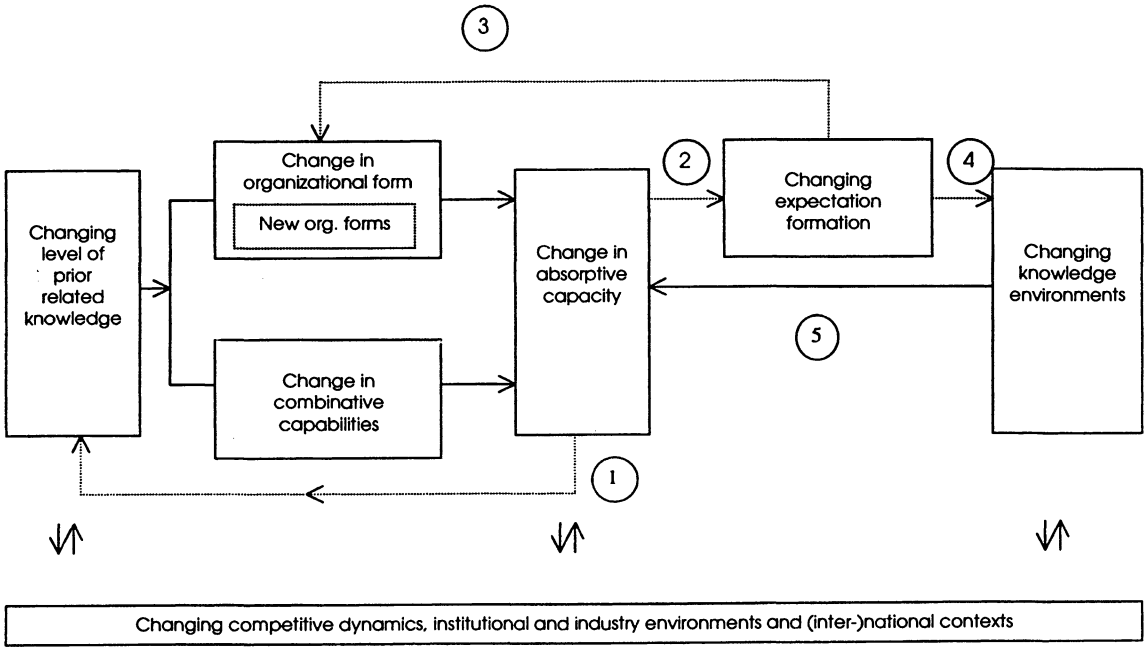
Coevolutionary Effects

We will now address our second and third research questions, namely how does absorptive capacity influence the knowledge environment and how can a firm's absorptive capacity be understood as a joint outcome of managerial actions and developments in the knowledge environment? In elaborating the coevolutionary aspects of the framework, we build on McKelvey (1997, p. 360) who states that "coevolutionary effects take place at multiple levels within the firm (microcoevolution) as well as between firms and their niche (macroevolution)." The proposed framework describes important coevolutionary effects both at the level of microevolution and at the level of macroevolution (see Figure 2). The first type of coevolutionary effect in the framework, the microevolutionary effect, deals with the impact of absorptive capacity on the level of prior related knowledge, on expectation formation, and on the exploitation/exploration path (left out in Figure 2) and how these, in turn, may influence organization form and combinative capabilities as organizational determinants of absorptive capacity. The first microevolutionary mechanism to be discussed (see arrow 1 in Figure 2) is labeled by Cohen and Levinthal (1990) as a "cumulativeness feature" of absorptive capacity. An increasing level of absorptive capacity leads to more readily accumulating additional knowledge in subsequent periods. Furthermore, they showed how this feature gives rise to the path-dependence phenomenon of absorptive capacity.

The second microevolutionary mechanism in the framework is the impact a changing level of absorptive capacity has on a firm's expectation formation or aspiration level (arrow 2), and related to that, a firm's exploitation/exploration. Although these impacts have already been discussed above and have been presented in Figure 1, we would like to extend the analysis to the organizational determinants. In order not to make the framework too complex, Figure 2 only shows the possible impact a firm's changing expectation formation can have on the organization form in use. We assume that changing expectation formation aimed at substantially increasing explorative activities may result in deliberately changing the organizational determinants of absorptive capacity or even in new organization forms (arrow 3) or new combinative capabilities. "New" here means either new to the firm, to the industry, or to the knowledge environments involved. Subsequently, these changing organization forms or combinative capabilities raise the level of the absorptive capacity, ceteris paribus the level of prior related knowledge. This increased level of absorptive capacity raises the aspiration level and changes the exploitation/exploration path again.

The second type of coevolutionary effect in the framework, the macrocoevolutionary effect, deals with how a firm's absorptive capacity influences expectation formation and the exploitation/exploration path, and how both of these may influence and be influenced by the knowledge environment (arrow 5 in Figure 2). Regarding the impact of a firm's changing expectation formation and changing exploitation/exploration path on the knowledge environment, Figure 2 only depicts the influence of changing expectation formation on the knowledge environment (see arrow 4). As discussed above, according to Cohen and Levinthal (1990), two opposite types of a firm's expectation formation can be distinguished: *proactive* in the case of higher levels of absorptive capacity and *reactive* in the case of moderate levels of absorptive capacity. Proactive expectation formation may influence the knowledge environment in several ways. For example, if a firm with higher levels of absorptive capacity absorbs new component knowledge (that is new to the firm and to its competitors) outside the existing knowledge environment of its industry, and subsequently utilizes it commercially, then this firm may have changed the knowledge environment of its competitors. Another example is the case in which firms with higher levels of absorptive capacity, as argued by Cohen and Levinthal (1990), will define opportunities present in their environment, independent of their current performance. Exploring these opportunities may create first mover advantages with a substantial impact on both competitors with modest levels of absorptive capacity and the knowledge environment. Knowledge environments may co-evolve with knowledge creation and absorption at the firm level. Inspired by McKelvey's (1997, p. 360) observation that "resource pools coevolve with the emergence of organizational forms suited for harvesting the resource," and assuming that knowledge is a key strategic resource needed for firms to survive, we suggest the following proposition

Figure 2 A Framework for the Coevolution of Firm Absorptive Capacity with Its Knowledge Environments



which includes both micro- and macrocoevolutionary effects:

PROPOSITION 2. *Knowledge environments coevolve with the emergence of organization forms and combinative capabilities suited for absorbing the knowledge.*

The framework contains a block reflecting a variety of contextual influences, such as changing competitive dynamics, that are important for further elaboration on macroevolutionary mechanisms (see Figure 2). Dijksterhuis et al. (this issue) show how macrolevel management logics may influence shared managerial schemas through contextual variation at national, industry, and firm level, and how these managerial schemas may have an impact on new organization forms. For instance, firms applying a classical management logic are likely to favor a functional form and systems capabilities. As a consequence this will seriously limit their absorptive capacity. National and industry contexts may have an enabling or restricting impact on the emergence of new organization forms. Clearly, these contextual factors do influence the organizational determinants of absorptive capacity, and therefore the expectation formation processes. Similarly, Lewin et al. (this issue) suggest that the evaluation of firm performance in Germany, Japan, and the U.S.A. reflects to a great extent country-specific financial performance measures. Undoubtedly, these measures will have an impact on expectation formation and the organizational determinants of absorptive capacity. In this paper, however, we leave aside these contextual influences.

In the next section, we will illustrate the framework by discussing two longitudinal case studies with the primary purpose of obtaining insights into how the firms' absorptive capacity at the time of transformation of the industry moderated and coevolved with the firms' strategic and organizational adaptations. These case studies describe how existing firms, when confronted with a turbulent knowledge environment, increase their absorptive capacity.

7. From a Stable to a Turbulent Knowledge Environment: The Case of Traditional Publishing Firms Moving into the Emerging Multimedia Complex

The case of traditional publishing firms moving into the currently emerging multimedia complex is used to illustrate the framework presented above. The multimedia complex lies at the heart of an evolutionary process of digital convergence (Yoffie 1997). Triggered by the digital revolution, technologies stemming from various industries are converging into hybrid forms. Among these industries are telecommunications, computers, software,

consumer electronics, and publishing. An early overview of this new competitive landscape is provided by McLaughlin and Biriny (1984). More recent contributions include Hagel and Eisenmann (1994) and Collis et al. (1997).

Traditional publishing firms are firms whose core business it is to commercially exploit the information content of a predominantly folio business. These firms have built up considerable experience in doing this. When these firms are confronted with turbulent knowledge environments such as the emerging multimedia complex, the strategic challenge is to change their aspiration level and exploitation/exploration path and to absorb new external knowledge to create a mixed-media portfolio. A mixed-media portfolio is a set of existing (books, newspapers, journals, etc.) and new media product-market combinations that are related to the same information content. In the context of our case studies, new media refer to online databases, CD-ROMs and the Internet. These media were new to the traditional publishing firms. A remarkable characteristic of these new media types is that their initial development took place "beyond the bounds of the traditional publisher's strategic heartland" (Kist 1987, p. 4). Hence, traditional publishing firms provide an interesting example of firms moving into a turbulent knowledge environment in which existing but alien component knowledge has merged with native component knowledge.

Context of the Case Studies

We examined a number of traditional Dutch publishing firms in the professional information market with a strong background in folio publishing. Our investigation took place in the middle of the change from a stable knowledge environment, in this case a mature single industry, to a turbulent knowledge environment, in this case an emerging industrial complex. The longitudinal case studies of two of these firms are presented below as examples. Within these two firms, multiple sources of evidence were used: semistructured interviews were held with persons at various management levels, and internal documents and public sources were studied to create a longitudinal picture of the process of change of the organizational determinants of absorptive capacity from the early 1980s to the middle of 1997. This period covers the transformation of both firms from a predominantly folio business to a hybrid business of both folio and new media. The specific type of new knowledge configuration the firms focused on was medium-neutral database management, which is a prerequisite for so-called publishing on demand. Publishing on demand is the ability to deliver information to customers exactly in the amount, format, medium, moment, etc. they desire. To this end, traditional publishing firms need to reconfigure the three basic types of component knowledge already indicated above: first, to reconfigure knowledge related to the enrichment of information content, i.e., product or service-related component knowledge; second, to reconfigure knowledge related to the process of information gathering, processing, refining, updating, storing, and distributing, i.e., production process-related component knowledge; third, to reconfigure knowledge related to the anticipation, interpretation, understanding, and stimulation of a customer's need for information, i.e., market-related component knowledge.

Case Study of Het Financieel Dagblad

Het Financieel Dagblad (HFD) is a publisher of mainly Dutch financial and business information, based in Amsterdam. HFD has a long history in publishing, going back as far as 1796. In 1997, HFD had about 160 employees, which makes it a relatively small player. Still, within the market for financial and business information, HFD holds a very strong position. Its newspaper is the only one of its kind, and is comparable to the British *Financial Times,* and the German *Handelsblatt.* The newspaper has a solid subscription base. It is the leading financial and business publication in the Netherlands. Besides the newspaper, HFD is now involved in a wide range of other information and communication activities as well. An important element of HFD's strategy to develop a mixed-media portfolio was its database, which includes the electronic archives of a number of existing folio products, of which the newspaper is the most important part.

HFD started exploring the opportunities for database information in 1982. In 1996, HFD changed its organizational structure to cope with the emerging multimedia complex. This event marks the start of stage two. Table 4 depicts the transformation of HFD's component knowledge, related to the three types of component knowledge described earlier. During stages one and two, enrichment of the information content remained the most important objective. HFD believed information demand would tend towards high quality content, creating an interesting niche for providers capable of creating the required added value. For a long time, however, the database was merely an electronic copy of the journal with not enough added value. The clear choice by HFD to concentrate on content was expressed by the modest attention that was paid to information technology, i.e., process-related component knowledge. In the spring of 1997, HFD's IT infrastructure was considerably improved when a fully integrated editorial, research, and graphical database system was introduced. Regarding the third, market-related, knowledge component, we observed that until 1988 the advertising

Table 4 The Transformation of HFD's Component Knowledge

Component Knowledge	Stage 1 (1982–1996)	Stage 2 (1996–1997)
Information Content	Most important component: Knowledge	Enlarged internal editorial staff, external news agents
	Internal editorial staff, external editorial suppliers and news agents; Focus on facts, strictly professional information source;	Move towards more personal interest newspaper and factual database
Information Technology	Focus on folio production process: Almost no Information Technology; Some Experiments	Basic and standardized information technology internally organized, no experiments Introduction of a fully integrated editorial, research, and graphical database system External partnerships regarding specialized information technology
Information Markets	External advertising agency Most underdeveloped component: Knowledge	Internal marketing department Further exploitation of high quality content and strong brand External partnerships regarding distribution

market was exploited by an external agency. HFD itself did not actively market its newspaper and could not absorb the necessary market knowledge. Over time, HFD discovered that the knowledge required for marketing of new media was fundamentally different from that needed for marketing of traditional folio products. Selling new media products and services required new distribution channels, such as Internet and database hosts. This called for a strong external orientation.

In developing the database, HFD clearly created changes to its organization form and combinative capabilities. In the mature industry stage, stage one, HFD utilized the functional form. There was a division between the editorial, prepress, and marketing activities. This offered the appropriate structure to create the required efficiency in knowledge absorption capacity, as suggested by our framework (see Table 2).

In early 1996, HFD decided to change its existing organizational structure, which marks the transformation between stage one and stage two. Part of the new structure was a new business development unit, which since then has become responsible for electronic products such as the database, as well as other activities, such as organizing congresses. The major benefit of the new business development department was bundled expertise and focused attention. Because of this stronger internal position, the new business development department also became better equipped to deal with and absorb new knowledge from external partners. An example of such new knowledge is network software and services. This triggered HFD to start an external partnership with a software company in 1996. By teaming up with the software company, HFD gained access to an unknown but highly attractive market, and acquired knowledge of selling its database within a network environment. The changing organizational structure resembles the innovative form, as suggested by Ansoff and Brandenburg (1971), to negate some of the disadvantages of the matrix form (Volberda 1998). The new business development unit focuses on increasing the scope and flexibility of knowledge absorption, while the current business exploits the efficiency of knowledge absorption.

Regarding combinative capabilities, the following changes occurred. In stage one, HFD employed few so-called hard mechanisms such as formal planning, budgeting, procedures, etc. Neither the hierarchical structure nor the promotion policy was very stringent. The same applied to the new business development activities, which were fairly unstructured. Partly, this was due to the traditional routines that ruled the publishing industry in general. There was no inclination within HFD to do things differently. Besides, the company was so unfamiliar with new media that they simply did not know what and how to plan, budget, control, etc. Instead, the firm clearly showed a strong reliance on socialization capabilities (see Table 5). Because of its long history, HFD has had a long time to develop a strong corporate culture to base its functionalized operations on. This was especially the case with the editorial staff department (journalists and editors), which was considered to form the core of the firm's existence.

Table 5 HFD's Deployment of Combinative Capabilities and Organization Forms in Stages 1 and 2

Combinative Capabilities	Stage 1 (1982–1996)	Stage 2 (1996–1997)
System Capabilities	Except for editorial articles, hardly present	Management guidelines, marketing targets, standardized IT
Coordination Capabilities	Hardly present	Dominant combinative capability; Project management, management team
Socialization Capabilities	Dominant combinative capability; Strong traditional publishing routines	Emergence of a new media mindset
Organization Forms	Functional form	Innovative form[a]

[a]Not a functional, divisional, or matrix form.

A considerable and complex product, which the database has become since then, requires a much more formalized approach. Increasingly, HFD is using systems capabilities to evaluate new business development activities. Another implication of HFD's choice to bundle new business development activities into a semi-independent unit is the need for extensive communication and knowledge exchange between the different departments. Project management appeared to be a suitable management instrument in this respect. Project teams bring together people with different functional backgrounds, which encourages the integration of different knowledge components. During stage one, however, project management was not used, due to a lack of clear external objectives. In stage two, and especially with regard to the exploration of new business opportunities, HFD started using project teams consisting of people from new business development, marketing, and the editorial staff. Altogether, the use of coordination capabilities in stage two was suggested by our framework, while the use of systems capabilities was not. Compared to stage one, HDF's absorptive capacity significantly increased. In terms of the three determinants of absorptive capacity suggested in Figure 1, this can be explained as follows. HFD's current knowledge base, the first determinant, has been expanded dramatically. As is indicated in Table 4, all three types of component knowledge have increased. Moreover, the change in organization form from functional to innovative (the second determinant) and the development of combinative capabilities (the third determinant) positively influenced the impact of prior related knowledge on the level of HFD's absorptive capacity. In addition, this raised HFD's aspiration level and enforced its passion for exploration adaptations. It stimulated other traditional publishers to speed up their knowledge absorption processes.

Case Study of SDU

SDU NV (SDU) is the former state publishing and printing office in the Netherlands. In 1988, SDU was separated from the government sector and was positioned as a commercially independent firm (public limited company) with about 1,100 employees. In 1998, SDU's stocks were still entirely owned by the Dutch government. This case study describes the transformation of SDU from a pure folio publisher to a publisher of both folio and electronic information products. The case description is based on interviews (conducted from 1995–1997), and internal and external documents. The case report on which this summary is based was approved in the middle of 1998. The analysis was based on two important mixed-media projects related to two product-market combinations. One deals with the creation of a CD-ROM version of the official spelling guide for the Dutch language and the incorporation of this guide into the software package of an international leading software company. This guide was drawn up under the joint responsibility of the Dutch and Belgian government. The second mixed-media project deals with the creation of a CD-ROM of the official yearbook of the Dutch government. The Ministry of the Interior is responsible for the content of the yearbook. In the period under investigation, 1986–1997, SDU was undergoing three major transformation processes. The first was the transformation from a governmental organization to a commercially independent company. The second was the change from a focus on printing activities to a focus on publishing activities. The first two transformation processes required, among other things, the absorption of new component knowledge, particularly with regard to information content and information markets (marketing and sales skills). The third and major transformation process was SDU's effort in coping with the increasing turbulent knowledge environment resulting from the emergence of the multimedia complex. This challenge necessitated the absorption of all three types of component knowledge (see Table 6). The event that marks the transition from stage one to stage two is the creation of the project group Database Publishing (DP) in 1994. Below, we will briefly describe the transformation of SDU's component knowledge as a result of changes in its organization form and the combinative capabilities that improved its absorptive capacity.

Table 6 The Transformation of SDU's Component Knowledge

Component Knowledge	Stage 1 (1986–1994)	Stage 2 (1994–1997)
Information Content	Not the owner, dependent on third parties	Improved by adding features and strengthening alliances
Information Technology	Lack of prior related knowledge due to various external parties involved	Improved by bundling of expertise in project group DP
Information Markets	Hardly present	Improved by bundling of expertise and alliance with word-processing firm

As indicated above, mixed-media publishing can be effectuated by reconfiguring the component knowledge related to information content (product-based), information technology (process-based) and information markets (market-related). Table 6 summarizes the transformation of SDU's component knowledge. In the first period, SDU did not own the information content of the two projects analyzed. In that period, SDU was very vulnerable. By adding value to the information content by introducing specific electronic features of different media and by strengthening learning alliances, SDU improved its component knowledge about information content. Regarding the second type of component knowledge, initially a lot of information technology–related tasks were outsourced. After establishing the project group DP in 1994, it took some time to develop the necessary knowledge of information technology and project management. As a result of the fact that marketing with folio products was often limited to the final stages of the development process, the third type of component knowledge was even harder to absorb. Market research was hardly being undertaken. Marketing was the last step in a sequential process controlled by publishers. The partnership with an international leading software firm involved in word processing appeared to be crucial. It offered the opportunity to absorb knowledge of electronic information markets.

At the start of our longitudinal research, when SDU had only just been split off from the Dutch government, it used the functional form—central organization along functional lines—that it had used previously. After a two-year restructuring process, publishing groups were created, which were responsible for both the maintenance of existing product-market combinations and the development of new ones. This form can be interpreted as a divisional form. When folio was still the dominant medium within SDU, it functioned very well. It provided the publishing groups with the freedom to run their own portfolio of product-market combinations. With the introduction of new media, however, the division form proved to be inappropriate. The publishing groups were not equipped with new media products and so could not absorb appropriate knowledge to develop them. The responsibility for these activities moved to the corporate staff, which later became the project group DP. This separate group could concentrate on absorbing the knowledge required for new media developments, while the publishing groups could maintain their regular portfolio. In the initial stage, DP became responsible for the whole process of development, production, marketing, and distribution. In addition to DP, SDU established a separate new business development department, which performed a central coordinating role. This deliberate choice reflected SDU's ambition to become a mixed-media publisher.

In 1997, SDU once again amended its organization form toward a matrix form. It decided to integrate DP and the new business development department into its publishing activities. An important reason for this decision was the desire to improve the integration of new business development and database publishing knowledge within the publishing groups. To compensate for the loss of centrally organized new business development and database publishing knowledge, SDU Publishers adapted important elements of the matrix form. On a corporate level, the organization form changed over time from a functional form in the beginning (1986–1988), through a divisional form (1988–1994) and a major departure of the divisional form (i.e., establishing the separate DP group in 1994) toward a matrix form (1997).

With respect to the combinative capabilities, the following developments took place (see Table 7). During the first stage, the use of systems capabilities such as planning, budgeting, and procedures was limited. Formal definition of the various parties' roles and their contribution to the mixed-media projects were lacking. In the first stage, financial guidelines, i.e., stringent profitability requirements, discouraged publishing groups from initiating new media projects. In the second stage, however, SDU's top management decided that the firm's overall transformation was more important than the issue of allocating the costs to specific new media projects. DP started using procedures to monitor the new media projects in their mutual coherence, preventing the publishing groups from reinventing the wheel. At stage one, SDU was characterized by a policy of strong decentralization

Table 7 SDU's Deployment of Combinative Capabilities and Organization Forms in Stages 1 and 2

Combinative Capabilities	Stage 1 (1986–1994)	Stage 2 (1994–1997)
System Capabilities	Besides financial control, hardly present	Dominant capability: DP rules that monitor all new media developments
Coordination Capabilities	Hardly present	Dominant capability: Management development, training, and conference sessions
Socialization Capabilities	Initially dominant capability: Strong traditional publishing routines	Several initiatives to shape an innovative atmosphere helped to overcome the traditional publishing routines
Organization Forms	Functional form (1986–1988) Divisional form (1988–1994)	Matrix form (1997)

and initially relied heavily on its socialization capabilities acquired over a long period of time. Coordination capabilities across the various semi-independent publishing groups were hardly present. At stage two, however, the need arose for coordination both between DP and the publishing groups, and across publishing groups. SDU established a management development program and organized training and conference sessions to accelerate the required knowledge absorption process. Existing socialization capabilities were severely challenged by the three transformation processes (see above) which SDU was undergoing. The first two transformation processes were demanding in terms of cultural, organizational, and management adaptation. These processes created familiarity with change and helped to overcome the traditional socialization capabilities.

Compared to stage one, SDU's level of prior related knowledge in terms of the three types of component knowledge increased considerably. By changing its organization form from a functional to a matrix, and by concurrently developing new systems and coordination capabilities, SDU's absorptive capacity further increased. Subsequently, this increased absorptive capacity positively influenced SDU's aspiration level and exploitation/exploration path. Instead of exploitation within the traditional printing sector, SDU's increased knowledge base facilitated exploration adaptations within the new multimedia complex.

8. Discussion and Conclusion

It is difficult for firms to switch to new knowledge components as neither the knowledge embedded in the organization form nor the combinative capabilities to support knowledge absorption are well understood. We showed in this paper what the essential impact of organization form and combinative capabilities are on a firm's absorptive capacity. Not only limitations in a firm's current knowledge base, but also the rigidity of organization forms and combinative capabilities may generate inertia in adapting absorptive capacity.

Our framework shows how organization form and combinative capabilities interact over time and what their combined effect is on the level of a firm's absorptive capacity. From this framework, we derived various ways in which firms, as a result of managerial intentionality, can change their form as well as their combinative capabilities in order to increase their absorptive capacity. Nonetheless, our empirical analysis of two publishing firms revealed interesting issues not included in our framework.

First, the use of *systems capabilities* by both firms in a turbulent knowledge environment did not seem to slow down the knowledge absorption process. On the contrary, in our analysis of HFD and SDU, the use of systems capabilities indirectly enabled the required acquisition, integration, and utilization of product, production process, and market knowledge. The benefit of using clear and strict directions for knowledge absorption is that it can facilitate the process of breaking down existing socialization capabilities. This raises a question regarding the speed of changing a firm's combinative capabilities. Both cases show that getting rid of existing socialization capabilities took a long time. Due to the three transformation processes which SDU was undergoing, the dismantling of existing socialization capabilities was accelerated.

Moreover, the stickiness of HFD's as well as SDU's old socialization capabilities closely matched customer expectations. The customers were still far from ready to absorb new media product-market combinations. This observation illustrates an interesting interaction between firms and their *customers* in which the aspiration level of the firm may be negatively influenced by those of the customers. This dynamic interaction of decreasing absorptive capacity, also discussed by Levinthal and March (1993) as learning myopia and by Christensen (1997) as the innovator's dilemma, is a result of firms listening to their customers, and investing aggressively in

technologies that will provide their customers more products ". . . along the dimensions of performance that mainstream customers in major markets have historically valued" (Christensen (1997, p. xii). Christensen (1997) also points out that in the case of disruptive technologies ". . . it is right *not* to listen to customers, right to invest in developing lower-performance products that promise *lower* margins, and right to aggressively pursue small, rather than substantial, markets." We expect that a prerequisite for such a strategy is a high level of absorptive capacity. As argued above, the higher the absorptive capacity, the more likely a firm's expectation formation will be defined in terms of the opportunities present in its environment, independent of current performance criteria, such as profitability.

Another interesting aspect of the framework is the nature of the *feedback loops.* As Baum and Singh (1994, p. 380) point out: "The goal of coevolutionary inquiry is understanding how the structure of direct interactions and feedback within organization-environment systems give rise to their dynamic behavior." The proposed framework contains examples of such feedback loops that can be compared to earlier contributions in the literature. According to Cohen and Levinthal (1990), the relationship between absorptive capacity and the level of prior related knowledge (arrow 1 in Figure 2) is a positive feedback loop: an increase in absorptive capacity causes a change in prior related knowledge in such a way that, ceteris paribus, the absorptive capacity increases. The framework suggests, however, that the influence (in terms of size and speed) of this feedback loop will depend on the combined effect (positive, neutral, or negative) of both a firm's organization form and combinative capabilities as well. This observation has at least two implications. First, when defining the feedback level of a loop as "the number of variables in the feedback loop" (Baum and Singh 1994, p. 387), the feedback level between absorptive capacity and prior related knowledge clearly is more than one. Second, a negative feedback loop may occur in the relationship between absorptive capacity and prior related knowledge. This is in line with Levinthal's (1994) notion of a competency trap, created by the fact that firms may be blindsided by new developments in the field because they focus on their prior related knowledge.

Furthermore, a distinction can be made between internal and external knowledge absorption. In the literature regarding absorptive capacity, two attributes of this concept are usually taken for granted. Namely, that absorptive capacity is a *firm-level construct,* and that the absorption relates to *external knowledge.* By shifting the unit of analysis to the learning dyad, Lane and Lubatkin (1998) explored the usefulness of the absorptive capacity construct in an interorganizational context. In addition, we suggest that it may be interesting to explore absorptive capacity in an *intraorganizational context,* that is, to discern the absorptive capacity of different organization parts within a firm. For example, in a firm with a division structure, it is possible that the absorptive capacity of a division regarding division-specific, external knowledge might be high. However, due to the lack of cross-divisional combinative capabilities, the resulting absorptive capacity at firm-level might be lower. Externally acquired knowledge has to be shared internally. The acquisition of new external knowledge by one division can subsequently be considered as new *internal knowledge* for the other divisions. As discussed above, the loose coupling among divisions suppresses integration and common utilization of knowledge between divisions. The use of cross-divisional coordination capabilities could enhance the sharing and integration of internal knowledge. Similar to our framework, in future research different organization forms and combinative capabilities can be assessed regarding their impact on the capacity to absorb new *internal knowledge.* We speculate that internal network forms of organizing might have a strong positive impact on the capacity to absorb internal knowledge. This speculation is based on the characteristics of knowledge flows in internal networks (Hedlund 1994, van Wijk and Van den Bosch 1998).

From a strategy perspective, at least two challenges for future research deserve attention. First, it would be interesting to analyze to what extent *first mover firms* in turbulent knowledge environments have a different process of adapting their organizational determinants of absorptive capacity compared to their followers. For instance, do first mover firms use complementarities (Whittington et al., this issue) between organization form and their combinative capabilities to a greater extent compared to their followers? Second, there is the strategic question: besides increasing absorptive capacity, are other strategies to increase the absorption of new external knowledge in certain circumstances viable as well? For example, future research could extend our framework by adding *interorganizational* forms to the organization forms building block and could investigate how strategic alliances may influence the knowledge absorption process (Inkpen and Dinur 1998, Kumar and Nti 1998, Lane and Lubatkin 1998, Lorenzoni and Lipparini 1999). Similarly, interorganizational combinative capabilities may be introduced in the framework to investigate whether alliances with an exploitation intent tend to use systems capabilities, while alliances with an exploration intent tend to use coordination capabilities (Koza and Lewin 1998). Moreover, conducting longitudinal case studies in other turbulent

knowledge environments, such as the emerging financial services complex and the industrial complex emerging around the pharmaceutical and biotechnology industries (i.e. the "life science" industrial complex), are important for broadening our insight as well (Lewin and Volberda, this issue).

To conclude, the blurring of industry boundaries between, for instance, computers, consumer electronics, entertainment, banking, and telecommunications has spawned experimentation with new and varied organization forms (Yoffie 1997). We have argued that, in these increasingly turbulent knowledge environments, firms are likely to develop new organization forms and adequate combinative capabilities to increase their absorptive capacity. Our empirical analysis showed some of the transitions in organization forms and combinative capabilities that traditional firms have gone through when successfully operating in emerging industrial complexes. In particular, our analysis of traditional publishing firms entering the multimedia complex has highlighted the stickiness of socialization capabilities and the need for new organization forms that facilitate the scope and flexibility of knowledge absorption. Of course, numerous scholars (cf. Ilinitch et al. 1996) and practitioners have convincingly promoted new forms for dealing with the competitive landscape. However, a framework for *calibrating* these new forms with respect to their absorptive capacity has been lacking. This paper has made a first effort to operationalize the absorptive capacity concept at firm level as a way to calibrate the viability of organization forms in a coevolutionary context. By suggesting two organizational determinants in this operationalization process, we have contributed to the call to develop ". . . a richer, even more behaviorally grounded characterization . . ." (Cohen and Levinthal 1997, p. 1468) of the absorptive capacity concept.

Acknowledgments

An earlier version of this paper was presented at the NOFIA Symposium, Erasmus University Rotterdam/Rotterdam School of Management, Rotterdam July 6–8, 1998. The authors gratefully acknowledge the comments and suggestions of the participants. They also appreciate the valuable comments from Arie Lewin, four anonymous referees, Eric Gedajlovic, Raymond A. van Wijk and Sander Heinhuis. Moreover, they would like to thank the management of both case companies for providing the opportunity to do in-depth case research and for the comments and suggestions provided regarding earlier versions of the case analysis. This research was funded by Erasmus Research Institute of Advanced Studies in Management.

References

Allaire, Y., M. E. Firsirotu. 1984. Theories of organizational culture. *Organ. Studies* **5** 193–226.

Ansoff, H. I., R. G. Brandenburg. 1971. A language for organizational design: Parts I and II. *Management Sci.* **17**(12) B705–731.

Baum, J. A. C., J. V. Singh, eds. 1994. *Evolutionary Dynamics of Organizations.* Oxford University Press, New York.

Bartlett, C. A., S. Ghoshal. 1989. *Managing Across Borders, The Transnational Solution.* Hutckinson Business Books, London.

Bettis, R. A., M. A. Hitt. 1995. The new competitive landscape. *Strategic Management J.* **16** 7–19.

Boer, M. de, F. A. J. Van den Bosch, H. W. Volberda. 1999. Managing organizational knowledge integration in the emerging multimedia complex. *J. Management Stud.* **36**(3) 379–398.

Boisot, M. 1998. *Knowledge Assets.* Oxford University Press, Oxford.

Burton, R. M., B. Obel. 1995. *Strategic Organizational Diagnosis and Design.* Kluwer Academic Publishers, Boston.

Camerer, C., A. Vepsalainen. 1988. The economic efficiency of corporate culture. *Strategic Management J.* **9** 115–126.

Child, J. 1984. *Organization, a Guide to Problems and Practice.* Chapman Publishing Ltd, London.

Christensen, C. M. 1997. *The Innovator's Dilemma, When New Technologies Cause Great Firms to Fail.* Harvard Business School Press, Boston.

Cohen, W. M., D. A. Levinthal. 1989. Innovation and learning: The two faces of R&D. *The Econom. J.* **99** 569–596.

——, ——. 1990. Absorptive capacity: A new perspective on learning and innovation. *Admin. Sci. Quart.* **35** 128–152.

——, ——. 1994. Fortune favors the prepared firm. *Management Sci.* **40** 227–251.

——, ——. 1997. Reply to comments on fortune favors the prepared firm. *Management Sci.* **43** 1463–1468.

Collis, D. J., P. W. Bane, S. P. Bradley. 1997. Winners and losers: Industry structure in the converging world of telecommunications, computing and entertainment. D. B. Yoffie, ed. *Competing in the Age of Digital Convergence.* Harvard Business School Press, Boston. 159–200.

De Leeuw, A. J. C., H. W. Volberda. 1996. On the concept of flexibility: A dual control perspective. *Omega* **2** 121–139.

Daft, R. L., A. Y. Lewin. 1993. Where are the theories for the "new" organization forms? An editorial essay. *Organ. Sci.* **4** i–vi.

Dijksterhuis, M., F. A. J. Van den Bosch, H. W. Volberda. 1999. Where do new organizational forms come from? Management logics as a source of coevolution. *Organ. Sci.* **10**(5). This issue.

Ferlie, E., A. M. Pettigrew. 1996. Managing through internal networks: Some issues and implications for the NHS. *British J. Management* **7** (Special Issue) 81–99.

Galbraith, J. 1973. *Designing Complex Organizations.* Addison-Wesley, Reading, MA.

——. 1977. *Organization Design.* Addison-Wesley, Reading, MA.

Grant, R. M. 1996a. Prospering in dynamically-competitive environments: Organization capability as knowledge integration. *Organ. Sci.* **7** 375–387.

——. 1996b. Toward a knowledge-based theory of the firm. *Strategic Management J.* **17** (Winter Special Issue) 109–122.

Gulati, R. 1998. Alliances and networks. *Strategic Management J.* **19** 293–317.

Hagel, J. III, T. R. Eisenmann. 1994. Navigating the multimedia landscape. *The McKinsey Quart.* **3** 39–55.

Hamel, G., C. K. Prahalad. 1994. *Competing for the Future.* Harvard Business School Press, Boston.

Hedlund, G. 1994. A model of knowledge management and the N-form corporation. *Strategic Management J.* **15** (Summer Special Issue) 73–90.

Henderson, R. M., K. B. Clark. 1990. Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms. *Admin. Sci. Quart.* **35** 9–30.

Ilinitch, A. Y., R. A. D'Aveni, A. Y. Lewin. 1996. New organizational forms and strategies for managing in hypercompetitive environments. *Organ. Sci.* **7** (3) 211–220.

Inkpen, A. C., A. Dinur. 1998. Knowledge management processes and international joint ventures. *Organ. Sci.* **9** 454–468.

Keesing, R. 1974. Theories of culture. *Ann. Rev. Anthropology* **3** 73–97.

Khandwalla, P. N. 1977. *The Design of Organizations.* Harcourt, Brace, Jovanovich, New York.

Kist, J. 1987. *Electronic Publishing: Looking for a Blueprint.* Croom Helm, New York.

Kogut, B., U. Zander. 1992. Knowledge of the firm, integration capabilities, and the replication of technology. *Organ. Sci.* **3** 383–397.

Koza, M. P., A. Y. Lewin. 1998. The coevolution of strategic alliances. *Organ. Sci.* **9** (3) 255–264.

Krijnen, H. G. 1979. The flexible firm. *Long Range Planning* **12** 63–75.

Kumar, R., K. Nti. 1998. Differential learning and interaction in alliance dynamics. *Organ. Sci.* **9** 356–367.

Lane, P. J., M. Lubatkin. 1998. Relative absorptive capacity and interorganizational learning. *Strategic Management J.* **19** 461–477.

Levinthal, D. A. 1994. Surviving Schumpeterian environments: An evolutionary perspective. J. A. C. Baum, J. V. Singh, eds. *Evolutionary Dynamics of Organization.* Oxford University Press, New York. 167–178.

———, J. G. March. 1993. The myopia of Learning. *Strategic Management J.* **14** 95–112.

Lewin, A. Y., C. P. Long, T. N. Caroll. 1999. The coevolution of new organizational forms. *Organ. Sci.* **10**(5). This issue.

———, H. W. Volberda. 1999. Prolegomena on coevolution: A framework of research on strategy and new organizational forms. *Organ. Sci.* **10**(5). This issue.

Lorenzoni, G., A. Lipparini. 1999. The leveraging of intrafirm relationships as a distinctive organizational capability: A longitudinal study. *Strategic Management J.* **20** 317–338.

March, J. G. 1991. Exploration and exploitation in organization learning. *Organ. Sci.* **2** 71–87.

McKelvey, B. 1997. Quasi-natural organization science. *Organ. Sci.* **8** 352–380.

McLaughlin, J. F., A. E. Biriny. 1984. Mapping the information business. B. M. Compaine, ed. *Understanding New Media.* Ballinger, Cambridge, MA.

Miles, R. E., C. C. Snow. 1984. *Fit, Failure and the Hall of Fame.* The Free Press, New York.

——, ——. 1986. Organizations: New concepts for new forms. *California Management Rev.* **27** 62–73.

Mintzberg, H. 1979. *The Structuring of Organizations.* Prentice-Hall, Englewood Cliffs, NJ.

Nelson, R. R., S. G. Winter. 1982. *An Evolutionary Theory of Economic Change.* Belknap Press, Cambridge, MA.

Nonaka, I. 1994. A dynamic theory of organization knowledge creation. *Organ. Sci.* **5** 14–37.

Ouchi, W. G. 1981. *Theory Z: How American Business Can Meet the Japanese Challenge.* Addison-Wesley, Reading, MA.

Pennings, J. M., F. Harianto. 1992. Technological networking and innovation implementation. *Organ. Sci.* **3** 356–382.

Schumpeter, J. A. 1934. *The Theory of Economic Development.* Harvard University Press, Cambridge, MA.

Van den Bosch, F. A. J., A. P. de Man, eds. 1997. *Perspectives on Strategy.* Kluwer Academic Publishers, Boston.

Volberda, H. W. 1998. *Building the Flexible Firm: How to Remain Competitive.* Oxford University Press, Oxford.

Whittington, R., A. Pettigrew, S. Peck, E. Fenton, M. Conyon. 1999. Change and complementarities in the new competitive landscape: A European panel study, 1992–1996. *Organ. Sci.* **10**(5). This issue.

Winch, G., E. Schneider. 1993. Managing the knowledge-based organization: The case of architectural practice. *J. Management Stud.* **6** 923–937.

Winter, S. G. 1987. Knowledge and competence as strategic assets. D. J. Teece, ed. *The Competitive Challenge: Strategies for Industrial Innovation and Renewal.* Ballinger, Cambridge, MA.

Wijk, R. A. van, F. A. J. Van den Bosch. 1998. Knowledge characteristics of internal network-based forms of organizing. S. Havlovic, ed. *Academy of Management Best Paper Proceedings.* (August 9–12) San Diego, CA. B1–B7.

Yoffie, D. B., ed. 1997. *Competing in the Age of Digital Convergence.* Harvard Business School Press, Boston.

Accepted by Arie Y. Lewin, Founding Editor-in-Chief Emeritus; received September 15, 1998. This paper has been with the authors for two revisions.

References

The Economic Efficiency of Corporate Culture

Colin Camerer; Ari Vepsalainen

Strategic Management Journal, Vol. 9, Special Issue: Strategy Content Research. (Summer, 1988), pp. 115-126.

Stable URL:

http://links.jstor.org/sici?sici=0143-2095%28198822%299%3C115%3ATEEOCC%3E2.0.CO%3B2-7

Where Are the Theories for the "New" Organizational Forms? An Editorial Essay

Richard L. Daft; Arie Y. Lewin

Organization Science, Vol. 4, No. 4. (Nov., 1993), pp. i-vi.

Stable URL:

http://links.jstor.org/sici?sici=1047-7039%28199311%294%3A4%3Ci%3AWATTFT%3E2.0.CO%3B2-R

Where Do New Organizational Forms Come From? Management Logics as a Source of Coevolution

Marjolijn S. Dijksterhuis; Frans A. J. Van den Bosch; Henk W. Volberda

Organization Science, Vol. 10, No. 5, Focused Issue: Coevolution of Strategy and New Organizational Forms. (Sep. - Oct., 1999), pp. 569-582.

Stable URL:

http://links.jstor.org/sici?sici=1047-7039%28199909%2F10%2910%3A5%3C569%3AWDNOFC%3E2.0.CO%3B2-S

LINKED CITATIONS

Knowledge Management Processes and International Joint Ventures

Andrew C. Inkpen; Adva Dinur

Organization Science, Vol. 9, No. 4. (Jul. - Aug., 1998), pp. 454-468.

Stable URL:

http://links.jstor.org/sici?sici=1047-7039%28199807%2F08%299%3A4%3C454%3AKMPAIJ%3E2.0.CO%3B2-W

Knowledge of the Firm, Combinative Capabilities, and the Replication of Technology

Bruce Kogut; Udo Zander

Organization Science, Vol. 3, No. 3, Focused Issue: Management of Technology. (Aug., 1992), pp. 383-397.

Stable URL:

http://links.jstor.org/sici?sici=1047-7039%28199208%293%3A3%3C383%3AKOTFCC%3E2.0.CO%3B2-6

The Co-Evolution of Strategic Alliances

Mitchell P. Koza; Arie Y. Lewin

Organization Science, Vol. 9, No. 3, Special Issue: Managing Partnerships and Strategic Alliances. (May - Jun., 1998), pp. 255-264.

Stable URL:

http://links.jstor.org/sici?sici=1047-7039%28199805%2F06%299%3A3%3C255%3ATCOSA%3E2.0.CO%3B2-D

Differential Learning and Interaction in Alliance Dynamics: A Process and Outcome Discrepancy Model

Rajesh Kumar; Kofi O. Nti

Organization Science, Vol. 9, No. 3, Special Issue: Managing Partnerships and Strategic Alliances. (May - Jun., 1998), pp. 356-367.

Stable URL:

http://links.jstor.org/sici?sici=1047-7039%28199805%2F06%299%3A3%3C356%3ADLAIIA%3E2.0.CO%3B2-V

Relative Absorptive Capacity and Interorganizational Learning

Peter J. Lane; Michael Lubatkin

Strategic Management Journal, Vol. 19, No. 5. (May, 1998), pp. 461-477.

Stable URL:

http://links.jstor.org/sici?sici=0143-2095%28199805%2919%3A5%3C461%3ARACAIL%3E2.0.CO%3B2-C